BETTER CROPS \

The Pocket B

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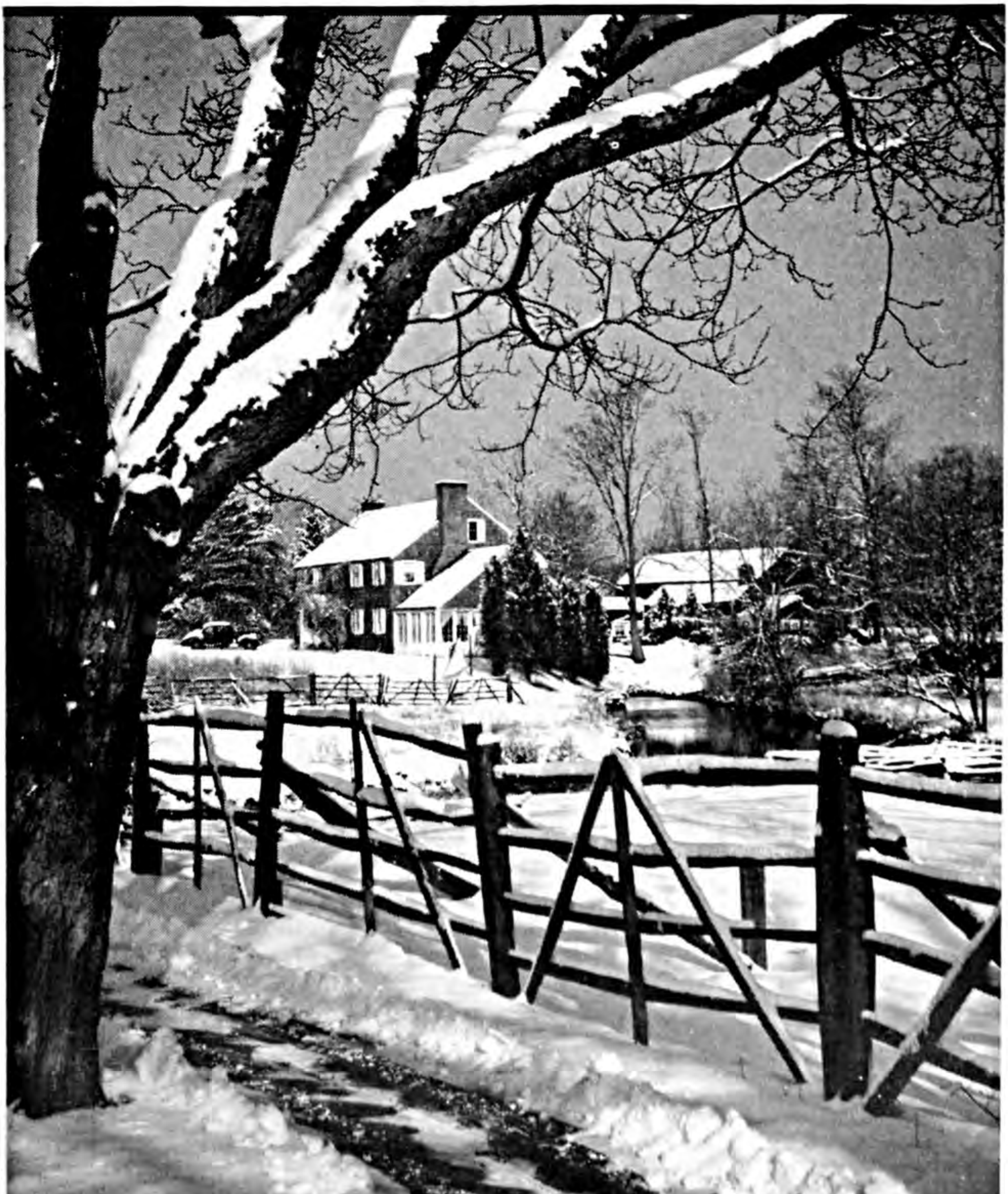

The Pocket Book of Agriculture

Better Crops *with* PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. Stinchfield, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

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The American Potash Institute, Inc.

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TELL-TALE TRAILS

Better Crops with PLANT FOOD

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Anticipating . . . . .

More Food, Fewer Farmers

Jeff McDermid

IMMIGRANT white men during the past two centuries moved the pastoral aborigines away to make room for the plow and the farm. Now these white races have become so successful in their mechanical perfection of production that they also are slowly moving off the land themselves, to huddle in congested cities.

To be sure, no Indians in so short a time in their accustomed ways could have transformed the wilderness and the plains into such a reservoir of food with which to safeguard the lives and the fortunes of so vast a host of people. Likewise, no Indian would have done some of the reckless, wasteful, and destructive things which we are belatedly trying to correct.

Our first settlers wanted room and freedom, dimly seeing a chance to build up a new vision of equality and opportunity. That they swiped huge areas of valuable land and natural conservation treasures while seeking to model a liberty-loving nation is probably a bit late to discuss. I presume our immediate task is to see that we preserve what we seized and dedicate it to the future in a way to offset some of the reproach in the original grab. Some developments lately rather discourage any optimism in that regard, but most of them lie in other realms than agriculture, the saints be praised!

Back in the first Yankee settlements of the Northeast, and to some extent along the Tidewater southward, farm families who replaced the poor redskins had little idea of acquiring cash wealth which they could spend in buying gadgets or taking tours with gaudy vestments and generous tips. We are all familiar with the self-sufficing nature of that colonial scene, where each farm was an end unto itself for the most part. Just a few necessities like iron, salt and some crude tools and equipages were bought in the small hamlets near their plantations.

LIFE was not easy physically, but the land supported a healthy, independent people who had courage and ability and called not upon the government or their provincial assemblies for much except reasonable measures for defense and common welfare. No far-flung commercial network relied upon them in the mass for trade and employment. Of course, the seeds of the great industrial system were germinating, but back in 1800 fully eighty per cent of the American population called the farm its home.

Before 1830, however, many farms began to show fainting spells and especially in New England were conditions such that boys soon found it wiser to inquire into opportunities lying in adjacent towns to enter mercantile, industrial, or railway careers. Lack of decent regard for the soil itself caused this in no small degree; although to be sure, the average farm family nurtured under thrifty and healthfully invigorating circumstances was as prolific as rabbits almost. That is, the rich virgin land bred up multitudes of human beings who later on found it more profitable to abandon attempts to coax more life back into the soil and to turn commercial. That's the first evidence we have of how commercial urges have deprived the land of its natural sustaining power, but it's not the last sign of such influence.

So we had captains of industry and merchant princes and even big showmen like Barnum leaving the cramped and meager topsoils of a decaying agriculture to push their fortunes in more favored places. When they began to do that the rest of the folks on the hill-holdings either hiked westward in droves or surrendered to a movement that smashed old craftsmanship locally and ushered in a growing non-farm economy.

I suppose we can pause here to remark that your dumb Indian would not have been smart enough to quit farming and go elsewhere when the land got lean. You can probably point to hundreds of redskin camps that froze out and left nothing but white bones behind. They were not engineers or architects or promoters. I don't expect they ever would have invented atomic bombs either—and by no stretch of imagination could you think of Hiawatha working as a tenant farmer. There's plenty they didn't think of, and a whole lot more it's too bad we ever did ourselves.

The white race, however, has used the farm as a source of food and raiment, as a refuge from spells of adversity when the big commercial machine broke down, and always as a place from whence must come the strength and the new blood to build up the rest of the whole American economy. I will not add that it has been a source of some votes and headaches, because this is, has been, and will continue to be painfully obvious.

BY this time the biggest part of the adventure seems to be over, or that is what so many aver. The wild country is gone—some of it into better conditions and a lot of it into worse. Since the rise of skillful experiment stations, we shrug our shoulders at further land seeking, because virtually all the land worth while under a profit system is already yielding up many times what we imagined it could. But unless we take heed and organize to conserve it, it may not be too long before we begin homesteading again on acres hitherto devoted to mountain goats and lizards. We'll have to admit before we get too boastful that the aborigine himself actually had much more good farming opportunities than we have. A good share of that opportunity lies in the oceans to which certain swift streams bore our soil.

I suppose everybody notices certain trends which are like Mark Twain's weather. You know they occur and that they often have vast significance for everyone, yet nobody can do very much about them. You can't go out in the road and stop trends or holler out loud on the radio and shift their course.

Anyway, there are said to be at least four major trends going on in our midst affecting farms and farm folks. First of all, with the coming of the machine age in agriculture we find fewer people on farms. The same thing occurred in the many advances made in industry. Some lost their places. In industry, however, there was usually some new invention or some new mode of life brought about by the machinery that opened new jobs.

It doesn't look right now as though agriculture could fix up more jobs to keep step with those which are lost because of the greater amount of work which one man can do in a season, mostly sitting on the seat of his pants. Some wiseacres insist that chemical marvels and new processes for the food and fibres raised on farms will provide just that extra employment we are looking for so hard.

Take tractors. I can recall those first demonstrations on farms by rival implement manufacturers and dealers. Observers thought it just about as likely that ordinary farmers would ever drive one of those snorters afield as that the small boys attending the circus would ever be ringmasters.

The census columns tell us that in 1910 not one farm in 1,000 had a tractor. In 1920 they were used on one farm in 28. In 1930 every seventh farm had one. The latest count taken in 1945 indicated that a tractor was furnishing field and belt power on one farm out of every three.

Our wheat harvest is all made by machinery. Corn is on the way and almost there. Cotton is next, and that really means something when it comes to displacing folks.

The coming of the completely mechanized cotton job will affect the lives and fortunes of over a million of the rugged basic stock of rural people in Dixie; and when it arrives by degrees, there is going to be need for adjustments that will make the corn and hog and little pig fracas of 1933 seem small as a midge.

Then you will also see a new design of tractor that will have equal speeds in both directions, and moreover there will be tractors so cheap and hookable to any kind of implement at any job that even the small places can hardly afford to navigate in the sea of changing agriculture without one.

SUCH trends toward doing the food-raising job quicker and easier are bound to kick up some dubious conjectures anon, and set the planners busy overtime. Maybe the government won't be able to stay out of the picture either. Trends like that take the average fellow unawares and upset his apple cart. I hope the human stomachs can expand enough to justify all this speed-up and efficiency.

Right along with mechanization there is the improvement in hybrid corn and

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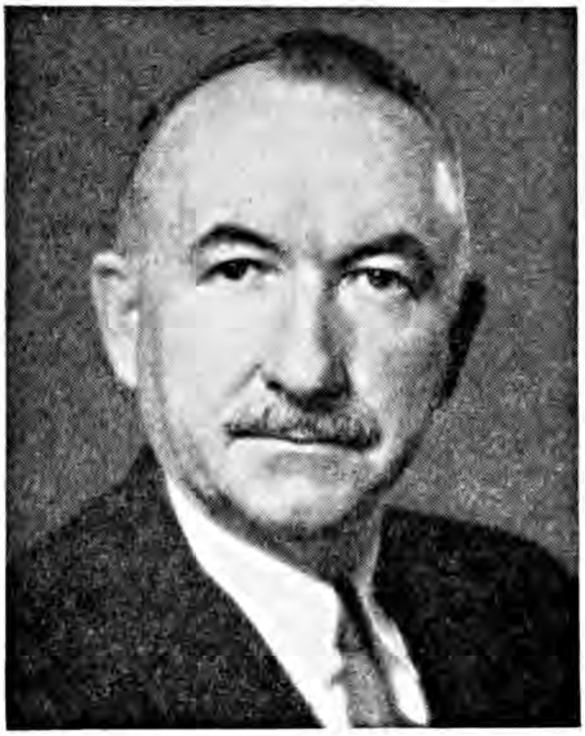
Thirty Years of Building-up The Soils in Wisconsin

By L. G. Monthey
Madison, Wisconsin



Clint J. Chapman, extension specialist in soil fertility.

FARMERS in Wisconsin are making real progress in building up their worn-out soils. In the past ten years they have applied more than 10 million tons of lime to the acid soils, so common throughout the State. During the same period they have increased their usage of commercial fertilizers by more than seven times, a record that few states, indeed, can even approach. In the year 1935 they used slightly over 28,000 tons; by 1944 they were using over 230,000 tons annually—a tremendous increase in the use of soil-building plant food that makes for better crops and more farm income.

Many people would attribute this amazing increase to the AAA and its program of benefit payments, for it has been a powerful factor in soil-improvement work all over the North Central Region. In 1943 alone, nearly 100,000 tons of fertilizer were distributed by this agency in Wisconsin.

However, close observers of this Wisconsin "miracle" are inclined to give more than just a little of the credit to an energetic, gray-haired man who has "stumped" the State for 30 years, awakening farmers to the need for soil improvement.

Professor Clint J. Chapman, known to thousands of Wisconsin farmers as "Chappie," ranks among the top soils extension men of the country. His enthusiastic, convincing talks at farm meetings are as "catching" as the measles; his thousands of feet of colored motion pictures keep farmers on the edge of their seats, when even an exciting Mickey Mouse film would fail to keep tired, out-of-doors people awake. His advice is eagerly sought not only by farmers, but also by fertilizer men, government officials, agricultural agents, and classroom instructors at the State College of Agriculture.

In 1916, when Chapman began his educational program of fertilizer experiments and demonstrations, less than two per cent of Wisconsin farmers were using commercial fertilizer, and the total annual consumption was less than 3,000 tons. By 1939, one farmer in five was applying plant food to his soils, and he was using an average of 1½ tons per year on his farm. Since then the increase in fertilizer usage has been phenomenal, and only the shortage of fertilizer materials has kept the tonnage at the 250,000 mark. Chapman's years of back-breaking toil were at last bearing fruit!

"I am glad," says Chapman, "to have had a part in this great program. It has been a battle against the forces of indifference and even downright opposition. In the early days even many of the county agents and other extension leaders had to be sold on this soil fertility idea.

"Our first soil fertility work in this State was primarily with potatoes and tobacco, both heavy feeders on plant food. Very little work was being done with small grains 30 years ago, and the hill application of fertilizer for corn was just getting underway. Our fertilizer mixtures were of very low grade compared with those in use at the present time."

The high-grade fertilizers of today, such as 0-20-20, 3-18-9, and 3-12-12, were relatively unknown in the early years of Chapman's work. Farmers were advised to use three and four hundred pounds of 1-10-1 (1 per cent nitrogen, 10 per cent phosphate, and 1 per cent potash) or 2-8-2 per acre on their potato fields, and these low-grade materials gave big increases in yield. Even applications of low-grade phosphate alone showed up well. It was therefore assumed that phosphorus was the chief limiting element of soil fertility, and the educational program leaned in that direction.

Need for Plant Foods

It wasn't until 1930 that the widespread need for potash was fully realized. The careful, thorough field experiments of Professor A. R. Albert on the sandy soils of the Hancock Experiment Station convinced Chapman that Wisconsin farmers on lighter soils could use potash fertilizers to good advantage. His field demonstrations resulted in amazing crop responses and supported his conviction. Soon it was found that not only sandy soils, but also peats, mucks, and the low "black bottom" soils were almost invariably deficient in this important fertility element.

Chapman immediately began a vigorous potash campaign throughout the State. Even some of the college people were not quite ready for the idea. One man, prominent in Wisconsin agriculture for nearly 30 years, came to Madison to voice his protest. "Chapman is talking potash promiscuously all over the State," said he.

Chapman has never quite been able to live this one down. Even today, years after, his colleagues delight in asking about this episode.

But the campaign continued and Wisconsin farmers became "potash conscious." No longer was phosphorus the chief element in soil fertility. Potash was literally "on the lips" of county agents, agricultural teachers, and farm leaders everywhere. As time went on it was found that more and more of Wisconsin's soils were too low in this important plant food. In just the last 10 years, a vast area of heavy silt loam in north-central Wisconsin, known for years as the State's "Clover-land," has been found to be potash hungry. This area of Spencer silt loan soil comprises over 5,000 square miles, and it has long been regarded as one of the finest dairy regions of the State.

"Even the soils of southern and eastern Wisconsin, the most productive in the entire State, have shown a profitable response to potash in better than 60 per cent of the demonstrations conducted in the past five years," says Chapman. "The regular and systematic use of phosphate-potash fertilizers should be a part of every dairy farmer's program of soil-building."

"Only in the last five to ten years," says Chapman, "has the important role of nitrogen in the production of all farm crops really come to the front."

For years the State Soils Laboratory had shown a deficiency of nitrogen in almost 90 per cent of the soil samples tested. Every spring Wisconsin farmers had noticed the lush, dark green

A fertilizer demonstration with small grain (Vicland oats) on the Merwin Hawks farm near Ashland, Wisconsin. The plot on the right received 275 lbs. of 0-20-10 at time of seeding and yielded 72.6 bu. The check plot yielded only 33.8 bu.

patches of grass growing where cattle had added nitrogen to the soil. But despite this evidence, the widespread use of expensive nitrogen fertilizer was discouraged. This was for several reasons. In the first place, many agronomists felt that the effective return of crop residues and animal manures would go a long way toward replacing the nitrogen lost through the production of crops. Furthermore, the use of more legumes in the crop rotations gave evidence of being the most economical way of replenishing the soil's supply of this important plant food.

In the years just before the war, however, Chapman's demonstrations and the experimental work at the College of Agriculture led to the conclusion that up to 40 per cent of the plant-food nutrients in manures and crop residue was being lost through careless and ineffective methods of handling. It was also found that some fields on the average dairy farm received little, if any, of these "natural fertilizers."

"Then too," adds Chapman, "we became convinced that legumes were not maintaining an adequate supply of nitrogen for succeeding crops. At the same time, they were found to be drawing heavily on the available phosphate and potash of the soil; in fact, much more heavily than we had previously thought."

Applications of from 100 to 200 pounds of ammonium nitrate and ammonium sulfate per acre on Chapman's permanent pasture demonstrations have produced an additional profit of from $10 to $30 per acre, when compared with similar unfertilized pasture areas. These profit figures are based on actual milk production.

"It is quite evident now," asserts Chapman, "that the number one limiting element in the growth of pasture grasses is nitrogen. But this is only one of several places where nitrogen fertilizer may be used with profit on the average dairy farm."

He points with justifiable pride to the results of adding nitrogen fertilizer to timothy and clover "hay meadows" up in the Lake Superior district of northern Wisconsin. The average increase in yield for 27 one-acre demonstration plots was 2,185 pounds of hay. And the hay was leafier, darker green, and much higher in its protein content, the latter being an extremely important factor in better milk production during the long winter months.

Even the fall and spring grains, so important to dairy farm cropping programs, are beginning to show splendid increases where small applications of nitrogen are being used in addition to the conventional treatment of phosphate-potash fertilizer at time of seeding.

"There is the danger, of course, of producing too much straw," cautions Chapman, "and in dry seasons the new seedings of alfalfa and clover can be damaged. But with the new short stiff-strawed, high-yielding varieties of oats and judicious use of these nitrogen fertilizers, we have been able to obtain an added net profit of more than $5 per acre in northern Wisconsin with only 75 to 100 pounds of ammonium nitrate."

Running hand-in-hand with this great increase in the use of commercial plant food on Wisconsin soils has been Chapman's liming program for the acid soils of the State. Since 1935, nearly 12 million tons of liming materials have been added to enhance the growth of clover, alfalfa, and the small grains. Through liming, alfalfa now flourishes where it would otherwise have been difficult to even obtain a satisfactory "catch."

"Our liming job is still far from being done, however, says Chapman. "Tests show that more than 65 per cent of our crop and pasture land still has acid soil. Nearly 25 million additional tons of liming material will be needed to complete the 'once-over' job on the soils of our State."

The trend in the placement of fertilizer during Chapman's 30 years of work with Wisconsin soils is every bit as interesting as the story of the materials used. Methods of application, too, have greatly improved since 1916.

In the early days, broadcasting was the chief method used, and although it resulted in good increases in yield, it was nowhere nearly as effective and economical as the methods used later on. Then came the combination fertilizer-grain drill, commonly referred to as the "fertilizer drill" by farmers throughout the Midwest. This effi-

Corn experiment on the farm of O. D. Brace, Janesville, Wisconsin. Hill fertilizer alone yielded 35.1 bu., while the same hill application in addition to 825 lbs. of 8-8-8 on the plow-sole yielded 55.6 bu., an increase of over 60 per cent.

cient piece of machinery not only resulted in uniform and economical application of the fertilizer material, but also placed it at the right depth and at the right time for quickest response on the part of both the small grain and the new seeding. It could easily be adjusted for rate of application and could be operated easily and without extra trouble.

"It was largely because of our experiments and recommendations here in Wisconsin," says Chapman, "that the fertilizer attachment on the corn planter was redesigned and made into the efficient implement that it is today."

Even as late as 1930 most of the attachments simply dropped the fertilizer in the hill, with the seed and fertilizer going down together. The result was inefficient use of fertilizer and even damage to the sprouting seeds. The modern "split-boot" attachment of today not only deposits the fertilizer right at the hills, but also places it in two bands, on either side of the seed, where it cannot harm the germinating corn.

Deep Placement

In recent years, deeper placement of plant food for corn and certain other crops has shown up remarkably well in Wisconsin and in other Midwestern states. At the Indiana Station the "plow-under" method, using 800 to 1,500 pounds of 8-8-8 fertilizer, resulted in corn increases of more than 50 bushels to the acre on some of the worn-out, less fertile Indiana soils. It was found that those soils originally low in plant food and those receiving little or no manure or crop residue responded particularly well to this quick "rehabilitation" practice. The "plow-sole" method, wherein bands of this rich plant food are placed down on the furrow bottom at time of plowing, also produced more corn. This was particularly true when the top few inches of the soil became dry due to summer drought just at the time the growing plants needed the fertility most.

Chapman was quick to adapt these methods to Wisconsin soils and crops. During the past five years, he has conducted hundreds of plow-sole demonstrations all over the State, using about 800 pounds of 8-8-8 fertilizer per acre. Profitable increases, ranging from 10 to 70 bushels of corn per acre, have been the result.

"It's a good method for bringing worn-out fields back into production quickly," advises Chapman. "Furthermore, one-half of the phosphate and potash added is left in the soil for the benefit of crops to follow. Dairy farmers in this State have purchased thousands of plow-sole fertilizer attachments for their plows, and many are applying this plant food in the fall of the year, when there is more time available on the average farm.

"Some of the larger farmers are now finding the present plow-sole attachment, with its small hopper capacity, too slow for fertilizer application on large acreages," says Chapman, "but we expect the smaller dairy farmer to continue using the regular attachment for his plow."

Recently an effective deep fertilization machine has been devised by a corn grower in Central Illinois for farmers plowing large acreages. It places the fertilizer at plow-sole depth and can cover up to 30 acres a day. Chapman believes that the Thorp machine, with its large 500-pound-capacity hopper mounted on a field cultivator base, will be the answer to the objections of larger operators to placing the fertilizer at "root depth" in the soil. Others have objected to the expense of such heavy applications of a high-nitrogen mixture.

"Here again," explains Chapman, "the answer is pretty much up to the judgment and experience of the individual farmer. He must carefully consider the price for his crop, the amount and cost of fertilizer per acre, and the increases which he is able to obtain through fertilizer application. These will give him the answer as to

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Potash Meets Its Responsibilities

(Reprinted from Commercial Fertilizer, November 1946)

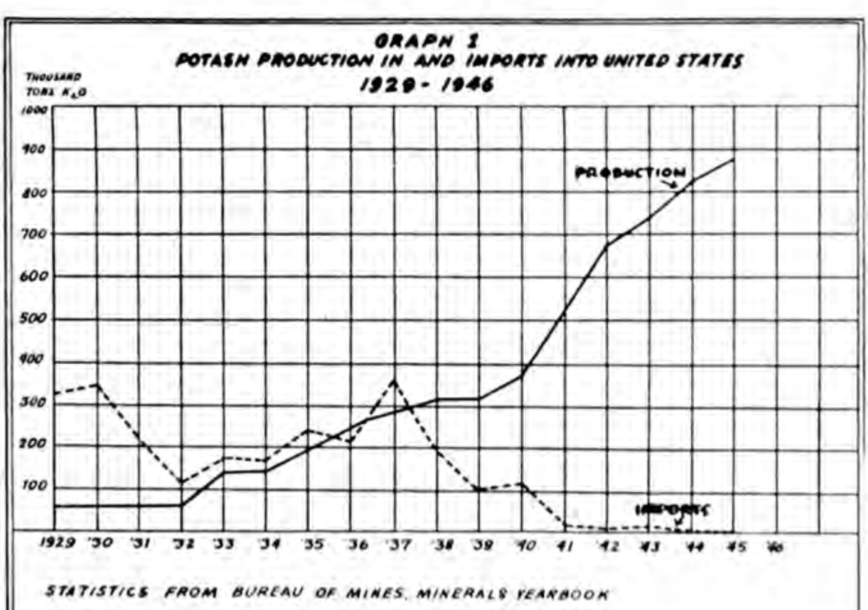
By Dr. H. B. Mann

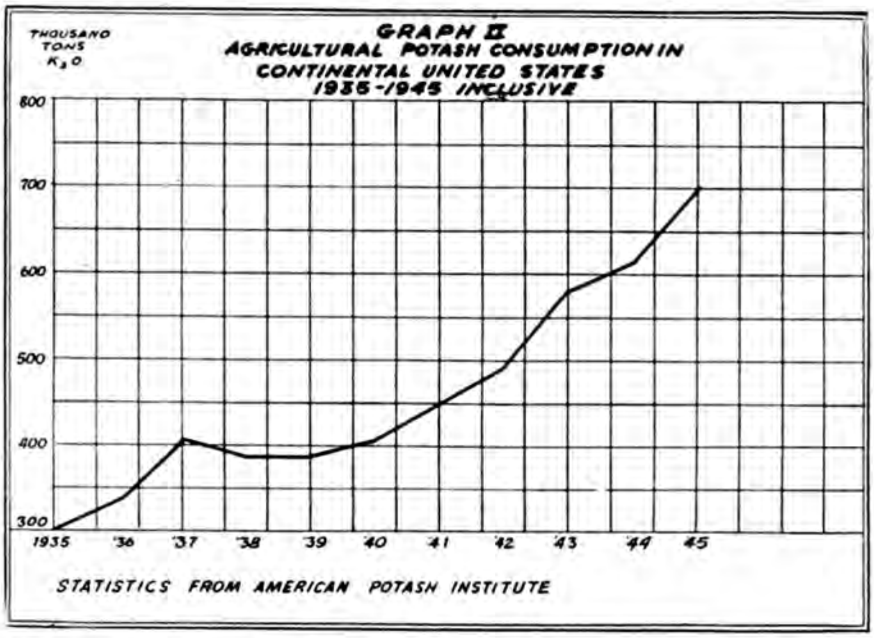
Atlanta, Georgia

POTASH production in the United States again reached a new high in 1945. Deliveries for the calendar year amounted to 1,583,473 tons of potash salts, containing 868,168 tons of K_2O. This is an increase of 52,351 tons in 1945 over 1944 and represents a gain of 6.4 per cent. Alone these figures are impressive, but their full significance can best be appreciated by reviewing briefly production changes in the American potash industry since World War I.

In 1919 U. S. production declined from 54,803 tons in 1918 to 32,474 tons. Not until 1929 did American production reach 60,000 tons, where it was fairly constant until 1933. That year, largely due to development of the Carlsbad, New Mexico deposits, production jumped to 143,378 tons and has increased each year since, except in 1939 when there was a very slight decrease from the previous year. In contrast, imports in 1929 were 324,638 tons K_2O, over five times the U. S. production. Imports decreased rapidly from 1930 to 1932 and ran fairly close to domestic production through 1937, when they again took a sharp decline, ceasing to be a factor after 1940. With substantially all imports cut off, American producers were called on to meet the requirements of the United States and other countries of the American hemispheres as well as many of those of our allies across the oceans. The record of production is shown in graph 1. The increase is from 61,590 tons K_2O in 1929 to 868,168 in 1945.

Thus the American potash industry has met its responsibility in supplying the requirements of agriculture and industry including the needs of this country and our allies while at war. Now as we adjust to peace, the producers are making every effort to meet the unprecedented demands of the nation's farmers despite the shortages incident to peacetime conversion.



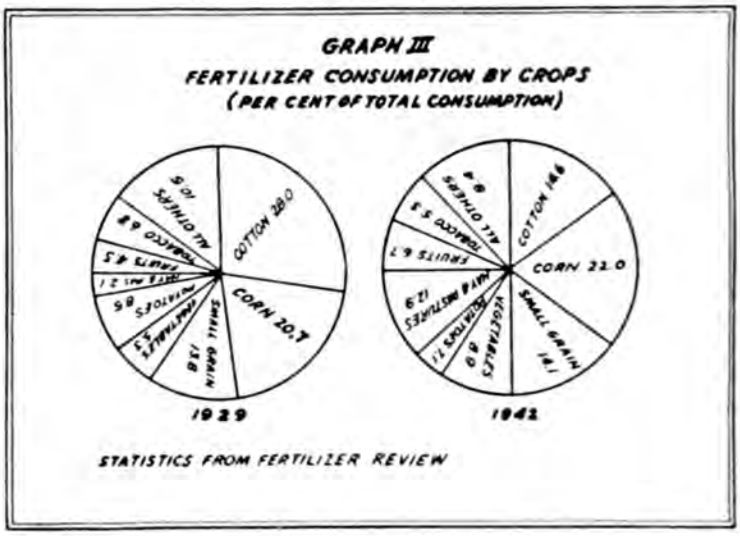


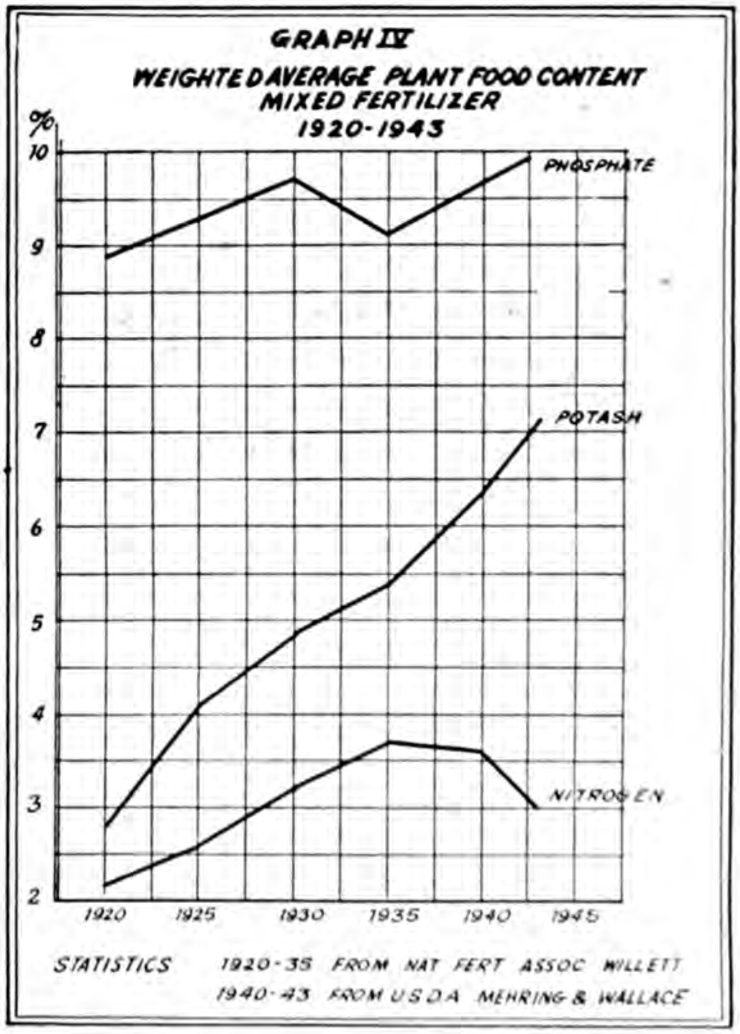
The greatly increased requirements for potash in agriculture shown in graph II are due largely to changes in farming practices and the use of fertilizer to meet the situation which has developed. Perhaps the most important change in its effect on fertilizer has been the shift from cotton to other crops. It will be noted from graph III that whereas in 1929 28 per cent of the fertilizer used in this country was applied to cotton, in 1943 this figure had dropped to less than 15 per cent. The land which was retired from cotton production is now being planted to peanuts, small grains, fruits and vegetables, hay crops, and pastures. In contrast to cotton, until recently little attention has been given to the fertilization of these crops yet they remove large quantities of plant food, particularly potash, from the soil. Agricultural officials have found and farmers are beginning to realize that if production is to be maintained, the plant food that is taken from the land by crops and livestock must be replaced.

Alfalfa, which is now assuming increased importance as a hay crop, for example, removes 135 pounds of potash in normal crop. Thus just to replace the potash removed by a three-ton crop of alfalfa will require an annual application of 675 pounds per acre of a fertilizer containing 20 per cent K_2O. A 25-bushel crop of soybeans with the leaves and stems requires 60 pounds of potash, the equivalent of 600 pounds per acre of a fertilizer containing 10 per cent K_2O. Corn is not generally recognized as requiring heavy mineral fertilization, yet a 60-bushel crop with two tons of stover will remove from the soil the amount of potash contained in a 700-pound-per-acre application of a 5-10-10 mixture. Peanuts take out of the soil 50 pounds per acre of K_2O, sweet potatoes 115 pounds, tomatoes 175 pounds, tobacco 115 pounds, wheat including grain and straw 30 pounds, and cabbage 100 pounds in good crop years. In addition, enormous quantities of potash are lost each year by erosion and leaching. Thus, it is not surprising that both plant-deficiency symptoms and chemical soil tests show we are rapidly depleting the available potash in a large percentage of our cultivated soils.

To meet this problem, fertilizers containing more potash are gaining in popularity throughout the country. A study of graph IV shows that in 1920 the average analysis of mixed fertilizer used in the United States was approximately 2-9-3. Since that time the nitrogen and phosphorus contents have been increased about one per cent each, while the potash has been increased four per cent, making the average in 1943, the latest data available, about 3-10-7. The decline in the per cent of nitrogen from 1940 to 1943 was undoubtedly influenced by the supply situation due to wartime restrictions. While the ratio of potash in mixed goods has gone up, the average application per acre has likewise been raised substantially. To these changes can be attributed the greatly increased demand for potash in sections of the country where the use of fertilizer has been long established. In addition, vast areas in which the practice has been to use little or no plant food, notably the Midwest and Southwest, have come into fertilizer usage in recent years. This has brought new demands and has been an important factor in the constantly increasing use of potash.

The question is often raised as to whether or not the rapid changes that have taken place in the use of potash are agronomically sound and economically justified. The answer is given in reports of agronomists and other official agriculturists throughout the country. In North Carolina, to determine the importance of K_2O in the production of relatively heavily fertilized crops such as Irish potatoes, sweet potatoes, and cotton, Cummings made comparisons between applications of potash corresponding to experiment station recommendations for these crops and smaller applications which were nearer to the amounts farmers were using at the time. No comparisons were made against plots which received no potash. Thus his findings were calculated to show what a farmer might expect if he increased his potash applications up to the experiment station recommendations. It was found that the yield response to one ton of K_2O used in this manner in the principal potato-producing area of North Carolina was 26,800 pounds Irish potatoes and that of sweet potatoes 87,300 pounds. In 12 cotton experiments conducted in the four principal cotton areas of the State, the yield response to one ton of K_2O varied from 4,640 pounds to 13,035 pounds seed cotton. On pastures which have until recently received little attention,





the response in the mountain area of North Carolina was 9.6 tons dry forage, in the upper coastal plain 24.1 tons, and the lower coastal plain 21.5 tons.

In South Carolina, Garman calculated from a series of experiments at the Sandhill Experiment Station that a farmer having similar soils with 80 acres of cotton could expect an increased income of $1,403 merely by applying with his nitrogen and phosphate 30 pounds K_2O per acre instead of 15 pounds. Similar calculations from cooperative tests with farmers on the Piedmont soils of the State showed a return of $943 after deducting the cost of the potash. On soils of the Pee Dee Experiment Station known to be especially deficient in potash, the return was $3,670 for one ton of 60 per cent muriate of potash used to increase the potash in a 5-10-2.5 to 5-10-5. Returns in the Southwest have not been as spectacular; however, from a series of experiments conducted with cotton in Louisiana, Sturgis reports the net profit from a ton of 60 per cent muriate of potash varied from $75 on the Mississippi river bottoms which are high in available potash to $407.70 on the Coastal prairies.

The importance of potash in the production of corn in the Midwest has been generally recognized. Bray of Illinois reports that corn has a higher requirement for both soil potash and added potash than either soybeans or wheat. On soils low in available potash he found that the addition of 72 pounds K_2O per acre with the recommended applications to other crops in the rotation could be expected to almost double the yield of corn. On soils with a higher content of available potash, increases were less but quite significant.

On the other hand, in the South the response of corn to potash fertilization has been inconsistent and often very slight even on the sandy soils of the Coastal Plain except where they were very low in available potash. The new program of corn production sponsored by Krantz, however, has shown that in

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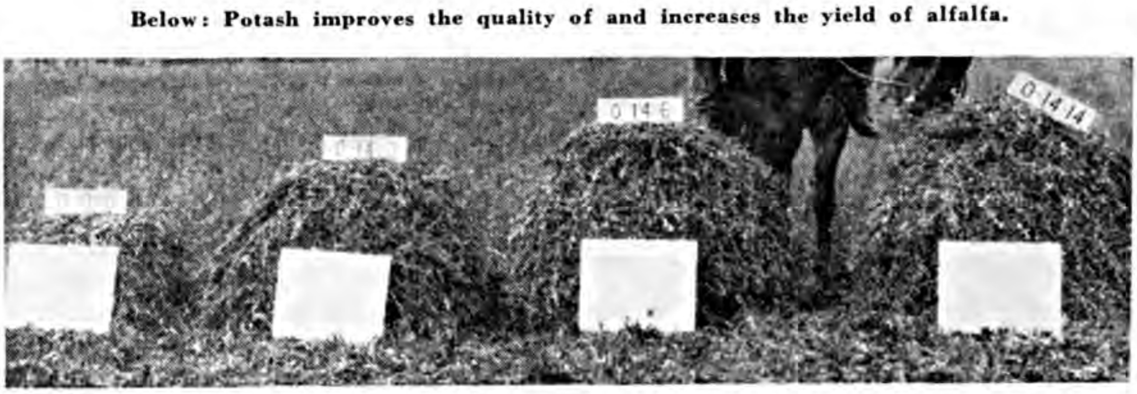
Above: Cotton rust controlled with 100 pounds per acre of muriate of potash. Field fertilized at planting with 400 pounds per acre of a 4-10-4. Right top-dressed June 8 with 100 pounds per acre of nitrate of soda. Yield 740 pounds seed cotton per acre. Left top-dressed June 8 with 100 pounds per acre of nitrate of soda and 100 pounds muriate of potash. Yield 1,260 pounds seed cotton per acre.

Below: Potash improves the quality of and increases the yield of alfalfa.



Hereford cattle graze good pasture of Bermuda grass, native bluestem, and clover on the Walker Jones farm in the Verdi-Grand Soil Conservation District at Wagoner, Oklahoma. The pasture has been fertilized and mowed.

Good Pastures Conserve And Pay

By W. M. Nixon

Regional Agronomist, Soil Conservation Service, Fort Worth, Texas

ONE of the most important of the many dovetailing soil and moisture conservation measures used by farmers cooperating with soil conservation districts is pasture development and management. The district cooperators, working with the aid of Soil Conservation Service technicians, have found that when the land is producing good pasture, soil and water losses are held to a minimum, and returns are high in comparison with other land uses.

The experience of Walker Jones, cooperator with the Verdi-Grand Soil Conservation District near Wagoner, Oklahoma, is representative. In his estimation, pasture is a much better risk on his farm than clean-tilled crops. Three successive years of poor crop yields and low income on his 440-acre farm prior to 1939 convinced him of that.

Jones' farm cost him only $15 an acre, but he knew he was losing money when his run-down land averaged only 10 bushels of corn and eight bushels of wheat an acre. He decided then, in 1939, that the time had come for him to make a change. He contacted the local Soil Conservation Service technicians assigned to the Verdi-Grand District and asked help in turning his farm to pasture so that he could concentrate on raising livestock. With the technicians he went over the entire farm and worked out a plan of conservation operations which would allow him to turn to pasture in a way calculated to make the best use of each acre on the place.

Then, he began his pasture improvement. He over-seeded 300 acres with Korean lespedeza, yellow hop clover, white clover, and rye grass. Some native bluestem grass and Bermuda grass already was present when he started.

Both have spread considerably. An average of 100 tons of barnyard manure has been put on this pasture land during each of the past three years. More than 300 tons of agricultural limestone and 16 tons of superphosphate also have been applied to the grasses. His pasture now carries an average of one head of livestock per acre for eight months during the year.

Jones still has some cultivated land—about 95 acres. He and the technicians agreed that he could grow crops profitably on those particular acres. Just as he follows conservation pasture improvement methods including mowing and rotation and deferred grazing, he uses needed conservation measures on his cropland.

Measures in effect on the place include diversions to keep water from rushing over areas which might wash and gully easily, terraces, terrace outlets, contour cultivation, contour sodding, planting a postlot, and building two farm ponds. Barnyard manure is applied regularly on the cropland in about the same proportion as on the pasture. A soil-improving legume is used regularly in the conservation crop rotation. He gets a bale to the acre now, where cotton made 150 pounds of lint an acre before 1939. His wheat produces 15 bushels to the acre instead of the former 8-bushel yield he used to get. Corn yield has jumped from 10 bushels per acre prior to 1939 to 30 bushels now.

When he began conservation farming Jones had 40 grade Hereford cows, 30 calves, and seven horses. He has sold most of the grade stock and replaced them with registered Herefords. His herd numbers 103 cattle. Other stock on the place includes several registered Belgian mares, stallions, registered jacks and jennies, several quarter horses, a flock of bronze turkeys, 100 high-grade sheep, and several registered rams.

In 1944 Jones' income from sales on his 440-acre farm was $7,091.07, while his expenses, chiefly for protein feeds, were $3,864.88. That left him a net income from sales of $3,226.19—that much profit on land that cost him $15 an acre. Jones believes his six years of conservation farming have doubled

Purebred Jersey dairy cattle on the Alfred Austin farm in the Benton County Soil Conservation District, near Maysville, Arkansas. The cattle, along with a few black-faced sheep, are shown grazing improved pasture of rye grass, hop clover, lespedeza, white clover, and ladino clover. The pasture averages over an animal unit of grazing per acre throughout the season.

The cost of building this improved pasture where the young Guernsey is grazing on the W. R. and J. B. Cutrer farm at Kentwood, Louisiana, in the Bogue Chitto-Pearl River Soil Conservation District was $17 an acre, not including the labor. The plants are clover and Dallis grass. The pasture had had the benefit of a complete fertilizer. Cattle graze the field continuously except when removed for the short time necessary to let the clovers and grass re-seed. Milk production jumped from below 300 lbs. daily to more than 600 when cattle were turned on the pasture. Feed bills dropped, and the Cutrers report the cows have no trouble at calving time now.

the value of his farm; certainly conservation farming has controlled erosion and improved fertility.

J. P. Seal's results with improving pastures in the Bogue Chitto-Pearl River Soil Conservation District at Franklinton, Louisiana, is another proof that returns from land producing good pasture are high in comparison with other land uses. Seal, who has developed his pasture with the help of Soil Conservation Service technicians assigned to the district, sold 16 four-month-old calves, averaging 360 pounds, for $60 each after they had pastured his improved grassland. His yearling native cattle raised in piney woods pasture brought him only $23 a head.

A 37-acre pasture improved by fertilizing, mowing, and seeding Bermuda grass and white dutch clover is paying off for F. L. Thompson of Leona, Texas, a cooperator with the Bedias Creek Soil Conservation District, by furnishing him year-round grazing for 32 head of livestock. The cattle on the 37 acres average 200 pounds heavier than Thompson's cattle which graze unimproved grassland. The heavier cattle have a slicked-off, glossy-haired look that the other stock do not show. Calves raised on the improved pasture brought Thompson two cents a pound more on the Fort Worth market than he was able to get for his calves raised on unimproved grassland.

At Cabot in the East Central Arkansas Soil Conservation District, farm operators, E. G. and W. G. Spence, say they had to borrow money every year while they were still trying to row-crop their farm. Careful examination revealed their acres are much better suited for dairy farming than for raising cultivated crops, and so they set to work building improved pastures and obtaining milk cows. Their change in land use has proved wise. Now, instead of owing money, they are out of debt and are the owners of 65 dairy cattle and 10 registered Herefords. The dairy cows average 1,100 to 1,200 pounds of milk annually.

A. J. Battle, a negro cooperator with

the Dugdemona Soil Conservation District in North Central Louisiana, has established a good pasture in one year. Don Spencer, Soil Conservation Service technician whose work unit gave technical assistance to Battle, states that it is one of the best first-year pastures that has been established in the District. The following procedure was followed in the development of the pasture:

1. Soil Conservation Service technicians assisted Battle in the preparation of a complete soil and moisture plan for his farm, which included proper land use.

2. It was determined that old pasture which consisted primarily of carpet grass and weeds would be improved.

3. Soil samples were taken and sent to the soils laboratory at Louisiana State University for analysis. The analysis showed that Battle should use 2,000 pounds limestone, 400 pounds superphosphate, and 100 pounds K_2O muriate of potash per acre.

4. The lime, potash, and phosphate were applied and the land disced before planting.

5. Ten pounds of a mixture of equal parts of hop, Persian, and white clover were sown on October 14, 1945.

6. April 1, 1946 a top-dressing of 50 pounds of muriate of potash per acre was applied.

7. Grazing was restricted April 1, and was begun again on April 25.

Many district cooperators are improving their pastures in the same manner as Battle. By fertilizing, liming, and seeding clovers early, grazing is provided. It is very important that all of the essential practices be followed very closely. Omitting any one of them such as liming, phosphating, potashing, seedbed preparation or seeding is very likely to result in failure or partial failure. Lespedeza, properly fertilized, provides grazing during the summer months.

Management of pasture, the second important phase, involves stocking the pasture with the proper number of ani-

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This picture shows extra growth obtained by using potash at the rate of about 500 lbs. per acre. (Note two samples in hands of Mr. A. C. Morris, District Conservationist of Dugdemona Soil Conservation District. The one in his right hand was taken from an area where 50 lbs. potash and the one in his left where about 500 lbs. potash per acre were added.) The high-potashed area yielded about four times the green matter produced by the area which had only 50 lbs. It is not believed that this heavy an application of potash is needed, however, it does indicate, in this case, a need for more than 50 lbs. per acre.

Fig. 1. G. L. F. truck spreading bulk fertilizer to cover crop.

Fertilizing Vegetables by Applying Fertilizer to Preceding Cover Crop

By Benjamin Wolf

Soil Chemist, Seabrook Farms Company, Bridgeton, New Jersey

EXPERIMENTS conducted by the G.L.F.-Seabrook Farms Raw Products Research Division in South Jersey have indicated that it is possible to fertilize peas and perhaps other crops as well by applying fertilizer to the preceding cover crop in the fall or late winter.

There are several advantages to such a system. The fertilizer can be applied during relatively slack periods thus reducing delay during the spring rush for application of fertilizer. With a crop such as peas which has to be grown in a relatively cool climate, the saving of several days during planting season can help to insure better yields. There is the advantage of increased organic matter, due to the supply of sufficient nutrients to the cover crop.

The actual increase of soil organic matter in any one year is small due to such fertilization but from the standpoint of cover and possible long-time effects, it is definitely important. In some cases, the dry weights of non-leguminous cover crops have been doubled by the application of fertilizer to the cover crop. The cover crop takes up the nutrients supplied and converts at least a part of them to organic forms which are released slowly. The method of applying fertilizers to the cover crops is, therefore, a means of converting cheap inorganic nitrogen to expensive organic forms.

Bulk Fertilizer Spreading

There are advantages also from the standpoint of fertilizer handling and therefore costs. Application of fertilizer to the cover crop with its lengthier period of application makes it feasible to use large heavy-duty equipment for bulk fertilizer spreading. The Co-op G.L.F. Soil Building Service Inc., Ithaca, N. Y., has been pioneering with equipment that can spread bulk fertilizer directly to the fields. Five to eight tons of fertilizer in bulk are loaded at the plant on a modified truck. This truck spreader is so designed as to provide a uniform feed at whatever field working speed the truck can be driven. The twin distributing fans are driven by an auxiliary motor to insure a uniform width of spread. The rate of application is determined by the size of the feed-gate opening, and the width of the "land" the operator selects. (Fig. 1 and 2.)

Handling fertilizer in bulk eliminates the cost of bags and costly handling. Moving bulk fertilizer as soon as it is manufactured saves considerable storage space in the fertilizer plant. With a lengthy season of application made possible by cover crop fertilization, it is much easier to keep the fertilizer moving. No lengthy curing of the fertilizer is necessary, for it is delivered to the farmer and spread before the fertilizer has "set up" to any serious extent.

The savings in bags, storage, and handling can mean a cheaper fertilizer for farmers. At present, the fertilizer is being delivered and spread on the field for somewhat more than the farmer would have to pay for the delivered bagged fertilizer. This may be reduced in time as equipment is kept busy and saving in storage space can be properly evaluated.

Need for Cover Crop Fertilization

For some time it has been known that full advantage of applied fertilizer to soils is often not fully taken unless there is sufficient organic matter present. A recent paper by App and Wolf* showed the presence of sufficient organic matter to be one of the prerequisites for high yields of certain vegetable crops. In soils receiving little or no manure

* "The influence of soil pH and organic matter upon the yield of some vegetable crops" by Frank App and Benjamin Wolf, Proc. Amer. Soc. Hort. Sci., 46, 309-319, 1945.

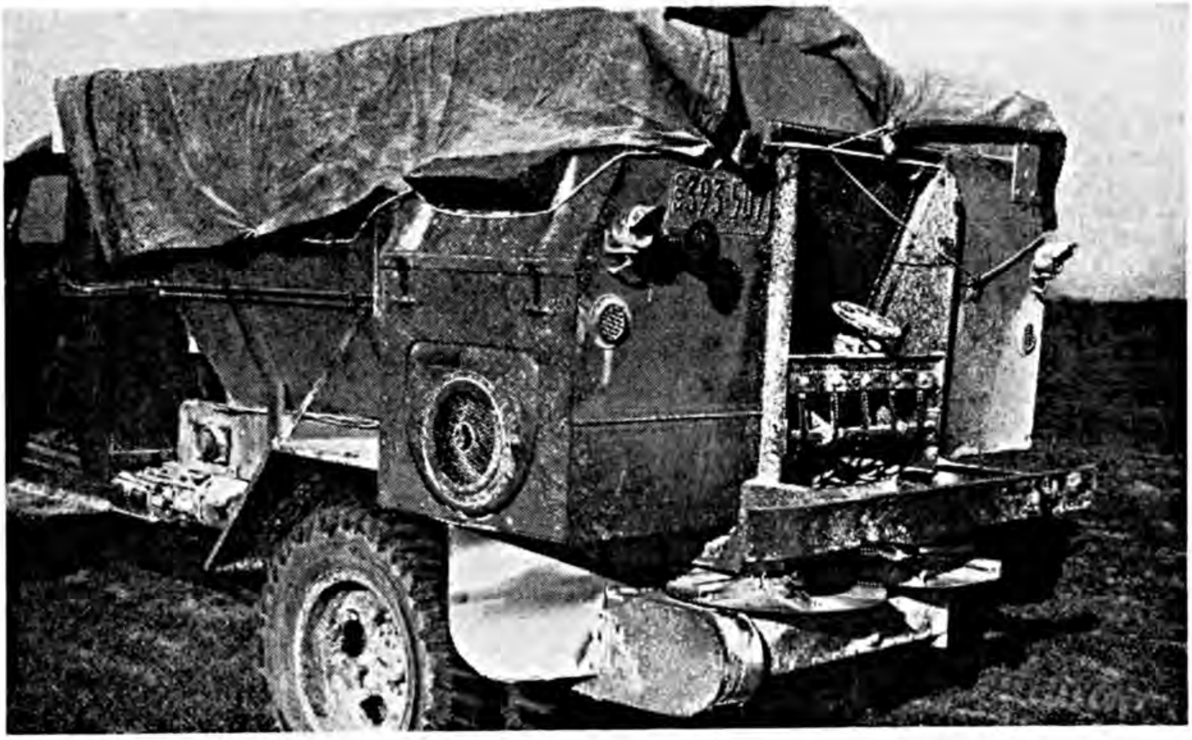

Fig. 2. Close-up of truck. Note enclosed motor at left rear, prongs to break up fertilizer as it falls on fan blades, crank for making adjustments of rate.

TABLE 1.—THE YIELDS OF COVER CROPS, TOP-DRESSED WITH NITRATE OF SODA[1] AND OF THE SPINACH WHICH FOLLOWED

Trial	Date of Nitrate App.	Date Harvested	Yield[2]	Spinach Yield[2]
			% Change due to N	% Change due to N fert. of cover
		Rye Cover Crop		
1	3/8/44	3/24/44	+9	−6
2	3/8/44	3/24/44	+22[3]	+33[3]
3	3/3/44	4/3/44	+25[3]	+42[3]
4	3/8/44	4/4/44	+14	+25[3]
5	3/8/44	4/10/44	+37[3]	+8
6	2/25/44	4/13/44	+100[3]	+33[3]
7	3/3/44	4/20/44	+97[3]	+37[3]
8	2/25/44	4/20/44	+165[3]	+67[3]
9	2/25/44	4/20/44	+104[3]	+67[3]
10	2/25/44	4/20/44	+50[3]	+41[3]
11	2/25/44	4/20/44	+119[3]	+110[3]
		Rye Grass Cover Crop		
12	2/25/44	4/17/44	+11	0
13	2/25/44	4/17/44	+34[3]	−15
14	2/25/44	4/20/44	+34[3]	+4
15	2/25/44	4/20/44	+63[3]	+16

[1] One hundred lbs. per acre.
[2] Cover crop yield based on dry wt. of five samples; that of spinach on fresh wt. of four samples.
[3] Significant differences.

the cover crop is an important source of organic matter. Not only does it supply organic matter but it helps conserve organic matter in the soil by reducing erosion. It is also about the cheapest form of organic matter that is available for farmers.

Unfortunately when cover crops are plowed early, the amount of organic matter formed is small and it rapidly decomposes. Anything which will increase the yield of cover crop would in the long run be advantageous from standpoint of organic matter production and conservation.

In a study of amounts of dry matter produced by various cover crops, it soon became apparent that poor soils produced poor cover crops. It was ironical that the soil-improving crops did the least amount of improvement on soils that needed it the most. This was especially true for the non-leguminous cover crops, rye and rye grass, which are grown extensively in the area. For rye this was especially serious since in many areas the cash crop comes off so late that no other cover crop than rye is feasible.

Many soil tests showed that growth of rye and rye grass was most often limited by lack of nitrogen and in some cases by insufficient phosphorus and potassium. It was thought, therefore, that cover crop yields could be materially increased by additions of complete fertilizer or at least of nitrogen.

Experimental Work

1943-44 results. The first work done by the Division with fertilization of cover crops dealt with the application

Fig. 3. The effect of nitrogen fertilization of rye grass. Left, 60 lbs. of N per acre, check on right. Note that stimulation of the top of plant on left has been at some expense of root growth. However, total yield is greater in case of treated plant.

of nitrogen during the late winter months of 1944. Nitrate of soda at the rate of 100 lbs. per acre was applied to rye and rye grass. Samples for dry weight of both tops and roots were removed just prior to plowing. At the same time a representative area of cover crop and soil on which it was grown was placed in pots. The pots were exposed to atmospheric conditions and later planted to spinach. An application of 4-12-8 fertilizer equivalent to 1,500 lbs. per acre was applied to all pots before planting spinach. The yields of cover crops and spinach which followed are given in Table 1.

The results in Table 1 indicate that there was a marked response by cover crops to winter applications of nitrogen. The extent of response was somewhat dependent upon the time between application date and harvest date. The yields of rye grass were much less affected. Part of this may be due to the fact that extra nitrogen stimulated top growth at the expense of some root growth in this crop (Fig. 3).

The yield of spinach on rye cover crop was generally beneficially influenced by applications of nitrogen to the cover. When supplied with sufficient moisture, spinach reauires more than 60 lbs. of applied nitrogen per acre. Therefore, in nearlv all cases there was a response to the extra nitrogen. This was not the case with rye grass. The exact reason for this is not known although it may be due to greater nitrogen demand for decomposing the larger yields of a woodier plant material.

1944-45 results. The marked responses in the above trials prompted further and more detailed experiments. These established in the fall of 1944 on 16 different fields were designed to note the affect of the three major nutrients on cover crop growth, the relative effectiveness of applying nitrogen in fall or spring, and the value of cover crop fertilization as compared to fertilization just prior to planting. On most fields there was a noticeable difference within 10 days in color of cover crop wherever N or mixed fertilizer was used. By early March, the difference in growth was quite striking (Fig. 4). The treated cover crop was a very efficient cover (Fig. 5). Again yields of cover crop were obtained by harvesting representative square foot areas and washing soil from roots. Samoles of cover crop and soil were placed in pots (Fig. 6) and in this case were planted to peas. Peas at harvest time are shown in Fig. 7. Results are given in Table 2.

These results confirmed the previous experimental data and gave new data to support the method of cover crop fertilization. It is of extreme interest that the yields of peas were as good following fertilized cover crops as those receiving fertilizer before planting. Examination of young seedlings showed that better growth was being made where fertilizer was applied to the cover crop especially in the double nitrogen and mixed fertilizer treatments. These early differences disappeared at a later

Fig. 4. Rye grass in cover crop fertilization experiment photographed in March 1945. Check in foreground; treated areas in background. From left to right, NPK, 2N, K, and P. Stakes between 2N and K have been removed but line is clearly visible. Treatments applied October 1944 except 2N plots which received one-half N in October 1944 and one-half in late February 1945.

date. Lima beans which followed but which received no additional fertilizer gave somewhat similar results as peas.

There was evidently no response to the additional organic matter produced which in several cases amounted to about two tons of dry matter per acre. Of course, this amount compared to the total soil organic matter present is very small (Two tons = 0.2% and these soils ranged from 1.0-1.6%). If such increases were obtained for a number of years on the same soil, it

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Fig. 5. Close-up of cover crop treated several months earlier with mixed fertilizer. Note how tall cover crop holds snow in place.

Left to right: Samuel W. Hill, FSA supervisor; Alton G. Wilson, farm owner; and Grady Wise, soil conservationist of Soil Conservation Service. Picture made in meadow strip.

Farm Security Administration Gave Me My Start

By Alton G. Wilson

Reidsville, North Carolina

I WAS BORN and raised on a farm in Rockingham County and my forefathers were farmers. In my youth I had a firm desire to own and operate a farm and put into practice better farming methods. Upon reaching the age of 21, my father's family of four boys had outgrown the 68-acre farm, and I, being the eldest, was free to seek employment elsewhere. This was in the early 1930's and wherever I turned for work there was a "No Help" sign hanging out. After many days of employment-seeking, I was forced to return home. After bargaining with one of our neighbors, who was badly in need of help, I became another of the many thousands of share-croppers in North Carolina.

In July a hail storm harvested our crop. Again I was forced out into the world seeking employment wherever it could be found. A friend told me that I might find work at a peach orchard in and around Southern Pines, and immediately I set sail, by thumb, with $2.00 given me by my uncle in my pocket. After buying a pair of work pants for $1.00, I reached White Hill, N. C., two days later, with two cents in my pocket. There I landed a job with the big pay of $3.00 per week and board, which made me very happy.

For five years I remained in this section of the State as a share-cropper. In 1938 I moved to Guilford County and farmed on shares with my cousin. It was on this farm that I first saw farming practices advocated by the Soil Conservation Service being carried out. These practices appealed to me very much. One day I read in the paper an article about a tenant farmer purchasing a farm through the Farm Security Administration. I did not say much about this but did store it in the back of my head, for I was thinking that some day I might marry and purchase a farm through that agency even though it was unbelievable that a share-cropper could buy a farm without the price. In 1939 I moved back to Rockingham County.

On January 8, 1940, I took unto myself a wife and moved out on a farm I had rented from William Cummings, who was a fine Christian gentleman and who gave me much helpful advice. He also had a wonderful wife, who was very kind and good to us.

It was on this farm that I again came into contact with farm practices that were being advocated by Soil Conservation Service and I liked them and could see the advantage of such farming methods.

One day I had a long talk with Mr. Cummings and told him what was on my mind, particularly about wanting a farm of my own. He advised me to contact the local Farm Security Administration and file an application with them to purchase a farm even though I had rented from him another year. That night my wife and I talked it over. I told her if we were going to continue to farm that we should have one of our own so we could make a better home for our children and have security in our old age. The children would have a place to come to after they were married and their children could visit us. So on April 2, 1941, I went to the local Farm Security Administration office and filed my application to purchase a farm.

August 8, 1941, was surely a Red Letter Day in our lives as on that date I purchased a farm through Farm Security Administration and, in addition, borrowed over $1,000 for stock, tools, fertilizer, seed, etc. That was a great debt for me, more than $5,000 Uncle Sam was gambling on Alton G. Wilson to make good. I was gambling on my farm to make good for me as every farmer does and as everyone gambles that the farmer will win with Mother Nature, thereby producing the needed food and fiber for them.

I believed I could only be successful if I used and followed the better farm practices and proper fertilization. This farm I had bought was badly eroded and in a poor state of cultivation. I immediately contacted Soil Conservation Service and a date was made with their county unit supervisor to visit me. Together with the County FSA Supervisor and the Soil Conservation Service work unit leader, I walked over my farm and a complete farm plan was mapped out that included proper soil management by rotation, strip cropping, contour tillage, terraces, meadow strips, pasture, and fertilization, which all hoped would

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Close-up of good red clover on land that has been well-limed, and had phosphate and potash added.

The Use of Dipicrylamine In Tissue Testing for Potash

By A. C. Richer

Department of Agronomy, Pennsylvania State College, State College, Pennsylvania

IN applying the filter paper technique of tissue testing for potassium according to Hoffer's (1) modification of the original Purdue tissue-testing procedure (2), the sodium cobaltinitrite and ethyl alcohol reagents sometimes give erratic results. The difficulties encountered in estimating potassium, with reagents have been discussed by Peech and English (3) and it is well known that age of reagent, method of shaking, temperature, and amounts of reagents used, affect the degree of turbidity obtained. Under controlled conditions, such as exist in the laboratory, reproducible results can be obtained with cobaltinitrite, but tissue testing under field conditions often represents a variety of conditions.

The use of dipicrylamine for the determination of potassium lends itself well to the filter paper technique and eliminates these difficulties. The test was originally designed by Poluektoff (4) and is described in several texts on delicate spot testing (5, 6).

Reagents and Procedure

Reagent No. 1. One gram of dipicrylamine (hexanitro-diphenylamine) is dissolved in 100 cc of boiling 0.1 normal sodium carbonate solution, allowed to cool, and filtered.

Reagent No. 2. Two normal hydrochloric acid solution.

For convenience in use the reagents are stored in dropping bottles.

Procedure:

Filter paper is saturated with plant sap according to the procedure of Hoffer (1), and a strip ½ to ¾ inch wide is cut from the bottom for the test. (The remainder of the filter paper may be used for nitrate and phosphate tests if desired). One drop or less of reagent No. 1 is smeared over an area of several square centimeters using the tip of the dropping bottle dropper, and then 1 or 2 drops of reagent No. 2 are smeared over the same area with its dropper. In the presence of potassium, an orange red fleck is formed which is not decolorized by the addition of the hydrochloric acid solution. If no potassium is present, the color fades to a sulfur-yellow.

Excess of reagent No. 1 should be avoided in making the original smear. Just enough should be smeared on the paper so that it is absorbed uniformly over the area tested without any free solution standing on the paper before reagent No. 2 is added. Otherwise, when reagent No. 2 is added a milky yellow precipitate may form which will partially mask any orange flecks on the paper.

Contact of the dipicrylamine reagent with the skin should be avoided since the reagent is poisonous.

Interpretation:

The test is made semiquantitative by arbitrarily setting the following standards for evaluation of the level of potassium.

0=pale sulfur yellow, no orange flecks=No potassium.

1=few orange flecks=Low potassium.

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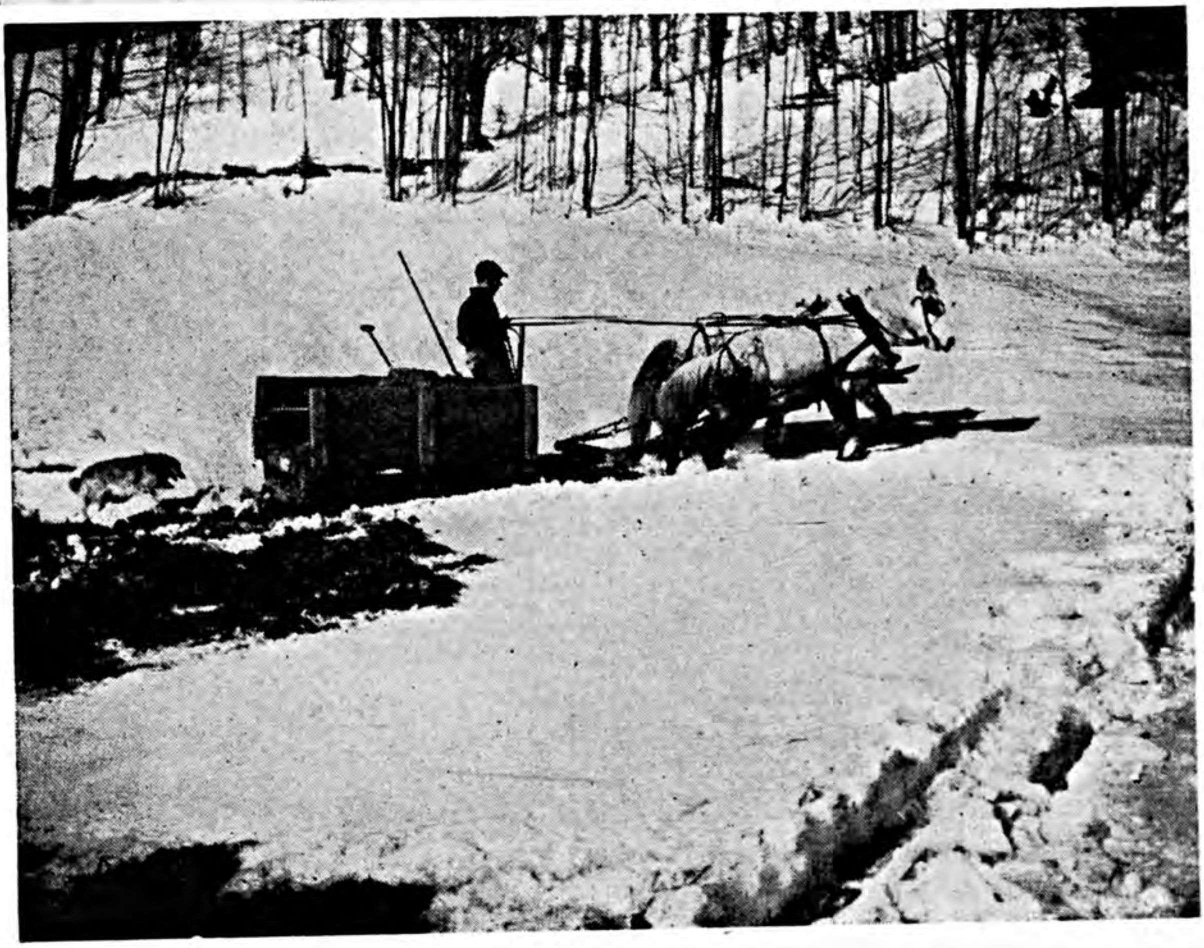
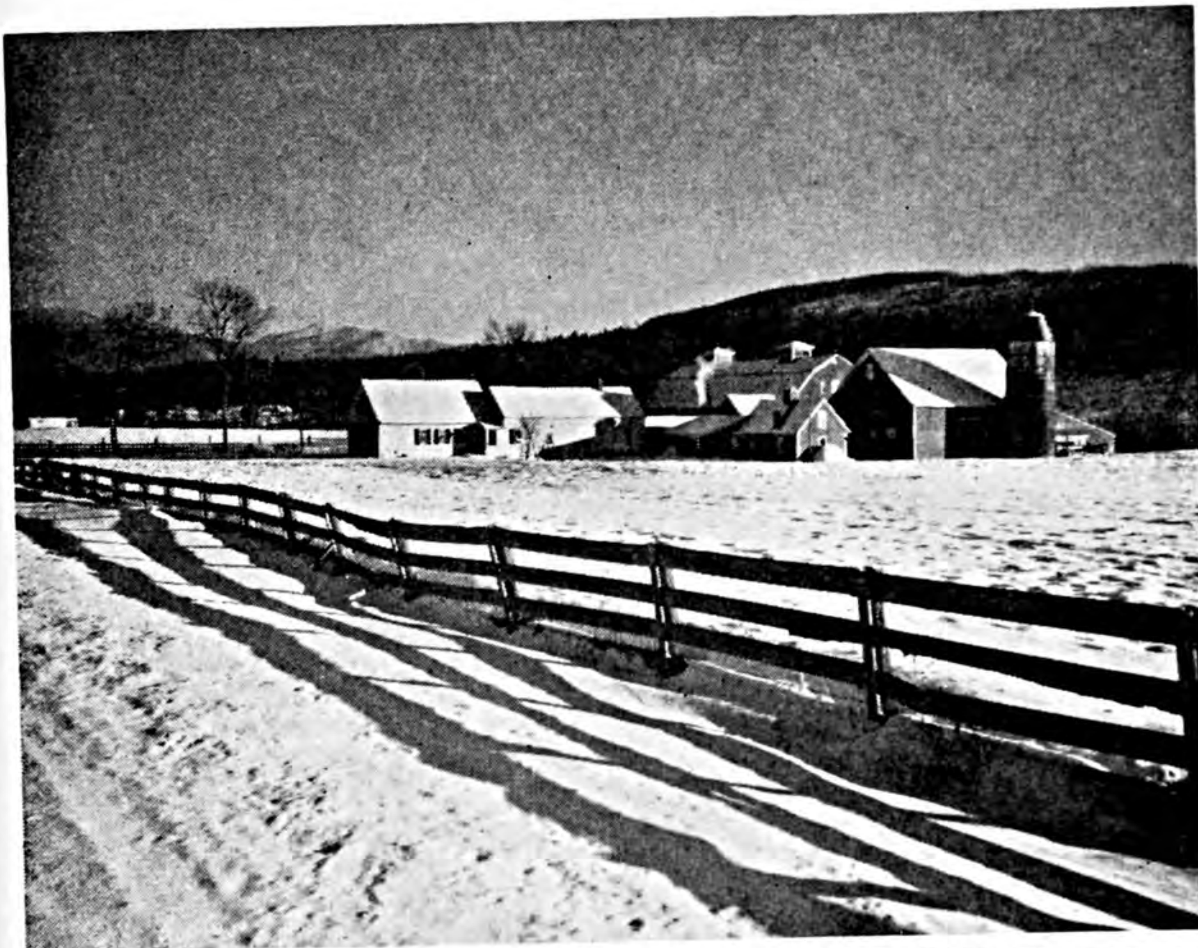
PICTORIAL

Farm children seldom lack pets of their own choosing.

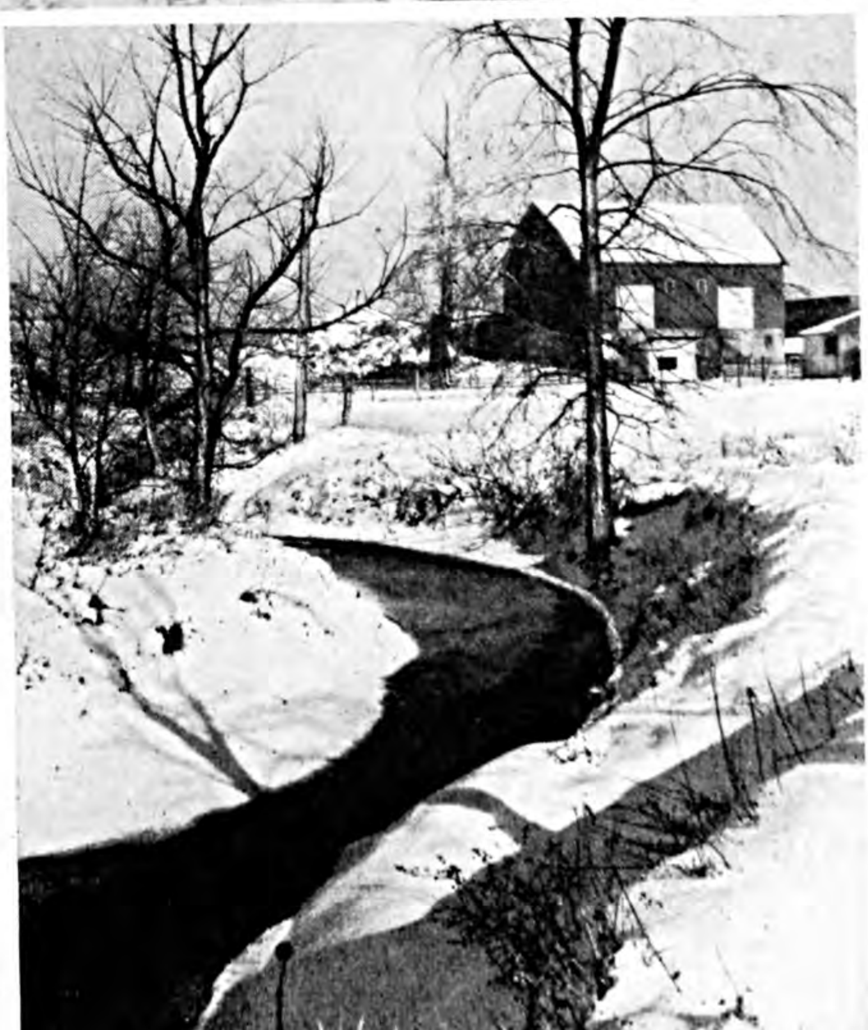
Winter

Chores





In Northern States



Left: Miss Carol Mitchell, Rochester, Indiana, Queen of the 14th Annual Indiana Muck Crop Show held at North Judson, Indiana. Carol spent considerable time in the onion fields this summer weeding onions on her father's farm.

Below: Whitney Gast, Akron, Indiana, Muck Crop farmer was crowned the Muck Crop Champion of Indiana for 1946 by Governor Ralph Gates. Mr. Gast produced 1,029 bushels of onions, 560 bushels of potatoes, and 117 bushels of corn per acre.

The Editors Talk

Agriculture 1947

Encouraged by a continuing strong domestic and export demand for farm products and a favorable price situation, American farmers are starting the new year with plans for high production records. Officially announced goals for 1947 call for another year of top farm output. It is safe to predict that with "breaks" in the weather and farmers still in wartime "gear" these goals will be achieved.

The total acreage called for—358.5 million, of which 297.5 million are for cultivated crops and the balance for hay crops—is about 3 per cent more than the 1946 actual acreage, which turned out America's all-time production record. According to the Bureau of Agricultural Economics, U. S. Department of Agriculture, this acreage is larger than is permanently desirable and many farmers who want to restore fertility reserves drawn on heavily during the war will once more have to change their plans. In view of the heavy drain intertilled crops make on soil resources and the resulting intense competition for use of land in some areas, farmers will examine goals very closely in relation to good land use. There will be cases where a decision on priority of commodities will have to be made, such as wheat or flaxseed, cotton or grain sorghums, dry beans or sugar beets. Farmers will want to reconsider their plans for planting spring wheat, in view of the need for flaxseed and the excellent condition of the large acreage of winter wheat.

Four important reasons for continuing heavy production in 1947 have been given. First, there is a strong domestic demand. Second, there is need to build up reserve stocks of some commodities depleted during the war. Third, many war-devastated areas are still critically short of food and other farm products which America can supply. Fourth, a margin of safety should be allowed for the possibility of less favorable weather and lower yields than have prevailed in recent years.

"In view of the severe world shortage of such commodities as fats and oils, sugar, and some of the cereals, maximum domestic production of these commodities is desired so that more supplies which might otherwise be shipped to the United States will be available for other countries," the Bureau states.

"This does not mean there is an unlimited demand for all farm commodities. The goals suggest cuts in the acreage of some crops. By exceeding the goals, especially for potatoes, peanuts, and burley tobacco, farmers could easily overproduce and bring on serious marketing difficulties. Substantial reductions in acreage of certain war-emphasized crops will be needed in some areas, while in others the suggested changes in crop goals call for acreage expansion. Greatest expansions over 1946 acreages are in cotton, flaxseed, dry beans, soybeans, barley, and grain sorghums. Continuation of the high wartime level of production is indicated for wheat, rice, and sugar crops."

On livestock, the goal calls for a slaughter of 34.5 million head of beef cattle as compared to an estimated slaughter of 32 million head in 1946. This goal is designed to provide for a consumption of 155 pounds of meat per capita, substantially higher than the 126-pound average for prewar years 1935-39, and above the 140-145 pounds for 1946. Because of the need for greater pork output in both 1947 and 1948, the goals ask for a substantial increase in hog production. The 9.2 million sows for farrowing next spring are about 13 per cent more than the number farrowed in the spring of 1946. The goal proposes a reduced slaughter of sheep and lambs to check the downward trend in sheep numbers. Slowing down in the recent heavy rate of culling and the heavier feeding of dairy cows to increase output per cow are stressed in order to obtain the increased dairy goal. The desired egg production can be attained with normal culling from the present indicated number of hens and pullets.

Little change in the cost of production in 1947 is expected. Operating costs of most farmers are now nearly two-thirds more than they were a half dozen years ago. However, labor-saving machines, better crop rotations, improved crop varieties, better livestock, and other good farming practices have materially increased the output per man and have permitted farm families to operate larger farms, thereby increasing total output and reducing real costs per unit.

Since 1941 the ratio of prices farmers receive for their products to fertilizer costs has been very favorable and will likely continue to be in 1947. The wartime rise in prices of farm products in contrast to comparatively small increases in fertilizer prices has been the most important factor in creating this favorable ratio; also, the trend toward the use of higher-analysis fertilizers and the general price-control program have been of considerable assistance.

It is the opinion of the Bureau that if present trends toward wider use of fertilizer to support more stable systems of farming are continued or accelerated, demand for fertilizer in the future may be less dependent on export crops, primarily cotton and tobacco, than it has in the past. Systems of farming that include more feed crops and livestock in areas that have been users of fertilizer should not decrease total fertilizer consumption but rather should sustain high demand. Future demand for fertilizer will also be influenced by consumption in areas that have previously used relatively small quantities. Wartime consumption of plant nutrients in the older and heavier-using areas rose about 70 per cent over prewar levels. There is need for considerable capital investment in soil improvement, such as additions of phosphate and potash particularly to many of the soils in the humid areas, the Bureau states.

All told, the year 1947 promises to be a prosperous one for American agriculture. Let us hope that in a year-end retrospect we can so record it.

Resolutions

It has been said that—"Resolutions are things that go in one year and out the other." Be that as it may, the approach of income tax time always makes a great many of us wish that we had stuck more closely to our resolution to keep clear and complete records on transactions during the year under consideration. Farming is a complex business; therefore, the greater the need for farmers to keep accurate accounts of money taken in and money spent. Along with these should go inventories, records on crop yields, fertilizer applications, livestock programs, and the many other factors which make for good business management. Now is the time for farmers to review their past year's accounts and "resolve to do better."

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1920...........	15.9	17.3	125.3	141.7	61.8	182.6	16.46	25.65	....
1921...........	17.0	19.5	113.3	113.1	52.3	103.0	11.63	29.14	....
1922...........	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923...........	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924...........	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925...........	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926...........	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927...........	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928...........	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929...........	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930...........	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931...........	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932...........	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933...........	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934...........	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935...........	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936...........	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937...........	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941...........	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942...........	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943...........	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	40.8	149.0	192.0	109.0	141.0	16.40	52.70	....
1945									
December....	22.84	43.8	137.0	194.0	109.0	154.0	15.40	51.40	....
1946									
January......	22.36	36.3	145.0	208.0	110.0	154.0	15.70	50.90	....
February.....	23.01	33.9	146.0	223.0	111.0	155.0	15.80	50.30	....
March.......	22.70	31.9	157.0	236.0	114.0	158.0	16.30	47.50	....
April........	23.59	42.9	162.0	245.0	116.0	158.0	15.00	48.00	....
May.........	24.09	43.0	157.0	251.0	135.0	170.0	14.80	49.60	....
June.........	25.98	59.0	147.0	251.0	142.0	174.0	14.70	51.50	....
July.........	30.83	56.7	148.0	275.0	196.0	187.0	15.00	60.00	....
August......	33.55	48.6	143.0	280.0	180.0	178.0	15.10	59.10	....
September...	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	....
October......	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November....	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1920...........	128	173	180	161	96	207	139	114	....
1921...........	137	195	163	129	81	117	98	129	....
1922...........	185	228	95	114	116	109	98	135	....
1923...........	231	190	133	137	129	105	110	183	....
1924...........	185	190	98	170	166	141	107	147	143
1925...........	158	168	245	188	109	163	108	140	143
1926...........	101	179	189	134	116	138	112	98	139
1927...........	163	207	146	124	132	135	87	154	127
1928...........	145	200	76	134	131	113	95	152	154
1929...........	135	183	189	133	124	117	92	137	137
1930...........	77	128	131	123	93	76	93	98	129
1931...........	46	82	66	83	50	44	73	40	115
1932...........	52	105	55	62	50	43	52	46	102
1933...........	82	130	118	79	81	84	68	57	91
1934...........	100	213	64	91	127	96	111	146	95
1935...........	90	184	85	80	102	94	63	135	119
1936...........	100	236	164	106	163	116	94	148	104
1937...........	68	204	76	93	81	109	74	87	110
1938...........	69	196	80	83	76	64	57	97	88
1939...........	73	154	100	85	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	107	117	107	81	211	129
1942...........	153	369	168	136	143	124	91	202	163
1943...........	160	405	188	232	174	154	125	231	245
1944...........	167	408	214	219	170	160	138	234	212
1945									
December....	184	438	197	221	170	174	130	228	223
1946									
January......	180	363	208	237	171	174	132	226	249
February....	186	339	209	254	173	175	133	223	275
March.......	183	319	225	269	178	179	137	211	283
April........	190	429	232	279	181	179	126	213	282
May.........	194	430	225	286	210	192	125	220	177
June.........	210	590	211	286	221	197	124	228	185
July.........	249	567	212	313	305	212	126	266	163
August......	287	486	205	319	280	201	127	262	162
September...	285	488	184	255	269	202	130	256	154
October......	304	530	175	238	266	213	136	293	151
November....	236	438	176	228	198	214	145	399	207

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945						
December	1.75	1.42	7.81	5.77	4.86	6.71
1946						
January	1.75	1.42	7.81	5.77	4.86	6.71
February	1.75	1.42	7.81	5.77	4.86	6.71
March	1.75	1.42	7.81	5.77	4.86	6.71
April	1.75	1.42	7.81	5.77	4.86	6.71
May	1.75	1.42	9.08	6.10	4.86	7.30
June	1.88	1.42	10.34	6.42	4.86	7.90
July	1.88	1.42	11.62	8.15	5.34	9.60
August	2.22	1.46	16.88	8.14	6.07	12.14
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish scrap	Tankage	High grade ground blood
1922	113	90	173	132	140	142
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945						
December	65	50	223	163	144	191
1946						
January	65	50	223	163	144	191
February	65	50	223	163	144	191
March	65	50	223	163	144	191
April	65	50	223	163	144	191
May	65	50	259	173	144	207
June	70	50	295	182	144	224
July	70	50	332	231	158	273
August	83	51	482	231	180	345
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1922	.566	3.12	6.90	.632	.904	23.87	....
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945							
December	.650	2.20	6.40	.535	.797	26.00	.200
1946							
January	.650	2.20	6.40	.535	.797	26.00	.200
February	.650	2.20	6.40	.535	.797	26.00	.200
March	.650	2.20	6.40	.535	.797	26.00	.200
April	.650	2.20	6.40	.535	.797	26.00	.200
May	.650	2.20	6.40	.535	.797	26.00	.200
June	.650	2.30	6.45	.471	.729	22.88	.176
July	.650	2.60	6.60	.471	.729	22.88	.176
August	.700	2.60	6.60	.471	.729	22.88	.176
September	.700	2.60	6.60	.471	.729	22.88	.176
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200

Index Numbers (1910-14 = 100)

1922	106	87	141	89	95	99	....
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945							
December	121	61	131	75	84	108	83
1946							
January	121	61	131	75	84	108	83
February	121	61	131	75	84	108	83
March	121	61	131	75	84	108	83
April	121	61	131	75	84	108	83
May	121	61	131	75	84	108	83
June	121	64	132	66	76	95	80
July	121	72	135	66	76	95	80
August	131	72	135	66	76	95	80
September	131	72	135	66	76	95	80
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1922	132	149	141	116	101	145	106	85
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	150	94	57	160	117	77
1944	195	176	151	96	57	174	120	76
1945								
December	207	183	156	97	57	175	121	78
1946								
January	206	184	156	97	57	175	121	78
February	207	185	156	97	57	175	121	78
March	209	187	158	97	57	175	121	78
April	212	188	160	97	57	175	121	78
May	211	192	162	99	57	189	121	76
June	218	196	163	100	60	203	121	70
July	244	209	181	103	60	230	121	70
August	249	214	187	116	67	293	131	70
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	128	67	382	131	78

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Since June 1941, manure salts are quoted F.O.B. mines exclusively.

** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Annual Report, State Board of Agriculture, 1945-1946," Dover, Del., Vol. 36, No. 3, Sept. 30, 1946.

"State Laboratory Fertilizer, Feed and Seed Report, Jan.-June 1946," State Board of Agr., Dover, Del., Vol. 36, No. 2, June 30, 1946.

"Effect of Fertilizer and Environment on the Calcium, Phosphorus, and Iron Content of Cowpeas," Agr. Exp. Sta., Experiment, Ga., So. Coop. Series Bul. 4, Nov. 1946.

"The Indiana Fertilizer Law and How to Comply With It," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 314, Jan. 1946, F. W. Quackenbush and O. W. Ford.

"Commercial Fertilizers in Kentucky in 1945," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Reg. Bul. 49, July 1946, J. D. Turner, H. R. Allen, and Lelah Gault.

"Analyses of Official Fertilizer Samples," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Reg. Bul. 53, Sept. 1946.

"Commercial Feeds, Fertilizers and Agricultural Liming Materials," State Insp. and Reg. Serv., Univ. of Md., College Park, Md., No. 199 Control Series, Aug. 1946.

"Progress Report on the Use of Boron in Walnut and Filbert Orchards," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Cir. of Inf. 363, May 1945, C. E. Schuster and R. E. Stephenson.

"Fertilizer Report," State Dept. of Agr., Harrisburg, Pa., Vol. 28, No. 3, May-June 1945.

"Fertilizer Report," State Dept. of Agr., Harrisburg, Pa., Vol. 29, No. 3, May-June 1946.

"Inspection and Analysis of Commercial Fertilizers," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 366, Nov. 1946, B. D. Cloaninger.

"Farm Manure," Ext. Serv., Clemson Agr. College, Clemson, S. C., Cir. 288, June 1946, H. A. Woodle and W. H. Craven.

Soils

"Summary of Results on the Physical and Chemical Condition of Ohio Greenhouse Soils," Agr. Exp. Sta., Wooster, Ohio, Agron. Mimeo. 101, Feb. 5, 1946, J. B. Page.

"The Salt Problem in Irrigation Agriculture," U.S.D.A., Washington, D. C., Misc. Publ. 607, Aug. 1946.

"Effect of Chloride and Sulfate Salts on the Growth and Development of the Elberta Peach on Shalil and Lovell Rootstocks," U.S.D.A., Washington, D. C., T. Bul. 922, Sept. 1946, H. E. Hayward, E. M. Long, and Rachel Uhvits.

"Strip Cropping for Conservation and Production," U.S.D.A., Washington, D. C., F. Bul. 1981, Sept. 1946, H. E. Tower and H. H. Gardner.

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Interesting information on the composition of numerous grasses and legume crops is given in Virginia Agricultural Experiment Station Technical Bulletin 102 entitled "Mineral Constituents and Protein Content of Certain Grasses and Legumes Grown in Pure Stands on Three Soil Types" by N. O. Price, W. N. Linkous, and H. H. Hill. The investigations were carried out over a period of years on three soil types, representing the limestone valley area, the Piedmont area, and the coastal plain. Among the leguminous crops grown were ladino clover, white Dutch clover, common lespedeza, Korean lespedeza, Kent wild white clover, Louisiana white clover, black medic hop clover, Dixie white clover, Altasweed clover, yellow trefoil, spotted bur clover, subterranean clover, Persian clover, and strawberry clover, while among the grasses were Kentucky bluegrass, orchard grass, timothy, perennial ryegrass, Chewings fescue, sheep fescue, red-top, Italian ryegrass, brome grass, tall fescue, tall oat grass, Canada bluegrass, Rhodes grass, rough stalk meadow grass, western wheatgrass, Bermuda grass, meadow foxtail, bulbous bluegrass, Reeds canary grass, crabgrass, Hardings grass, and several different strains of other grasses. Not all of these grasses are reported at each location. The legumes usually were higher in proteins than the grasses, although there were exceptions. The phosphorus content was not nearly so variable, the grasses in general holding their own with the legumes. Calcium tends to be distinctly higher in the legumes. The magnesium tends to be higher in the legumes, while there was considerable variation in the potash, the grasses carrying in general about as much as the legumes. There was considerable variation in composition due to the soil on which the plants were grown. Data on nitrogen:calcium, calcium:phosphorus, and nitrogen: phosphorus ratios are given, as well as experience ratings in getting stands of the various grasses and legumes.

Growers of flue-cured tobacco in South Carolina and neighboring states will find Clemson Agricultural College Extension Circular 287, "Tobacco Production" by H. A. McGee and J. M. Lewis, a source of much useful and practical information. The authors bring out that while tobacco is grown on a wide variety of soils, there must be certain characteristics, especially with reference to drainage and organic matter, if tobacco is to be successfully grown. These can be modified to some extent, but the nearer they come to the desired characteristics, the more successful the tobacco growing is likely to be. Rotations are important although usually are not as systematically carried out as might be desirable. Legumes are usually not desirable crops to precede tobacco, Austrian winter peas being especially undesirable. Non-leguminous winter cover crops such as small grains give good results, while letting the ground grow up to weeds preceding the tobacco usually gives excellent results. Several rotations that fit in well with tobacco and at the same time furnish a comparatively well-balanced farming system are suggested. The authors take up the individual elements in the nutrition of tobacco. There probably is no crop grown which requires greater care in its fertilization than does the tobacco crop, if high quality and good yield are to be obtained. Nitrogen and potash are particularly important. Nitrogen must be available in amounts up to 20 to 40 lbs. per acre, but an excessive quantity can play havoc with the crop. Experimental evidence indicates that it is desirable to have at least half of the nitrogen in an organic form in order to spread the supply throughout the season. Potash is important in determining growth and quality of the crop and since most tobacco soils are deficient in this nutrient, rather large quantities are needed in the fertilization of this crop. It is stated that 60 to 90 lbs. K_2O per acre usually are used, with 100 to 150 lbs. desirable. Phosphorus usually is necessary in quantities of 60 to 80 lbs. of phosphoric acid per acre. The fertilizer should be such that some chlorine will be furnished, but excessive quantities of this element are to be avoided. It is suggested that the fertilizer contain 2 to 3% of this element. Sulphur also is needed. With the common materials now going into fertilizer, it is usually a problem to hold the sulphur within a certain limit. It is suggested that the fertilizer contain at least 3% but not more than 5% sulphur. Magnesium is another element important in the nutrition of tobacco, the lack of it giving rise to a condition known as sand drown, and it is suggested that the fertilizer contain 2% magnesium oxide. Calcium is needed for the plant, but an excess is to be avoided, with the maximum of 5% calcium oxide in the tobacco fertilizer suggested. In general the crop desires an acid soil. Among the secondary and minor elements are boron, copper, iron, manganese, and zinc, which at one time or another have been shown to be needed on tobacco. The limits between optimum amounts and toxic amounts are rather narrow, so these materials must be used with care and in accordance with the specific needs of the fields on which the crop is being grown. As a general recommendation, the authors state that a fertilizer for flue-cured tobacco should contain 3% nitrogen, 8% phosphoric acid, 6 to 9% potash, 2% magnesium, 5% calcium oxide, 2% chlorine, and 3% but not more than 5% sulphur, at the rate of 800 to 1,200 lbs. per acre. Information on variety, soil preparation, transplanting, cultivation, management during the growing season, marketing, and the early history of tobacco completes the publication.

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Slow Fires in the Soil

By G. D. Scarseth

Director of Research, American Farm Research Association, Lafayette, Indiana

ORGANIC MATTER is the firewood in the soil. Too often we smother this fire and then we are in for trouble. Let's have lots of fuel in the soil, but if it is to do the most good it must burn brightly when we need it.

On a cold winter evening it is comfortable to hear the old living-room heater roar as the wood is changed to gasses that burn. The destruction of the organic matter of the wood goes on at such a fast rate that the heat released becomes intense.

A hard run for a stray calf makes the sweat pour because the body must "burn up" some food fast enough to supply the necessary power. For a noon nap, some covers feel comfortable because, thus relaxed, not enough energy is used to keep the resting body warm, although the room is at a desirable temperature when moving about.

A snake or alligator moves so seldom that it can get along on a meal only every few weeks or months and need not burn enough fuel for energy to even warm its body.

When silage or sauerkraut is started the bacteria and yeasts find the sugars in the mass of material such an abundant supply of food, that they multiply so rapidly the chemical reactions of this first stage of decomposition give off more heat than is conducted away, with the result that the silage or kraut becomes warm. Wet hay may decompose so fast, because of microbial action, that the heat of decomposition may accumulate sufficiently to ignite the hay.

Therefore, we see that whenever an organic substance, like wood, coal, straw, manures, or any vegetable matter decomposes, heat is given off. The amount of heat given off is actually the same if the total destruction is rapid as from burning by fire or slow as from microbial decomposition. The heat effect in decomposition is ordinarily not noticed because the heat produced is usually conducted away too fast to be observed.

Keep the Drafts Open

Everybody knows that a soil rich in organic matter is likely to be highly productive if that organic matter is rotting fast. If it is rotting fast it is releasing available nitrogen and phosphorus and other nutrients for plant roots to use. But if organic matter is to decompose rapidly, the air (oxygen) supply must be abundant. In other words, if the organic matter is to "burn" fast, the drafts and all check dampers, as in the stove, must be wide open—the soil must be porous and warm.

The comparison of decomposition of organic matter to a burning fire goes even further. If the fire in the stove is suddenly smothered, the burning of the carbonaceous wood or coal would not be able to convert the carbon to carbon dioxide, as in a well-aired fire. Some of the gasses produced would be the poisonous carbon monoxide. Likewise, in a soil well supplied with organic matter (fuel for microorganisms) if the air supply is poor because of waterlogging or lack of porosity because of poor tilth, a wrong kind of decomposition (burning) takes place. Certain bacteria called anaerobes will rob oxygen from oxides in the soil, as from iron oxides or oxides of sulfur (sulfates), and convert these to poisons, as hydrogen sulfide (the smell of rotten eggs or a frozen cabbage field thawing), or to ferrous iron—the bluish color of poorly drained subsoils. Besides producing these poisonous products the carbon dioxide produced by this smothered rotting or slow burning fills the air spaces and further crowds out the oxygen.

This comparison illustrates how important it is that organic matter must be in an active process of decaying with lots of air entering the soil to feed these slow fires and to ventilate out the bad air. The ideal condition is like that Nature builds in unpastured woodland soils. Here the porosity is at a maximum and new fuel, fresh organic matter, is decomposing every warm day when the soil is moist.

Organic Matter as a Fuel for Warming the Soil

We have been thinking of organic matter as beneficial primarily for improving the soil tilth, supplying available nitrogen, and adding to the moisture-holding capacity of the soil; but the heat effect of decomposing organic matter has usually gone unnoticed. From the foregoing we know that when decomposing organic matter, such as cornstalks, is plowed under it is safe to estimate that another ton of roots is involved. Three tons of tops and roots per acre would give off as much heat in total decomposition as the burning of about 1.5 tons of hard coal. This amount of heat is not to be ignored—it has real value to the farmer. But in order for it to be of value, the organic matter must be decomposing actively—the slow fires of the soil must actually burn and more fuel must be added from time to time as with legumes or manures plowed under.

Good Pastures Conserve And Pay

(*From page* 18)

mal units, correct seasonal use, mowing and the re-application of phosphorus, potash, and lime as needed. Both Seal and Jones have been doing considerable management work since they started improving their pasture.

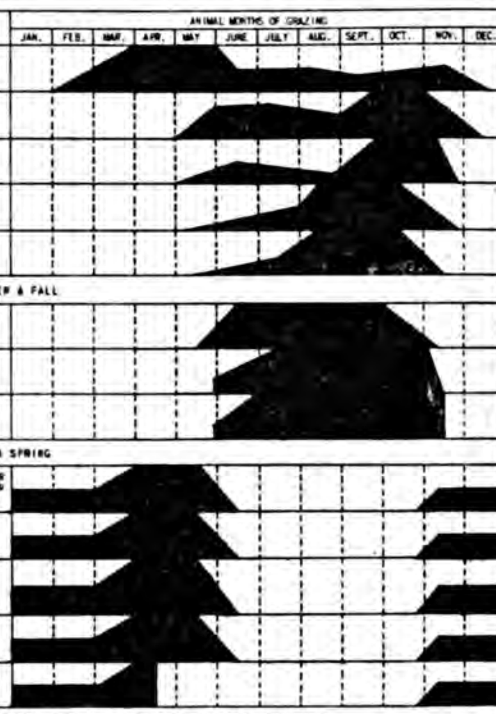
Very few permanent pastures are capable of providing the year-round grazing which Seal gets. Usually it is essential that supplemental pasture and feed be provided.

Many soil conservation districts, with

the aid of the Soil Conservation Service technicians, have prepared pasture calendars or charts to be used as guides by the district cooperators in establishing and managing pastures properly. Typical of these pasture calendars is the accompanying one which was prepared by W. E. Dee, District Conservationist, Kentwood, Louisiana, for use in a district in southeast Louisiana.

PERENNIAL AND SUPPLEMENTAL PASTURE FOR THE FELICIANA AND BOGUE CHITTO-PEARL RIVER SOIL CONSERVATION DISTRICTS, LOUISIANA

NO.	CROP	LBS. SEED PER ACRE	SEEDING DATE	ACRE PER COW	REMARKS
	I PERENNIAL PASTURES				
A	HOP, PERSIAN AND WHITE CLOVERS DALLIS GRASS	10-15 20-30	NOV. 1 to DEC. 15	1/2	ON MOIST BOTTOMS OR WET LANDS, ADD ALSIKE CLOVER. THOROUGH PREPARATION & FIRM SEED BED ESSENTIAL. PROPER APPLICATION OF LIME & FERTILIZERS ARE NECESSARY.
B	COMMON LESPEDEZA DALLIS GRASS	20-30 20-30	MAR. 1 to MAR. 31	1/2	THESE SEED MAY BE SOWN ON OATS WITHOUT FURTHER PREPARATION. SEED BED MAY BE PREPARED BY LIGHTLY DISKING CULTIVATED FIELDS. LIME AND FERTILIZER ARE NECESSARY.
C	COMMON LESPEDEZA BERMUDA GRASS	20-30 - -	FEB. 15 to MAR. 1	1/2	LIME AND FERTILIZER SHOULD BE APPLIED. LESPEDEZA MAY BE SOWN ON BERMUDA SOD BY LIGHTLY DISKING, OR RUNNING OVER SOD WITH WEIGHTED SECTION HARROW
D	COMMON LESPEDEZA CARPET GRASS	20-30 - -	FEB 15 to MAR. 15	1	LIME AND FERTILIZER SHOULD BE APPLIED. SOD SHOULD BE TORN UP THOROUGHLY, PREFERABLY BY TURNING UP SIDE DOWN WITH PLOW AND THEN DISKING.
E	CARPET GRASS	- -	-	2	LIGHT DISKING MIGHT IMPROVE CARPET SOD.
	II SUPPLEMENTAL PASTURES - SUMMER & FALL				
F	SWEET SUDAN TIFT SUDAN	20-30 20-30	APR. 15 to JULY 1	1/2	IT IS PREFERABLE TO PLANT 10 # PER ACRE IN 24 TO 36 INCH ROWS AND CULTIVATE. USE 300 # TO 500 # 8-8-8 FERTILIZER AND TOP DRESS WITH 100 # TO 200 # NITRATE PER ACRE.
G	ALYCE CLOVER	20-30	MAY 15 to JULY 15	1/2	USE 700 # 0-14-7 FERTILIZER; OR 500 # SUPERPHOSPHATE AND 100 # OF 50% MURIATE OF POTASH PER ACRE. GRAZE OFF AREAS WHERE GRASS AND WEEDS EXCEED CLOVER GROWTH AND MOW.
H	KUDZU	1000 Crowns	FEB. 15 to APR. 1	1/2	LIBERAL AMOUNTS OF MANURE AND PHOSPHATE FERTILIZER SHOULD BE APPLIED SEVERAL MONTHS BEFORE PLANTING. PLANT ONLY ON WELL DRAINED SOILS. CULTIVATE FOR TWO YEARS.
	III SUPPLEMENTAL PASTURES - WINTER & SPRING				
I	OATS (CAMELLIAS PREFERRED)	3 Bu.	SEPT. 1 to NOV. 1	1	USE COMPLETE FERTILIZER. TOP DRESS WITH 200 # NITRATE PER AC. EARLY SEEDING, ON SHALLOW, FIRM SEED BED GIVES EARLIER GRAZING, AND LITTLE LOSS IN GRAZING TIME DUE TO WET SOIL.
J	BARLEY	6 to 10 pecks	SEPT. 1 to NOV. 1	1	USE TEXAN BEARDED SEED. USE COMPLETE FERTILIZER. TOP DRESS WITH 200 # NITRATE PER ACRE. PREPARE SEED BED AS FOR OATS
K	OATS OR BARLEY WITH VETCH, CRIMSON CLOVER OR SINGLETARY PEAS	2 Bu. 20-30 30-50	SEPT. 1 to NOV. 1	1	PREPARE SEED BED AND FERTILIZE WITH COMPLETE FERTILIZER.
L	CRIMSON CLOVER	20-30	OCT. 1 to NOV. 1	1	APPLY 300 # TO 500 # 0-14-7 FERTILIZER PER ACRE. DO NOT PLANT CRIMSON CLOVER UNLESS YOU HAVE SUFFICIENT MOISTURE FOR IT TO COME UP. HARD SEED CRIMSON CLOVER PREFERRED.
M	SINGLETARY PEAS	30-50	AUG. 1 to OCT. 15	1	FERTILIZE AS FOR CRIMSON CLOVER. DO NOT COVER SEED OVER 1 INCH DEEP. CAUTION: DO NOT GRAZE AFTER THE PEAS BLOOM IN THE SPRING.



IMPORTANT: SAMPLES OF SOIL SHOULD BE TAKEN, AND SENT TO THE L.S.U. SOILS LABORATORY FOR ANALYSIS TO DETERMINE THE AMOUNT OF LIME, PHOSPHATE AND POTASH REQUIRED FOR IMPROVED PASTURES. WHITE, PERSIAN AND HOP CLOVERS, ALYCE CLOVER, CRIMSON CLOVER, SINGLETARY PEAS AND VETCHES SHOULD BE INOCULATED.

SUMMARY: A COMBINATION OF THE PERENNIAL PASTURES (I) AND THE SUPPLEMENTAL SUMMER AND FALL PASTURES (II) AND THE SUPPLEMENTAL WINTER AND SPRING PASTURES (III) LISTED ABOVE WILL APPROACH 12 MONTHS GRAZING PROVIDED HAY IS HARVESTED FROM THESE PASTURES DURING PEAK GRAZING PERIODS, WHICH IS DENOTED BY FULL LINES.

EXAMPLE: ANY COMBINATION OF PASTURES OF I, II, AND III MAY BE USED. BUT THE AUTHOR FAVORS THE FOLLOWING:

- I-A — WHITE, HOP AND PERSIAN CLOVERS AND DALLIS GRASS — 1/2 ACRE PER COW.
- I-B — COMMON LESPEDEZA AND DALLIS GRASS — 1/2 ACRE PER COW.
- II-F or II-G — SWEET SUDAN, TIFT SUDAN OR ALYCE CLOVER — 1/2 ACRE PER COW.
- III-K — OATS OR BARLEY WITH CRIMSON CLOVER OR SINGLETARY PEAS — 1 ACRE PER COW.

NOTE: REMOVE CATTLE BY FEB. 15 IF SMALL GRAIN IS TO BE HARVESTED. PROVIDE EACH PASTURE WITH PURE, CLEAN WATER. SHADE SHOULD BE PROVIDED IN PASTURES. DIVIDE PASTURES WITH CROSS FENCES TO PROVIDE FOR ROTATION OF GRAZING. MOW WHEN WEEDS ARE IN BLOOM.

Prepared by: W. E. Dee, District Conservationist, Soil Conservation Service, Kentwood, Louisiana   Reproduced by: U.S.D.A. Soil Conservation Service.

A pasture calendar prepared for use in the Feliciana and Bogue Chitto-Pearl River Soil Conservation District, Louisiana.

The Use of Dipicrylamine in Tissue Testing for Potash

(*From page* 26)

2=moderate orange flecks=Medium potassium.

3=almost solid orange=High potassium.

Application of the Test and Comparison with Cobaltinitrite

In order to establish the desirability of the dipicrylamine test for potassium, tissue tests were made on corn from the Jordan Soil Fertility Plots (7) by both methods and compared with the treatments applied to the soil and any observable deficiency symptoms.

The filter paper samples were obtained by expressing the sap from the midribs of corn leaves. The samples represented about 2½ inches of midrib at the base of the leaf immediately below the main ear. Eight plants from each plot were sampled and the eight midrib portions were combined into one sample, rolled in filter paper, and the sap expressed with pliers. The midribs were discarded and the saturated filter paper was folded in a paper towel, dried, and tested at a later date. (The filter paper procedure has been found to be particularly useful when large numbers of plots are to be sampled in a relatively short time since the dried samples can be stored and tested at any convenient later date.)

Included in the 36 plots of each tier of Jordan Soil Fertility plots are 10 plots receiving no commercial potassium, fertilizer, or manure, 4 plots receiving manure in different amounts, and 20 plots receiving potash at the rate of 100 pounds of K_2O per acre. These treatments are applied with different amounts and carriers of nitrogen and phosphorus and have been continuous for over 60 years. These categories were selected for simplicity in the following comparison.

The results for the cobaltinitrite method were obtained under controlled conditions in the laboratory using a Klett-Summerson colorimeter for the estimation of turbidity. The readings shown are simply the scale readings of the colorimeter. The evaluation of the dipicrylamine test was on the basis previously mentioned.

The decimals shown under the dipicrylamine method are the result of averaging the readings for the number of plots shown in each group respectively. Reading for any one determination is on the basis of whole numbers 0, 1, 2, and 3, or when undecided whether a reading is for example a 2 or 3, it can be recorded as 2.5. Accuracy beyond general classes such as high, low, and medium is usually unwarranted.

The results indicate that both methods reflect the amount of potassium in the plant sap satisfactorily, and that these readings correspond to observable potash-deficiency symptoms. Pronounced marginal scorch of the lower corn leaves occurred on many of the potash-deficient plots. However, since the dipicrylamine procedure yielded results as satisfactory as the cobaltinitrite procedure, and eliminated the difficulties sometimes encountered with cobaltinitrite, it appears to be a more desirable tissue test for potassium using the filter paper technique.

Furthermore, preliminary trials in the field indicate that with a crop like corn the test can be performed directly on the split stalk or a diagonal cut of the stalk (analagous to the diphenylamine test for nitrates on the split stalk). The white background of corn pith and its absorbing ability serve in the same fashion as the filter paper. One drop of reagent No. 1 is smeared on the split stalk and then 1 or 2 drops of reagent No. 2 are smeared over the same area. If potassium is present, the orange red fleck precipitate is readily observable on the corn pith. The desirability of the test on the stalk itself will only be properly evaluated with further use of the test and experience gained in interpretation of the readings.

	Cobaltinitrite method	Dipicrylamine method
Average of 10 plots receiving no potash or manure	55	0.6
Average of 4 manure-treated plots	166	2.9
Average of 20 potash-treated plots	166	2.6

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Farm Security Administration Gave Me My Start

(*From page* 25)

lead to my being a successful farmer.

Needless to say all these things were essential and I could not leave any of them out and be successful. As I proceeded to establish these recommended practices, I found they work hand in hand, each depending on the other; *i.e.,* my pasture, four acres, had previously been sown but not treated. I immediately limed and used a balanced fertilizer, with an additional 100 pounds potash and 300 pounds phosphate per acre. This increased the grazing from not enough for one cow to more than enough for two cows. In the last four years I have used 50 tons of dolomitic limestone, with about four tons of a complete fertilizer yearly. In addition to this I use a liberal application of nitrogen top-dressing on corn and small grain. On tobacco, I top-dress with 100 pounds of 5-5-20 per acre. This liberal use of fertilizer along with my four-year rotation has increased my yields as follows:

> Corn from 15 to 40 bushels per acre
> Tobacco from 860 to 1,150 pounds per acre
> Barley from 20 to 46 bushels per acre
> Lespedeza from 5 to 6 inches to 12 inches in height and ½ ton per acre increase in hay.

Does this increase in yield per acre mean more money? Yes.

Does it mean more work? Yes, only at harvest time.

Does it mean more work per unit of feed or pounds of tobacco? No, actually less work.

Is labor cheaper than fertilizer? My answer is definitely no, although labor is more scarce.

After four years' farming by methods described, I am firmly convinced that it is not only cheaper, and more productive, but is the most satisfactory method of farming. I plan to keep right on with conservation farming.

In conclusion let me say that of more than $5,000 I borrowed from Uncle Sam through Farm Security Administration in 1941, I now owe only $2,000. The value of my farm and buildings has increased on a normal market at least $2,000. Farm Security Administration has been to me a big brother; Soil Conservation Service, a grand friend; and Uncle Sam, a father.

Thirty Years of Building-up Soils in Wisconsin

(*From page* 10)

the kind and amount of fertilizer he can use to best advantage."

For many years Chapman has been recommending the following fertility program to Wisconsin dairy farmers: "Lime every acre of acid soil on the farm and apply from 200 to 300 pounds per acre of a phosphate or phosphate-potash fertilizer such as 0-20-0, 0-20-10, or 0-20-20 at the time of seeding down. For corn in the rotation, apply 100 to 150 pounds per acre of 3-18-9 or 3-12-12 fertilizer in the hill or row as a supplement to stable manure. Where animal manure is not adequate, an additional treatment with a high-grade complete

Note the striking difference between the fertilized and unfertilized portions of one of Chapman's permanent pasture demonstrations. The half on the left received 175 lbs. of ammonium nitrate per acre, and it yielded an added net profit of $20 per acre.

fertilizer is necessary. In my judgment, this is a well-rounded soil fertility program."

As to what the future holds for progress in soil fertility, Chapman contends that prediction is difficult.

"Our rates of application at present are too small. We could easily double with profit the amount of plant food now used on grain and legume seedings. The use of fertilizers on pastures and meadows is just getting underway. We know that more nitrogen can be used on our corn, sugar beets, cabbage, tobacco, hemp, and other special non-legume crops. Even this is but a beginning. Our farmers in Wisconsin have just awakened to the need for and the profit in using commercial plant food.

"One thing I am quite sure of," adds Clint Chapman, "Wisconsin crops are still hungry for plant food."

Fertilizing Vegetables by Applying Fertilizer to Preceding Cover Crop

(*From page* 23)

perhaps would give different results.

1945-46 results. Large pilot tests were established in the fall of 1945 to determine the practicality of cover crop fertilization. Mixed fertilizer (4-12-8) at the rate of 1,500 lbs. per acre was applied by G.L.F. equipment to portions of four fields of rye and one of rye grass on October 11. Other portions of the same field were treated with 750 lbs. of fertilizer at this date and another 750 lbs. in the late winter (week of February 27). A third portion was treated with 1,500 lbs. of 4-12-8 during the same week in February. The remainder of the field was fertilized just prior to planting the peas and in case of corn on April 5. Peas were grown on four of the fields while the fifth, because of its very sandy nature, was planted to sweet corn.* Altogether about 100 acres and 75 tons

* Too sandy to use mechanical pea harvesters.

TABLE 2.—THE RELATIVE YIELDS OF COVER CROPS TOP-DRESSED[1] WITH VARIOUS FERTILIZERS AND OF THE PEAS WHICH FOLLOWED

Treatment	Yield		
	Cover Crop [2]		Peas [3]
	Rye	Rye Grass	
Check (no fertilizer)	100	100	100
N applied in fall to cover	165	122	105
N applied in winter to cover	139	109	108
N applied before planting	....	....	103
2N applied ½ in fall, ½ in winter	204	134	104
2N applied before planting	....	....	102
P applied in fall to cover	104	98	110
P applied before planting	....	....	108
K applied in fall to cover	106	100	108
K applied before planting	....	....	106
NPK applied in fall to cover	173	118	113
NPK applied before planting	....	....	114

[1] N = Ammonium nitrate; P = triple super, 47% P_2O_5; K = muriate of potash, 61% K_2O } at rate of 200 lbs. per acre.
[2] Based on 18 samples for rye and 15 samples for rye grass.
[3] Based on 11 tests, duplicate pots in each or a total of 22 pots for each treatment.

of fertilizer were used in this test. Relative yields are given in Table 3.

The results of Table 3 indicate that for producing peas, cover crop fertilization was at least as good as regular methods of fertilization and perhaps slightly better. It also produced a better cover crop. However, increases in yields of cover crops were relatively small evidently due to the early plowing dates. This also may be the reason for the very poor showing of the late winter fertilization.

For corn grown on Sassafras sand, early fertilization on cover crop was as good as late fertilization. Split applications were slightly better although the difference is not significant. Unfortunately, a much larger amount of fertilizer was applied by conventional

TABLE 3.—RELATIVE YIELDS OF COVER CROP AND THE PEAS AND SWEET CORN WHICH FOLLOWED AS INFLUENCED BY FERTILIZATION OF THE COVER CROP

Treatment	Cover Crop [2]	Peas [3]		Ears of Sweet Corn [4]	
		Vines	Seeds	No	Wt.
Check [1]	100	100	100	....	....
All applied Oct. 11, 1945	128	113	106	100	100
½ in Oct.; ½ in week of Feb. 27	128	113	112	100	108
All applied during week of Feb. 27	104	108	112	100	100

[1] 1,500 #4-12-8 per acre applied just before plowing cover crop.
[2] Based on dry wt. of 9 samples, each 1 sq. ft. in area.
[3] Based on fresh wt. of 20 samples, each 1 sq. yard in area.
[4] Based on 5 fifty-ft. strips for each treatment. Wt. = fresh wt. of corn on the cob.

Fig. 6. Placing soil and cover crop in pots to note effect of cover crop fertilization on succeeding crop. Rye grass in foreground treated with 200 lbs. ammonium nitrate per acre, check in background.

fertilizer spreaders to the remainder of the field set aside as a check, so that no comparative data with regular fertilization is available. However, yields of the corn fertilized at different times would indicate no serious loss of nutrients. Because of the very sandy nature of this soil this is an extremely interesting fact.

Discussion

It would appear from the foregoing that fertilization of non-leguminous cover crops has definite possibilities. Much research, however, remains to be done on the following subjects:

Time of application. The yields of cover crop were greatest when fertilizer was applied in the fall. The fertilizer in all cases has been applied while the ground was still open and plants actively growing. It is not known how late in the season such fertilizer may be applied and still have a large portion of the soluble nutrients retained. There is some indication that a split application of fertilizer would be more useful. Also not known is the best age of cover crop for applying fertilizer and also whether such fertilizer can be applied before cover crop is up. Work is now being started to check on all these points.

Time of plowing cover crop. The time of plowing under the cover crop has an important bearing on the response to late winter applications. It may also have some significance in the release of nutrients for the succeeding crop. In all our experiments the cover crop was plowed early—by April 20—and while the plant was in a succulent stage. It is not known whether the practice of cover crop fertilization would have given as good results if the cover crop was allowed to become woody before plowing. This has to be investigated thoroughly before it can be recommended as a general practice.

Phosphorus fixation. We have no serious problem of phosphorus fixation on the soils used in these investigations. Plowing under of fertilizer has as a rule given about as good yield as any other method of fertilization. Where phosphorus fixation is a problem, the spreading of fertilizers on cover crop may cause some tie-up of phosphorus. How-

Fig. 7. Peas grown on soil and cover crop removed from experimental plots. Pot 4 received mixed fertilizer on the cover crop in the field; pot 5 received fertilizer before planting peas.

ever, phosphorus absorbed by the plant should be highly mobile and available for succeeding crops. Phosphorus broadcast on cover crop and plowed under should, therefore, suffer less fixation than phosphorus applied to bare land or to cover crops just prior to plowing.

Leaching of nutrients. Work is now being done to determine the extent of nutrients lost when applied to cover crop in fall or late winter. Many more plant analyses will have to be completed before this is properly evaluated. From the standpoint of yields only, it seems that there is no greater loss of nutrients from this method than conventional application of fertilizer. It must be remembered that fertilizer was always applied to a cover crop which was already well established. This is important because loss from leaching and erosion will be markedly influenced by the type of cover present. Also, in our large field experiments, ammoniated superphosphate was the source of nitrogen. Previous experiments have shown this form of nitrogen to be quite resistant to leaching. Chances of success with this method of fertilization are enhanced with the use of a resistant form of nitrogen in the mixed fertilizer and if fertilizer is applied to cover crops already established.

Long-time effects. The small changes in organic matter brought about by cover crop fertilization have not been enough to appreciably affect organic matter in soil or yields of following crops. It is suspected that continued use of such a practice would make an appreciable difference.

Practical application. Bulk fertilizer spreading is possible without cover crop fertilization. It definitely becomes a practicality when fertilizer can be spread over large areas during long periods. From the viewpoint of both fertilizer dealer and farmer, the fertilization of cover crops need only be as good as regular methods of fertilization. If is is as good, both stand to gain by bringing a lower cost fertilizer to the farmer and eliminating considerable drudgery from an important farm operation.

Conclusions

Based on three years of experimental work, findings of the G. L. F.-Seabrook Farms Raw Products Research Division have shown that fertilization of non-leguminous cover crops:

1. Will produce a larger amount of organic matter by the cover crop. The rye cover crop is greater stimulated than rye grass.
2. Can be used as a means of supplying fertilizer to peas and perhaps other vegetable crops.

The fertilization of the cash crop by applying fertilizer to the cover can be a major factor in making the bulk fertilizer spreading program practical. Bulk fertilizer spreading means savings in costs of fertilizer and eliminating the hard work of an important job on the farm.

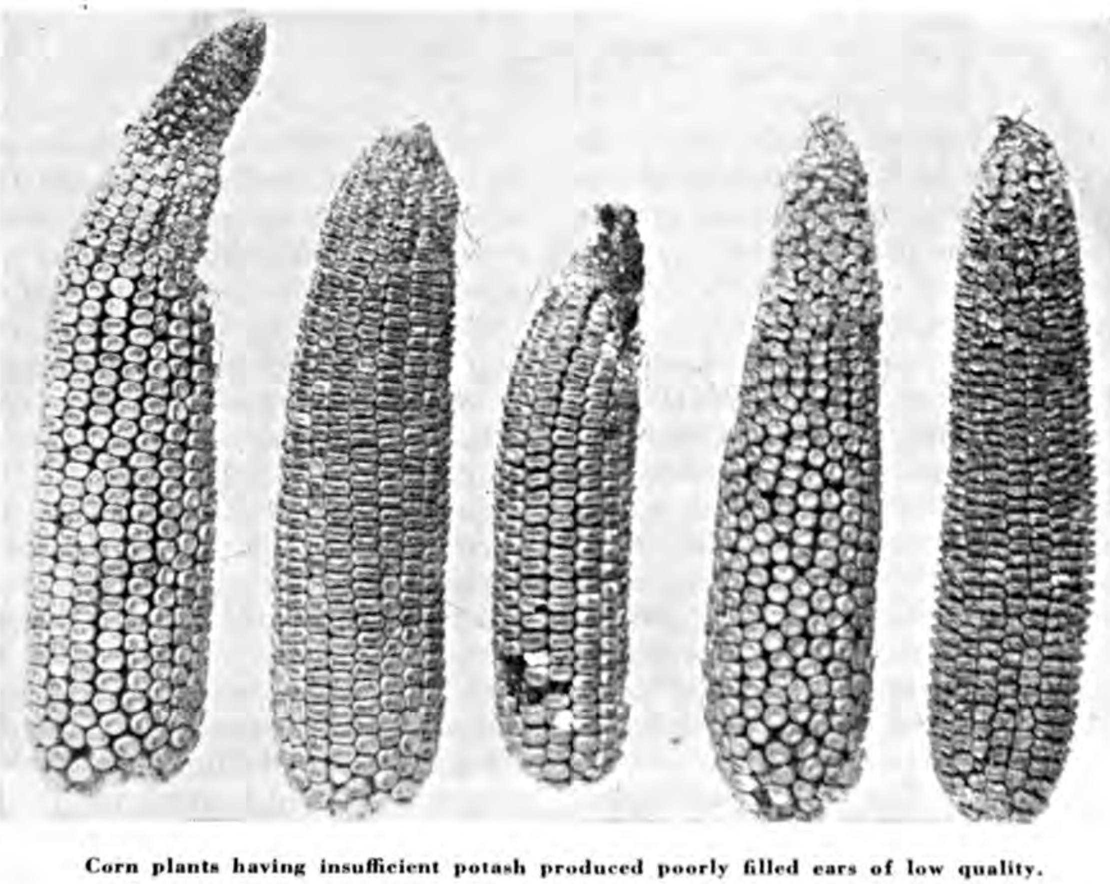
Potash Meets Its Responsibilities

(*From page* 14)

previous experiments yields have been limited because of insufficient nitrogen. In many of these experiments no increases were obtained from other treatments because nitrogen was the limiting factor. With close spacing, shallow cultivation, sufficient nitrogen, and adequate mineral fertilization, yields of corn are being doubled and trebled throughout the South. Instead of small applications of straight nitrogen, Southern agronomists are now recommending pre-planting applications of 400 to 600 pounds per acre of such mixtures as 6-8-6, 6-8-8, 4-8-8, or 3-9-9 with heavy applications of nitrogen as a side-dressing.

As vegetable growers satisfy the lime requirements of their soils and find it impossible to get animal manure, it is necessary to use more potash. Commenting on vegetable fertilization, Tiedjens states: "The ratio of nutrients in any case must be determined locally. There is one thing that seems well established. As the lime requirement of the soil becomes satisfied, the potash level must be higher. The phosphate level need not be emphasized. In other words, where a 5-10-5 is being used at the present time, the grower may find that an 8-8-16 or a 10-10-20 in equivalent amounts will increase yields materially."

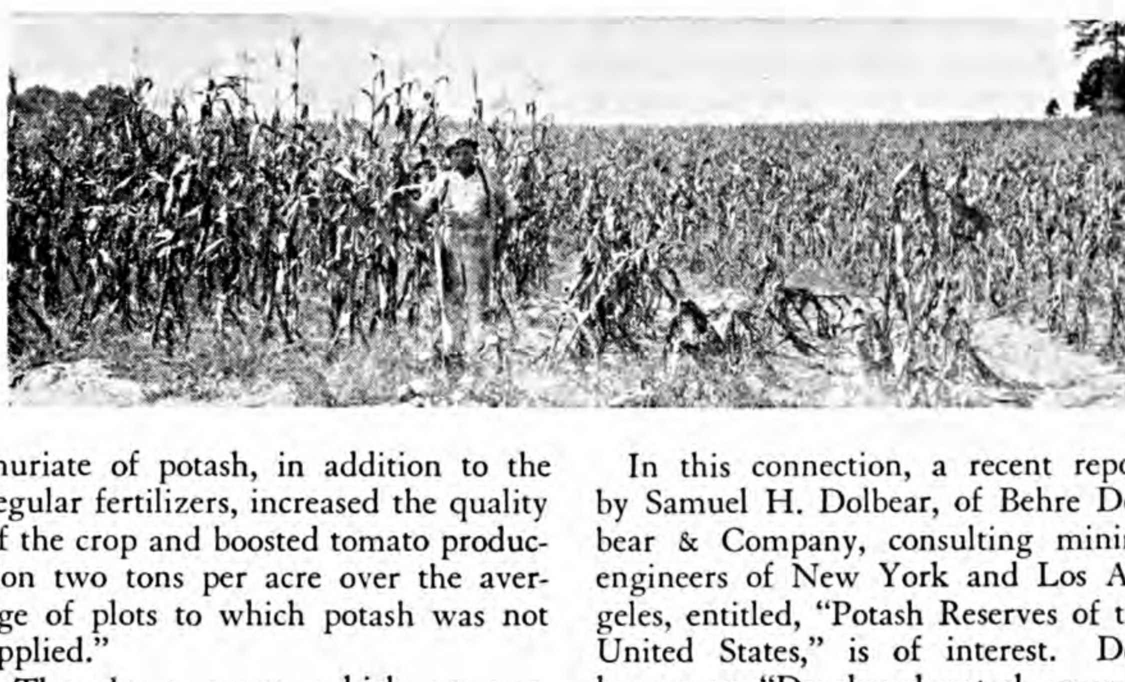
On many truck crops such as potatoes and tomatoes, potash in addition to that in the regular fertilizer is recommended. The Delaware Extension Service in its annual report states: "1940 saw the continuance of costs of production records and fertilization tests on tomatoes in Kent County. Twenty-five tomato growers maintained cost account records. Seventeen of these same tomato growers demonstrated that the use of 200 pounds of



Corn plants having insufficient potash produced poorly filled ears of low quality.

Above: Corn plants having an abundance of nitrogen, phosphate, and potash produce well-filled ears of high quality.

Below: Additional potash prevents lodging of corn. Corn on right fertilized with 8 pounds K_2O per acre; on left fertilized with 48 pounds K_2O per acre.



muriate of potash, in addition to the regular fertilizers, increased the quality of the crop and boosted tomato production two tons per acre over the average of plots to which potash was not applied."

The above reports which are supported by others from every section of the country indicate that not only will the high rate of potash in mixed fertilizers be maintained, but that it will undoubtedly continue to increase. Realizing this, much interest has been manifested recently by the industry, government officials, and others in regard to the potash reserves of the United States. The opinion has been expressed that the supply from which we are drawing is not sufficient for more than 100 years at current rates of consumption or for 50 years at desired rates.

In this connection, a recent report by Samuel H. Dolbear, of Behre Dolbear & Company, consulting mining engineers of New York and Los Angeles, entitled, "Potash Reserves of the United States," is of interest. Dolbear says: "Developed potash reserves in mines now under operation comprise a small part of the total potash resources of the United States. They are, however, of substantial size and they constitute the present sources of potash supply for agriculture and industry in the United States. That the tonnage of highly soluble salts in the New Mexico area will be substantially extended if exploratory work is undertaken, there can be little doubt. The potential additional potash ore in that area is possibly 400 million tons or four times that presently developed." It is also pointed out that the beds of sylvite-carnallite ore in eastern Utah appear to be 10 to 20 times as thick as the sylvite beds in New Mexico; that polyhalite is widely distributed through New Mexico and Texas, and the established reserves in Carlsbad area alone are extensive enough to supply the demand in the United States for over 200 years. In addition other soluble and insoluble forms of potash are reported. Dolbear thus concludes: "Potential and developed potash reserves in the United States are of such magnitude that, with a reasonable rate of exploration and development, there is no foreseeable shortage of supplies for agriculture and industry for hundreds of years."

More Food—Fewer Farmers

(*From page* 5)

high-yielding, disease-resistant cereals. If you think that such better strains don't take a whale of a lot of extra plant food to make a crop, then you are sadly behind the times. The scientists have figured that it takes about two pounds of mineral plant food to produce each extra bushel of corn. In Iowa alone the 15-bushel increase in average corn yield per acre has meant using up 30 pounds or more extra plant food. That figures to 160,000 tons of extra plant food for Iowa soil alone, as a result of the smart work done by Henry Wallace and his fellow corn breeders.

That doesn't solve the man-depleting problem though. Machines will handle the fertilizer-restoring task easily. What to do with the displaced hired men and crop of boys is our next pesky problem. They can't all be coal barons or labor bosses. We have to find some respectable work for them.

Next, or second, on the agenda is the fact that our farms are getting fewer and larger. Along about 1920 we boasted six and a half million separate farms. Now this has shrunk by more than half a million. In 1920 the average farm occupied 150 acres. From the latest report I got from the census, it had reached fully 200 acres.

Back in the days of the Centennial Exposition of 1876 there were not 4,000 farms that covered up to 1,000 acres each. Right now there are 110,000 farms in that category. And there's another angle. In 1930 we had close to a billion acres in farms. The 1945 census shows a total of 1,500,000,000 acres. We now have four times as much farm land as we had 100 years ago. It has been growing at a fast clip, although the pity is that a good share of the present acreage is not worth much more than when the Kiowas and the ground-hogs and rattlesnakes owned it. I mean it isn't if you put it to the acid test of a few unfavorable price or weather seasons.

Now let's see what the working force amounts to in terms of production power. The only trouble in comparing 1870 with later years is that in the good old days they counted in kids 10 years old, while nowadays with all the gadgets we have to do with, we begin counting employed persons on farms at 14 years of age.

About 75 years ago some 6,850,000 persons worked the land. Their combined food output was worth about $360 apiece. In 1946 they tell me that 8,200,000 workers are engaged in farming, 20 per cent more, but they make a crop valuation at recent prices which gives them an average productive worth of 700 per cent better than the old-timers. That means the farm laborer today makes a crop worth $2,500 at going rates of value. I am not saying a word here about how much more it costs him to keep going, because therein also lies a vexing topic for menders to tinker with.

GRANTED that mere price differences might distort any such contrasting picture, it still remains true that the average farm of our era outyields the one of our grandsires by nearly three times. The same machine age that has done so much to make this possible has also operated to expand the markets of the farms and bring their products to consumers at greater distances.

While all this was taking place something else was happening to the traditional family farm unit. Compared to the years at the beginning of American independence, we now have 350 times as many of our people residing in cities, but only 16 times as many folks staying on farms. Only one person in seven works at agriculture.

Despite all our courageous efforts and our earnest experiments and resolutions to safeguard and make attractive the life on the land, we witness a dwindling farm force as the years go by. To be sure when severe depressions come our way, as come they ever will, the tide turns a trifle for a season or two—and we find refugees crowding back on farms to make themselves as useful as possible even in the face of a poor market outlet and a vastly accelerated output.

Temporarily also when wars surge up on our shores and we man the defenses and spur production, we see a drift by the ambitious farm crew into crafts that pay bigger money and shorter hours. As far as present returns show, not all of those who left the land during the latest carnage have come back again. Land values are too high and equipment too costly, and there is not room enough even to take care of the youngsters who left five years ago—with all the multiple power we now possess to plow and reap.

America's breadbasket of the Midwest lost about two and a third million persons from farms in the 12 years between 1930 and 1942. Here we have the richest food larder in the world, perhaps, with what should continue to be a profitable place to make a decent living and rear upstanding families.

Without doubt the machine, more than any other single factor, is accountable. The same thing has happened in Virginia, as one of my friends on a farm journal has noted. He remarks that improved machinery has not seemed to reduce the average day's work in that State very much, because there are fewer hands left in the wake of the new power. The sons and daughters of these good agricultural regions are moving out as fast as their jobs become scarce, with the purchase of better equipment.

THE birth rate drops gradually and the proportion of older farmers increases along with this drift away on the part of the vivid and virile juniors. If you want to do some thinking, just figure for your own state the percentage of operators of farms who were 55 years and over in 1945.

Does this mean a permanent falling off in the quality of our available management and man power in years ahead for agriculture? Is it possible that enough of the "prodigals" who left the farms will retain enough actual or secondary interest in the enterprise to filter back as the elderly operators relinquish their titles and become too few and feeble even to ride a tractor? Are we going to see a slow but sure increase in our birth rate by these husky young men and women who pose for pictures as health champions at 4-H fairs? So far the answer is a negative one. Modern couples on or off the farm simply do not reproduce themselves in the hearty old-fashioned way. You can't bank on the rapid bulge in the post-war baby crop to be maintained. That's one thing at least we can't speed up with our modern mechanization technique.

IN fact, I don't know what it takes. Some say security and content. Maybe parity prices or soil conservation or stabilization is the answer, but I doubt it. If you think production control with hogs and corn has almost ruined farm integrity, how about birth control—which is just a different form of production control anyhow.

Of course, the fecundity rate is better in the open country still than it is in the Hogan's alleys or on the Broadways, but it simply isn't too good anywhere—compared to the good old days. And if you can tell me how we are going to keep on mechanizing for more food on one hand and skimping our infant output with the other and still come out minus the surplus bogey, I will be well paid for my time.

The real answer could be hunted for among the neglected zones of this and other lands where the baby crop gets less thought than the pig crop maybe. Malnutrition is a big foe of the birth-and-child-rearing industry. Some of the surplus can be thus diverted if we can find a way to make it pay us. Charity gets so monotonous that it seldom gets a royal welcome attached to any food-distributing scheme.

We must not quit on a sour note. Fully 98 per cent of our six million farms are run as family units yet. They are a way of life even in the face of overwhelming pressure to make them commercial. There are some remarkable counties in the country, notably in the East and Northeast, where production increases steadily, soils are safeguarded well, and the farm population does not diminish.

They say that if the whole area of some rich Midwest state were farmed according to the system long in use in some of the most intensive rural counties aforesaid there would be provided enough profitable employment for several hundred thousand more families.

There is a way also to encourage more canning, packing, and processing industries in the heart of the Corn Belt, and to get more general manufacturing there, so that the huddling of so vast a portion of our folks in cities will not add to the terror of any struggle between powerful business and labor groups.

I shun from naming any atom bomb business as reason for development of larger rural centers, but I know that we are entering an era of shorter work weeks and some city inhabitants will begin to look for places in the country to combine local factory or shop jobs with part-time farming.

At any rate, I for one will not get so ruthless in my philosophy as to allow that we must have cheap food, no matter if efficiency in its production means having many less folks living on farms. I think there are lots of people yet who keep up old aspirations and visions regarding the normal values and virtues of farming. They hate to be completely out of date or queer and behind-hand in their ways and works, but they cling somehow to old ideals that held up the farm as something besides just a place of barter and cash on the barrel head.

I DON'T know as I care to live and ride the roads as I used to if we are obliged to shift gears plumb smack dab into a maze of dollar signs and high pressure commercialism plastered on every rural gate post. I wouldn't find my kind of folks living there I'm afraid. Let's hold back on it as long as we can even at the risk of being old fogeys.

More Power!

The farmer was trying to get his balky horse started when the local doctor came along. "Can you get this derned animal to move?" asked the farmer. Doc nodded his head, opened his bag, took out some powder and placed it in the horse's mouth. The horse rolled his eyes, switched his tail, and suddenly went into action, galloping down the road. Watching the horse rapidly disappearing, the farmer asked anxiously, "How much did the powder cost, Doc?"

"About a quarter," was the answer.

"Then you better give me 'bout a half dollar's worth—quick—'cause I've got to ketch 'im!"

A Few Whinnies

The train was pulling out of the station when a young man threw his bag onto the observation platform, and swung himself up over the handrail. He stood panting as the train gathered speed. An elderly party said scornfully: "You young fellows don't keep yourselves in condition. When I was your age I could carry a cup of coffee in one hand, run half a mile and catch the 8:15 and still be fresh as a daisy."

"You don't understand pop," said the young man, "I missed this train at the last station."

"How dare you swear before my wife," demanded the indignant husband.

"I am very sorry," replied the intoxicated man, "I was unaware that your wife wanted to swear first."

If louses are lice
And mouses are mice
Would you say that a guy
With two spouses had spice?

Today I met a friend of my youth who used to be an ardent socialist, filled with visions of reforming the world. He says he never got over it until he married and found how difficult it is to change just one woman.

She: "There's one thing I want to tell you before you go any further."

He: "What's that?"

She: "Don't go any further."

Wife: "What tense is 'I am beautiful'?"

Husband: "Past."

"Yo sho does look worried."

"Boy, I'se booked up solid on worrying. I'se got so many worries on mah mind that if sumpin happens to me today, Ah won't get time to worry about it foh two weeks."

The doctor had examined the lanky recruit and was filling in the medical form. "That's everything except the sputum test," he said. "Just expectorate in one of those vials on that shelf at the far end of the room."

"What d'you mean, doc?"

"Spit in one of those bottles on the shelf at the far end of the room."

"What! All the way from here?"

Sue was congratulating Mary on her driving ability: "Why, you're handling the car like a veteran."

"How do you know," countered Mary. "You've never seen me handle a veteran."

Ad in English paper: Owner of tractor wishes to correspond with widow who owns a modern thresher; object matrimony; send photograph of machine.

DRIVER'S License Examiner: "Do you know what it means if a driver puts out a hand?"

Applicant: "Well, if it's a woman, it means she is going to turn right or left, shake the ashes off her cigaret, or reverse or stop, or she's pointing to a hat store, or admiring her ring, or—"

Examiner: "Yeah, and if it's a man?"

Applicant: "Why he's usually waving at a woman."

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Better Corn (Midwest) and (Northeast)

Reprints

T-8 A Balanced Fertilizer for Bright Tobacco
N-9 Problems of Feeding Cigarleaf Tobacco
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What Is the Matter with Your Soil?
E-2-42 Fertilizing for More and Better Vegetables
II-12-42 Wartime Contribution of the American Potash Industry
H-2-43 Plant Food for Peach Profits
J-2-43 Maintaining Fertility When Growing Peanuts
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
FF-8-43 Potash for Citrus Crops in California
A-1-44 What's in That Fertilizer Bag?
H-2-44 Efficient Fertilizers for Potato Farms
AA-8-44 Florida Knows How to Fertilize Citrus
CC-8-44 Soil Fertility's Effect on Asparagus
QQ-12-44 Leaf Analysis—A Guide to Better Crops
C-1-45 Fertilizers for Cotton and Corn Following Lespedeza
G-2-45 Some Whys and Wherefores for Air-Conditioning Soils
P-3-45 Balanced Fertility in the Orchard
R-3-45 Higher Corn Yields for North Carolina
Z-5-45 Alfalfa—the Aristocrat
DD-5-45 A Case of Combined Potassium and Boron Deficiencies in Grapes
EE-6-45 Balanced Sods in Orchards
FF-6-45 Orcharding from the Ground Up
GG-6-45 Know Your Soil
LL-8-45 Fertilizing for Better Soybeans in North Carolina
MM-8-45 Red Clover Suggests Shortage of Potash
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
PP-10-45 More Vegetables for Less Money
QQ-10-45 A Little Boron Boosts Sweet Potato Yields
SS-10-45 How to Start White Dutch Clover Pastures in Florida
TT-10-45 Kudzu Responds to Potash
YY-11-45 Potash—In War and Peace
ZZ-11-45 First Things First in Soil Fertility
BBB-12-45 Success with Blueberries
CCC-12-45 Poor Soils—Poor People
A-1-46 Crop Production Horizons
B-1-46 Potash Increases Tomato Yield and Quality
D-1-46 A New Legume for the South—Wild Winter Peas
E-1-46 The Sources of Potash for Flue-cured Tobacco
H-2-46 Plow-sole Placed Plant Food for Better Crop Production
J-2-46 Correcting Potash Deficiency in Growing Corn
N-3-46 Sweet Potatoes Are Proving New Gold for the South
O-3-46 Fertilizer Placement for Corn in Kentucky
P-3-46 The Story of Potash
Q-4-46 Potash Treatment Makes Better Sweet Clover
R-4-46 Alfalfa in Mississippi Decreased as Soil Fertility Declined
S-4-46 Plow-under Fertilizer Ups Corn Yields
T-4-46 Potash Losses on the Dairy Farm
W-4-46 Muck Soils Produce Quality Sweet Corn for Canning
X-4-46 Potash Pays Good Dividends in Louisiana
Y-5-46 Learn Hunger Signs of Crops
Z-5-46 I Saw It Happen in the Soil-testing Laboratory
AA-5-46 Efficient Fertilizers Needed for Profit in Cotton
BB-5-46 The Soil Is Our Heritage
CC-5-46 Corn Production in Mississippi
EE-6-46 Dynamic Sassafras Soils
FF-6-46 The Newest Potato Pest—Golden Nematode
GG-6-46 A Machine for Deep Fertilizer Placement
HH-6-46 Mistakes Versus Essentials of Pond Management for Fish
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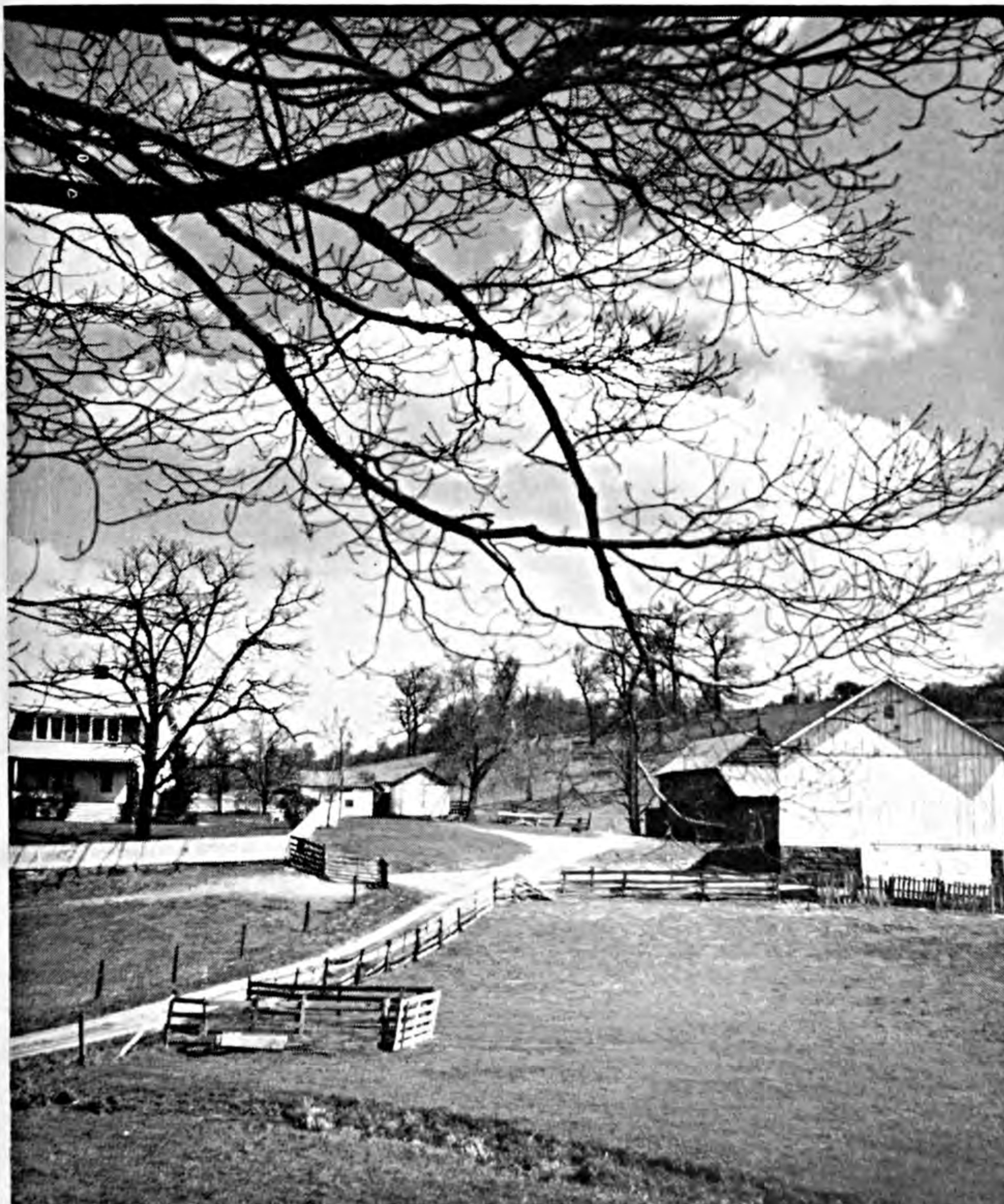
Better Crops WITH PLANT FOOD

February 1947 10 Cents



The Pocket Bo k of Agriculture

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

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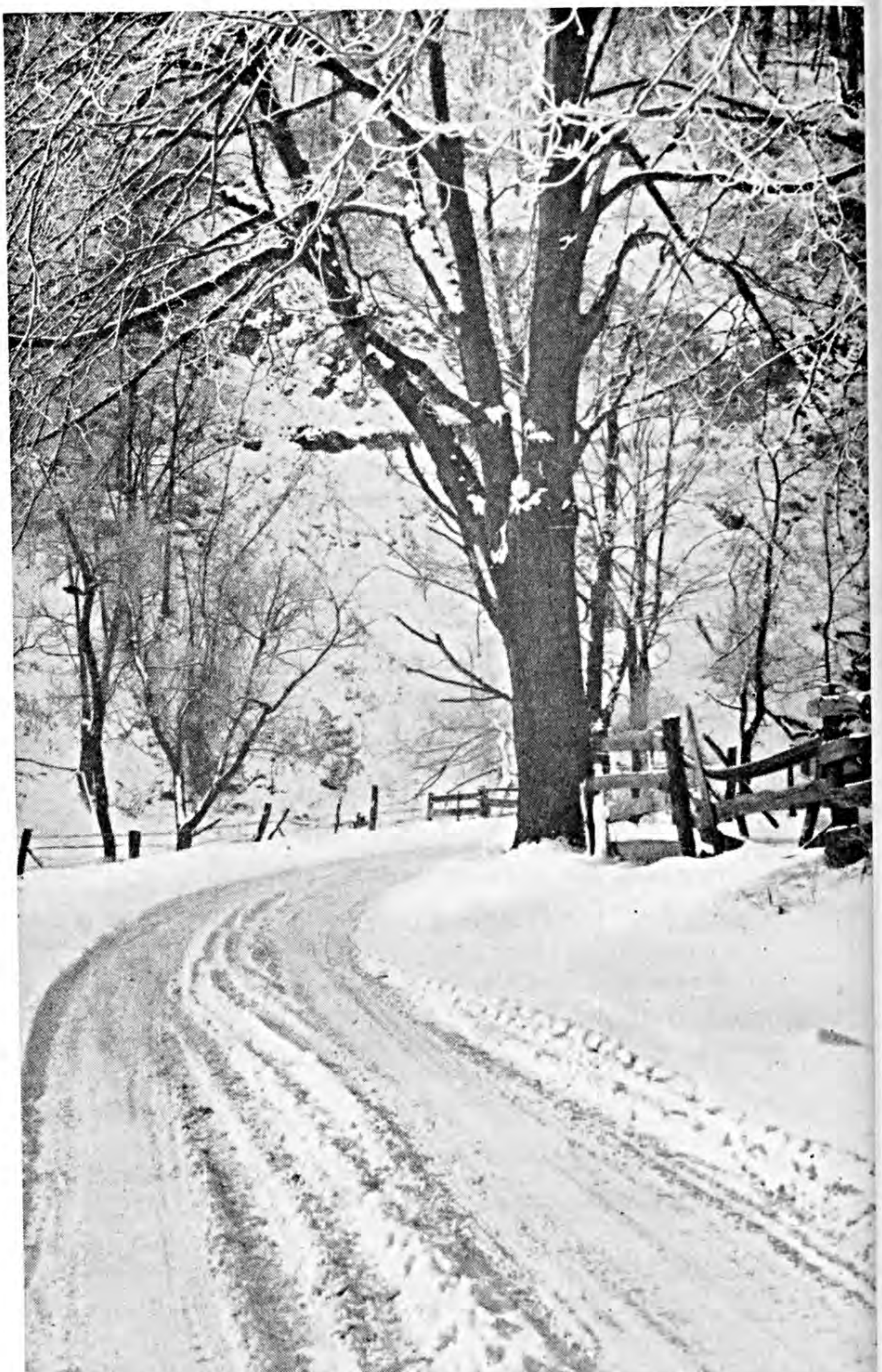

A FEBRUARY LANDSCAPE

Better Crops with PLANT FOOD

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VOL. XXXI WASHINGTON, D. C., FEBRUARY 1947 No. 2

Presenting a . . .

Home Town of Heroes

Jeff McDermid

"HOME town boy makes good" is a common prideful boast of many Main Street newspapers in America, yet if you care to consider the case of Alexandria, Virginia, some interesting points develop. For Alexandria has the oldest daily newspaper in the country, the venerable Gazette dating to pre-revolutionary times, and its scribes can point with inky insouciance to several famous national heroes of the present, as well as to the wealth of history, romance, and rumor which testify to the success of two outstanding "home town boys"—George Washington and Robert Edward Lee. Likewise General "Tooey" Spaatz of Air Force fame resides there, albeit he is merely a Yankee importation.

This being the traditional Washington month, one need spend but a bit of space to General Lee in his relations to this ancient town. Situated on Oronoco Street opposite the present much-publicized home of doughty "Jawn" L. Lewis is No. 607. Here in 1818 Mrs. General Henry (Light Horse) Harry Lee, then a widow, brought her son Robert to live. He roamed the adjacent wild acreage north of town, then known as the Prince George Meadows, and attended Alexandria Academy which is still standing. In the next house lived a Quaker teacher, Benjamin Hallowell, to whose kind tutelage Mrs. Lee consigned her son in preparation for his entrance to West Point.

Their neighbors across Oronoco Street were the Philip Fendalls. The first Mrs. Fendall was the mother-in-law of the aforesaid Light Horse Harry Lee, while the second Mrs. Fendall was Mary Lee, sister to the same cavalry general of the Revolution. Later on this mansion was bought by one of the numerous Lee family and occupied by them for years. It was here that the citizens of the town met to plan their part in Washington's funeral.

Today it has become the domicile of the coal mine boss himself. Possibly few of its residents have exerted as much personal power. Its interior is shrouded in mystery and kept tightly shuttered from the public gaze, but Mr. Lewis sometimes likes to entertain and show visitors his period furniture and antiques.

ALONG this quiet side street passed the cavalcade in honor of Marquis Lafayette, who paid a respectful visit to General Harry Lee during his memorable visit to the town in 1825. Two blocks south is the Lloyd mansion built in 1793 wherein General Lee got first news of his appointment as leader of the Confederate forces in Virginia, while visiting there after Sunday services at Christ church, then the parish meeting house for Arlington where he resided.

There is still a second dwelling in Alexandria that was for awhile the home of the most famous Lees. It is on Cameron Street a block south of the one just noted. Here Light Horse Harry's family lived just before his death. He was Governor of Virginia in 1794 and was the one who created the tribute to Washington: First in war, first in peace, and first in the hearts of his countrymen.

One other venerated spot is associated with Robert E. Lee. It is Leadbeater's drug store, retaining all its old original trappings and medicine jars. It was a favorite gossiping spot for the town worthies. Here in October, 1859, a message came to General Lee from General "Jeb" Stuart, then a Colonel, requiring his aid in the quick settlement of a disturbing fracas near Harper's Ferry caused by a hot-headed old fanatic from up in the Maryland hills.

Of course the links are close between the two favorite sons of Alexandria because General Lee married Mary Custis, daughter of Washington's adopted son, George Washington Parke Custis —and we now swing back into the trail which befits this month especially.

In July, 1749, George Washington at the age of 17 received his surveyor's commission, and one of his first jobs was to lay out the streets in Alexandria. He had previously served apprenticeship in civil engineering of the day with George William Fairfax, with whom he had made excursions out over the rugged wilds along the King's Highway westward—the same trail that Governor Dinwiddie took and on which Braddock marched to meet defeat, and which still later became the pathway for the weary "foot cavalry" of Stonewall Jackson.

Originally Alexandria was known as Bellhaven, where a company of Scotch merchants from Glasgow built a big tobacco shipping warehouse. In 1748 the town was incorporated by Thomas Lord Fairfax, John Carlyle, William Ramsay, and Lawrence Washington, half-brother of the General. It was a gallant age of pomp and splendor for the rich planters and merchants of the province.

Mary Washington, then a widow, was living at her farm home on the Rappahannock near Fredericksburg, while the oldest brother, son of Augustine Washington and his first wife, resided at the ancestral homestead of Mt. Vernon. Naturally, George stuck with his own mother who was Augustine's second wife. He thus had two half-brothers, Lawrence and Augustine, Jr., and his full brothers and one sister were named John Augustine, Charles, Samuel, and Elizabeth.

WHILE the gentry of means in northern Virginia were prosperous, George and his folks were poor. Mary Washington was too proud to ask for financial help and George was keen to ply his rod and chain along the Shenandoah Valley and forego the blandishments of society. Poor crops and too many dependent slaves impoverished the dwindling fortunes of George and his mother's branch of the family, so that the fees he earned from Alexandria assignments and other roadbuilding jobs came as a welcome fund during the years before the General reached his majority.

At the age of 21 history notes that George Washington accepted a commission from Governor Dinwiddie to inquire into the numbers and objec-

tives of a French force on the Ohio, and he equipped himself with the journey's necessities at Alexandria. After two months' absence he returned to Williamsburg to file his official report, which aroused the people of Virginia to their menacing dangers.

By this time George had indeed become a freeholder in the parish of Alexandria, as his deceased brother Lawrence had willed Mt. Vernon to him. Meanwhile General Edward Braddock had set sail for Virginia and finally landed at the port of Alexandria with two regiments who sailed past the wooded promontory of Washington's Potomac farm enroute to their rendezvous with the colonists. Robert Orme, the English aide-de-camp, asked Washington to join the proposed campaign against the French and Indians.

Moving to Alexandria to be near the scene of preparations, the young patriot took quarters at Gadsby's Tavern and helped drill raw recruits to serve with the Redcoats on their trek into the wilds. It seems interesting as one visits this old hostelry on the corner to realize how so much of the General's biggest exploits and social diversions took place within its crumbling walls. The fatal outcome of that stubbornly and foolishly planned expedition by Braddock, impervious to pioneer warnings, is too well-known to be repeated except to point out that Washington, although ill with fever and bearing bullet holes in his coat, managed to guide the routed soldiers back to their starting place—Carlyle House on the Potomac, now a shrine of faded grandeur. Later he returned to finish off the French on almost the same battleground in 1758. The next year he married Martha Dandridge Custis, widow of Colonel Dan Parke Custis, and began the only interval of rural life and agricultural security he experienced until that brief period after his retirement from high posts of public duty.

While Washington was not a profoundly religious man, he served as vestryman for at least two churches, the Truro parish and church at Pohick, seven miles west of Mt. Vernon, and for a short time the Fairfax parish. Vestries were chosen by the freeholders and they performed the duties of civil officers and assisted the courts in certain secular affairs.

The General was on the building committee and helped draw the plans and personally bossed the building of the Pohick church and accepted the estimates and arranged the contract for building of the Falls church, located at Falls Church eight miles from Alexandria. He also served on the building committee for the famous Christ church in Alexandria, all three structures having much the same exterior style of Georgian architecture.

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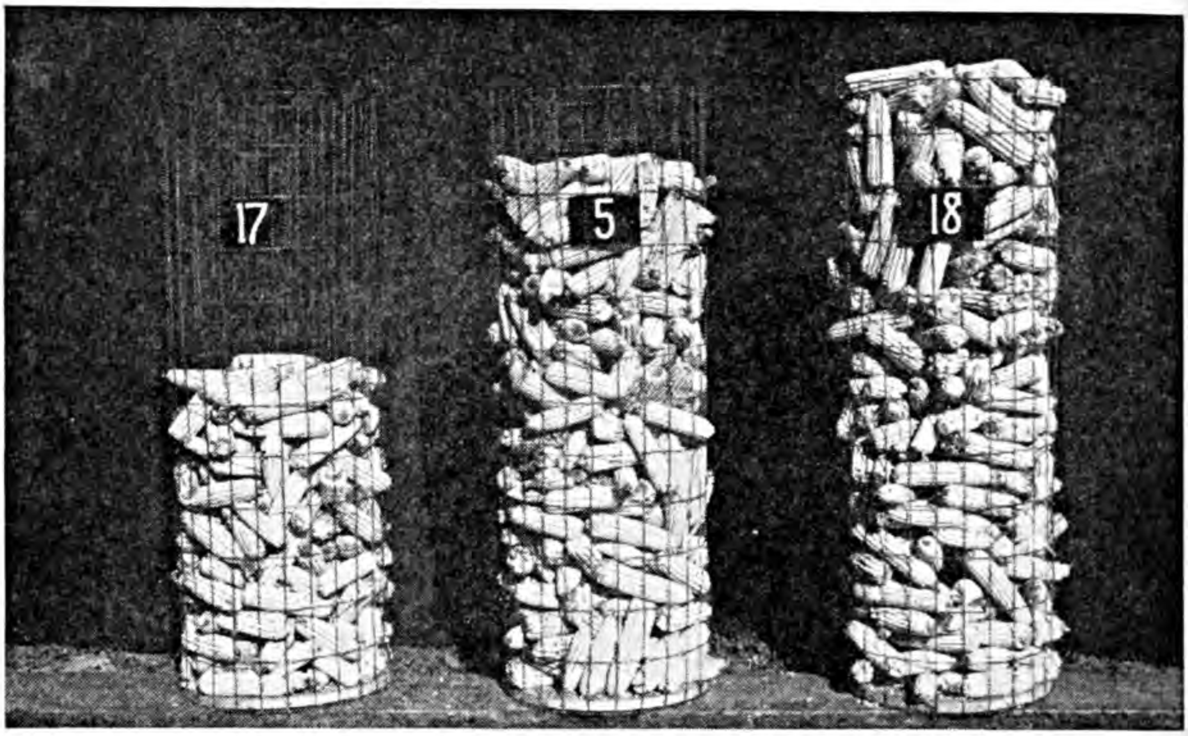

Fig. 1. Corn taken from plots which had stands of 4,000, 9,000, and 12,000 plants per acre in an experiment on Bladen very fine sandy loam, J. V. Taylor farm, Pitt County. The yields were 53, 82, and 93 bushels per acre, respectively. All plots received 20-80-80 at planting and 180 lbs. of nitrogen side-dressing.

Research Points the Way For Higher Corn Yields In North Carolina[1]

By B. A. Krantz[2]

Agricultural Experiment Station, Raleigh, North Carolina

RECENT research findings in corn fertilization, breeding, and culture indicate great potentialities for increasing North Carolina's corn yield. A hybrid corn-breeding program, initiated about 10 years ago and greatly expanded some eight years ago by Dr. Paul H. Harvey, has already produced several adapted hybrids. In 1944 an intensive research program in corn fertilization and culture was started. Fortunately, there were several well-adapted hybrids available for use in these experiments. Thus we were able to combine our efforts in fertility research with those of the corn breeder and make the most of the yield capability of these new hybrids.

Neglected

Little progress has been made in increasing corn yields during the past 30 years in North Carolina. Table 1 shows

[1] North Carolina Agricultural Experiment Station and the Division of Soils, Fertilizers and Irrigation; Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. D. A. cooperating.
[2] Associate Soil Scientist, Division of Soils, Fertilizers, and Irrigation, U. S. D. A.

that the corn yield during 1936-40 averaged only 3.2 per cent higher than in the 1916-20 period and in 1941-44 the yield was 18.0 per cent above the 1916-20 period. Cotton and tobacco yields were increased 45.0 and 56.0 per cent, respectively, during the period 1916-20 to 1941-44. These relatively large increases in yields of cotton and tobacco are due to many factors, such as better varieties, more adequate fertilization, and improved cultural practices. However, neither of these crops is being fertilized for maximum growth primarily because of the increased boll-weevil hazard in cotton and the possibility of producing inferior quality in tobacco. Since there is no present indication of any such serious complications from fertilizing for maximum growth in corn, there appear to be great potentialities for increasing corn yields in North Carolina.

Experiments in 1944

In 1944, 11 experiments were conducted to explore the possibilities of increasing corn yields by fertilization when adequate stands of adapted hybrids were used and properly cultivated. North Carolina adapted hybrids were used with a plant-spacing of about 16 inches in a 3.5 foot row. This spacing provides about 9,000 plants per acre which is 50 to 100 per cent higher than normal for the State. All row fertilizers were placed in bands about 3 inches on either side of the seed. Weeds were controlled by shallow cultivation until the corn was 2.5 feet high and then cultivation was stopped. The experiments were conducted under weather conditions ranging from excellent to very dry.

In going from an application of no-nitrogen up to 120 pounds of nitrogen per acre, the largest yield response was from 19 to 107 bushels, or an 88-bushel-per-acre increase, and the lowest response was from 18 to 51 bushels, or a 33-bushel-per-acre increase. The former was obtained under excellent moisture conditions and the latter under very droughty conditions. The average yields of all 11 experiments were 21, 32, 48, 59, 63, and 72 bushels per acre from plots receiving adequate phosphorus and potash and 0, 20, 40, 60, 80, and 120 pounds of nitrogen per acre, respectively.

Experiments in 1945

In 1945, fourteen experiments were conducted to get more information on some of the trends in the 1944 data and also to study some additional factors. The response to fertilizers in 1945 was quite comparable to that of 1944 wherever similar conditions were encountered. In order to obtain maximum

TABLE 1.—THE YIELDS AND PERCENTAGE INCREASE IN YIELDS OF CORN, COTTON, AND TOBACCO FROM 1916–1945 GIVEN IN FIVE-YEAR PERIODS FOR NORTH CAROLINA

Period	Corn		Cotton		Tobacco	
	Bus./A	Per cent change from 1916–20	Lbs./A	Per cent change from 1916–20	Lbs./A	Per cent change from 1916–20
1916–20	18.9	....	262	....	663	....
1921–25	17.9	− 5.3	284	+ 8.4	643	− 2.3
1926–30	18.2	− 3.7	260	− 0.8	713	+ 7.5
1931–35	17.7	− 6.3	292	+11.4	782	+18.0
1936–40	19.5	+ 3.2	315	+20.2	900	+35.7
1941–45	22.3	+18.0	380	+45.0	1032	+56.0

Yield figures in this table were furnished by H. B. James of the Agricultural Economics Department.

fertilizer response, it has been necessary to provide adequate stands, use adapted hybrids, and employ improved cultural practices. An experiment on a Norfolk sandy loam in Hoke County illustrates these points quite well. This experiment involved four levels of nitrogen, four plant spacings, and four "varieties" grown in all combinations.

Adapted Hybrids Yield Better

The data in table 2a indicate that a well-adapted hybrid is able to make much more effective use of applied nutrients than is the native open-pollinated corn. The performance of the three hybrids used varied somewhat, but they were all far superior to the native corn. The average yields of all conditions, low to high nitrogen and wide to close spacing, were as follows:

N. C. hybrid 1028—55 bushels per acre (yellow);

N. C. hybrid 1111—57 bushels per acre (white);

N. C. hybrid 5002—60 bushels per acre (yellow);

Native one-eared corn—38 bushels per acre (white)

One can readily see the need of using adapted hybrids in a program for increasing corn yields.

Adequate Stand Necessary for High Yields

The extent to which the nitrogen supply determines the desirable thickness of stand is brought out in table 2b. At the lower levels of nitrogen, yields tended to be decreased at the closest spacing, while at the higher levels of nitrogen the yields were increased at the thicker planting. All three of the hybrids used were of the prolific type. The yield increase from close-spacing over that of wide-spacing at the higher nitrogen levels would have been expected to be even greater if single-eared hybrids had been used.

In another experiment in Pitt County (fig. 1) three spacings (4,000, 9,000, and 12,000 plants per acre) were tried at a high level of fertilization. The per-acre yields were 53, 82, and 93 bushels, respectively. Under these conditions of high fertilization, yields were increased about 75 per cent by increasing the plant stand.

It was interesting to note the differential weed growth in these plots during the growing season. The corn was free of weeds at "laying by" time (about 2.5 ft. high). However, by roasting-ear time the plot with 4,000 plants per acre had a solid cover of weeds (mainly cockleburs) about hip high, while in the plots with thick spacing, there were only a few small scattered weeds. The thickly planted corn was able to compete favorably with weeds until the corn was "made," even under these conditions of high rainfall and fertility. Four thousand plants per acre has been the conventional stand in some sections of the State.

Ample Nitrogen Required for High Yields

When adequate stands of adapted hybrids are used, large and profitable yield increases can be expected from adequate fertilization under most soil

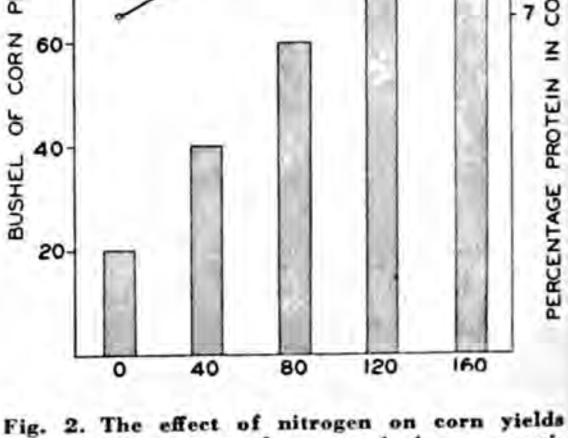

Fig. 2. The effect of nitrogen on corn yields and protein content of corn grain in an experiment conducted on Norfolk fine sandy loam, H. G. Shelton farm, Edgecombe County. All plots received phosphoric acid and potash. N. C. hybrid 1114 was spaced 16" apart in a 3.5-foot row, providing 9,300 plants per acre.

TABLE 2.—THE INFLUENCE OF VARYING FERTILIZATION, VARIETIES, AND PLANT STAND ON THE YIELD OF CORN IN BUSHELS PER ACRE ON NORFOLK LOAMY SAND, C. F. TAPP FARM, HOKE COUNTY.

a. The effect of fertilization on different varieties

	N. C. hybrid 5002	Local white variety
20–80–80	38	15
70–80–80	65	39
120–80–80	76	55
170–80–80	78	45
Least significant difference	9.4	9.4

b. The effect of spacing at variable nitrogen levels (ave. of three hybrids)

No. of plants per acre*	20–80–80	70–80–80	120–80–80	170–80–80
4,000	39	52	59	57
7,000	39	58	67	65
10,000	41	65	69	72
13,000	36	59	73	73
Least significant difference	8.3	8.3	8.3	8.3

* The 4,000, 7,000, 10,000, and 13,000 plants per acre were provided by plant spacings of 37.4", 21.4", 15.0", and 11.5", respectively, in a 3.5 ft. row.

conditions in North Carolina. In the experiment in Hoke County (table 2), yields were more than doubled when higher amounts of nitrogen were added. In an experiment in Edgecombe County where a no-nitrogen treatment was used as a base, the yield response due to nitrogen was even greater (see figure 2). It is particularly significant to note that within the range of response, 0 to 120 pounds per acre of nitrogen, the yields were increased about one bushel per acre for each two pounds per acre of nitrogen applied. Under optimum growth conditions, somewhat greater efficiencies have been obtained. However, we have obtained this efficiency in so many of our experiments that the "2 to 1 rule" has become a measuring stick in evaluating response to nitrogen.

The high July rainfall (60 per cent above normal) and high humidity made conditions very favorable for the development of *Helminthosporium maydis* (commonly called "leaf spot"). The leaves were seriously blighted by late roasting-ear stage and this condition appears to have limited the grain yield.

Corn responded significantly to nitrogen in 23 of the 25 experiments conducted during 1944 and 1945. The two experiments in which the yield response to nitrogen was not significant were located on clay loam Piedmont soils which encountered June and August droughts severe enough to limit yields to about 40 bushels per acre. In these two experiments, the soil nitrogen available to the corn following lespedeza was sufficient to produce the 40-bushel yield.

The average yields of all 25 experiments were 24, 46, 56, 63, and 70 bushels per acre from plots receiving adequate phosphorus and potash and 0, 40, 60, 80, and 120 pounds of nitrogen per acre, respectively (figure 6).

Experiments on Low Potash Soils

There are many dark-colored soils in the Coastal Plain where corn and soybeans have been grown continuously for many years with little or no fertilization, and the available potash supply has become depleted. To study this situation, an experiment was set up on a Coxville fine sandy loam which had been cropped to corn and soybeans in alternate rows for many years. For the past few years, the soybean yields have been about 4 bushels per acre and the corn yields ranged from 10 to 20 bushels per acre. In the experiment where a sufficient stand of an adapted hybrid was adequately fertilized, the yield was 93 bushels per acre (figure 3). However, when potash was omitted from the fertilizer the corn leaves showed marginal burning, the plants lodged badly, and the yield was only 62 bushels per acre. This soil contained only 0.11 m.e. of potassium (103 lbs. per acre of K_2O).* The yields were increased 31 bushels when 40 pounds per acre of K_2O (65 lbs. of muriate of potash) were applied, but no response was obtained from higher applications of potash. Rainfall and leaf disease conditions were similar to those in the Edgecombe County experiment and appeared to have limited yields at the higher levels of fertilization.

In another experiment conducted on a Coxville very fine sandy loam containing 0.04 m.e. of potassium, yields were increased 16 bushels by a 40-pound-per-acre application of K_2O. A 40-pound potash application increased the corn yields 24 bushels per acre on a Dunbar sandy loam soil in which the exchangeable potassium in the surface and subsoil was 0.10 and 0.04 m.e., respectively. In experiments where corn followed well-fertilized crops such as tobacco and cotton, no response to potash was found. Apparently the potash residues left in these soils were sufficient to produce at least one good corn crop.

Phosphate

Significant yield response to phosphorus was obtained in three Piedmont experiments where the soluble phosphorus content ranged from 3 to 6 p.p.m. (14 to 28 lbs. of P_2O_5 per acre). The greatest response was found on an Alamance silt loam where the yield

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* Soil analyses were made under the supervision of J. R. Piland, Assoc. Soil Chemist.

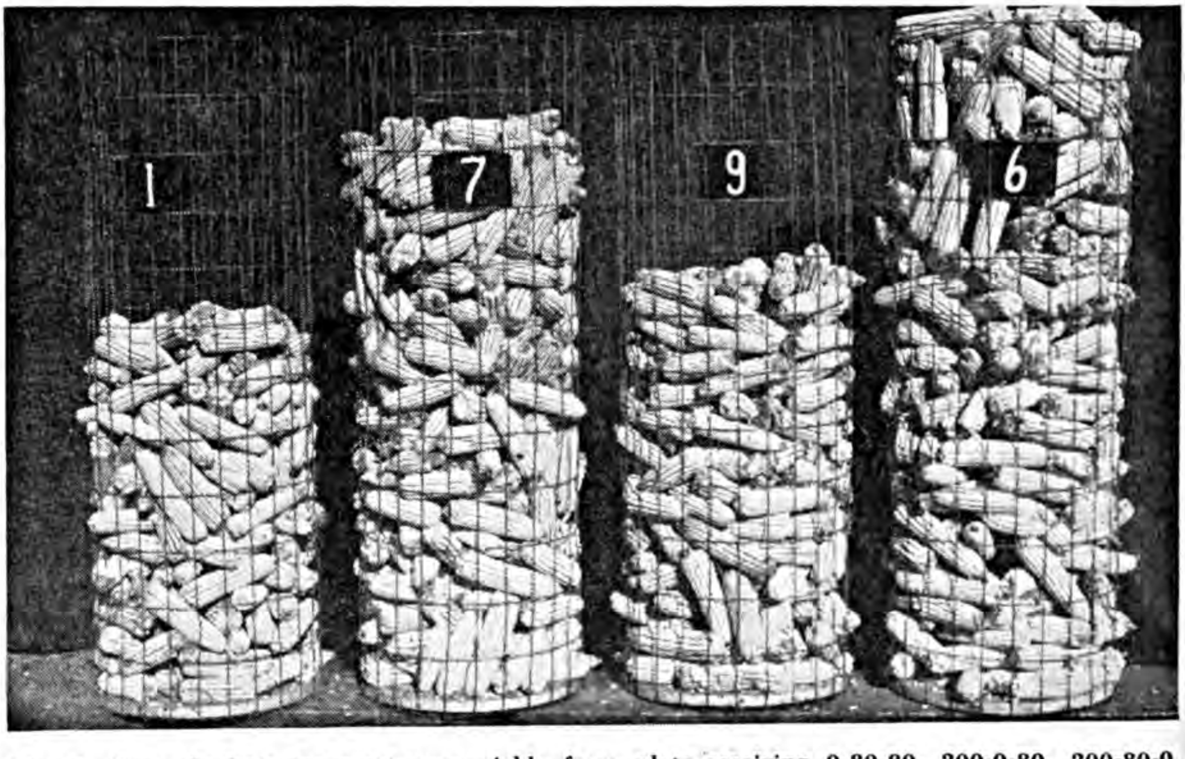

Fig. 3. These baskets represent corn yields from plots receiving 0-80-80, 200-0-80, 200-80-0, and 200-80-80 on a Coxville fine sandy loam, H. T. Stokes farm, Pitt County. The yields were 58, 79, 62, and 93 bushels per acre, respectively.

This ladino and timothy pasture will support high-producing cows and keep them in good milk flow all summer long.

Large Grasses for Pasture

By Ford S. Prince

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IN the Northeast, interest in pasture improvement which had its beginnings in the use of fertilizers on permanent pastures during the 1930's continues to hold the limelight so far as farm improvement on dairy farms is concerned. During the past year in New Hampshire, in connection with the organization of conservation subdistricts, farmers have had an opportunity to answer the question, "What in your opinion can the Soil Conservation Service do to help you most on your farm?" The overwhelming majority of replies indicated that farmers would like to have rough pasture lands bulldozed so that these areas can in the future be plowed or worked and seeded to more productive pasture crops.

There isn't very much question but that this request has sprung from a realization in the farmer's mind that the so-called permanent pasture does not solve the pasture problem. In spite of heavily fertilized bluegrass-white clover sods, there is a period of six weeks to two months in the summer when such pastures do not supply enough forage to meet the needs of high-producing cows. The result is that these same farmers who have been fertilizing their permanent pastures (and will continue to do so) are turning now to more productive, temporary, semi-permanent, or rotated pastures for more of their feed. Hence, the requests for bulldozing.

This means that the interest in pastures is shifting rapidly from one of straight top-dressing to a frequent seeding program, on land that is kept in a fairly high state of fertility by manuring, liming, and fertilization. Fortunately, for the Northeastern dairyman, ladino clover has been introduced and is being used as a basis of all new seedings of this nature. Ladino has proved to be our most productive clover for pasture. It is not only high-yielding, but gives a good account of itself for four or five years or longer, if properly fertilized and if it isn't seeded with species that form too dense a sod. A heavy sod offers too much competition to ladino which is able to maintain itself somewhat better in an open than a tight sward.

Evaluating Grasses

Here in New Hampshire we have been using a half dozen of the larger grasses singly with ladino in an experimental way to try to evaluate each one of the grasses as to its productivity, palatability, compatibility with ladino, and like factors and at the same time to study the behavior of ladino in the simple mixtures. In some of the fields where studies have been made, there has been an opportunity to observe the behavior, survival, and yield of similar areas seeded to complex mixtures which contained seeds of the denser sod-forming species such as red top and Kentucky bluegrass.

We do not claim to have the last word on a study of this sort. We believe, however, that we have secured some information that may be of significance in furthering the use of ladino clover and also in helping evaluate the large grasses for use in the pasture reseeding program which lies ahead of the farmers in this region.

In 1942, when our first seedings of this nature were made, several of the large grasses were seeded singly with ladino in relatively small plots in the same field. The big disadvantage encountered with these small areas arose from the fact that the large grasses do not come to the grazing stage at the same time. Orchard grass is earliest; this is followed closely by smooth brome. The others, including reed canary, tall fescue, timothy, and perennial rye grass are more nearly alike in early growth. But since the plots in our 1942 and 1943 seedings were small, it was not possible to fence each grass or each group of grasses to pasture when it was most advisable. Since 1942, we have tried to remedy these experimental seedings by making them on a field scale. This method eliminates the disadvantages found in the earlier seedings but it increases the soil differences, thus increasing the variations between plots.

PASTURE YIELDS BY GRASSES

Grass	Pasture Years	Oven-dry material per acre—Tons
Smooth Brome	16	2.82
Orchard Grass	22	2.66
Tall Fescue	14	2.62
Perennial Rye	14	2.53
Timothy	18	2.50
Reed Canary	12	2.46

Since there is a great deal of interest in ladino and in these larger grasses which make a better midsummer growth than Kentucky blue or red top, we are presenting here the clipping records which have been made on the pastures seeded in 1942 and '43. The figures represent the average yields of all plots harvested in which the grasses in question were seeded with ladino clover on relatively small areas.

By pasture years, we mean that one plot was harvested one year. During that year, it may have been clipped four, five, six, or seven times so that 16 pasture years represent the summation of from 64 to more than 100 clippings.

Smooth brome shows up very well in these data, having the highest yield of all the grasses, although there is a range of but .36 tons of dry weight of forage between smooth brome, the highest, and reed canary, the lowest yielder in the group. It is believed that the ladino in these seedings tended to iron out possible variations in yield and ladino was a constant in the seeding mixtures, as we have pointed out before.

It must also be understood that other grasses besides those seeded volunteered into the stand to a greater or lesser degree. Here in New Hampshire, as in all the Northeastern States, probably Kentucky bluegrass and bent grasses creep into any seeding after a year or two. The higher the fertility, the more likely this is to occur and these soils were all fairly well-fertilized, hence were not exceptions to this general rule.

Stand estimates at the close of the 1946 season indicated that these volunteer grasses occupied a greater percentage of the sward in the perennial rye grass plots than in the others This is probably due to perennial rye being less hardy than the other grasses. On the other hand, orchard grass, reed canary, and tall fescue maintained their stands better than timothy, smooth brome, or the rye grass. This may be due in part to the greater palatability and consequently closer grazing by the animals on smooth brome, timothy, and rye grass, since in most cases the cows had access to them all at the same time.

With two exceptions, all the pastures in these tests were carefully managed to control grazing. There was a good stand of ladino on these two pastures in 1943 but very little in 1944. In another instance, near the seacoast, there was no snow cover during the winter of 1943 and the stand of ladino winter-killed. The result of losing the ladino in these three pastures was a reduction in yield of about one ton of dry forage per acre, when the 1943 and 1944 seasons are compared. The pastures in which the stand of ladino was not reduced yielded as well in 1944 as they had in 1943.

Another point of interest in yields is a comparison between the tall grasses and mixtures in which red top and Kentucky bluegrass were included in the same field and treated alike so far as fertility was concerned. The data

	Yield, dry weight per A.—Tons
Average of tall grasses	2.88
Average of complex mixtures	2.63

show a quarter of a ton higher yield on the average for the simple mixtures with the larger grasses. Stand estimates in 1946 showed a lower percentage of clover in the plots seeded to complex mixtures than in those seeded to a single grass with ladino.

During the period of this study, fertilizer variables were not introduced since the variable among the plots was the grass. In most cases, the plots have been fertilized annually with manure and 0-14-14 or 0-20-20. If manure was not applied, a suitable complete fertilizer with a 1-2-2, 1-3-4, or 1-4-5 ratio was usually applied. It has been the aim to get from 70 to 100 pounds each of phosphoric acid and potash on the plots annually. The farmers who cooperated are believers in using a well-balanced fertilizer containing at least as much potash as phosphoric acid. In spite of certain differences in these grasses, we still believe that the most important thing to consider in making a pasture seeding is the use of ladino in the mixture. After the stand is secured, it is important to keep the ladino there by adequate fertilization and judicious management. The choice of a grass or grasses to use is of less importance since an excellent pasture can be made with any of the grasses that we have tried, provided the emphasis at first is on the ladino.

Naturally, however, and in spite of the foregoing statements, we prefer some of the grasses over others on the grounds of cow preference, of how they behave in association with ladino, their persistence, and like factors. Because of the rather pronounced differences among the grasses, we have attempted to summarize their virtues as well as their disadvantages as we see them today in the following paragraphs.

Timothy is, of course, our old standby. It is very palatable, compatible with ladino, makes good hay or silage, has a long cutting period during which it does not become too woody, etc. It does not yield quite as well as we like, especially in hot weather, and it can be overgrazed. It is easy to seed, and the seed is relatively inexpensive. We believe that timothy will continue to form the foundation of most of our hay and many of our pasture seedings. New varieties like Marietta for an early strain and Milton and Lorain for later sorts will improve the place of timothy in our farming scheme by lengthening the harvesting and pasturing periods.

Smooth brome has yielded somewhat better than timothy in these tests, is the most palatable of any of the grasses, and works well with ladino. It makes excellent hay or silage and gives an earlier bite in the pasture than timothy. It can easily be overgrazed and because of its extreme palatability should be carefully managed. It is more difficult to seed than timothy or orchard grass since the seeds are too light and feathery to mix with clovers in the grass seed compartment of the grain drill. It can be mixed with the oats at seeding or it can be seeded separately and harrowed in. Many farmers have "fallen out" with it because of seeding difficulties. When they learn how to seed it, smooth brome will be a much more popular grass than it is today. Its gaining popularity is indicated by the fact that two of the cooperators in these tests during the past season have made their third seeding to smooth brome since 1942.

Orchard grass has not achieved the popularity of smooth brome or timothy largely because it isn't as palatable. Cows will eat it well if confined to it, however, and it comes on for grazing very early which is a distinct advantage in seasons following short

(*Turn to page* 41)

There are thousands of acres of pasture like this in New England that await improvement by some method of brush control, applying plant food, and seeding to ladino clover and grass.

Fertilizers and Human Health

By Firman E. Bear

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UNDER the stone floor of Westminster Abbey in London lies the body of one Thomas Parr who was born in 1483, lived through the reign of ten princes, and died at the age of 152. In his later years Parr became a celebrity and his death was finally brought about by overindulgence in food and drink. His long life is especially remarkable because in those days the average age attained by a human being was only about 20 years. Now that the span of life has been greatly increased one might expect to find an occasional man who had passed the two-century mark.

A Man Older Than Methuselah

The Russian census of 1926 revealed some 30,000 centenarians of whom the oldest was a 166-year old man living in Daghestan. But men have been known to live to be considerably older than that. One of the most interesting studies of old age in man was that of Bogomolets * who devoted his life to determining why people grow old prematurely. In his opinion a man of 60 or 70 had lived only half his natural life. To substantiate this he pointed to a considerable list of men and women who had attained an age of more than 150 years. Two of these had lived to be 185. One old gentleman and his wife dwelt together in connubial bliss to the ages of 172 and 164, respectively.

These and many other authenticated cases of longevity fall far short of Methuselah of Biblical fame who attained the ripe old age of 969. Yet he, in turn, was only a boy in comparison with Lew Wallace's Prince of India who was condemned to tarry on earth until Christ returned and, presumably, is still living as of the year 1946 A. D.

Knowing that the Prince of India was born of the imagination and that possibly Methuselah was as well, it seems best to be satisfied with a somewhat lesser span of life, say a couple of centuries. Two questions are raised:

1. Why do most men die before the age of 75?

2. Why do men die at all?

Trees Have Lived 5,000 Years

It might be best at this point to stop a moment and examine into the matter of longevity of a much simpler form of life, the plant. This was the subject of a lifetime of study by Molisch.* He concluded that, of the larger plants, the giant Sequoia trees of California had reached the greatest age. He estimated from their annual rings that the oldest of these trees had started their careers at least 2,000 years before the birth of Christ.

Molisch pointed out, however, that this longevity was more apparent than real. The old part of a tree was the dead wood in its center rather than the living tissue that surrounded it. From this living tissue new cells were produced but the old ones eventually died. He believed that, at best, the oldest living cells in these trees were probably not over 100 years of age.

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* The Prolongation of Life. Translated by Peter V. Karpovitch and Sonia Bleeker; Duell, Sloan, and Pearce, Inc., New York, 1946.

* The Longevity of Plants. Translated by E. H. Fulling. The Science Press Printing Co., Lancaster, Pa., 1938.

The Simplest Forms of Life Live Longest

The possibilities for eternal life are greatest in the simplest forms of plant and animal life such as the single celled bacteria and protozoa. These reproduce by division and, presumably, could survive forever. Molisch recorded an experiment in which a single *Paramaecium* was bred for a period of 10 years through 8,000 generations and could, no doubt, have been kept going permanently. To accomplish this, however, it was necessary to transfer each newly-formed cell to a fresh nutrient solution.

It is known that bacteria can survive for long periods of time in a state of almost complete inactivity. Lipman * made a unique study of the span of life of microbes. For this study he obtained mud bricks from very old structures: a 600-year-old Arizona pueblo, a 1,000-year-old Mexican pyramid, a 1,400-year-old Peruvian pyramid, a 4,000-year-old Egyptian wall, and a 5,000-year-old Mesopotamian building. The outsides of these bricks were carefully sterilized by being soaked in a bath of paraffin at a temperature of 250° C. The bricks were then broken up with a sterile chisel and hammer and the outer paraffin-drenched material was removed. Small internal fragments were then placed in sterile water, the water was plated out, and the plates were incubated to see whether any bacterial colonies would develop. Selecting the 1,400-year-old Peruvian brick as an example, the counts showed 1,800,000 colonies per gram of stone.

Whales Are Longest-Lived Animals

The case of multicellular plants and of the larger forms of animals is considerably more complicated than that of the single-celled forms. It is generally believed that the multicellular forms must perish sooner or later. Life can be prolonged, however, by various devices. Thus plants that fruit only once and then die can be prevented from fruiting with the result that dying is delayed.

The growth habits of higher animals are altogether different from those of the higher plants. Animals develop in a closed system whereas plants follow an open one. Thus a horse never has more than four legs and having reached maturity, he never grows taller or longer. In contrast, oak trees develop new branches each year and continue to grow taller and to have a wider spread with advancing age.

Of the higher animals the longest-lived are the whale, elephant, tortoise, crocodile, pike, and parrot. Molisch records that whales may live several centuries. The conditions for survival would seem to be especially good for whales. They have a high degree of mobility by which they escape from their excretions and they live in sea-water, which contains all the mineral elements that might conceivably be of value to whales. But even so a whale finally dies.

Fertilizers Blamed for Early Death of Man

Within recent years considerable publicity has been given to the idea that food produced from soil fertilized with chemicals is the cause of an increase in the prevalence of degenerative diseases in man. The proponents of this concept charge that agriculture's attempt to correct soil exhaustion with chemicals has not been successful. They say that inorganic fertilizers disturb the chemical balance of the soil and that this in turn affects the health of the animals that consume the crops. They advocate the use of manure instead of fertilizer.

The primary promoter of this concept of the value of manure as a health-promoting agent is Ehrenfried Pfeiffer* of Switzerland. The central theme of Pfeiffer's philisophy is that fertilizer drives away or destroys earthworms,

* Science in the University, University of California Press, Berkeley, 1944.

* Bio-Dynamic Farming and Gardening. Anthroposophic Press, New York, 1938.

bacteria, and fungi, the supposed generators of necessary life-giving substances in soils and plants.

Facts Fade Into Fancies

An international cult of Pfeiffer's followers is cluttering up our soils' literature with a mixture of facts and fancies that are so cleverly interwoven that it is very difficult to know where one leaves off and the other begins. The following quotations selected from the published statements of this group will serve to illustrate:

Pfeiffer: "The seeds and still more the leaves of plants fertilized with stable manure have the peculiarity, when used as food for animals, of increasing their capacity for resisting disease to a greater degree than the corresponding seeds and leaves of minerally fertilized plants. The former thus have a higher biological value than the latter."

Howard*: "What may be conveniently described as the NPK mentality dominates farming alike in experimental stations and the country-side. Vested interests, entrenched in time of national emergency, have gained a strangle hold. Artificial manures involve less labour and less trouble than farm-yard manure. The tractor is superior to the horse in power and in speed of work. . . . But these chemicals and these machines can do nothing to keep the soil in good heart. . . . In the years to come chemical manures will be considered as one of the greatest follies of the industrial era. . . . Mother earth has recorded her disapproval by the steady increase of disease in crops, animals, and mankind. . . . The population, fed on improperly grown food, has to be bolstered up by an expensive system of patent medicines, panel doctors, dispensaries, hospitals, and convalescent homes. A C_3 population is being created."

Balfour**: "In watching caterpillar and aphis attacks I have noticed that both compost- and chemically-grown plants will be attacked, but whereas the plant grown with chemicals . . . will . . . be stripped to the rib, those grown with compost . . . are only slightly damaged and quickly recover . . . Howard formed the opinion that the key to disease resistance was a fertile soil and that soil fertility could not be brought about by the use of artificial fertilizer. . . . His subsequent experiments convinced him that the best results were obtained when humus was scientifically manufactured *outside* the field, and that this humus was only fully effective if composed of *both vegetable and animal wastes.*"

* An Agricultural Testament. Oxford University Press, New York, 1940.
** The Living Soil. Faber and Faber, Ltd., London, 1943.

Rodale*: "Chemical fertilizers are a sort of dope or soil stimulant and can be compared to the taking of medicine . . . Between the chemicals and the spray poisons the biologic life of the soil is reduced almost to the vanishing point. Gone are the earthworms, and the bacteria and fungi almost disappear. The soil is practically dead. . . . In spite of billions of dollars spent for medical research work the average person today has more colds than his forebears and has more teeth cavities than his father and grandfather. Not only that but he suffers more from rheumatism, heart trouble, gall stones, ulcers, and arthritis."

A somewhat different approach, but one that leads to much the same conclusion with respect to fertilizers, is presented by some of the advocates of plowless farming:

Faulkner**: "This discovery (working organic matter into the surface soil rather than plowing it under) means that hereafter no one needs to buy nitrogen as a fertilizer. It means also that no one needs to grow legumes in order to have the benefit of the nitrogen they accumulate in the soil. Furthermore since lime is used on the land solely because it creates better conditions

* Pay Dirt. The Devin-Adair Company, New York, 1945.
** Plowman's Folly. University of Oklahoma Press, Norman, 1943.

for legumes, there will no longer be a necessity for farmers to buy and apply lime to their soil. . . . Very early in the process of rejuvenating soil by restoring organic matter to its surface farmers will discover that no application of fertilizer, however great, results in an increased crop yield."

A closely related concept is found in the teachings of those who believe in the necessity of protecting earthworms against chemicals and in supplying large amounts of special organic foods designed to increase their rate of multiplication:

Barrett*: "In the earthworm we have a perfect, quick-acting humus factory. . . . In the chemical and mechanical laboratory of the earthworm's intestine are combined all the processes of topsoil building. The earthworm swallows great quantities of mineral earth, with all that it contains of vegetable and animal remains, bacteria, and the minute and microscopic life of the soil. In the powerful muscular mill of his gizzard, using grains of sand for millstones, the ingested material is thoroughly ground and mixed, as the abundant digestive secretions are poured in to exert their solvent and neutralizing action. Slowly the semi-liquid mass moves through the long intestine, undergoing further mixing as it takes on valuable animal hormones and substances. Finally it is ejected in and on the surface of the earth as castings—earthworm manure—humus—a crumbly, finely conditioned topsoil richly endowed with all the elements of plant nutrition in water-soluble form."

No Escape From The Dung Heap

The concepts of those who deal with the various aspects of "biodynamic farming," some of which are expressed and others implied, are as follows:

1. Plants, animals, and man are inseparably bound in Nature.
2. Disease resistance is conferred on plants, animals, and man by the use of manure.
3. Manure must contain both plant and animal by-products to provide these health-giving qualities.
4. Raw organic matter must be composted outside the soil or worked into the surface of the soil and not plowed under.
5. Fertilizers destroy earthworms and microbial life in the soil.
6. Earthworms are essential for the production of humus and for digesting the soil.
7. Micorrhizal fungi flourish only in manured soils and form a necessary living bridge between soil and plant.
8. Crops deteriorate when grown from seed of successive generations of plants produced by the use of fertilizers.
9. Diseases of man originate largely as a result of the use of fertilizers.
10. Fertilizers are only temporary expedients that must ultimately be discarded.

Such teachings link the farmer inseparably with the manure pile and peasantry. They set aside some of the most important findings of a century of agricultural science. They throw the 35-million-ton lime and fertilizer industries of this country into the discard. They decry the work of the agricultural experiment stations. Their proponents skip blithely from fact to fancy and fall back on the supernatural when pressed by the scientist.

Plants Are Only Source of Soil Organic Matter

Science came on the organic matter scene about a century ago when Justus von Liebig wrote a new page on this subject. His predecessors had contended that organic matter was the food of plants. Liebig pointed out that plants must have preceded the humus. Originally the earth and all its parts were entirely inorganic. All of the ca

(*Turn to page* 43)

* The Earthmaster System. Thomas J. Barrett, Roscoe, California, 1943.

A scene from one of the earlier pea operations on the Raschke Brothers' farm near Chehalis. Horse-drawn equipment has been replaced with motorized equipment. The Raschke Brothers, however, are still growing peas.

Potash Pays for Peas At Chehalis, Washington

By Karl Baur and J. J. Tremblay

Western Washington Experiment Station, Puyallup, Washington

AS with many other successful agricultural ventures, the production of peas in the Chehalis Valley had a humble beginning. It was in 1933 when Tom Nesbit, Clarence Young, and Tom Fishback made experimental plantings of a little less than 40 acres of peas for the local cannery. The acreage was divided about equally between the varieties Surprise and Perfection. In 1934 these same men planted approximately 80 acres of the Alderman variety which was processed by freezing. The results both years were encouraging, the yields approximating two tons of high quality peas per acre. The peas were processed by the National Fruit Canning Company under the supervision of Walter Nichols.

The years 1935 and 1936, however, turned out to be rather unfavorable with low yields, and the reports indicate that these low yields were due in part to very poor weather conditions and heavy infestations of aphis which, in those days, were not dealt with as effectively as they are now. However, with the perseverance that is characteristic of many farmers, these men continued to plant peas with the encouragement of Mr. Nichols. These and other growers continued to plant acreages of peas until in 1946 almost 5,000 acres of peas were planted in the area.

The growers and the field departments of the several concerns that now obtain peas from that area studied the problem of pea production under Chehalis conditions. After a period of time it was found that when peas were planted at what was then considered extremely early dates in the spring, a reasonably good crop could be expected.

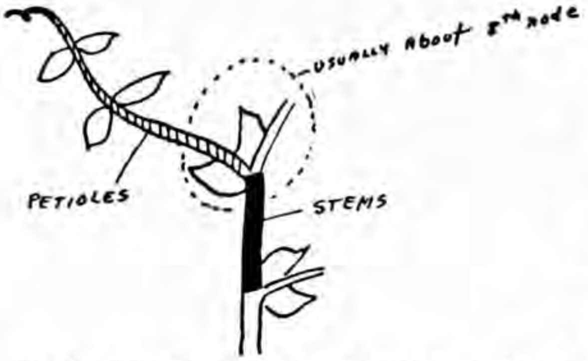


Fig. 1. Portions of stems and petioles to sample for tissue analysis when pea plants are 70-80 days old (two weeks before blossom).

Today some peas are planted in that area as early as the latter part of February and heavy plantings occur in March and April. May 10-15 is considered the deadline for planting by many growers and production men. The soil now used for the production of peas (practically 100% for processing by freezing) was formerly devoted to the production of oats, principally for grain. The returns per acre have probably been from two to three times as great from the production of peas as was the case when oats were grown. To this must be added the additional return in the form of pea vines which are used for ensilage and are well liked by dairymen as a feed for livestock. We hear much today about the reclamation of desert, swamp, and stump lands through irrigation, drainage, and clearing. To the people of Chehalis the switch from the low-acre value crops such as oats to peas is as important a reclamation project as are the others previously mentioned.

The development of pea growing in the Chehalis valley offers an additional advantage to certain of the processors in Western Washington. Early planting in that area means early harvesting. Many of the viners are started by June 25 and by the 4th of July the harvest is generally in full swing. These concerns obtain their early peas from Chehalis, then move their operations to the northern counties of Western Washington. At least one concern has had a pea processing run in excess of 90 days the last three years. The last of the peas were harvested after September 15 from the marsh lands in the vicinity of Snohomish. It is generally agreed that such long runs add to the efficiency of any processing operation.

The peas in the Chehalis area are grown almost exclusively on the river-bottom soils of the Chehalis, Newburg, and Wapato series. These soils are derived from residual materials of basaltic and marine origin (Olympic and Melbourne). The soils of the Chehalis series are principally silty clay loams which have developed a very fine structure and excellent drainage for the most part. These silty clay loam soils require considerable care in seedbed preparation. When worked too wet, they are susceptible to puddling and there is sufficient clay in the soils so that if allowed to dry beyond a certain point, they can be worked into a suitable bed only with a great deal of difficulty. Most growers in the area, however, do an excellent job of soil preparation. Most of the Chehalis soils are above the present flood plains. The Newburg soils occupy the present flood plains. The topography is undulating in character and consists principally of soils of a sandy loam texture.

The Wapato soils are darker in color and are underlain from 12 to 18 inches with highly impervious subsoils. Areas of Wapato soils are usually reserved for the later plantings. Excellent yields of peas have been obtained from them when drainage was sufficient and excessive rainfall did not occur during the critical period.

TABLE 1

Chehalis silty clay loam	pH	Exchangeable Nutrients* Pounds per acre		Available P† Lbs. per A.	Per cent Org. Matter
		Ca	K		
I. Topsoil	5.60	13,956	152	128	5.67
IA. Subsoil	5.65	13,664	69	72	4.42
II. Topsoil	5.65	13,144	129	128	5.92
IIA. Subsoil	5.75	11,836	65	80	2.87
III. Topsoil	5.75	13,040	148	138	5.81

* Extraction with neutral normal ammonium acetate.
† .002 N H_2SO_4 extraction according to Truog.

The plow layer of the soils mentioned above have pH values ranging from 5.5 to 6.5. The organic matter content ranges from 4.0% to 6.0%. Pertinent data concerning the Chehalis soils used in recent studies are given in Table 1.

Although the annual rainfall at the nearest station is around 45 inches, the precipitation pattern is characterized by rather dry summer months. The average precipitation for June is 1.79 inches and for July and August combined is 1.59 inches. Rainfall anywhere in Western Washington is subject to wide fluctuations.

There has developed a great local interest in supplemental irrigation by sprinkling. Very little irrigation was carried on, however, before 1940. Since then, installations have been made so rapidly that to all practical purposes the water supplies of the Chehalis River and its tributary streams have been appropriated to the practical present-day limits. One or two of the pea growers have applied water to this crop and the interest in the possibility of irrigating peas is growing by leaps and bounds.

Characteristic of the peas grown in the area is the extremely heavy nodulation produced on the roots. The nodule-producing organism is present in abundance wherever peas are planted, and artificial inoculation, with few exceptions, appears to be of little value on the river-bottom soils of the area. The viability of the inoculating organisms in these soils may perhaps be attributed to good drainage, a relatively high lime content, favorable pH, and the past successful production of vetches.

Fertilizer Studies

Fertilizers of any kind, with the exception of barnyard manure, were used very sparingly until the inception of the

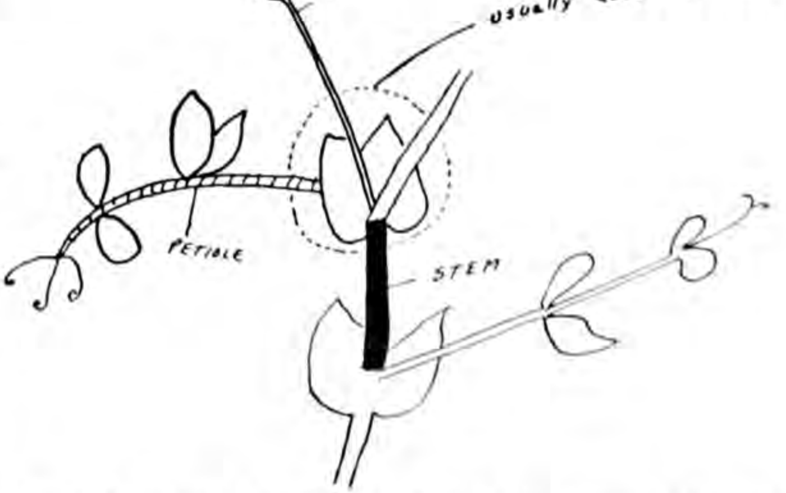


Fig. 2. Portions of stems and petioles to sample when pea plants are in full bloom (usually about 85-95 days).

AAA program, after which some phosphorus was applied to meadows and pea land.

Fertilizer studies with peas were inaugurated by the Soils Department of the Western Washington Experiment Station in 1944. The plots were located that year on Chehalis silty clay loam on the Tom Nesbit farm. The 1945 and 1946 experiments were also located on Chehalis silty clay loam on the Art Hamilton farm operated by Errett Deck. (Pertinent information on the soil of the Deck plots is given in Table 1).

The studies at Chehalis revealed two important facts concerning fertilizer requirements for peas in that area. They showed clearly the need of potash and phosphorus for maximum production of peas on these soils and also that the pre-drilling of fertilizer resulted in greater yields of peas than when the materials were broadcast and disced into the soil.

The results of the 1946 fertilizer ratio studies conducted at Chehalis are shown in Table 2.

As previously mentioned, the data in Table 2 show clearly the response obtained as a result of the application of phosphorus and potash when applied together. Of interest also is the trend toward even greater yields when the potash application was increased from 60 to 90 and 120 pounds per acre. The return of 1,000 lbs. of peas from an investment of 300 pounds of 0-20-20 per acre is indeed profitable. A return of at least $5.00 for every dollar invested in fertilizers has been obtained from the 300 lbs. per acre in the trials at Chehalis.

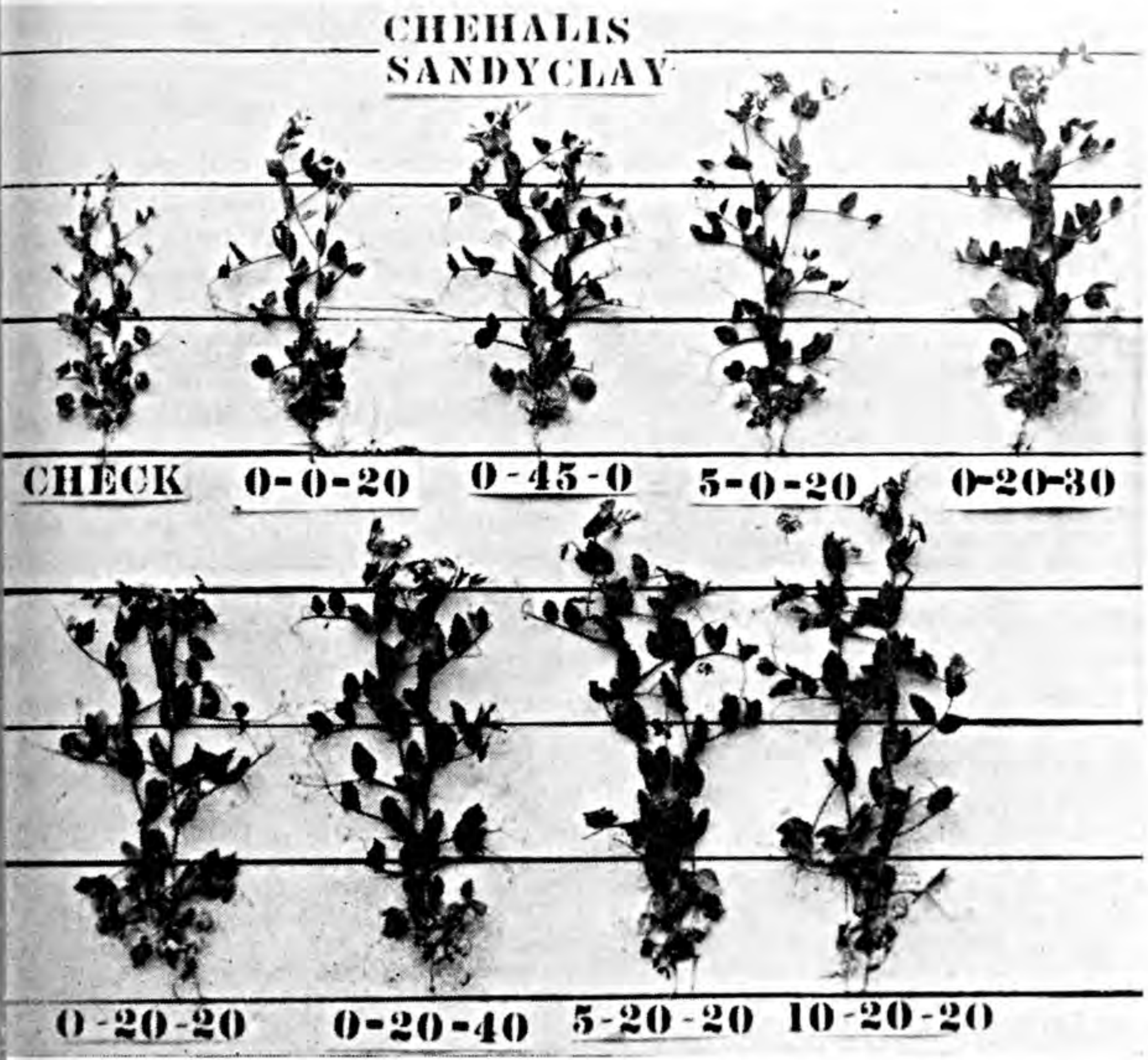
TABLE 2: EFFECT OF FERTILIZER ON YIELDS OF PEAS—CHEHALIS, 1946.

Treatment	
Check	2,843
30– 0–60	3,010
0–60– 0	3,299
15–60–60	3,863
0–60–60	3,859
0– 0–60	2,903
30–60–60	3,556
0–60–90	4,045
0–60–120	4,110

Variety, Bonneville.
Least significant difference (5% level) 315 lbs.
Unless otherwise indicated, the fertilizers were placed in bands approximately ½ inch to side and 1 inch deeper than the seed. The fertilizers were added in quantities of N, P_2O_5, and K_2O indicated in the table.

Nitrogen, on the other hand, applied with phosphate or potash or both failed to increase yields and, in fact, has resulted in suppression of yields on a number of occasions at Chehalis and in other pea-growing areas in Western Washington. The application of nitrogen results in a marked stimulation of the early growth of peas. Leaf size is increased appreciably and the plants appear vigorous and thrifty in the early part of the season. As the peas approach maturity, however, the rate of pod-filling and general growth decreases rather abruptly. It is assumed by the writers that the greater growth resulting from the nitrogen application demands a much greater supply of moisture than is required by the plants that have not been stimulated by nitrogen. Then because moisture supplies during July are at a critical level there is not enough left in the soil for the nitrogen-stimulated plants to complete their development.

Potash-deficiency symptoms on peas on the Chehalis soils usually appear most pronounced toward the later part of the growing season. The characteristic symptom is a scorch of the lower leaves. The leaves lose their normally light green color, soon wither and dry, and may in severe cases fall from the plant. These symptoms always appear on the lower leaves first and progress upward from the base of the plant. The growth of the entire plant and its component parts, particularly the leaves, was much less on the potash-deficient plots. While applications of 60 pounds of potash in combination with phosphoric acid have given splendid increases in yield, all of the potash-defi-



Comparative growth of peas resulting from the band application of 300 pounds per acre of the fertilizer mixtures indicated on the photograph.

ciency symptoms were not eliminated by such applications in 1946. Although no certain evidence is available, it appears that potash deficiency is more evident and more serious during dry seasons than in years when precipitation is more plentiful.

Numerous experiments on fertilizer placement by the Western Washington Experiment Station have shown clearly the advantage of band over broadcast application. No commercial drills designed to apply the fertilizer and seed in separate bands have been available for purchase. For this reason experiments were set up at Chehalis to compare broadcasting, pre-drilling, and precise placement. When pre-drilling the fertilizers, the materials were put into the fertilizer hopper of the ordinary pea drill with fertilizer attachments. The disc openers were set for maximum soil penetration. This operation was only for the application of the fertilizer. The seed was drilled in the next operation. It was necessary to use care in the seeding operation to avoid planting the seed too deeply.

The placement studies (Table 3) showed that under conditions encountered at Chehalis, pre-drilling the fertilizer resulted in yields almost as great as those obtained from the placement of fertilizer in precise positions in relation to the seed. Both the placed and pre-drilled fertilizer resulted in yields much above the broadcast treatment and those obtained from the unfertilized checks.

TABLE 3: EFFECT OF FERTILIZER PLACEMENT ON YIELD OF PEAS GROWN ON CHEHALIS SILTY CLAY LOAM IN 1945 AND 1946.

Treatment	Yield per acre—Pounds	
	1945	1946
Broadcast.......	2,274*	3,248
Pre-drilled.......	2,656	3,980
½" S, 1" B......	2,726	3,835

Fertilizers used 1945—300 lbs. of 0-20-20 per acre with rock phosphate as source of phosphate; 1946—300 lbs. 0-20-20 with phosphate supplied from superphosphate.

* Least significant difference (5% level—1945, 251 lbs., 1946, 521 lbs.

In view of the results of the studies at Chehalis the Experiment Station recommends the following fertilizer treatments for peas in the area.

1. The pre-drill application of 300 pounds of 0-20-20 per acre. In the seeding operations the drills should run in the same direction as the fertilizer was pre-drilled.
2. Do not broadcast the fertilizer.
3. Do not use nitrogen in the fertilizer.
4. Drills may be used in tandem, one drilling the fertilizer, the other the seed.

Tissue Analysis *

Preliminary results with plant analysis substantiated the belief that the Chehalis soils were low in available potash.

Samples of pea plants were obtained from plantings at Chehalis and Puyallup in 1944. The plants obtained at Puyallup were from soils believed to be well supplied with available potash in so far as peas were concerned. It was hoped that the differences in the apparent availability of potash in the two soils would be reflected in the potash composition of the plants grown on them. Pea samples were obtained from fertilizer plots whenever possible. A number, however, were obtained from commercial plantings.

Tables 4 and 5 show the results of these analyses. As was anticipated, there was a marked difference in the average potassium content of the pea

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* Plant samples were dried at 70-80 degrees C. in an oven and ground in a Wiley mill to pass a 40-mesh sieve. 0.1 gram samples were ashed in an oven at 550 degrees C. The ash was dissolved in 2 per cent acetic acid, and the potash precipitated with sodium cobaltrinitrite. The precipitate was washed and the amount of potash present was determined volumetrically using 0.05 N. potassium permanganate.

TABLE 4: POTASSIUM CONTENT OF LEAVES AND STIPULES FROM RANDOM PLANT SAMPLES TAKEN IN THE CHEHALIS AREA IN 1944.

Chehalis (Chehalis silty clay loam)

Grower	Stage of plant growth	Per cent K	
		Leaves	Stipules
Nisbet....................	Pods ¾ ripe..............	0.29	0.40
Nisbet....................	Pods ½ ripe..............	0.40	0.49
Senn......................	Pods ¾ formed............	0.50	0.44
Goernt....................	Pods ¾ formed............	0.90	0.88
Goernt....................	Pods ⅓ formed............	1.06	1.01
Etheridge.................	Pods ¾ ripe..............	1.07	1.17
Hamilton..................	Before bloom.............	1.33	1.30
Young.....................	Blossoms.................	1.39	1.17
Goernt....................	Blossoms.................	1.49	1.34
Fitz......................	Pods ¾ formed............	1.54	1.69
	Average..................	1.00	0.99

Yields Tell The Story

By J. Lloyd Burrell

Information Service, Production and Market Administration
U. S. Department of Agriculture, Atlanta, Georgia

DOES a planned agricultural program pay? Editor Ernest Camp thinks it has in the case of Walton County farmers in Georgia.

"Good farm planning, with a liberal application of sweat and good fertilizers, has brought us farm profits," this editor wrote in the tenth agricultural edition of his Walton Tribune, weekly newspaper in Monroe, Georgia.

"When in a period of less than 10 years, crop yields rise in some cases to an increase of 100 per cent, a marked stride towards better agricultural methods is proven," he said. "Incredible as it seems, the same acre of ground is doing twice as much work for us as it did 10 years ago."

Rapid Progress

Walton County farmers have, of course, been improving agriculture for many years, but H. H. Shores, their county agent for the Agricultural Extension Service, can show a fast rate of progress since the first concentrated agricultural program was inaugurated in 1938.

Briefly, in eight years, the per-acre yield of cotton has risen to 500 pounds of lint; less acreage of sweet potatoes is bringing a quarter million dollar's more; less acreage of corn is producing over 200,000 bushels more; dairy products marketed have jumped from $33,000 to $238,000; and broiler production has skyrocketed from 5,000 to 1,200,000.

Back in 1938, County Agent Shores and Home Demonstration Agent Miss Anna Holbrook got together with representatives of the other agriculture agencies in Walton County. A six-point agricultural plan was the result, with emphasis on feed and soil-improvement crops, livestock, and cash crops. Later, in 1943, this plan was increased to a 12-point scheme, in order to care for expanding agriculture and related activities.

Walton County is in the northern half of Georgia, near Atlanta, and despite the fact that it is one of the state's biggest (and best) cotton counties, it ranks with any of Georgia's other 158 counties from the standpoint of diversification. Let's look over Walton farmers' 1946 Better Farming 12-Point Agricultural Program and see what it has to offer, as well as how it operates.

Cotton is point number one. Every community in the county is a one-variety cotton community, and all communities are joined in a county-wide organization. More than 99 per cent of the annual acreage is planted to the same high-yielding, improved variety.

"Among the reasons for our phenomenal success with cotton are use of a liberal amount of well-balanced fertilizer and the treatment of planting seed," County Agent Shores explains.

And speaking of phenomenal success with cotton, Walton farmers have won two state-wide awards for excellence in production of this fleecy crop. At the beginning of the war, they were presented with a trophy signifying greatest achievement in cotton production for the year in Georgia. In 1945 one of Walton's communities produced an average per-acre yield of 525 pounds of lint to win another state trophy.

Mr. Shores advises farmers to plant cotton on good land, fertilize heavily, plant in 30- to 36-inch rows, two stalks in hills 8 to 12 inches apart, and fight

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Tissue Analysis *

Preliminary results with plant analysis substantiated the belief that the Chehalis soils were low in available potash.

Samples of pea plants were obtained from plantings at Chehalis and Puyallup in 1944. The plants obtained at Puyallup were from soils believed to be well supplied with available potash in so far as peas were concerned. It was hoped that the differences in the apparent availability of potash in the two soils would be reflected in the potash composition of the plants grown on them. Pea samples were obtained from fertilizer plots whenever possible. A number, however, were obtained from commercial plantings.

Tables 4 and 5 show the results of these analyses. As was anticipated, there was a marked difference in the average potassium content of the pea

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* Plant samples were dried at 70-80 degrees C. in an oven and ground in a Wiley mill to pass a 40-mesh sieve. 0.1 gram samples were ashed in an oven at 550 degrees C. The ash was dissolved in 2 per cent acetic acid, and the potash precipitated with sodium cobaltrinitrite. The precipitate was washed and the amount of potash present was determined volumetrically using 0.05 N. potassium permanganate.

TABLE 4: POTASSIUM CONTENT OF LEAVES AND STIPULES FROM RANDOM PLANT SAMPLES TAKEN IN THE CHEHALIS AREA IN 1944.

Chehalis (Chehalis silty clay loam)

Grower	Stage of plant growth	Per cent K	
		Leaves	Stipules
Nisbet	Pods ¾ ripe	0.29	0.40
Nisbet	Pods ½ ripe	0.40	0.49
Senn	Pods ¾ formed	0.50	0.44
Goernt	Pods ¾ formed	0.90	0.88
Goernt	Pods ⅓ formed	1.06	1.01
Etheridge	Pods ¾ ripe	1.07	1.17
Hamilton	Before bloom	1.33	1.30
Young	Blossoms	1.39	1.17
Goernt	Blossoms	1.49	1.34
Fitz	Pods ¾ formed	1.54	1.69
	Average	1.00	0.99

Yields Tell The Story

By J. Lloyd Burrell

Information Service, Production and Market Administration
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DOES a planned agricultural program pay? Editor Ernest Camp thinks it has in the case of Walton County farmers in Georgia.

"Good farm planning, with a liberal application of sweat and good fertilizers, has brought us farm profits," this editor wrote in the tenth agricultural edition of his Walton Tribune, weekly newspaper in Monroe, Georgia.

"When in a period of less than 10 years, crop yields rise in some cases to an increase of 100 per cent, a marked stride towards better agricultural methods is proven," he said. "Incredible as it seems, the same acre of ground is doing twice as much work for us as it did 10 years ago."

Rapid Progress

Walton County farmers have, of course, been improving agriculture for many years, but H. H. Shores, their county agent for the Agricultural Extension Service, can show a fast rate of progress since the first concentrated agricultural program was inaugurated in 1938.

Briefly, in eight years, the per-acre yield of cotton has risen to 500 pounds of lint; less acreage of sweet potatoes is bringing a quarter million dollar's more; less acreage of corn is producing over 200,000 bushels more; dairy products marketed have jumped from $33,000 to $238,000; and broiler production has skyrocketed from 5,000 to 1,200,000.

Back in 1938, County Agent Shores and Home Demonstration Agent Miss Anna Holbrook got together with representatives of the other agriculture agencies in Walton County. A six-point agricultural plan was the result, with emphasis on feed and soil-improvement crops, livestock, and cash crops. Later, in 1943, this plan was increased to a 12-point scheme, in order to care for expanding agriculture and related activities.

Walton County is in the northern half of Georgia, near Atlanta, and despite the fact that it is one of the state's biggest (and best) cotton counties, it ranks with any of Georgia's other 158 counties from the standpoint of diversification. Let's look over Walton farmers' 1946 Better Farming 12-Point Agricultural Program and see what it has to offer, as well as how it operates.

Cotton is point number one. Every community in the county is a one-variety cotton community, and all communities are joined in a county-wide organization. More than 99 per cent of the annual acreage is planted to the same high-yielding, improved variety.

"Among the reasons for our phenomenal success with cotton are use of a liberal amount of well-balanced fertilizer and the treatment of planting seed," County Agent Shores explains.

And speaking of phenomenal success with cotton, Walton farmers have won two state-wide awards for excellence in production of this fleecy crop. At the beginning of the war, they were presented with a trophy signifying greatest achievement in cotton production for the year in Georgia. In 1945 one of Walton's communities produced an average per-acre yield of 525 pounds of lint to win another state trophy.

Mr. Shores advises farmers to plant cotton on good land, fertilize heavily, plant in 30- to 36-inch rows, two stalks in hills 8 to 12 inches apart, and fight the boll weevil and other insects. For fertilizing cotton generally, he recommends 600 to 800 pounds of 4-8-6.

"The 1938 income from cotton in Walton County as indicated by the U. S. Department of Agriculture was $1,266,458. The income in 1945 on 6,000 less acres is estimated to be $3,606,200. The advanced price of cotton has had some bearing on this difference but the yield per acre since 1938 has increased approximately 200 pounds, which would indicate better farming methods and better selection of seed."

Incidentally, Walton's 1945 estimated per-acre yield of 500 pounds lint is the highest ever recorded in Georgia for a county average.

The number two point for 1946 is sweet potatoes, a supplemental cash crop to cotton. In 1938 the potato was introduced as a supplemental cash enterprise, the variety being the improved Puerto Rican. Every family who has suitable soil and sufficient labor is urged to grow sweet potatoes for early market. In 1945 growers realized $251,000 more for their potatoes than in 1938, and the yield has increased about 100 bushels per acre. To grow this cash crop in the quickest possible time for the early market, Walton growers fertilize the potatoes with 600 to 800 pounds of 4-8-12.

A year-round garden for every farm family—an ultimate goal in Walton County—is point number three. Recommended size of the garden is one-fourth to one-half acre for home use, and one acre for canning and sale. Heavy fertilization is advised. Community canning plants are operated by vocational agriculture teachers, and one freezer locker is now serving many Walton families. These two preservation sources are contributing greatly to improving the food supply and are affording means of preserving the surplus garden vegetables for off-season use.

Point number four recommends the setting out of a home orchard, berry patch, and grape vineyard. New home orchards in this Georgia county are very noticeable since the inauguration of the intensive farm planning program eight years ago.

The fifth point explains that every farm family should have two good dairy cows and should use good bulls.

"Farmers who have sufficient cows and home-grown feeds are urged to sell grade "A" or "B" milk, since markets are already established for both in the county," Agent Shores points out. Recent years have seen tremendous increases in Walton's dairy production. The value of dairy products sold has increased seven times in seven years.

Grow out one beef cow for home consumption is number six in Walton's 12-point farm plan. And if home-grown feed is available, farmers are advised to grow out as many extra animals as possible for market. The county now has at least three outstanding registered beef cattle herds and others of grade and purebred beef.

Two hogs for each farm are recommended in point seven. In addition, production of hogs for market is strongly advised if feed on the farm is available.

"Every farm operator," says County Agent Shores, "is urged to have one brood sow to furnish pigs for his own use and for his tenants. We also advise the growing of one to three grazing crops for hogs."

Grow out at least 200 baby chicks and save 50 of the best pullets for laying hens—that's point number eight. For growth of broilers on a large scale, plenty of planning is recommended to help insure profitable returns. For Walton farmers, commercial broiler production has skyrocketed since 1938—from $2,500 to more than a million-dollar enterprise.

One big underlying factor in Walton's agricultural success is point number nine; namely, feed and soil improvement crops. Today, farmers in this

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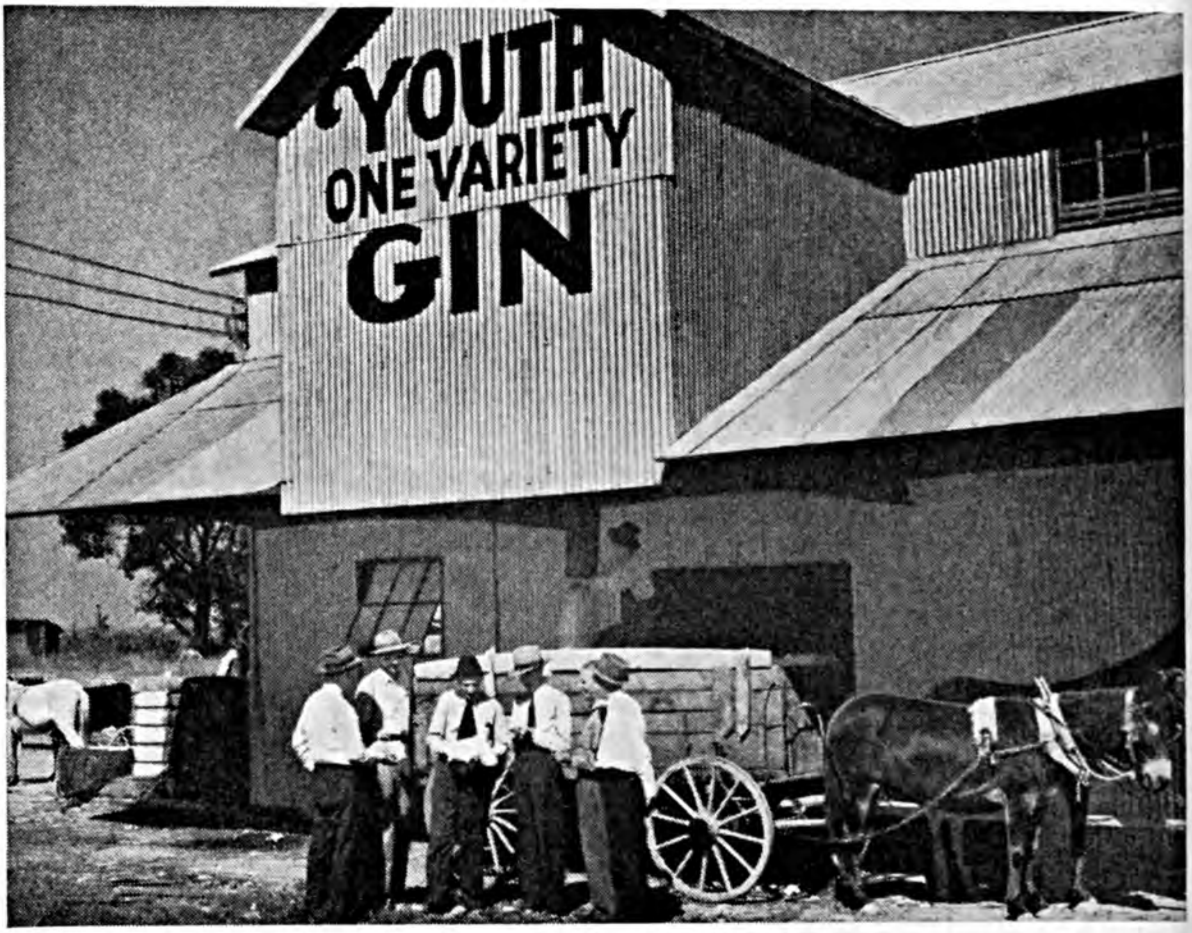
J. F. Hester, Walton County farmer, points out to County Agent H. H. Shores the diversification he is practicing on his farm.

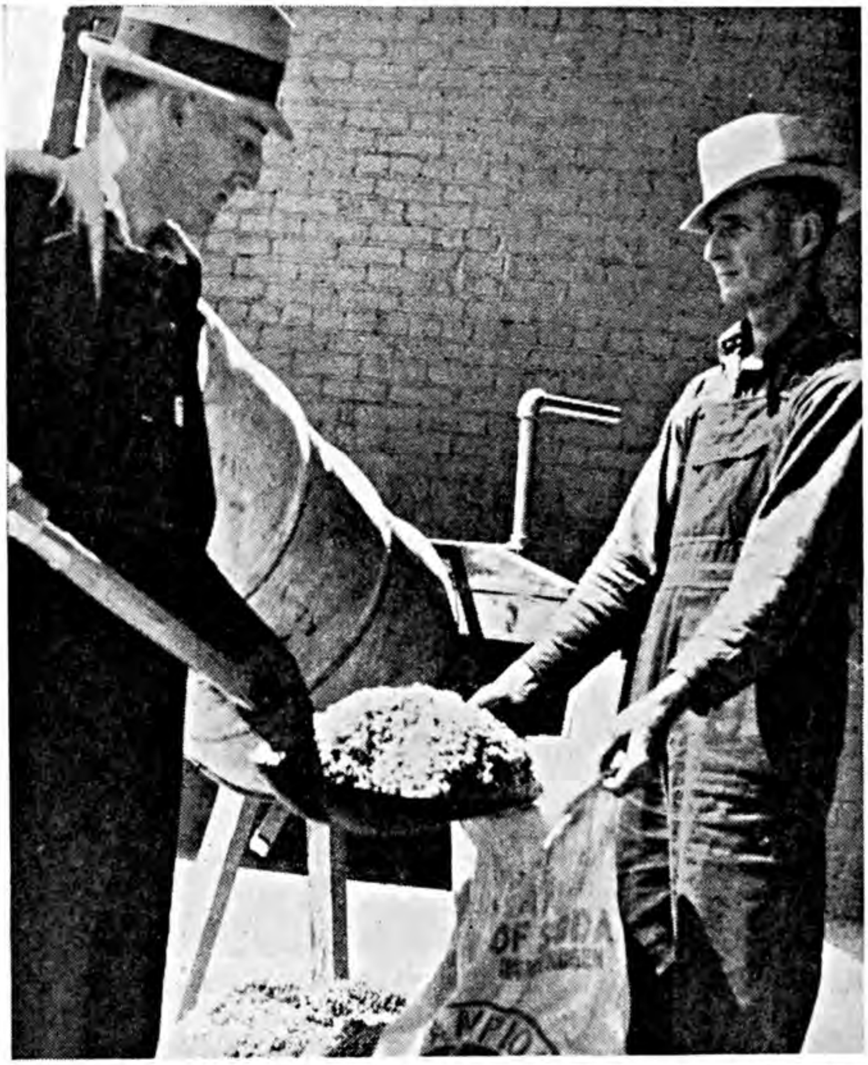


Above: Walton farmers use all the approved practices of cotton production, including good ginning.

Below: Fertilization and other good practices mean better pasturage for Walton County livestock.

Above: Here is an electrically heated hot-bed for sweet potato plants used by Walton farmers.

Below: Dairying occupies a big part in the Walton farm set-up and good mules supply farm power.



Left: Seed treatment is an important step in Walton County cotton production. Last year farmers in this Georgia county produced more than 26,000 bales on approximately 26,000 acres.

Below: (Left to right) L. I. Skinner, Ass't. Dir., Ga. Agr. Ext. Serv., J. T. Byrd, Pres. of Cotton Improvement Assoc., and H. H. Shores, Walton County Agent, admire trophy presented for excellence in lint production practices which include liberal use of fertilizers.

The Editors Talk

A New Film on Boron

Only recently has boron assumed a field of importance in plant nutrition. Where once we used to say that the list of minor elements could be taken care of by the catchy words "C Hopkns Cafe Mg. (mighty good)" we now have to add a number of other elements including boron as essential for plant growth. The comparatively small quantities involved caused these elements to be overlooked in earlier investigations since they were furnished by impurities in the materials used or the containers, like glass, in which the plants were grown. Modern techniques have changed this picture and reinvestigation of many projects once thought closed has necessitated conclusions entirely different from those originally drawn.

The famous boron experiments at Williamsburg, Virginia, conducted over the last several years have furnished striking results on the use of borax on alfalfa. Conversation with a plant pathologist disclosed, however, that around 1900 he was called to investigate trouble growers had been experiencing with alfalfa in that area, but lack of boron as the cause was never suspected. For many years it was felt that the growing of alfalfa was not a practical or profitable practice over most of the South. It has now been found by the use of boron and potash along with the previously recognized lime and phosphate that alfalfa will produce fine crops over most of this region. Many sections were having difficulties in maintaining the yield and quality of their vegetables and fruits due to trouble which was thought to be disease but which now has been found to be boron deficiency. Numerous other instances undoubtedly could be cited, and recognition of the necessity for boron and other minor elements is changing agricultural practices over wide areas of the country.

In order to acquaint agricultural audiences with the symptoms of boron deficiency, how boron can be used, and its source, a film entitled *Borax From Desert to Farm* has recently been released. This motion picture was sponsored by the two largest borax producers in America—the American Potash and Chemical Corporation and the Pacific Coast Borax Company. It is being distributed by the American Potash Institute under whose direction it was produced with the helpful cooperation of many agricultural experiment stations and extension staffs including Alabama Agricultural Experiment Station, University of California, Clemson Agricultural College, Cornell University, University of Maryland, New York State Agricultural Experiment Station and Extension Service, Virginia Agricultural Extension Service, and the University of Wisconsin. This 16 mm. color film has a commentary on the sound track describing the background and action as they are being shown.

The picture opens with scenes in California showing the beautiful and interesting country in which borax is produced. Colorful scenes in the desert around Searles Lake and in Death Valley as well as at the two producing plants are shown. Brief mention is made of the industrial uses of borax especially in the glass, enamel, and chemical industries. From there the film turns to the agricultural side of borax usage. Commonly recognized symptoms due to boron deficiency are shown for a large number of crops including apples, olives, alfalfa, celery, sugar and table beets, cauliflower, sweet potatoes, and others.

The American Potash Institute will be pleased to loan *Borax From Desert to Farm* to agricultural colleges and experiment stations, county agricultural agents, vocational teachers, other responsible agricultural advisory and farm groups, and members of the fertilizer trade. Requests for bookings should be directed to the Institute at 1155 Sixteenth St., N. W., Washington 6, D. C., its home office.

The Southerners Take Stock

At the 44th annual convention of the Association of Southern Agricultural Workers held in Biloxi, Mississippi, January 15-17, nearly 2,000 of the South's men and women of science took inventory of their assets and liabilities. They not only were reviewing the war years, during which no conventions were held, but were looking ahead through the next 10 years.

Sessions of the meeting were likened to a 16-ring circus. If there could be any criticism of the program, it would be that so much was taking place simultaneously that one person could not cover all spots of interest. Sectional groups included agricultural and rural sociology, agricultural editors, agricultural engineers, agronomy—soils and crops, animal husbandry, commissioners of agriculture, dairy science, entomologists, forestry, home economics, horticultural science, marketing, phytopathology, plant physiology, poultry, and soil conservation. Leaders in the respective fields presented problems and the results of research work.

In referring to the financial progress of the farmers of the South, W. C. Lassetter of Memphis, Tennessee, out-going president of the Association, listed five points for consideration:

1. Bank deposits in the country banks now are six times larger than they were in 1939 and 1940.
2. The farmers have more cash in their pockets than during these same years.
3. They have additional money in such things as bonds, which can be converted into cash.
4. They have another high cash potential in their present investments in quality livestock—a much bigger investment than ever before.
5. The farm mortgage indebtedness is at its lowest point in years, having been reduced by more than $800,000,000 in 17 years to a low now of about $1,200,000,000.

Mr. Lassetter stated that of all the farms in the country providing their owners with a $1,000 annual cash income (equal to $1,700 for a city worker) 42 per cent of them are in the 14 Southern states.

To science was given most of the credit for this progress. The South has learned to restore and maintain the fertility of her soils. She has learned the growing of pastures for quality livestock. She has learned to diversify along other lines and to mechanize to cut costs of production. As in agriculture in any other territory or with any other industry anywhere, there are still many more problems to be solved. That most of these will be, before another 10 years roll around, is guaranteed by the eager interest everywhere evident at this convention.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1920	15.9	17.3	125.3	141.7	61.8	182.6	16.46	25.65	....
1921	17.0	19.5	113.3	113.1	52.3	103.0	11.63	29.14	....
1922	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
January	22.36	36.3	145.0	208.0	110.0	154.0	15.70	50.90	....
February	23.01	33.9	146.0	223.0	111.0	155.0	15.80	50.30	....
March	22.70	31.9	157.0	236.0	114.0	158.0	16.30	47.50	....
April	23.59	42.9	162.0	245.0	116.0	158.0	15.00	48.00	....
May	24.09	43.0	157.0	251.0	135.0	170.0	14.80	49.60	....
June	25.98	59.0	147.0	251.0	142.0	174.0	14.70	51.50	....
July	30.83	56.7	148.0	275.0	196.0	187.0	15.00	60.00	....
August	33.55	48.6	143.0	280.0	180.0	178.0	15.10	59.10	....
September	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	....
October	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1920	128	173	180	161	96	207	139	114	....
1921	137	195	163	129	81	117	98	129	....
1922	185	228	95	114	116	109	98	135	....
1923	231	190	133	137	129	105	110	183	....
1924	185	190	98	170	166	141	107	147	143
1925	158	168	245	188	109	163	108	140	143
1926	101	179	189	134	116	138	112	98	139
1927	163	207	146	124	132	135	87	154	127
1928	145	200	76	134	131	113	95	152	154
1929	135	183	189	133	124	117	92	137	137
1930	77	128	131	123	93	76	93	98	129
1931	46	82	66	83	50	44	73	40	115
1932	52	105	55	62	50	43	52	46	102
1933	82	130	118	79	81	84	68	57	91
1934	100	213	64	91	127	96	111	146	95
1935	90	184	85	80	102	94	63	135	119
1936	100	236	164	106	163	116	94	148	104
1937	68	204	76	93	81	109	74	87	110
1938	69	196	80	83	76	64	57	97	88
1939	73	154	100	85	88	78	67	94	91
1940	80	160	78	97	96	77	64	96	111
1941	137	264	116	107	117	107	81	211	129
1942	153	369	168	136	143	124	91	202	163
1943	160	405	188	232	174	154	125	231	245
1944	167	420	214	219	170	160	138	234	212
1945	181	435	199	228	178	169	127	230	224
1946									
January	180	363	208	237	171	174	132	226	249
February	186	339	209	254	173	175	133	223	275
March	183	319	225	269	178	179	137	211	283
April	190	429	232	279	181	179	126	213	282
May	194	430	225	286	210	192	125	220	177
June	210	590	211	286	221	197	124	228	185
July	249	567	212	313	305	212	126	266	163
August	287	486	205	319	280	201	127	262	162
September	285	488	184	255	269	202	130	256	154
October	304	530	175	238	266	213	136	293	151
November	236	438	176	228	198	214	145	399	207
December	242	435	181	239	190	217	149	406	166

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
January	1.75	1.42	7.81	5.77	4.86	6.71
February	1.75	1.42	7.81	5.77	4.86	6.71
March	1.75	1.42	7.81	5.77	4.86	6.71
April	1.75	1.42	7.81	5.77	4.86	6.71
May	1.75	1.42	9.08	6.10	4.86	7.30
June	1.88	1.42	10.34	6.42	4.86	7.90
July	1.88	1.42	11.62	8.15	5.34	9.60
August	2.22	1.46	16.88	8.14	6.07	12.14
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.90

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish scrap	Tankage	High grade ground blood
1922	113	90	173	132	140	142
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
January	65	50	223	163	144	191
February	65	50	223	163	144	191
March	65	50	223	163	144	191
April	65	50	223	163	144	191
May	65	50	259	173	144	207
June	70	50	295	182	144	224
July	70	50	332	231	158	273
August	83	51	482	231	180	345
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	338

Wholesale Prices of Phosphates and Potash **

	Super-phosphate Balti-more, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. At-lantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. At-lantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. At-lantic and Gulf ports	Manure salts bulk, per unit, c.i.f. At-lantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1922	.566	3.12	6.90	.632	.904	23.87	....
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
January	.650	2.20	6.40	.535	.797	26.00	.200
February	.650	2.20	6.40	.535	.797	26.00	.200
March	.650	2.20	6.40	.535	.797	26.00	.200
April	.650	2.20	6.40	.535	.797	26.00	.200
May	.650	2.20	6.40	.535	.797	26.00	.200
June	.650	2.30	6.45	.471	.729	22.88	.176
July	.650	2.60	6.60	.471	.729	22.88	.176
August	.700	2.60	6.60	.471	.729	22.88	.176
September	.700	2.60	6.60	.471	.729	22.88	.176
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200

Index Numbers (1910-14 = 100)

	Super-phosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1922	106	87	141	89	95	99	....
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
January	121	61	131	75	84	108	83
February	121	61	131	75	84	108	83
March	121	61	131	75	84	108	83
April	121	61	131	75	84	108	83
May	121	61	131	75	84	108	83
June	121	64	132	66	76	95	80
July	121	72	135	66	76	95	80
August	131	72	135	66	76	95	80
September	131	72	135	66	76	95	80
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1922	132	149	141	116	101	145	106	85
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
January	206	184	156	97	57	175	121	78
February	207	185	156	97	57	175	121	78
March	209	187	158	97	57	175	121	78
April	212	188	160	97	57	175	121	78
May	211	192	162	99	57	189	121	76
June	218	196	163	100	60	203	121	70
July	244	209	181	103	60	230	121	70
August	249	214	187	116	67	293	131	70
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] **Since June 1941, manure salts are quoted F.O.B. mines exclusively.**

** **The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizer Sales, By Grades, 1946 Season," Ala. Coop. Crop Reporting Serv., Office of Agr. Statistician, 121½ Lee St., Montgomery 4, Ala., Oct. 16, 1946.

"Agricultural Mineral Sales as Reported to Date for Quarter Ended September 30, 1946," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., FM-134, Dec. 12, 1946.

"Commercial Fertilizer Sales as Reported to Date for Quarter Ended September 30, 1946," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., FM-135, Dec. 12, 1946.

Supplemental List, Commercial Fertilizers Registrants for the Fiscal Year Ending June 30, 1947," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., FM-136, Dec. 26, 1946.

"Supplemental List, Agricultural Minerals Registrants for the Fiscal Year Ending June 30, 1947," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., FM-137, Dec. 26, 1946.

"Chemical Investigations of the Metabolism of Plants: I. The Nitrogen Nutrition of Narcissus Poeticus," Agr. Exp. Sta., New Haven, Conn., Bul. 496, Feb. 1946, H. B. Vickery, G. W. Pucher, A. J. Wakeman, and C. S. Leavenworth.

"Inspection of Commercial Fertilizers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 318, April, 1946.

"Inspection of Commercial Fertilizers and Agricultural Lime Products," Agr. Exp. Sta., Mass. State College, Amherst, Mass., Bul. 130, July, 1946.

"Liquid and Solid Sources of Nitrogen for Cotton Production, 1943-45," Agr. Exp. Sta., Miss. State College, State College, Miss., Serv. Sheet 399, Jan. 1946, John Pitner and F. E. Edwards.

"Placement of Nitrogen Fertilizer for Corn and Oats," Agr. Exp. Sta., Miss. State College, State College, Miss., Serv. Sheet 400, Feb. 1946, John Pitner.

"Fertilizer Studies With Vegetables in Cameron County," Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1025, Aug. 16, 1946, B. S. Pickett.

"Distribution of Fertilizer Sales in Texas, January 1-June 30, 1946," Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1037, Sept. 19, 1946, J. F. Fudge.

"1946 Results of Plow-Sole Fertilizer Demonstrations in Wisconsin," Soils Department, College of Agr., Madison, Wis., C. J. Chapman.

"1946 Results of Fertilizer Demonstrations on Small Grain and Hay," Soils Dept., Univ. of Wis., Madison, Wis., C. J. Chapman.

"Consumption and Trends in the Use of Fertilizer in the Year Ended June 30, 1944," U.S.D.A., Washington, D. C., Cir. 756, Nov. 1946, A. L. Mehring, Hilda M. Wallace, and Mildred Drain.

Soils

"The Effect of Tillage on Soil and Moisture Conservation and on Crop Yields at Langdon and Edgeley and at Other Points in North Dakota," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Bul, 341, Aug. 1946, C. L. Englehorn.

"Progress Report on Tillage Methods in Preparing Land for Corn," Depts. of Agron. and Agr. Eng., Ohio Agr. Exp. Sta., Wooster, Ohio, Mimeo. 102, April 18, 1946, J. B. Page, C. J. Willard, and G. W. McCuen.

"Our Land, Its Conservation, Improvement, Best Use," Clemson Agr. College, Clemson, S. C., Cir. 286, June 1946.

"Soil-Moisture Studies Lead to Improved Cultural Practices," U.S.D.A., Washington, D. C., R.A.S. 65 (P) Aug. 30, 1946.

Crops

"Oats for Grain, Grazing, Hay," Ext. Serv., Ala. Polytechnic Inst., Auburn, Ala., Cir. 310, Rev. June 1946, J. C. Lowery.

"Plant Winter Legumes Where Peanuts Are Harvested," Ext. Serv., Ala. Polytechnic Inst., Auburn, Ala., Cir. 311, July 1945, J. C. Lowery.

"Vegetable and Herb Seed Production in Arizona," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 204, July 1946, A. E. Griffiths, W. W. Jones, and A. H. Finch.

"Wheat, Barley and Rye Variety Trials in Arkansas," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 461, Feb. 1946, C. K. McClelland.

"1945 Arkansas Corn Yield Tests," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Ser. 2, Jan. 1946, D. B. Shank.

"1945 Arkansas Rice Yield Tests," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Ser. 3, Jan. 1946, C. R. Adair, L. C. Kapp, and E. M. Cralley.

"1945 Yields of Fall Sown Oat Varieties in

Arkansas," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Ser. 4, Jan. 1946, W. J. Wiser, H. R. Rosen, and C. K. McClelland.

"Gardening By the Month," Ext. Serv., Colo. A & M College, Fort Collins, Colo., Ext. Bul. 386-A, April 1945, C. M. Drage.

"Preliminary Report of Green Grazing Versus Hays for Fattening Swine," Ga. Exp. Sta., Experiment, Ga., Cir. 152, Nov. 1946, Z. A. Massey and S. W. Fisher.

"Grafting the Avocado in Hawaii," Agr. Ext. Serv., Univ. of Hawaii, Honolulu 10, Hawaii, Ext. Cir. 211, Nov. 1946, William Bembower.

"Fifty-third Annual Report of the Idaho Agricultural Experiment Station," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Bul. 268, July 1946.

"Value and Use of Tobacco Stalks in Farm Practice," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 486, May 1946, M. E. Weeks and P. E. Karraker.

"A Twelve-Month Grazing Program for the Rice Area of Louisiana," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. 407, Sept. 1946, R. K. Walker and M. B. Sturgis.

"Sixty-first Annual Report of the Maine Agricultural Experiment Station 1944-1945," Agr. Exp. Sta., Univ. of Maine, Orono, Maine.

"Progress Through Research, 58th Annual Report of the Agricultural Experiment Station 1944-1945," Univ. of Md., College Park, Md.

"Vegetative Propagation of White Pine," Agr. Exp. Sta., Mass. State College, Amherst, Mass., Bul. 435, July 1946, W. L. Doran.

"A Fast Way To Seed Hairy Vetch in Cotton," Agr. Ext. Serv., Univ. of Mo., Columbia, Mo., Cir. 533, July 1946, J. R. Paulling and Ralph Ricketts.

"Progress of the New York State Extension Service," N. Y. State College of Agr., Cornell Univ., Ithaca, N. Y., Ext. Bul. 699, July 1946.

"Research and Farming, 68th Annual Report, 1945," Agr. Exp. Sta., Univ. of N. C., Raleigh, N. C., P.R. 4.

"Better Tobacco Plants," N. C. Agr. Ext. Serv., State College Station, Raleigh, N. C., Ext. Cir. 293, Sept. 1946.

"Tree Ring Studies in North Dakota," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Bul. 338, April 1946, G. F. Will.

"Introduction and Spread of Weeds and Other Plants in North Dakota," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Bul. 339, May 1946, O. A. Stevens.

"Range Vegetation Studies," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Bul. 340, June 1946, W. C. Whitman and E. A. Helgeson.

"Gladiolus, Their Culture and Care in North Dakota," Ext. Serv., N. D. Agr. College, Fargo, N. D., Cir. A-92, Jan. 1946, H. A. Graves.

"The Ohio Corn Performance Tests: 1943 and 1944," Dept. of Agron., Agr. Exp. Sta., Wooster, Ohio, Sp. Cir. 71, Feb. 1946, G. H. Stringfield, R. D. Lewis, and H. L. Pfaff.

Science for the Farmer, 59th Annual Report," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 480, July 1946.

"Pepper Variety and Strain Trials—1946," Agr. Exp. Sta., Pa. State College, State College, Pa., Paper 1335, Dec. 18, 1946, M. L. Odland.

"Sweet Corn Variety and Strain Trials—1946," Agr. Exp. Sta., Pa. State College, State College, Pa., Paper 1340, Oct. 1, 1946, M. L. Odland and C. J. Noll.

"Pea Variety and Strain Trials, 1946," Agr. Exp. Sta., Pa. State College, State College, Pa., Paper 1343, Oct. 23, 1946, R. E. Larson.

"Trials of Annual Flowers, 1946," Agr. Exp. Sta., Pa. State College, State College, Pa., Paper 1347, Nov. 15, 1946, E. I. Wilde and John R. Culbert.

"Tomato Variety and Strain Trials, 1946," Agr. Exp. Sta., Pa. State College, State College, Pa., Paper 1351, Dec. 9, 1946, M. L. Odland.

"Lima Bean Variety and Strain Trials—1946," Agr. Exp. Sta., Pa. State College, State College, Pa., Paper 1354, Dec. 13, 1946, M. L. Odland.

"Rutabaga Variety and Strain Trials—1946," Agr. Exp. Sta., Pa. State College, State College, Pa., Paper 1356, Dec. 17, 1946, C. J. Noll and M. L. Odland

"Sweet Potato Production Possibilities in South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 364, April 1946, M. J. Peterson, G. H. Aull, E. W. Knobel, and J. C. Downing.

"The Cotton Contest—1944," Clemson Agr. College, Clemson, S. C., Cir. 267, Feb. 1945, H. G. Boylston.

"Small Grains in South Carolina," Clemson Agr. College, Clemson, S. C., Cir. 292, Oct. 1946, H. A. Woodle and W. H. Craven.

"Early Planted Treated Seed Produces Higher Sorghum Yields," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Bul. 381, April 1946, W. F. Buchholtz.

"Alfalfa Strains for Middle Tennessee," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Cir. 94, Aug. 1946, J. B. Washko and J. A. Ewing.

"Panorama of Agricultural Research, Texas, 58th Annual Report, 1945," Agr. Exp. Sta., Texas A & M, College Station, Texas, C. H. McDowell.

"Vetch Improves Soil Fertility in East Texas," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1024, Aug. 8, 1946, E. B. Reynolds and J. C. Smith.

"Austin Wheat," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1027, Aug. 23, 1946, I. M. Atkins and E. S. McFadden.

"Factors Influencing Cotton Harvesting Methods on the High Plains," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1029, Aug. 27, 1946, D. L. Jones and H. D. Lynn.

"Grasses for Greater Production in Wash-

ington," Ext. Serv., State College of Wash., Pullman, Wash., Cir. 81 (Rev.), Sept. 1946.

"Clovers for Greater Production in Washington," Ext. Serv., State College of Wash., Pullman, Wash., Cir. 83 (Rev.), Sept. 1946.

"Grasses for Greater Production in Washington: Seeding Grasses and Legumes," Ext. Serv., State College of Wash., Pullman, Wash., Cir. 104, Sept. 1946.

"Data on Weather from 1924 to 1945 at the Irrigation Branch Experiment Station, Near Prosser, Washington," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. 473, April 1946, C. Emil Nelson.

"The Fruit Orchard in Wyoming," Agr. Ext. Serv., Univ. of Wyoming, Laramie, Wyo., Cir. 58 (Rev.), March 1945, W. O. Edmondson.

"Report of Cooperative Extension Work in Agriculture and Home Economics, 1946," Ext. Serv., U.S.D.A., Washington, D. C., Oct. 15, 1946.

Economics

"Land Tenure in Arkansas: IV. Further Changes in Labor Used on Cotton Farms, 1939-44," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 459, Aug. 1945, O. T. Osgood and J. W. White.

"Twenty-first Annual Report of the Farm Bureau Farm Management Service, 1945," Dept. of Agr. Econ., Univ. of Ill., Urbana, Ill., AE-2389, May 1946, M. L. Mosher and F. J. Reiss.

"Complete Costs and Farm Business Analysis on 24 Farms in Champaign and Piatt Counties, Illinois, 1945," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., AE-2410, Aug. 1946, R. H. Wilcox, J. R. Harris and A. C. Ruwe.

"An Economic Study of the History, Status and Operation of Agricultural Cooperatives in Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Bul. 518, 1946, T. L. Canada and E. H. Matzen.

"Costs, Returns, and Practices in Producing Tobacco in Jefferson County, Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., S.B. 519, 1946, F. V. Smith.

"Suggested Adjustments in Kansas Agriculture for 1947," Kans. Agr. Exp. Sta., Manhattan, Kans., Agr. Econ. Rpt. 30, Aug. 1946.

"Problems Pertaining to Farm Real Estate Assessment as Reported by County Assessing Officers," Kans. Agr. Exp. Sta., Manhattan, Kans., Agr. Econ. Rpt. 31, Oct. 1946, N. J. Anderson, Harold Howe, and W. H. Pine.

"The Operators' Cost of Producing Some Field Crops in Central Missouri," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Res. Bul. 399, March 1946, B. H. Frame.

"Some Effects of the War on Rural Life in Missouri, 1939-1945," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Res. Bul. 401, April 1946, Gerard Schultz.

"Looking Ahead With Montana Farmers and Ranchers," Ext. Serv., Montana State College, Bozeman, Mont., Cir. 170, July 1946, H. R. Stucky and H. G. Halcrow.

"Looking Ahead With Montana Farmers and Ranchers, Farm and Home Topics," Ext. Serv., Mont. State College, Bozeman, Mont., Cir. 171, Oct. 1946, H. R. Stucky and H. G. Halcrow.

"Wartime and Peacetime Farming in South Carolina, 1945," Clemson Agr. College, Clemson, S. C.

"The Utah Price Situation," Utah Agr. Exp. Sta., Logan, Utah, Mimeo. 330, Sept. 29, 1946, W. P. Thomas

"The 1947 Agricultural Conservation Program for: WR 47-1, Ariz.; WR 47-1, Calif.; WR 47-1, Colo.; WR 47-1, Idaho; WR 47-1, Kans.; NER-1110-Mass.; WR 47-1, Mont.; WR 47-1, Nev.; NER-1110, N. H.; NER-1110, N. J.; New Mexico; WR 47-1, N. D.; NER-1110, Pa.; NER-1110, R. I.; WR 47-1, Utah; NER-1110, Vt.; WR 47-1, Wash.; WR 47-1, Wyo.," U.S.D.A., Washington, D. C.

"The 1947 Handbook of Conservation Practices for: ECR-1101, Del.; ECR-1101, Md.; ECR-1101, N. C.; ECR-1101, Tenn.; ECR-1101, Va.: ECR-1101, W. Va.," U.S.D.A., Washington, D. C.

"Purchasing Hybrid Seed Corn Cooperatively," Farm Credit Admin., U.S.D.A., Washington, D. C., Misc. Rpt. 100, Aug. 1946, T. E. Hall.

"World Rice Production and Trade," Office of Foreign Agr. Relations, U.S.D.A., Washington, D. C., Foreign Agr. Rpt. 15, Oct. 1946, F. J. Rossiter, L. Thelma Willahan, and W. E. Cummings.

"Agricultural Outlook Charts," U.S.D.A., Washington, D. C., Book 1, Oct. 1946.

"Citrus: Estimates of Production and Utilization, 1943-44 to 1945-46," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Oct. 1946.

"United States Tariff Rates on Agricultural Products (Rev.)," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Aug. 1946, C. F. Wells.

LAST CHANCE

They had searched in vain for a hotel room. "Well, mother," he said, "I guess we'll have to sleep in one of those night clubs, even if they do charge $5 for covers."

Johnny: Pa, is it wrong to say cofferdam?

Pa: No, my son. Why?

Johnny: Well, the other day our old cow got choked on a turnip and I thought she'd cofferdam head off.

Fifty-One Bushels Difference

As much as 51 bushels of corn per acre are lost each year by the farmer who uses inadequate fertilizer and checks his corn on rolling land. The principal thief is the runoff from the watershed carrying soil and fertilizing elements.

A study of these losses from runoff and the influence of conservation practices is being made by the Purdue University Agricultural Experiment Station and Soil Conservation Research Division at the Throckmorton farm, south of Lafayette.

In 1945, corn watersheds that were contour-cultivated and had 900 pounds of 8-8-8 and six tons of manure plowed under yielded more than during any of the three previous years, indicating that the beneficial results as measured by crop yields accumulate. The corn yield from the contoured field was 122 bushels while the yield from the adjacent watershed was 71 bushels or a difference of 51 bushels. The comparative yields in 1942, the first year that conservation farming methods were used on the one field, were 92 and 67 bushels respectively in favor of the conservation methods.

The story of the disappearing crops is told in figures giving the amount of soil washed away on the comparative fields. Last year the total of solids lost from two watersheds in corn check-seeded and fertilized with 150 pounds of 0-14-7 per acre was three and one-half tons per acre.

Nitrogen losses were likewise more than six times as great on the untreated as on treated watersheds. This explains in part the lower yields, as crop yields are often limited by the lack of nitrogen during critical growing periods.

Mechanized Farms Expand

In farm mechanization there has been the double problem of fitting the machine to the farm and of fitting the farm to the machine. Some farm machines have been getting smaller. For example, many modern combines are midgets compared with the early horse-drawn combines built for the "bonanza" wheat farmers. In general, however, U. S. farms are growing in size to fit the machines, Elco Greenshields of the Bureau of Agricultural Economics says in an article, "Farms Are Getting Larger and Fewer," in *The Agricultural Situation.*

On farms still operated by a family —a father or a father-and-son combination—mechanization favors a larger farm because the same work force can care for more acres. Also, if mechanized labor saving is to be economical, the machine must be kept working enough to pay its way. The family-sized farm, also, is forced into competition with the farms of larger acreage which mechanization has made possible as commercial ventures. Such information helps account for some of the following highlight facts from this article.

"The average farm for the country as a whole is now 50 acres larger than 25 years ago, 20 acres larger than five years ago. In the Midwest, where extreme sizes are less numerous, the average farm has increased about 30 acres in 25 years."

"Today, over half of the farm land in the country is in farms of over 500 acres, compared to only a third in 1920. And farms over 1,000 acres now account for 40 per cent of the farm land compared with less than a fourth 25 years ago.

The number of 100-acre to 180-acre farms decreased by over 110,000 during the war.

"The census would show an even more pronounced trend toward larger farms if the very small units—those under 10 acres and for the most part not much more than rural residences for city workers—were not included in the total. The number of those so-called farms has increased over 300,000 since World War I, nearly 90,000 in the past five years."

Large Grasses for Pasture

(*From page* 14)

hay crops. Orchard grass is reputed to be better adapted to infertile soils than timothy. Since the fertility in our plots has been equal, we cannot judge as to this factor. We do know it is very compatible with ladino and resists incursions of volunteer grasses better than brome and much better than rye grass. It makes as much growth in the heat of summer as smooth brome and more than timothy. It should not be seeded on wet, cold soils since it will be ready to graze or may even be headed out before the land is ready for the trampling of the animals. If it does "head out," the seed will spread and infest other nearby areas. The biggest weakness of orchard grass is that it can be overgrazed in late fall to the point of killing out. It appears to be necessary for it to go into the winter with some growth which is indicative of root reserves. On the other hand, fairly close grazing early and until September first is desirable, with management, of course.

Reed Canary grass has long been recognized as being very well adapted to wet land. In our trials, it has been seeded on well-drained soils, where it has proved to be both hardy and drought-resistant. It lacks palatability, however, and unless closely grazed competes too much with ladino. Like orchard grass, reed canary resists the incursion of other grasses. Our impression of reed canary in these trials has been that it looks better than it really is and that a clipping or harvest as we make it does not bulk up or weigh up as it does on a similar growth with the other grasses. Its use should probably still be confined to wetter areas which may be too wet for ladino and other clovers, but where it will undoubtedly do better than its mates in these trials.

Perennial rye grass has proved to be the least hardy of any of these grasses and has been too quickly supplanted by Kentucky blue and bent grass in our tests. Perhaps new varieties will be developed to overcome this fault. Until they are, we would favor seeding this grass in a complex mixture with other grasses rather than singly with clovers. The grass is palatable and ladino appears to do well with it. It has long been the chief pasture grass of northern Europe and the British Isles where it is very highly regarded. Measured by our yardsticks, it does not rank as high as its virtues abroad would appear to indicate.

Tall Fescue has maintained itself somewhat better than the other grasses in this test. Part of this may be due to its lack of palatability, part to its decumbent habit of growth. This habit causes the leaves at the crowns of the plants to lie flat on the ground and for that reason they are difficult for the animals to browse closely. It is the best yielder of all these grasses in late fall and apparently this factor coupled with its resistance to grazing allows it to persist. Ranking below orchard grass and reed canary in palatability, probably because of the harshness of the foliage, it isn't likely that tall fescue will achieve the importance that its persistence and yielding ability would deserve. These virtues speak well for its inclusion in conservation programs in which the emphasis is placed upon soil cover rather than palatability and grazing value.

Yields Tell the Story

(*From page* 26)

southern county are growing crimson clover, lespedeza, velvet beans, soybeans, cowpeas, and rye for grazing, soil improvement, hay, and seed. They are planting corn, grain, and hegari to feed livestock and provide food for the family. They are producing wheat for feed and home use. They are seeding five to seven bushels of small grain and legume mixture per acre for fall and winter temporary grazing. County Agent Shores urges heavy fertilization of corn and advises larger acreage of hybrid corn which brought excellent yields in 1944 and 1945. The Farmers Bank of Monroe sponsors annually a five-acre corn contest.

Soil erosion control, as point number ten, is well established in the county. This has been accomplished through terracing, use of sericea and kudzu, definite plans of crop rotation, reforestation, and sericea border strips around fields and woods.

Without sufficient acreage in permanent pasture (point number eleven), the tremendous increase in livestock income would have been difficult. Mowing of pastures at least three times a year to control weeds is advised.

Point number twelve in Walton's dozen-barreled farm planning is one that the rest of Georgia and the nation are watching closely. It concerns health. Walton was one of six counties in the United States elected by the Inter-Bureau Committee on Postwar Program of the U. S. Department of Agriculture in 1942 to conduct an experimental rural health program. Last year 673 families received medical care through this health association which is non-profit and designed to administer medical care at low cost.

Sums up County Agent Shores, with Home Agent Miss Holbrook in agreement: "Progress made by the farm people in the development of their farms and homes and in the development of cash crops since 1938 clearly indicates that Walton farm families are following the agricultural program recommended by their Program Planning Committee."

And as Editor Camp observes in his weekly newspaper: "The boy on many a farm will not be content with the livelihood provided by cotton yields of 250 pounds or corn crops of 10 bushels to the acre."

Walton County, however, is keeping most of its farm boys at home by growing more commodities on fewer acres—a situation that is providing land for so many uses: crop rotation, soil conservation practices, permanent pasture, reforestation, and others that will add to the ultimate income. You don't have to ask Walton County farmers if a planned agricultural program pays. They've already proven it.

It ain't the school Mary hates, it's the principal of the thing.

A perfect gentleman makes every other man in the room uneasy.

Time is the greatest healer, but he's certainly no beauty specialist.

Fertilizers and Human Health

(*From page* 18)

bon, the key element in organic matter, was in the atmosphere as carbon dioxide. In due time primitive forms of life came into existence. Only through these, and the higher forms of plant life that evolved from them, was the inorganic carbon of the atmosphere combined with water, air, and soil to form organic matter. Animals made use of the organic matter that had been manufactured by plants but they did not construct organic matter from its primary constituents.

The validity of Liebig's concept has been verified in many plant physiology greenhouses. Luxuriantly perfect crop plants are being widely grown to full fruit production on mineral salts dissolved in distilled water. Soil-less plant culture is now being practiced on a large scale for commercial purposes. It consists in dissolving the necessary chemicals in water and allowing this water to flow through beds of sand, gravel, cinders, or other similar inorganic materials that provide standing room for the plants while they are being fed. The beds contain no humus and no earthworms. Plants grown in this manner are equal in size and appearance to those in the field. Selected seed produced by these plants yield identical plants generation after generation.

Fertilizers Designed From Plant Ash

Analyses of plant ash were the starting point in finding out how to formulate the fertilizers required to replace the elements consumed by plants. It is conceivable that animals need a larger number of elements than is contained in fertilizers. Two schools of thought exist as to what should be done about minor-element deficiencies in food and feed. One group insists that these extra elements be added to the soil so they can be built up into plant tissue and thus, hopefully, become more useful to animals and man. The others believe that the need for extra mineral elements can best be met by adding traces of them to common salt. It is now standard practice to add iodine to salt as a preventive for goiter. In some areas livestock are being fed cobalt sulfate as a cure for anemia. Manganese sulfate is being used as a remedy for slipped tendons in poultry. Large amounts of limestone and phosphate are fed to milk cows to insure adequate bone development.

Organic Matter Has Real Value in Soil

Although one can grow perfect plants in the complete absence of organic matter this does not argue against encouraging greater attention to soil organic matter in agricultural practice. What is being aimed at is to separate facts from fancies so that intelligent consideration can be given to the perplexing problems with which the soil conservationist has to deal.

It is now generally agreed that organic matter has value in the soil because:

1. It aids in the control of soil erosion by wind and water, whether in the form of growing roots, the crude residues of plants, or as humus.

2. It serves as food for various types of desirable soil microorganisms, including the non-symbiotic types that fix atmospheric nitrogen.

3. It contains major and minor mineral elements that were left behind in plant residues and can be reused by the crop that follows.

4. It improves the physical qualities of both light and heavy soils.

5. It aids, in mulch form, in preventing loss of water by evaporation and in the regulation of soil temperature.

Many other more or less obscure values can be assigned to soil organic matter, not excluding the possibility of its release of plant-stimulating hormones during decay or of their production by the soil microorganisms that bring this about. It is at this point that the scientist sees "through a glass darkly" but tremendous possibilities exist for the untrammeled imagination of the charlatan.

Organic Matter Grown with Inorganic Fertilizers

It has been repeatedly demonstrated that one of the most effective means of adding organic matter to the soil is by the intelligent use of purely inorganic fertilizers. In an experiment at the West Virginia Agricultural Experiment Station * it was shown that five tons of fertilizer per acre over a period of 15 years not only multiplied the yield by three but increased the soil's organic matter 50 per cent.

Some 30 years ago the Director of the Ohio Agricultural Experiment Station pointed out that the second highest authenticated long-continued yield of wheat ever produced was 33.5 bushels per acre. This was the 74-year average for the annually-manured, continuous-wheat plot on the Rothamsted Experiment Station Farm in England. But a plot alongside that had never received anything but chemical fertilizers during this same period averaged one bushel more.

Fertilizers Stay the Hand of Famine

The essential plant-food elements are in continuous circulation from air to plant to air and from soil to plant to soil, sometimes by way of the animal and sometimes not. During this process a part is lost to the sea by way of drainage and sewage waters. Agriculture speeds up the rate of circulation of the elements and, in so doing, speeds up the rate of loss of elements to the sea. The lime and fertilizer industries fulfill highly essential functions in restoring these losses by bringing the essential elements back from ancient seas. They also aid the plant in recapturing the nitrogen that escaped back to the air. A limited population may get along fairly well without these industries, a larger population may continue to exist, but an ever-growing and thriving population such as we enjoy in the United States must have their help. Millions of people die from starvation every year in the Orient where practically no fertilizers are used, and many more millions go to bed hungry every night of the year.

No Cure for Old Age in Man

Man has been subjected to many hazards in the evolutionary process. Many of these hazards still remain to be dealt with. Marett* concluded that the first man originated in an area of iodine deficiency as a result of which he lost the hair of his simian ancestors. Metchnikoff ** thought many of man's ills grew out of the toxins that developed in his large intestine, an obsolete organ that failed to evolve as rapidly as man himself. Many other highly intelligent scientists have devoted their lives to one or another phase of this problem. Cowdry *** assembled a 936-page volume that dealt with all the known facts about the aging of man, but he could not put his finger on a primary cause.

It is believed that the field of nutrition offers the most promising line of attack in extending the lifespan of man. As previously pointed out, a deficiency of one or more of the minor elements or a lack of balance in those of the major group of fertilizer elements may be responsible for part of his troubles. But few of the people of the United States eat the produce of just one soil. Such rapid advances have been made in

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* Residual Effects of Fertilizers, West Virginia Agr. Exp. Sta. Bul. 160, 1916.

* Race, Sex, and Environment. The Chemical Publishing Company, Brooklyn, 1936.

** The Prolongation of Life. G. T. Putnam and Sons, New York, 1910.

*** Problems of Aging. Williams and Wilkins Company, Baltimore, 1942.

methods of transportation that most of us are now the product of the soils of the whole earth. Any lack in the produce of one could conceivably be made up by an abundance in the produce of some of the others.

No doubt there is some connection between fertilizers and human health, and the fertilizer industry would do well to finance an extensive research program to study this problem. A one-sided fertilizer program could lead to human disaster, just as an up-and-down-hill plowing program with a tractor would lead to land ruin. But just as the tractor is a powerful weapon for good when employed to construct terraces on the contour, so fertilizer, when rightly used, permits of working wonders with the soil, not only in terms of the quantity but also of the quality of the crop that is produced.

It seems probable that what appears to be an increasing tendency toward degenerative diseases in this country is merely an outgrowth of the great improvement in the control of the diseases of youth. In proportion as more of the youth survive, more people live to be 60 or 70 and a larger number are caught by the diseases of these older ages. But whether at 5, 50, or 150, men die, if not from one cause then from another. Death may be delayed but, in so far as is now known, it is inevitable.

Research Points the Way...in North Carolina

(*From page* 10)

was increased from 42 bushels with no phosphate to 57 bushels where 40 pounds of P_2O_5 per acre were applied. No yield increase was obtained from higher phosphate applications.

Early vegetative responses to phosphate application were also found in Coastal Plain soils which contained as much as 58 p.p.m. of soluble phosphorus. However, yields were not increased by phosphate fertilization. Adequate nitrogen and potash applications were used in phosphate comparisons.

Nutrient Balance Important

The need for nutrient balance was shown clearly in the experiment on the Dunbar soil. There was a striking yield response to nitrogen at the high potash level and no response to nitrogen when no potash was applied. Likewise, there was a marked yield response to potash at the high and intermediate nitrogen levels, but no response to potash when 0 or 20 pounds of nitrogen per acre were applied.

Winter Legumes Furnish Nitrogen

Figure 4 shows the effect of a good growth of Austrian winter peas on corn yields with and without additional nitrogen. The yield increase from winter legumes in plots where no additional nitrogen had been added was about 40 bushels per acre. At turning time there was a solid cover of Austrian winter peas about one foot high which amounted to 2,100 pounds per acre of air-dry top growth which contained about 56 pounds of nitrogen per acre. The corn yield increase from this legume growth was about the same as that obtained from 60 pounds of chemical nitrogen per acre.

In the plots where 60 pounds of nitrogen were applied in addition to that furnished by the winter legume, an additional 20-bushel-per-acre increase was obtained. These data indicate that

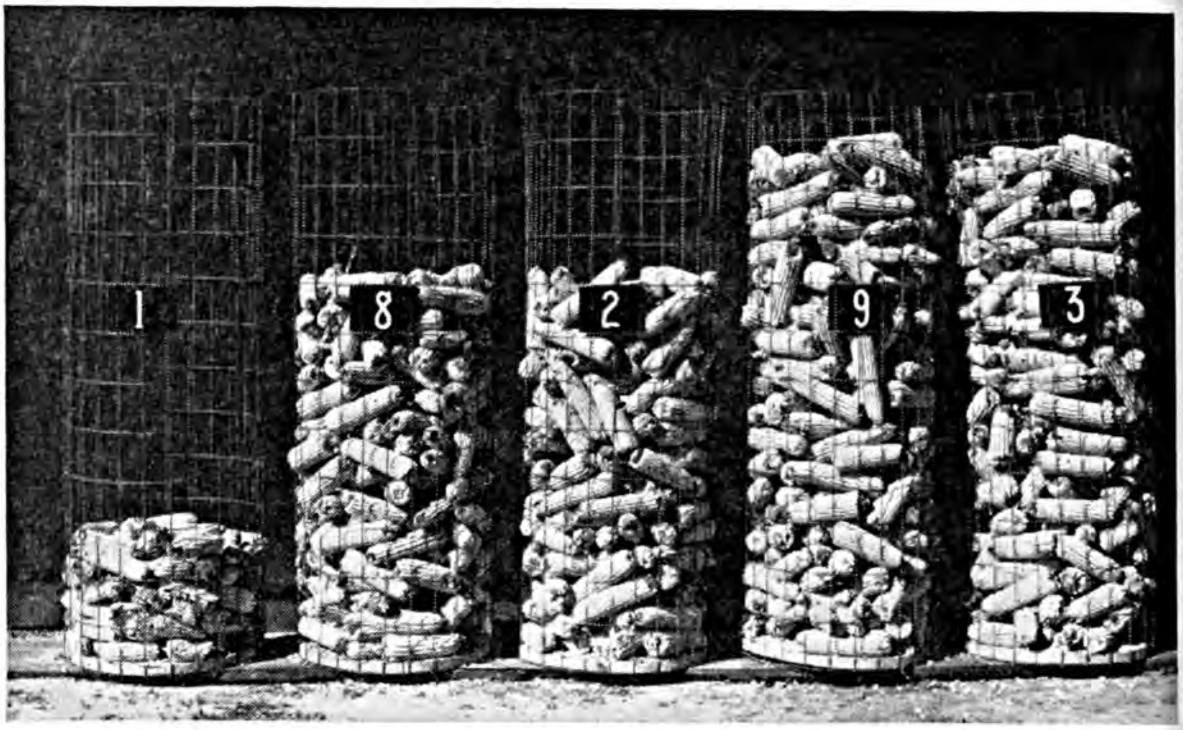


Fig. 4. Corn taken from plots receiving 0, 0 plus Austrian winter peas, 60, 60 plus Austrian winter peas, and 120 lbs. nitrogen per acre on a Norfolk fine sandy loam, C. H. Parker farm, Johnston County. The yields were 17, 58, 59, 79, and 78 bushels per acre, respectively.

winter legumes furnish a substantial quantity of nitrogen for corn production but that supplemental nitrogen is necessary to produce maximum yields.

Nitrogen Boosts Protein in Grain

Nitrogen applications had marked influence on the protein content of the corn grain in all 25 of the experiments conducted in 1944 and 1945. The magnitude of increase in protein was usually the greatest where the yield response to nitrogen was lowest and vice versa. This relationship is shown in

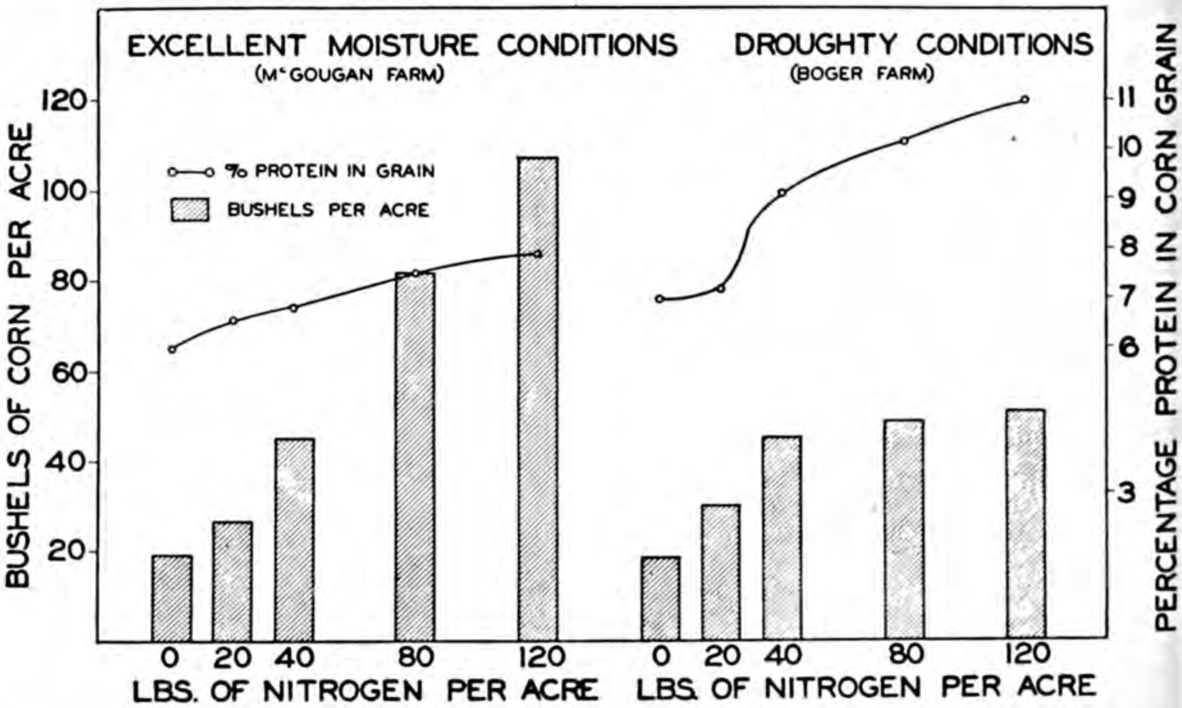


Fig. 5. The effect of nitrogen application upon corn yields and percentage protein in the grain under excellent moisture conditions at the J. M. McGougan farm, Hoke County, and under conditions of a June-August drought at the M. G. Boger farm, Davie County, in 1944.

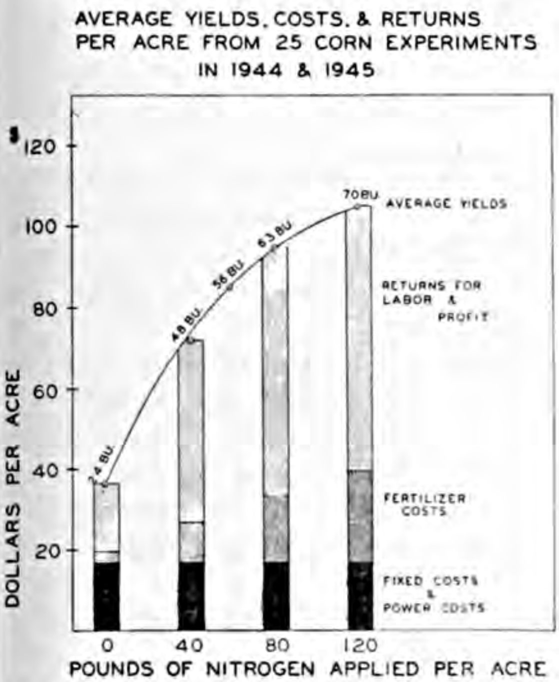


Fig. 6. Returns in dollars from average yields of 25 corn experiments. Values are figured at 1944 and 1945 prices (corn $1.50 per bushel, labor 30¢, mule power 22¢ per hour). Fertilizer cost includes cost of nitrogen applied plus cost of one and one-half times the phosphoric acid and one and three-fourths times the potash removed by the corn yields. (Corn prices, fixed costs, and labor cost figures were obtained from Agricultural Economics Department). Power, labor, and equipment costs are all based on mule operation and hand harvesting. These costs have been found to be considerably less on mechanized farms.

figure 5. Under the excellent moisture condition the yield response to nitrogen was exceptional and the increase in protein percentage was relatively low. However, under the droughty condition yields were increased only 31 bushels. Further yield increases were limited by a lack of moisture, but the protein content continued to increase. In the Edgecombe County experiment (figure 2) there was no yield response beyond the 120-pound nitrogen application. However, the protein percentage was substantially increased by an additional 40-pound nitrogen application. Leaf disease which occurred at the late roasting-ear stage destroyed much of the leaf tissue and apparently retarded further carbohydrate manufacture, while nitrogen uptake and protein synthesis continued.

The nitrogen content of corn grain varied from a low of 0.92 per cent to a high of 1.99 per cent, or an approximate range or 5.8 per cent to 12.5 per cent protein. Although corn is not sold for its protein content, it does seem that it should receive some consideration. Certainly substantial amounts of high-priced protein concentrates could be saved when hogs or poultry are fed corn containing 11 to 12 per cent protein as compared to corn with 6 to 7 per cent protein.

Costs and Profits

The average corn yields, the fixed costs, fertilizer costs, and returns for labor and profit obtained in the 25 experiments conducted in 1944 and 1945 are shown in figure 6. Since fixed costs and power costs per acre are almost constant, the data indicate that the greatest potentiality for profits in corn production came with adequate fertilization and high-per-acre yields. Thus with a moderate investment in fertilizer the farmer can produce his feed requirement on fewer acres and with less labor and greater profit.

Summary

The development of adapted corn hybrids through breeding research combined with the research findings on corn fertilization and culture offers an opportunity for the North Carolina farmer to greatly increase his corn yields. It should be emphasized that the farmer should use close spacing and avoid deep or late cultivation of his corn if he is to make most effective use of the yield potentiality of his improved soil fertility and adapted corn hybrids.

Salesgirl: "Yes, Mrs. Jones, our girdles come in four fixed sizes—small, medium, wow, and holy mackerel!"

Real intelligence is like a river—the deeper it is the less noise it makes.

Potash Pays for Peas at Chehalis, Washington

(*From page* 24)

leaves and stipules from the two areas, the samples from the Chehalis area averaging around one per cent while the average from the Puyallup area was over two per cent. In order to check the data more closely pea samples were taken from experimental pea plots in both areas in 1945 and separated into leaves, stipules, petioles, and stems. Table 6 shows the percentage potash in the various plant parts sampled at the full bloom stage.

The potassium analyses of both years (1944 and 1945) check quite closely and show a close correlation with the yield data presented earlier in this paper.

Since these preliminary studies showed some promise of indicating the nutrient status of the various soil types in Western Washington by using the pea plant as an absorbing medium, an elaborate study was undertaken in 1946. The data will be reported in another paper.

A brief summary of the pertinent data is listed below:

(1) The best time for a single sampling appears to be approximately two weeks before full bloom. If two samples are to be obtained the best times appear to be two weeks before blossoming begins and when the plants are in full bloom.

(2) Results to date indicate that the stems or the petioles are satisfactory plant parts for analysis. These plant parts are illustrated in figures 1 and 2. The leaves are also indicative of the nutrient status of the soil as has been shown, but they do not have the wide ranges of potash content present in the petioles and stems. In addition, further unpublished data seem to indicate that the petiole and stems are the best plant parts to sample for available phosphorus, thus enabling a single plant part to serve for both analyses.

It is hoped to undertake a survey of all the pea-growing areas in Western Washington in 1947 to ascertain the levels of phosphorus and potash by these methods. After the areas have been surveyed, field plot studies will be carried out in the various deficient areas to determine fertilizer requirements.

TABLE 5: POTASSIUM CONTENT OF LEAVES AND STIPULES FROM RANDOM PLANT SAMPLES TAKEN IN THE PUYALLUP AREA IN 1941.

Grower	Stage of plant growth	Per cent K	
		Leaves	Stipules
Experiment Station	Blossoms	1.90	1.91
Experiment Station	Pods ¼ formed	1.94	2.06
Experiment Station	Pods ¼ formed	2.02	2.10
Experiment Station	Pods ¼ formed	2.02	2.02
Experiment Station	Pods ¼ formed	2.07	2.07
Experiment Station	Blossoms	2.21	2.29
Experiment Station	Blossoms	2.41	2.53
Experiment Station	Blossoms	2.50	2.68
Experiment Station	Blossoms	2.53	2.66
Experiment Station	Blossoms	2.57	2.49
	Average	2.22	2.28

TABLE 6: POTASSIUM CONTENT OF LEAVES, STIPULES, PETIOLES, AND STEMS OF PEA PLANTS SAMPLED AT FULL BLOOM STAGE FROM THE PUYALLUP AND CHEHALIS AREAS IN 1945.

Fertilizer*	Puyallup—Sultan silt loam				Chehalis silty clay loam			
	Leaves	Stipules	Petioles	Stems	Leaves	Stipules	Petioles	Stems
0-20-20 (Rock)†	2.15	2.24	1.86	1.89	1.17	1.30	1.05	0.87
Check	2.33	2.40	1.83	1.83	0.73	0.82	0.54	0.58
5-20-0	2.09	2.33	1.68	1.73	0.90	0.90	0.57	0.64
5-20-20	2.20	2.46	1.87	1.77	1.05	1.17	0.87	0.79
0-20-20	2.12	1.99	1.70	1.80	1.13	1.35	1.08	0.87
0-20-0	2.32	2.32	1.62	1.71	0.87	0.90	0.54	0.60
Average	2.20	2.29	1.76	1.79	0.98	1.07	0.78	0.73

* Figures based on 300 lbs. 5-20-20 fertilizer.
† All phosphate supplied by rock phosphate.

Home Town of Heroes

(*From page* 5)

IT is reliably said by Alexandrians that Christ church was built and paid for with Oronoco tobacco, in which form of exchange the contractors were reimbursed. The first rector of this parish was also paid in tobacco, receiving 7,280 pounds of this leaf for his services plus 1,000 pounds extra to meet his living quarters.

In his diary, Washington records attending church mostly at nearby Pohick parish prior to the Revolution, and afterwards he and his family were generally in attendance at the Alexandria church. Here he bought a pew for 36 pounds, 10 shillings, noted on a fly leaf of his day book.

Frolic, sports, and serious business occupied the famous General upon his return to private life in 1783 after resigning his commission. From his diary comes this notation, October 10, 1786: "At Alexandria in company with Major Washington and Mr. Lear; went to see the Jockey club purse run, dined by invitation from the members of same, and returned home in the evening."

Shortly thereafter when the proposed constitution had been ratified by Virginia and New Hampshire, Alexandria citizens staged a big rally for general rejoicing. Describing the event in a letter to Charles Pinckney, Washington concluded with this observation: "The people of Alexandria in this meeting constituted the first company in America to gather in public to pour a libation to the prosperity of the ten states that had actually adopted the general national government. The day has been memorable. I have just returned from assisting at the entertainment."

Upon being formally notified of his election as president, he set out on a journey full of ovation all the way from Mt. Vernon to New York. First, however, he must pause enroute for a testimonial dinner in Alexandria with an address by Dennis Ramsay, the mayor. In closing the mayor exclaimed, "Farewell, go and make a noble people happy."

Only a few years were left for the General to enjoy the bucolic scenes and village frolics on his retirement from public life. On his last birthday he spent a few hours amid old friends in Alexandria and watched maneuvers by the Uniformed Corps and took in an elegant ball at Gadsby's Tavern later. He did no dancing himself, however, as he said his dancing days were over. The balcony where the musicians played that night and the woodwork trim in the ballroom were removed a few years ago and taken to the Metropolitan Museum in New York.

This hostelry on Royal Street, or part of it, was erected in 1752 and in 1793 the structure was bought by John Gadsby and wife, who made it a favorite spot for travelers and townsfolk. Many of the best public events in the General's career, from the Braddock campaign to his last review of the Independent Blues a month or so before his death, were at this Tavern. Not only were the military balls in honor of his birthday celebrated here, but even prior to the war of liberation many similar celebrations were staged here to honor the natal day of the British monarch. Admiral John Paul Jones was a frequent guest also, and amusing anecdotes are rife about some of his eccentric tricks and convivial jests.

ONE more noteworthy incident remains as a reminder of how much the General looked to the future. Old Alexandria Academy which is still a landmark and a spot for youthful games was built through private funds. In colonial times it was strictly a private school, except that General Washington managed to have it specified that one room in the building must be set aside for use as a public school room, and some say this was the very first such educational institution in America.

The quaint old town is full of noteworthy types of colonial architecture. Its doors and windows and some of its mantels are said to be masterpieces. It is not generally known that the Brothers Adam were among the pioneers of Alexandria. J. Adam was a noted silversmith while R. Adam was a cabinet maker and wood designer. His famous interior trim-work influenced American architecture and furniture design for many years and is prized today.

The town has been the home of countless famous people, partly because of its own charm and leisurely way of life, and partly owing to its nearness to the Nation's Capital. Two of the natives who reached fame were Charles Callahan, historian and Masonic leader, and Florence Crittenden Barrett —the lady who established a number of boarding homes for women and girls, known as the Florence Crittenden homes. Today numerous artists and writers reside there. Two well-known characters much in the public eye who claim this town as theirs are Judge Hugo Black of the Supreme Court and Archibald McLeish, former librarian of Congress.

Between the close of the War Between the States and World War I the town fell into somnolence and decline. It enjoyed a brief revival in the 1917-21 period and then drew back into its shell again. But since the Jap attack of 1941 thrust us again into conflict a rush of war work, army post services, and government residences resulted in a wave of increased activity. Today the town has a population of more than 75,000 and is a separate chartered entity with no "county" allegiances.

AS one looks across the broad Potomac river in its winding course past Alexandria, where it is a trifle over a mile in width, one is not apt to realize that this town once boasted the second most thriving shipping port and ship building yards in the country.

At the outbreak of the Revolution her shipyards and ship carpenters were asked to speed up their efforts to assist the Colony and her heroic General. In 1776, famous year of Independence, two galleys were built there, each manned with fourteen guns and a crew of ninety-six men. The building was supervised by an old friend and social associate of the General, none other than George Mason of Gunston Hall. With the feeble Government hard-pressed for funds and with its ragged soldiers in need of all the fighting spirit that Tom Paine could coax into them, it was finally necessary for some of the Alexandrian Scotchmen to dig into their own purses to foot the shipbuilding project. How that must have hurt them!

BY summer of 1781 the British flotilla sailed up the quiet river, stopping long enough to take on food and refreshments seized at Mt. Vernon itself. It seems that this insult was a bitter pill for the absent General. His distant cousin, Lund Washington, was caretaker. In a right smart reproving letter the General later told Lund what he thought of his behavior, saying that it was bad enough to yield to the enemy that way, but simply terrible and disgraceful for him to board their vessels and converse with them. "This communing with scoundrels may become a subject for animadversion," wrote the wrathy hero to his relative.

Meanwhile the doughty defenders of Alexandria relied too much for protection upon two twelve-pounders to be mounted on traveling carriages and moved into a place of safety if a superior force of navy crewmen attacked the town. Except for some raids by privateers and a few bold threats to sack and burn the town nothing eventful happened after all.

The *Gazette* files bore many woodcut engravings of full-masted schooners with full sail to windward as decorative headpieces for the current nautical news. They reported the arrival in 1783 of "The Hunter," built in the local yards for direct trade with Russia, arriving with a cargo of iron, cordage, and canvas. John Ladd announced the coming to port of "the Genera," loaded with plaster of paris, cordage, and smoked herring. Other vessels advertised to take freight or charter to all European waters and the ports of the Indies.

Other ports of entry besides Alexandria in those days were at Norfolk, Bermuda Hundred, Tappanhannock, Yorktown, and such ocean towns along the Virginia coastline. Captains and crews from Alexandria sailed with full cargoes of flour, bread, shingles, tar, slate, barrel staves, and tobacco. The port was a place of call for mariners needing repairs. Some remnants of this old-time glory remain along the steep streets which lead to the river, a few of the rough lanes being still paved with the cobblestones put there by interned Hessian prisoners of war.

Vicious struggles with smugglers who sneaked in cargoes of rum and other goods were noted in the news columns. The town appointed an official searcher whose duty it was to board and seize all vessels that violated the port regulations. It transpired that a few of the town worthies were themselves in league with the smugglers and after a series of shady events, fines were levied upon sundry offenders among the local gentry and a few of them were beaten bv the masked populace—a sort of repetition of the exploits of Paul Revere and his tea-party gang.

During the war with France, which was never officially declared, the Revenue Marine was organized. In one of the encounters with the enemy a local ship was lost. But later on in the War of 1812-14, the English fleet set siege to the town and after some Scotch deliberation, the mayor and his selectmen surrendered. Besides taking away some good craft of seaworthy quality, the enemy fined the town 16,000 barrels of flour, 1,000 hogsheads of tobacco, 150 bales of cotton, and lots of wine.

Twice since the early days faded to a memory have these old shipyards come to life again. Once during World War I, when Jones' Point echoed to the sounds of riveters and clash of steel, and recently with the erection of the Naval Torpedo Station for armament during World War II, have the traditions been revived to good purpose and without surrender.

AND so life proceeds amid a blend of hallowed memory and ancestor worship, sacred landmarks and venerated traditions, mingled with the zip and zest of modern youth and up-to-date contrivances—a most interesting place to visit and a hard place to forget.

Some of its sidewalks are not easy to navigate even in the sunlight, with big root waves thrust across them from adjacent ancient sycamores, and with the edges strewn with loose bricks escaped from their moorings. Some of the stores along the principal thoroughfare have all the mellowness attributed to their age and respectable history. It is pointed out without much chance to doubt it that there are at least sixty business houses between the river and the Washington Masonic Memorial on Shooter's Hill that were built before 1830. If you find a floor wobbly and uneven or a sill leaning crazily, better not shout too loud about it because that's part of the most treasured local color.

Those fortunate enough to have automobiles may find a wealth of teeming lore and scenic beauty within a few hours' drive inland. So all in all, we may toast Alexandria, home town of Washington, just as honestly and heartily as we revere his memory and his exploits. For both are worth it.

Someone had wired a government bureau asking whether hydrochloric acid could be used to clean a given type of boiler tube. The answer was: "Uncertainties of reactive processes make use of hydrochloric acid undesirable where alkalinity is involved."

The inquirer wrote back, thanking the bureau for the advice, saying that he would use hydrochloric acid. The bureau wired him: "Regrettable decision involves uncertainties. Hydrochloric will produce submuriate invalidating reactions."

Again the man wrote thanking them for their advice, saying that he was glad to know that hydrochloric acid was all right. This time the bureau wired in plain English:

"Hydrochloric acid," said the telegram, "will eat hell out of your tube."

A Negro, riding home on his mule, passed under an apple tree, so he stopped and reached up for a tasty apple on a high branch. Just as he did so, the mule started off, leaving Mose hanging perilously. Just then the owner of the orchard came along.

"What are you doing up there?" he demanded.

"Befo' de Lawd," said Mose, "Ah jes' fell off mah mule!"

* * *

A very small boy came home dejectedly from his first day at school. "Ain't goin' tomorra," he muttered. "And why not?" his mother asked. "Well, I can't read and I can't write and they won't let me talk, so what's the use."

* * *

Lecturer—"Of course you all know what the inside of a corpuscle looks like."

Chairman—"Most of us do, but you'd better explain for those that haven't been inside one."

* * *

He: "Do you know that I am something of a mindreader?"

She: "So? Well, why are you sitting at the other end of the davenport?"

* * *

Sailor (getting in barber chair)—"Cut all three short."

Barber—"Which three?"

Sailor—"Whiskers, hair, and chatter."

Visitor: "What a charming baby, and how it does resemble your husband."

Hostess: "Gracious, you alarm me; we adopted the baby."

* * *

A businesswoman entertaining some businessmen at luncheon in a French restaurant, and not wishing to be obvious about paying the check, whispered to her waiter when the meal was over, *"L'addition, s'il vous plaît."*

"Downstairs to your left, lady," he replied.

* * *

The sergeant was taking particulars from a new recruit.

"Are you married?"

"Yes, sir."

"Any children?"

"Yes, sir. Five girls and four boys."

"Nine altogether."

"No, sir. One at a time!"

* * *

Mabel: "So he says to me, 'You are very laconic.' "

Maybelle: "Gee, what does that mean?"

Mabel: "I dunno. But I give him one in the nose to be on the safe side!"

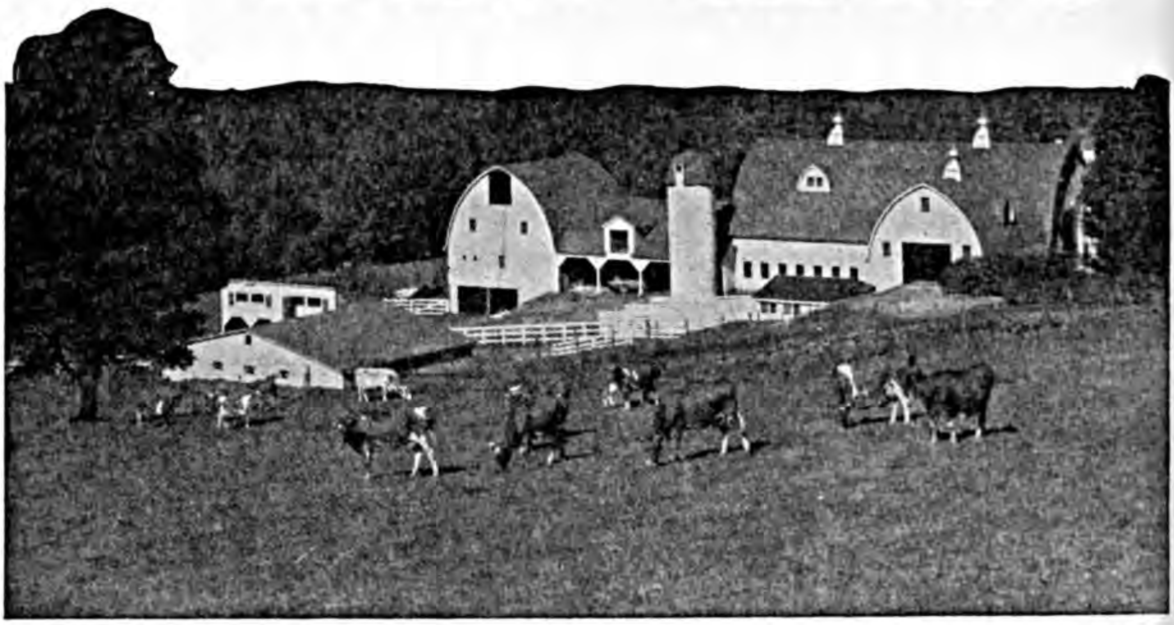
* * *

COULDN'T GIVE HER AWAY

Two Irishmen, one accompanied by his wife, met on the street.

Said Pat to Mike, "Let me present me woife to yez."

"No, thanks," replied Mike, "Oi got wan o' me own."



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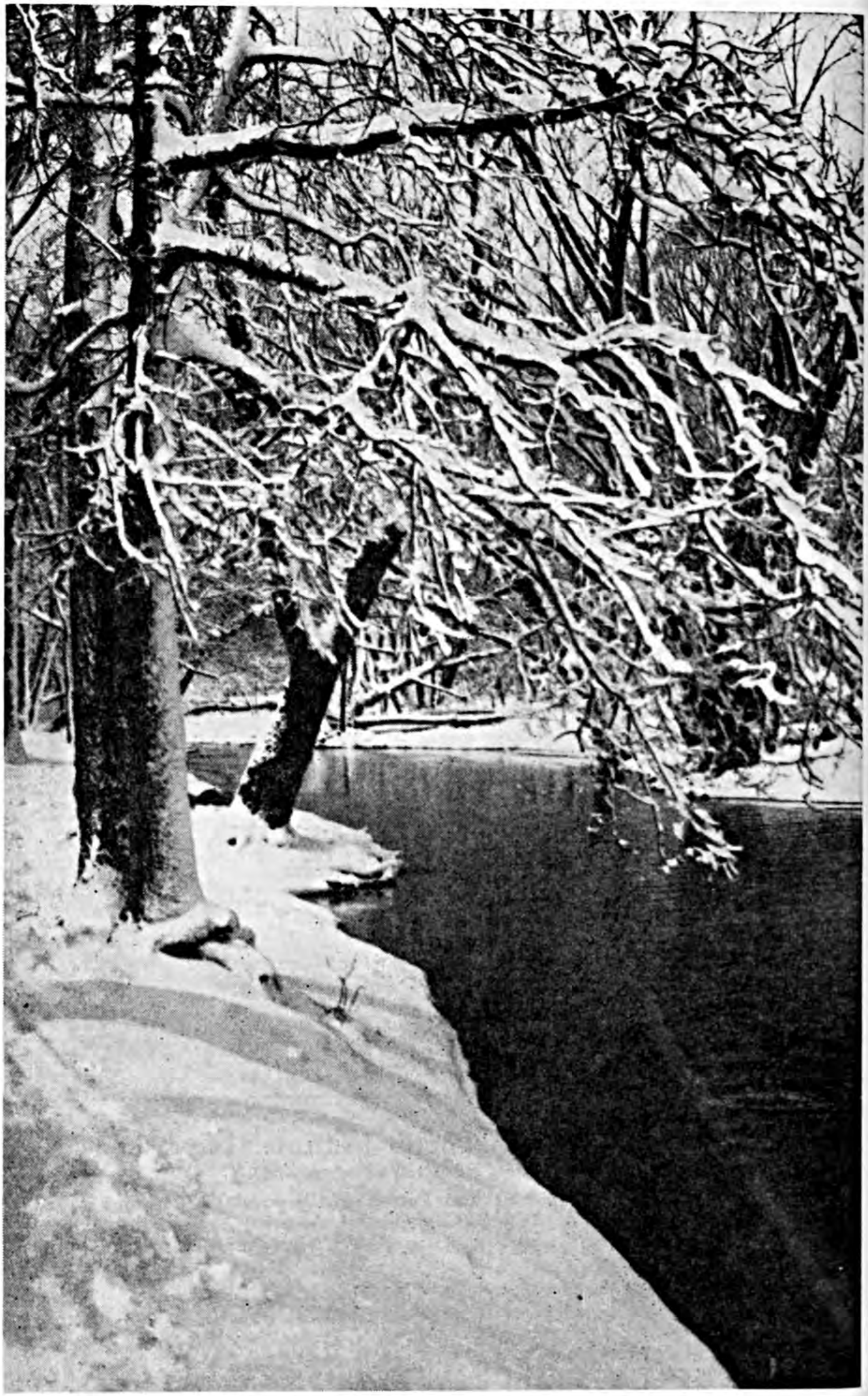

PRECEDING THE BREAK-UP

Better Crops with PLANT FOOD

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Vol. XXXI WASHINGTON, D. C., MARCH 1947 No. 3

Some Judicious . . .

Backtracking

Jeff McDermid

BEFORE trying to fag your brains in attempting to make a wise choice of a farm program to guarantee absolute and unconditional solvency to the ones who grow your grub, it might not be amiss to take a refresher in respect to the steps we took to get where we are and why.

Even though we've lived through all of these economic experiences and written, talked, and heard many things about them, one soon forgets the pains of childbirth or what the doctor cost us. Then, moreover, some of us knew the chief actors in the drama and either sent them flowers after each performance or lambasted them with eggs and cabbages.

Of late, there have been divers worthy feelers put out to test the prevailing spirit of the ruralite anent the particular brand of salvation and relief which he is least apt to snarl about or cast votes against. Little, if any, cognizance is taken meanwhile of the other folks who pay the ultimate bills or who are expected to eat up sundry surplus when the planners happen to guess wrong.

However, far be it from me to take sides in this scuffle or inject any unhappy similes or untoward references which could be interpreted as exhibiting bias or signs of a recalcitrant and reactionary mind. As a matter of fact, your scribe has done yeoman service at the business end of a Remington for three decades, nobly reporting the infinite zeal and unselfish loyalty of the "squash" bucklers who carried the fight from some obscure point in Iowa to the front pages of the Federal Register. All this, and heaven too, will be his reward!

Let us, therefore, be up and doing, scanning the pages of agrarian history. We begin beyond that plebeian time that we knew so well as kids. In our salad days, about the only forms of government aid on the docket were the sums openly or covertly handed out to old soldiers, big banks, and the railroads.

The banks and railroads had an easy time getting it out of Uncle Sam's wallet pocket, but the indigent veterans of Gettysburg and San Juan Hill had to hire talented galaxies of high-priced legal lights to pry loose some small change in partial remuneration for physical disability.

Then we took on another war in 1917 to bolster our crop of fresh heroes and give the farmers temporary prosperity. During two years of war in Europe we produced food in more abundance than ever before and by 1919 the Secretary of Agriculture acknowledged that the plow had saved civilization again. In much the same manner as today, the rural expectation was whetted to believe in a long period of heavy demand for the grain and livestock which this country could raise—with a few sour notes to mar the jubilant chorus.

THEN in the summer of 1920 agricultural prices began to waver and decline, slapping the war-bloated farmer into a coma just as he loaded up with produce to sell in exchange for mighty likely looking doodads in the mail-order catalogs. What was worse, the prices he had to fork over for factory and store goods stayed up close to the fever pitch of wartime. The farmer thought that a world with tight belts, after severe rationing, would treat him nicer than that. It looked like somebody was pulling shenanigans, and folks who had extended their credit pretty thin in town banks to cover the purchase price of more acreage called the situation indecent, only this was not the exact language used at all times.

This process whereby a yielding yeomanry banged up solid against the rock of rigid buying prices caused two things to happen—death of an old rural regime and birth of the farmers' partnership with government. Not right away quick, you understand, but with the protracted yet potent power commonly seen in the joyful fermentation of a mess of pot-likker.

FACED with old debts contracted under happier times and insulted daily at the market place by meager tithes for their toil, it is no wonder that those days between 1920 and 1924 were the boom era of the so-called farm propaganda organizations.

During the hectic 1920 campaign which put Harding in the front seat, the speeches made in the tall grass in support of price-fixing policies received no echo in Washington. Here the talk was mostly about getting higher tariff fences built, more loans to push foreign exports, more chances to get farmers into debt with easy money, and a frill or two of legal trimming for the newly born cooperatives.

By dint of considerable vocal force and election threats, the boys from back there finally induced the Congress to establish a fact-finding commission of agricultural inquiry, which reported late that season that the pitch-fork element had taken a shellacking. This was not exactly news out West, but it showed that the country was aware anyhow that part of the machinery was in need of grease. Their modest estimate that farmers had only 77 per cent of the buying power which their mazuma had pre-war probably justified clerical costs spent by the commission, but it saved nobody's skin. It is true that the commission ventured a few cautious recommendations, including giving co-ops a legal advantage if possible, a workable system of intermediate credit for farmers, reduced freight rates, higher rural life standards (if they could be found), and better roads to market. It closed with a pious adherence to the shelf-worn dictum that "interplay of economic forces and not legislative formulas must be sought for in restoring agricultural prosperity."

Applying the panaceas sketched by the conference, Congress extended the life of the War Finance Corporation

with a double-barreled objective—to finance more exports and to make loans to rehabilitate agriculture. The President signed a new and higher tariff rate schedule to "protect" our industry from foreign imports, which set the stage for further maladjustment and grief. Moreover, the first signs of a prolonged crusade were indicated by formation of the so-called "farm bloc" in the House and in the Senate.

Fortunately, there was at the time a new Secretary of Agriculture who had first-hand acquaintance with the plight of agriculture. Against the opinions of some other cabinet members, Secretary Henry C. Wallace talked President Harding into calling the first National Farm Conference, opened with his address reminding farmers that legislation can do little more than give them a chance to adopt more efficient methods and then organize to "help themselves." He little knew how prophetic his last phrase really was, or how efficient farm leaders would become in finding ways to "help themselves" to all that seemed desirable for a fair exchange balance.

This national forum met in Washington almost exactly 25 years ago. Secretary Wallace told them that agriculture was in a bad way, causing suffering and stagnation to the entire business and industrial structure. In true American fashion, the meeting set up a dozen different specialized committees with lengthy reports and recommendations.

While the reports as a whole echoed some of the new ideas then cropping up and revolving around the slogan of "equality for agriculture," they could not get away from old paths of approach to fancied prosperity. They favored higher tariffs, more credit to get rid of surplus in foreign trade, more farm credit, and price stability to be won through broader powers and privileged positions for the farmer cooperatives. But tucked away in some obscure corner of the report were suggestions for a system of crop insurance and requests for government guaranty of farm prices.

PERSONALLY, the writer saw nothing of the national conclave, but numerous side issues and hectic verbal battles came under his ken in the Midwest. It was about this time that Jim Howard tried to get a hearing in Washington and was told to "go home and slop the hogs." It was in this era that the Farm Bureau and the grain and livestock boys formed action committees with ambitious plans galore, and at one big assembly in Chicago we corn-belt scribes listened to the impassioned and lively oratory of Aaron Sapiro, who for a year or more became the Tom Paine of the embittered dairy and livestock crowd, with his shibboleth for taking the initiative through "organizing by commodities.' Only a few old-timers today ever heard of Aaron, who did not last long because he treated the wheel-horses of the farm phalanx with contempt and subjected their theories to open ridicule. The horny-handed wheat and hog bosses of

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Fig. 1. The mechanism employed in aerating the jars is illustrated above. A total of eight jars was connected in series and attached by rubber hose to the pump. A total of six such series was employed and each series was aerated two hours per day.

Sugar Beets Require Adequate Soil Aeration

By Floyd W. Smith and R. L. Cook [1]

Soil Science Department, Michigan State College, East Lansing, Michigan

OBSERVATIONS of growth exhibited by sugar beets in field fertility experiments have shown that a leguminous crop in the rotation preceding this crop is less beneficial if unfavable soil tilth and moisture conditions exist at planting time or shortly thereafter. Actual plot yields have verified these observations.

The effects of poor soil aeration on the growth of several crops have recently been reported by several investigators. Hoffer (3) attributes the failure of corn, on certain Indiana soils, to respond to fertilizer treatments to the lack of sufficient soil aeration. Lawton (4) noted that lack of aeration reduced the total absorption of certain nutrient elements by the corn plants on Iowa soils. Farnsworth (1) has noted significant increases in the growth of sugar beets when the non-capillary porosity of a soil was maintained at a level of six per cent or above and has suggested that aeration of the soil is likely to become a limiting factor in sugar beet growth if the air capacity of a soil is below nine per cent.

An investigation to study the effects

[1] The senior author is now Assistant Professor of Soils, Kansas State College, Manhattan, Kansas.

of soil aeration on the growth and yield of sugar beets in pot cultures was recently conducted by the Michigan Agricultural Experiment Station (6). The soil used in this greenhouse experiment was a Brookston clay loam similar to that on which certain adverse effects due to poor soil tilth had been observed in the field. Inasmuch as alfalfa and sweet clover are the two leguminous crops frequently produced immediately prior to the sugar beets in a rotation and since corn is the non-leguminous crop often produced immediately before the sugar beets when the leguminous crop occupies some other place in the rotation, it was decided that any investigation of the effect of aeration on sugar beets should take these factors into consideration. These crops were, therefore, grown before the sugar beets, and following the harvest of these crops the entire plant tissue was finely chopped with scissors and incorporated with the mass of soil in the jar.

Physical treatments were employed in preparing the cultures for sugar beets so as to provide different states of aeration therein. Half of the jars were continued at the moisture equivalent of 25 per cent while the other half were provided with excess water so as to maintain them at 28.2 per cent moisture. Half of the soil from the various cultures was compacted by tamping upon being returned to the jars prior to planting the sugar beets. This compaction process resulted in a volume weight of 1.43 on these cultures as compared to 1.0 on the uncompacted cultures. Artificial aeration was provided for half the cultures by use of the air pump mechanism shown in figure 1. The treatments thus provided included (1) normal, (2) aeration, (3) compaction, (4) aeration and compaction, (5) excess water, (6) excess water and aeration, (7) excess water and compaction, and (8) excess water, aeration, and compaction.

Certain chemical studies were conducted during the growth of the sugar beets. The oxidation status of the soil was investigated by means of the technique described by Hoffer (2). Nitrate nitrogen determinations were made in accordance with the technique of Prince (5).

Certain outstanding facts were apparent as a result of the investigation described above. The effect of lack of aeration on the oxidation status of the soil was clearly illustrated. The accumulation of the objectionable ferrous iron on all of the compacted cultures suggests that the normal oxidation processes were very markedly disturbed. In-

Fig. 2. The top growth of sugar beets for the alfalfa series at the time of harvest is illustrated above. Treatments from left to right are: (1) Normal; (2) compaction; (3) aeration; and (4) aeration and compaction.

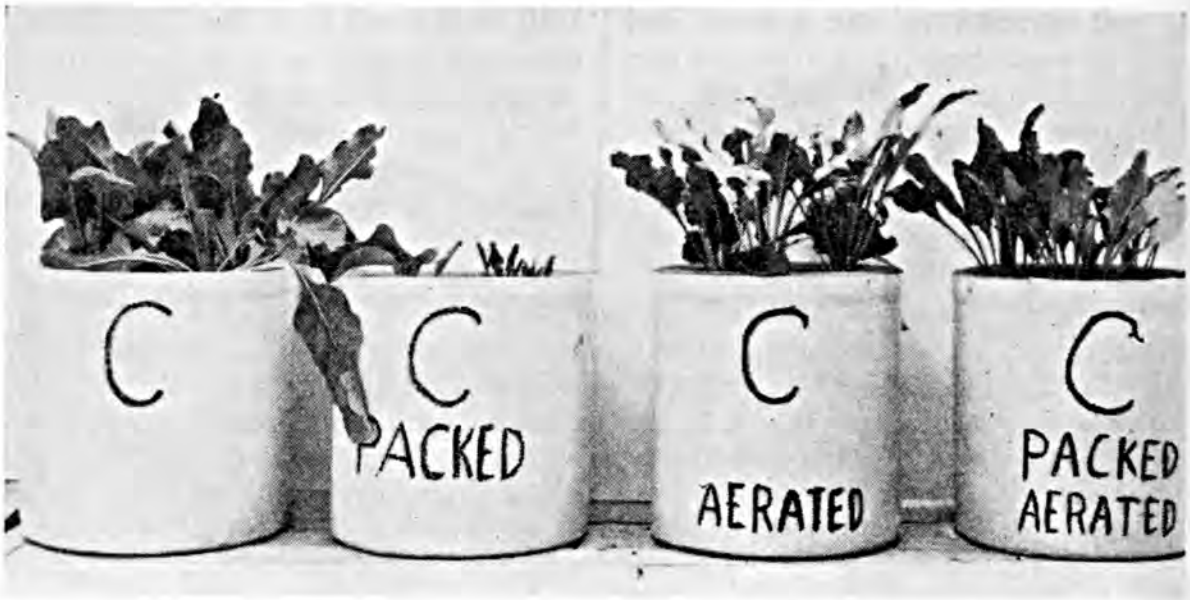

Fig. 3. The top growth of sugar beets for the corn series at the time of harvest is illustrated above. Treatments from left to right are: (1) Normal; (2) compaction; (3) aeration; and (4) aeration and compaction.

asmuch as the artificial aeration on certain of the compacted cultures resulted in partially eliminating this accumulation of ferrous iron and restoration of the supply of ferric iron, it is readily apparent that insufficient aeration is the cause for such accumulation. Since the artificial aeration treatment did not overcome this tendency on the compacted soils which were subjected to the excess water treatment, it is seen that a minimum effective air capacity as well as an exchange of gas between the soil and atmosphere is essential to the maintenance of the proper oxidation status in soils of this character.

The data presented in table 1 with regard to the nitrate nitrogen content of the soil also serve to illustrate that normal processes within the soil are very much disturbed by limited aeration. The failure of those cultures, which were compacted, to produce a high level of nitrification even after the incorporation of large amounts of nitrogenous material offers some explanation

TABLE 1. NITRATE NITROGEN DATA.

Physical treatment	Mean[1] nitrate nitrogen content for			Series average ppm
	Alfalfa series ppm	Corn series ppm	Sweet clover series ppm	
1. Normal	33.21	2.42	41.94	26.05
2. Aeration	33.42	6.33	62.98	34.92
3. Compaction	2.33	1.29	1.99	1.82
4. Aeration and compaction	2.66	1.67	2.60	2.31
5. Excess water	40.80	4.70	22.16	22.56
6. Excess water and aeration	52.10	2.49	53.94	36.00
7. Excess water and compaction	2.19	.67	2.37	1.74
8. Excess water, aeration, and comtion	1.96	1.19	2.76	1.97
Average for all treatments	21.09	2.59	23.82	15.83

[1] Mean of four replicates.

Fig. 4. The top growth of sugar beets for the sweet clover series at the time of harvest is illustrated above. Treatments from left to right are: (1) Normal; (2) compaction; (3) aeration; and (4) aeration and compaction.

as to why a preceding legume crop may be ineffective in stimulating sugar beet yields under field conditions when there exists the presence of excess moisture and a state of poor tilth, either alone or in combination. It may also be observed in table 1 that artificial aeration partially restored normal nitrification processes but not entirely so. This, as did the evidence pertinent to the oxidation status of the soil, suggests the desirability of maintaining a maximum effective air space in the soil for the production of sugar beets.

The effect of the various physical treatments on the yield of sugar beet roots presents itself in a striking manner in table 2. Comparative good and uniform yields of sugar beet roots were obtained as a result of any physical treatment of the soil considered herein and succeeding either corn, alfalfa, or sweet clover so long as this treatment did not involve compaction. Slight

TABLE 2. YIELD OF SUGAR BEET ROOTS.

Physical treatment	Mean[1] dry weight of sugar beet roots for			Series average grams
	Alfalfa series grams	Corn series grams	Sweet clover series grams	
1. Normal	16.75	17.93	11.88	15.45
2. Aeration	17.00	17.80	18.23	17.68
3. Compaction	.88	2.23	1.18	1.43
4. Aeration and compaction	6.04	7.07	2.47	5.19
5. Excess water	16.18	13.90	19.18	16.42
6. Excess water and aeration	17.95	19.20	19.98	19.04
7. Excess water and compaction	.18	.16	.37	.24
8. Excess water, aeration, and compaction	2.06	1.49	1.98	1.84
Average for all treatments	9.61	9.97	9.40	9.66

[1] Mean of four replicates.

increases in yield were obtained where additional water and air were provided uncompacted soils, especially on those cultures where the preceding crop was sweet clover. Additional water, without artificial aeration, on a soil which was not compacted was slightly detrimental on the culture which had previously produced corn. However, these minor variations suggest that aeration on a soil which is not compacted and which has an air capacity of over 30 per cent is not likely to become a limiting factor in the production of sugar beets.

Compaction of the soil, following all crops, resulted in a considerable reduction in the yield of sugar beets. This reduction was evidenced both in root and top growth, as indicated in tables 1 and 2, respectively. The reduction in the former was of considerably greater magnitude, however, as is indicated by a consistent decline in the ratio of roots to tops on those cultures which received compaction. The effect of compaction on the soil was more serious than the addition of excess water as applied in this experiment. This observation was not surprising inasmuch as compaction alone resulted in the disappearance of much more of the original air capacity of the normal soil than did the addition of the excess water. The fact that the application of excess water alone resulted in slight stimulation of yields suggests that normal aeration is not a limiting factor on the uncompacted soil. That additional water may, under certain conditions, be highly detrimental is demonstrated by its addition to the compacted soil.

Proof that aeration was a limiting factor in the growth of sugar beets on the compacted soils is offered by the stimulation of yields as a result of artificial aeration on the compacted soil. The fact that stimulation was less on the compacted soil with excess water present can be explained on the basis of the extremely low effective air capacity. It is interesting to note that marked stimulation resulted from this artificial aeration treatment on all of the compacted cultures which did not receive excess water and it is especially interesting to note that this stimulation was very marked on the cultures which previously had produced corn. This treatment on the cultures following the growth of corn resulted in a yield more nearly approaching those from the uncompacted soil than did any other treatment on any series. This fact adds to evidence already presented as

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Fig. 5. The relative growth of representative sugar beets within the various cultures is illustrated above. Treatments represented by the beets are as follows for each of the series—alfalfa, sweet clover, and corn: (1) Normal; (2) compaction; (3) aeration; and (4) aeration and compaction.

The Role of Major Elements in Plant Nutrition

By L. D. Davis

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ANY discussion of the internal factors associated with the development of plants will nearly always include the essential elements and the part they play, just as it would probably include a discussion of some phase of their water relations, their translocation problems, the mechanism or channels involved, the problem of respiration, the phenomena of growth and in recent times that of the growth promoters.

The discussion of the elements necessary for plant growth is probably not so simple and straightforward as it once was and, I suspect, the role of each cannot be stated so conclusively. It has been almost a hundred years (1844, according to Brenchley) since the first paper was published describing deficiency symptoms and calling attention to the essential nature of certain elements for plant growth. This first element was, as might be suspected, iron, since its lack is so striking. For a number of years (by 1860) the technique of growing plants in solution cultures from which one element was omitted had developed so far that it was considered that 10 elements were necessary for plant growth. These 10 were carbon, hydrogen, oxygen, nitrogen, magnesium, iron, sulfur, calcium, phosphorus, and potassium. These investigations were repeated and verified so often that these 10 came to be recognized as the essential elements, even though it was known that a number of other elements were to be found in plants by analysis.

In 1915 Mazé published a paper showing that other elements besides these 10 might be necessary, but so well-grounded was the belief in the 10 that it was another 10 years before there was acceptance of the fact that the 10 might not be all that were needed for normal growth. This situation raises the question of what might be a criterion by which the indispensability of an element would be judged. A basic concept would probably be as follows: "Necessity of an element for normal plant metabolism is demonstrated only if lack of it can be shown to result in injury, abnormal development, or death." The hub of this concept lies in the "lack" of an element. Under our present concept of technique this means that the plant must be grown in some sort of culture solution from which the element in question has been eliminated or reduced by the most refined methods. Modern investigations have recognized the difficulties associated with eliminating an element from culture solutions and have suggested certain previously unrecognized sources of error in the older experiments: (1) Many of the "pure" chemicals used contained, at least, traces of other elements which may have been sufficient to supply the plant with its needs; (2) the elements stored in the seeds were not usually considered in these experiments and sufficient amounts of an element might be contained here for normal growth; and (3) certain elements may dissolve from the walls of the containers in which the plants are growing or in which the reagents are stored.

A failure to place emphasis upon the "lack" of an element is shown by some investigators who have noted increased growth when an element has been added to a complete culture solution.

By such a procedure there have been many elements reported as increasing plant growth and the assumption made that they were therefore necessary. Such a condition may, however, fall short of proof that such an element is necessary for growth; it may only alter some characteristic of the solution making it more favorable for growth of the plant. Furthermore, before the necessity of an element for green plants has been proved it should be shown necessary for a number of species.

Using the critical concept indicated above there are probably 14 or 15 so-called essential elements for plant growth, even though as many as about 40 have been found in plants on analysis and one writer has suggested that the whole periodic table may be found when proper techniques have been developed.

To recapitulate: Our original concept of the elements necessary for plant growth obtained by the technique of solution culture was so well-founded that it wasn't seriously challenged for more than 50 years. The change in concept has been in the nature of additions rather than revision, occasioned by improved technique and an understanding of the very small amounts necessary. The current concept would suggest that the list might keep growing as additional and more critical investigations were made.

A number of ways of classification of these necessary elements are possible, none of which are wholly satisfactory. The following classifications are representative of the attempts that have been made:

1. According to their source; C, H, O coming from the air and water, the remainder of the elements from the soil.

2. According to their ashing properties, C, H, O, N being lost on burning, the others remaining in the ash.

3. According to their supposed function:

a. energy exchange group—H, O

b. energy storers—C, N, S, P

c. translocation regulation—K, Ca, Mg

d. oxidation reduction regulators—Mn, Fe, Zn, Cu.

4. According to the amount necessary for growth—the major and minor (micro, trace), elements.

It can be seen that none of these classifications is entirely satisfactory. The first two are strictly artificial and give no indication of the role of the elements. The third is a more nearly rational one but the difficulty lies in exactly cataloguing an element so that all its functions lie in that group. It omits entirely the function that some element may have in some building structure or in a compound. The last classification is perhaps a more desirable one for our present thinking, especially if the emphasis is placed upon the historical or developmental aspect. It scarcely seems wise to lay too much emphasis upon the relative amounts needed by the terms "major" and "minor." Certainly "major" and "minor" cannot be taken to indicate degrees of indispensability since I assume there is no such thing. They are indispensable or they are not!

Possible Functions of the Elements

The elements needed by plants may subserve a number of functions. Among them are the following:

1. Some of them are component parts of the cell structure such as the cell wall or of the protoplasm. The amount of the different elements used for these purposes may be relatively large, and any deficiency of them is soon noticed in the general growth of the plant.

2. As sources of energy for the varied functions.

3. As influencing elements.

a. on osmotic pressure of cells

b. on acidity and buffer action

c. on hydration of the cell colloids

d. on permeability of cell membranes

e. as antidotal or antagonistic agents

f. as carriers of other ions

g. as catalyzers of reactions.

Role of the Specific Elements

It is not always easy to assign a specific role to an element and feel certain that its sole function lies here. When an element forms an integral part of some building material or compound whose function is known, and whose lack in a culture solution does not result in irregularities other than those expected of this building material or compound, then the role is rather easy to assign. But frequently the lack of an element will result in abnormalities that cannot be simply explained.

All of the 10 major elements have been shown to be necessary to the growth of trees under controlled conditions. The symptoms of a lack of an element are in general the same for trees as for other experimental plants. Primarily, I assume, because of the ease of manipulation nearly all the work in exploring the role of the elements has been done on plants other than trees. What will be said regarding the role of each will therefore be the result of investigations on other plants, but it may be a fair assumption that they would play the same role in trees.

Carbon, Hydrogen, Oxygen (C), (H), (O)—These three are constituents of a very large proportion of all the materials in a plant. They serve:

1. As part of the cell structure in the cell wall and protoplasm.
2. As energy materials—carbohydrates, fats, oils.

In trees the primary energy material is usually in the form of carbohydrates. These may be broken down into those used (a) for current use and (b) for storage.

For our discussion three carbohydrates may be considered as furnishing the bulk of those for current use. These are the sugars—glucose, levulose, and sucrose. All three are water-soluble and serve as the sugars that are translocated from one part of the plant to another. The first two of these, glucose and levulose, have the power of reducing certain compounds and are therefore spoken of as reducing sugars. Sucrose does not have this power of reduction and is therefore spoken of as a non-reducing sugar. In the literature dealing with the metabolism of trees, reducing sugars refers primarily to dextrose and levulose, non-reducing to sucrose, and total sugars means the sum of all three. In trees, the chief storage carbohydrate is starch. This material breaks down into glucose when hydrolyzed by dilute acids or by enzymes. It can, therefore, be considered as a condensation product of a number of molecules of glucose. An additional carbohydrate, hemicellulose, occurs in trees and vines and is said to be a reserve storage product. It yields reducing substances when hydrolyzed by dilute acids; in this case, however, a mixture of sugars results, glucose mixed with two five-carbon sugars, xylose and arabinose. There is considerable controversy regarding whether or not hemicellulose is a storage material. We can, perhaps, best leave it by saying that it does occur in varying quantities in trees and that investigators are not agreed about its function.

Nitrogen (N)—As a component of the proteins and therefore of the protoplasm, this element has a role in which a lack is very readily visible by reduced growth and a lack of green color. Nitrogen is also a part of the chlorophyll molecule.

Iron (Fe)—This element is necessary for the synthesis of chlorophyll, although it doesn't enter into the chlorophyll molecule. The state of the iron in the plant is important, an abundance may be present yet not be in an available form. Such a condition exists in our lime-induced chlorosis. Iron is also supposed to act as a catalyst or oxygen-carrier in oxidation-reduction processes occurring in living cells. The proportionate amount of this element in plant tissues is low, much of it in organic compounds. It is one of the most immobile of the elements, no appreciable redistribution ever occurring from one tissue to another. Hendrickson has observed that chlorotic pear leaves sprayed with iron sulfate became green under a drop of spray but not in adjacent areas not wet by the spray.

Magnesium (Mg) — Magnesium forms a part of the chlorophyll molecule and as such is necessary in green plants. When lacking, characteristic chlorosis and perhaps bronzing occurs. Unlike Fe, Mg is readily redistributed from older to younger parts of the plant. Mg is also believed by some workers to be associated with the synthesis of oil and nucleo-proteins in plant cells. Many cases of Mg deficiency have been reported under field conditions.

Calcium (Ca)—A large proportion of the Ca in most plants is located in the leaves. Very little redistribution ever takes place. The Ca content of leaves constantly increases throughout the season. This element apparently plays a multiple role in plant metabolism. (a) It is a constituent of the cell wall as Ca-pectate in the middle lamella. (b) It may influence the permeability of the cytoplasmic membrane. It has been found that plants growing in Ca-deficient solutions may lose ions to the solution, whereas in solutions above a certain concentration of Ca accumulation occurred. (c) It may serve as a neutralizer for certain organic acids, especially oxalic or as an antidoting agent for other ions. (d) It may serve as an aid in translocation of carbohydrates. In absence of Ca starch has been observed to accumulate presumably due to lowered diastatic activity. In culture solutions lacking Ca there was a severe stunting of growth, and almost total failure of roots.

Sulphur (S)—S is a constituent of the amino-acid cystine, which in turn is one of the compounds from which many plant proteins are made. It is also a constituent of glutathione, a compound supposed by many investigators to play a part in the respiration process. Although the exact role is not known, at least one case of deficiency has been reported, that of tea yellows.

Phosphorus (P)—This element apparently plays both a direct and an indirect role in the plant's metabolism. It forms a part of various organic compounds such as the nucleic acids and the phospholipids (lecithin). Deficiency of P interferes with the synthesis of these compounds and hence may interrupt normal cell division. In addition, P acts as the co-enzyme of zymase, seems to exert an accelerating effect on other oxidizing and reducing enzymes and seems to be necessary for hydrolytic transformations of carbohydrates. This element occurs in the greatest abundance in young meristematic cells and in seeds. It is apparently readily redistributed in plants from one part to another.

Potassium (K)—Unlike the other major ash constituents K is not definitely known to be built into organic compounds of fundamental physiological significance. A large proportion of the K in plants is in a soluble form and seems to be readily translocated from one part to another. Relatively large quantities, compared to some of the other ash elements, seem necessary to avoid serious injury. Since it is not used in the construction of some vital cell constituent, it must play a regulatory or catalytic role. The following processes seem to need K for their normal maintenance: (1) The synthesis of simple sugars and starch; (2) translocation of carbohydrates; (3) reduction of nitrates; (4) synthesis of proteins, particularly in meristems; and (5) normal cell division. These conclusions are based upon such experiments as those of Russel for mangolds where 7,255 pounds of leaves produced 14,684 pounds of root in a K-deficient soil, whereas 8,508 pounds of leaf produced 40,128 pounds of root in the same soil that had been supplied with K. Or the experiments of Nightingale in which sugars accumulated in K-deficient plants because N-assimilation had been interfered with. In Spirogyra, normal nuclear division failed to occur in the absence of a potassium supply.

Center—no potash.

Recent South Carolina Studies on Potash with Cotton

By A. B. Bryan

Extension Service, Clemson Agricultural College, Clemson, South Carolina

THE economic significance of the cotton crop in the South emphasizes the desirability of research studies on more efficient production and processing of cotton as well as wider utilization of the cotton fiber, Dr. H. P. Cooper, director of the South Carolina Experiment Station of Clemson Agricultural College, said recently.

This great economic significance of cotton is explanation and justification for great and continuous attention and effort which Clemson research agronomists, including Dr. Cooper, himself an able and well-known soil scientist, have given to the study of cotton production for many years.

Some of the most recent research on cotton production in South Carolina has had to do with the influence of potash with and without limestone; residual effects of potash; best rate and time of applying potash; comparative yields from potassium chloride and sodium chloride; and the effect of sodium on different levels of potash fertilization.

The accompanying table shows what happened to the yields of cotton when potash was applied to cotton with and without dolomitic limestone. The tests, made on Norfolk sand at the Clemson Sandhills branch experiment station, have covered a period of 13 years through 1944.

The basic fertilizer treatment of these test plots consisted of 640 pounds of a 5-10-5 per acre and 50 pounds of K_2O. One half of each plot received 1,500 pounds of dolomitic limestone per

Treatment	Condition of soil	Average yield pounds seed cotton per acre	Increase from lime	
			Lbs.	Per cent
No potash	Unlimed	102		
	Limed	98	−4	−3.9
With potash	Unlimed	717		
	Limed	882		

acre in 1931 and 1,500 pounds more in 1935.

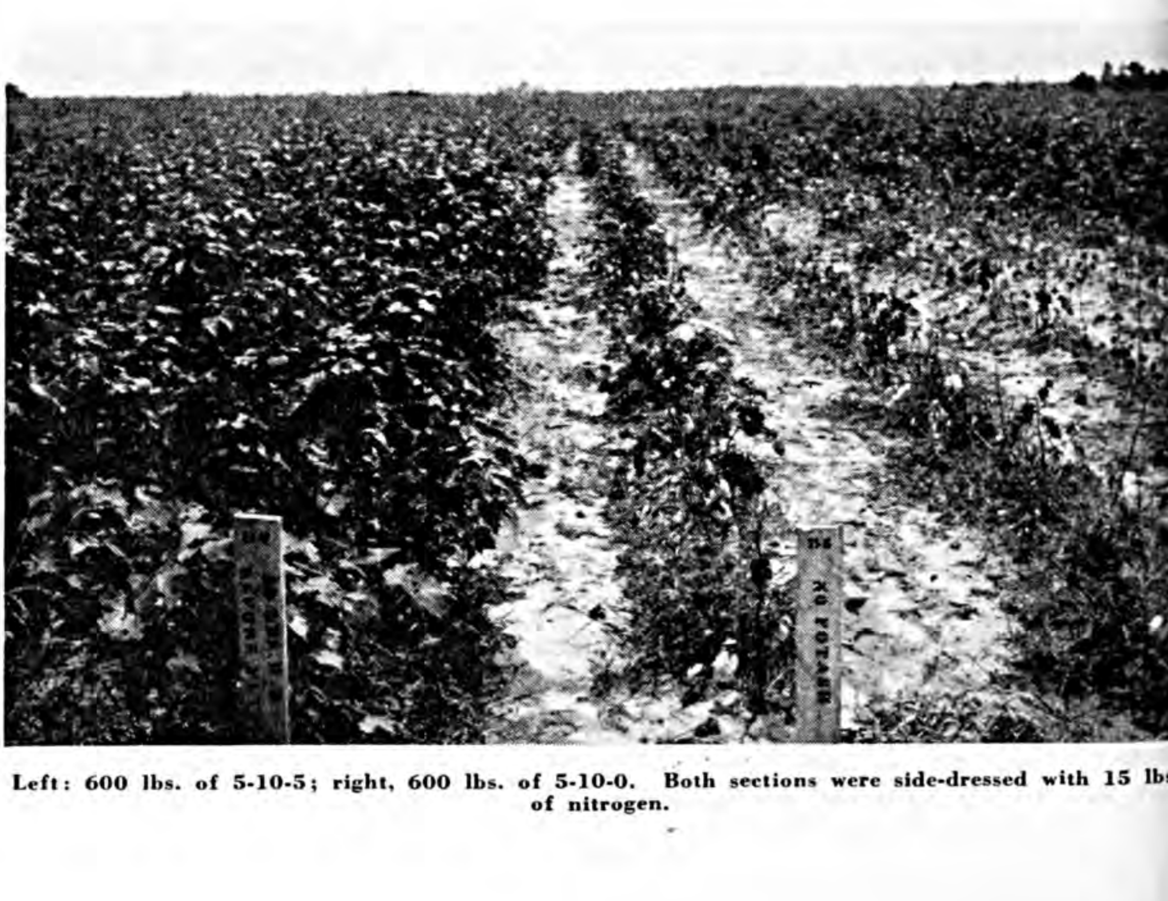
Dr. Cooper's report on the tests shows that the average yield for 13 years (no data for 1941 because of crop failure) was very low on plots that did not receive potash, 102 pounds of seed cotton per acre from the unlimed plots and 98 pounds from the limed plots. It is explained that the slightly lower yield from the limed plots was doubtless due to the generally accepted idea that the addition of calcium in the form of limestone decreases the solubility and the availability of the potash in the soil.

The average increase in yield from the use of limestone was 23 per cent. The range in the percentage increase for the different years was from 0.4 to 48.6 per cent. The greatest increase seems to have occurred in the years of higher total production.

How Much Potash, and When, for Cotton

Further evidence and more direct evidence on the importance of potash are to be found in the tests by Clemson agronomists on rate and time of applying potash to cotton. These tests on how much potash is most economical and what is the best time to apply it date back to 1931 also for their beginning and therefore offer some conclusive evidence.

They show, first, that there were increases of 16 to 25 pounds of seed cot-



Left: 600 lbs. of 5-10-5; right, 600 lbs. of 5-10-0. Both sections were side-dressed with 15 lbs. of nitrogen.

ton per acre for each pound of potash applied as a fertilizer.

They showed, second, that there was little difference in the yield of seed cotton from potash applied at different times.

In these tests all plots received a treatment equivalent to 600 pounds per acre of a 5-10-0 fertilizer mixture before the crop was planted and 15 pounds of nitrogen from calcium nitrate, Cal-Nitro, or ammonium nitrate applied as a side-dressing. In addition, potash was applied at the rates of 0, 15, 30, 45, and 60 pounds per acre, which with the basic mixture were equivalent to 600 pounds per acre of a 5-10-0, 5-10-2.5, 5-10-5, 5-10-7.5, and 5-10-10 fertilizer, respectively.

The average results for 13 years show that the yields became larger as the amount of potash in the fertilizer was increased. The average yield for the plots not receiving potash was 522 pounds per acre. The average yields from the plots receiving 15, 30, 45, and 60 pounds of potash per acre were 903, 1207, 1338, and 1478 pounds of seed cotton per acre, respectively.

These yields represented increases of 381, 685, 816, and 956 pounds over the plots which did not receive potash. It should be noted that these plots did not receive any sodium in the fertilizer. It has been observed that where considerable quantities of sodium are included in the fertilizer there is less response to the use of potash, particularly at the higher rates of application.

The average results of these tests are shown in the following table.

Residual Potash and Yields

That a soil low in available potash suffers only relatively small losses of potash if the cotton stalks and leaves remain on the soil is clear from experiments conducted at the Sandhills branch station since 1932.

This experiment was started to determine the residual effect of applications of potash on cotton production. Muriate of potash was applied broadcast at the rates of 100, 200, and 400 pounds per acre on Norfolk sandy loam. Six hundred pounds per acre of a 7.5-10-0 fertilizer were applied annually to all plots but no potash has been applied since the original application in 1932.

Results from the 12-year-test, 1932-1944 inclusive, show there were increases in the yield of seed cotton over no potash of 45, 77, and 105 per cent from 100, 200, and 400 pounds of muriate of potash per acre, respectively. These data indicate the efficiency of the cotton plant in the utilization and conservation of fertilizer nutrients. The effects of an application of 100 pounds of potash were very significant after a 12-year period.

Effect of Sodium with Potassium

Another interesting phase of these 13-year tests in cotton fertilization has to do with the comparative yields of cotton from the use of sodium chloride and potassium chloride. In the wording of the report by Dr. Cooper and his associates—

"These data suggest that the addition

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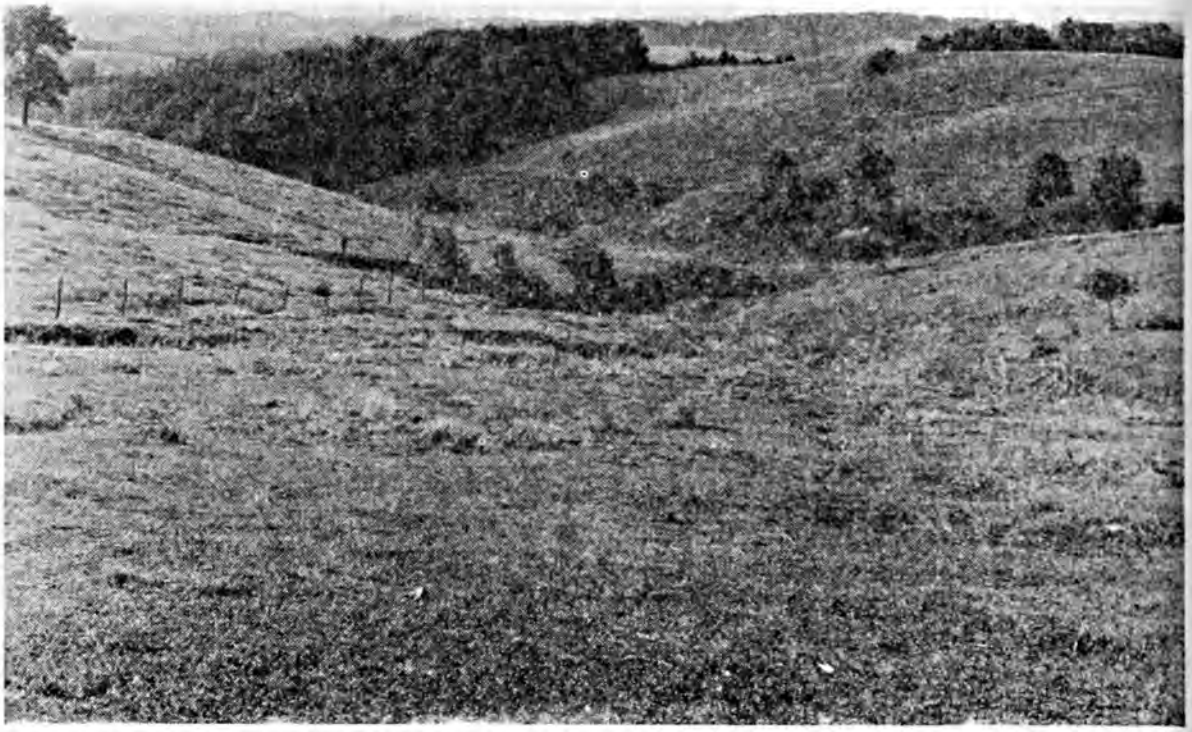
Pounds of potash applied	Average for each rate, pounds	Increase over preceding similar treatment, pounds	Increase over no potash		Increase in seed cotton for each pound of potash, pounds
			Lbs.	%	
None	522				
15	903	381	381	73	25
30	1,207	304	685	131	23
45	1,338	131	816	156	18
60	1,478	140	956	183	16



Thousands of acres of poor, weed-infested, overgrazed, and nitrogen-starved pastures such as this one could be improved by "renovation." This program of rejuvenation calls for liberal treatment with lime and fertilizers, thorough seedbed preparation with the disc, spring tooth harrow, or field cultivator, and then a liberal seeding with clovers, alfalfa, and brome grass.

Efficient Management For Abundant Pastures

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wisconsin

GOOD PASTURES! These two words bring to our minds a picture of lush fields of palatable, green, succulent forage. That is the kind of pasture that makes milk and meat. Dairy cows that can fill their paunches in two hours on good pasture and then lie down and chew their cuds the next two hours will come in at night with a pail full of milk for their owners.

Too much of our pasture is thin and sparse, in fact is little more than open-air exercising grounds for our dairy herds. Cows that have to hustle and rustle all day to fill their stomachs are not able to convert much of their feed into milk or meat.

In spite of all the talk about pasture improvement during the past 10 years, we do not see very many really good pastures as we travel over the country. Isn't it true that the average farmer has devoted about 90% of his time and energy toward the production of crops on his cultivated fields? We have made real progress in this matter of liming and fertilizing our cultivated crop land. Farmers are sowing and planting all of the new high-yielding varieties of grain and corn. The new rust—and smut—resistant oats, including Vicland, Tama, Clinton, Bonda, Benton, and Eaton are now being grown extensively on farms in the Midwest. Our

Wisconsin Blackhawk and Henry wheats have been bred for disease resistance and higher yields. Hybrid corn, in all conceivable genetic crosses, has been bred for higher yields and resistance to lodging and diseases.

The average farmer, I say, devotes 90% of his time and energy to the production of cultivated crops. He fits and fertilizes his crop land in the spring, sows his seed, cultivates his crops, then harvests and stores these crops in his barns and granaries. In turn he "chores" all winter in converting this feed into milk and meat. But when spring comes most farmers turn their cows out on what has always been just taken for granted—permanent pasture! A few farmers have made a start in the renovation of their old permanent grassland pastures. Many farmers are providing some rotational pasture and every year use a certain portion of their legume acreage for pasture. Some farmers are growing an acreage of sudan grass or other emergency crops for mid- and late-summer grazing.

Renovation Recommended

We have talked and heard a lot about renovation in the past few years. The writer suggested this program to farmers in Wisconsin as early as 1923. In the past 25 years I have had an opportunity to see first hand the thousands of acres of weed-infested, thin, poor, and unproductive pasture land. In talking with the owners of these farms as we walked over their pastures, I tried to describe to them the opportunity for pasture improvement by the way of more abundant crops of drought-resistant legumes. Sweet clover for these pastures was so much a part of my vocabulary in the early days that I was nick-named "Sweet Clover Chapman." As I read over these early recommendations for pasture improvement way back in 1922, '23, and '24, I find that I was suggesting about the same procedure that is now being advocated in our present-day renovation program: namely, liberal applications of lime and fertilizer, followed by a thorough tearing-up of these old grub-infested, thin sod pastures with field cultivator, disk, or spring-tooth harrow, and then reseeding with sweet clover and pasture grass mixtures.

About the only change in this so-called renovation program as now advocated is the inclusion of brome grass and ladino clover. Pasture specialists who have in recent years given so much time to the study of pasture improvement by renovation now recommend plowing instead of disking or surface fitting where it is possible to plow. They now recommend the inclusion of a light seeding of oats with the grass seed mixtures where fields are being fitted either by surface cultivation or by plowing.

Pasture improvement by renovation is the number one program we all recommend for the conversion of these thousands of acres of thin, poor, weed-infested, permanent pastures to lush and abundant fields of clovers, alfalfa, ladino, and brome. True the cost per acre in terms of cash and labor is rather high. It means the fencing out of these pasture fields for a period of three or four months while the seedings become well established. And this means the loss of part of a farmer's pasture for the months of May, June, and July. However, it is frequently possible to turn cows into these renovated pastures by the middle of August and graze them lightly up to the middle of September or later.

Dairymen who will follow out this program of renovation and do the job right will be richly rewarded. The second year following renovation is when a farmer really "cashes in" with four to five times as much feed from a given acreage. But we know that sweet clover and alfalfa and other legumes seeded in these pastures will eventually "peter out"; the grasses—brome, timothy, red top, and June—will again take over. And at this point I wish to suggest another great opportunity, as I see it, for pasture improve-

This 23-acre pasture on the Wells Himsel farm at Paoli, Wisconsin, was divided in equal halves with an electric fence in April 1945. The left half received an application of 200 lbs. of ammonium nitrate per acre. The entire herd of dairy cattle was rotated back and forth during the grazing season and a record kept of the pounds of milk produced from each half. When the final records were tabulated, the fertilized half had produced 29,899 lbs. of milk and the unfertilized portion 16,678 lbs. The increase—13,221 lbs. at $3.25 per cwt.—was worth $429.68. The cost of the fertilizer was $48.

ment. It is the story of pasture improvement through the use of nitrogen fertilizer.

Nitrogen, a Source of Protein Feed

Eighty per cent of the air we breathe is nitrogen and yet not an ounce of it is available to man or beast in this elemental form. Where combined with oxygen in the form of "fixed nitrogen" this element becomes an important plant-food nutrient which can be utilized by plants in the synthesis and building of protein. We, of course, all know that the family of legumes is endowed by nature with the power to convert elemental nitrogen of the air into protein. This is accomplished through the action of bacteria working within the nodules which develop on the growing roots of these legumes. We inoculate our clover, alfalfa, peas, beans, etc. in order to be sure that a good strain of the right kind of nitrogen-fixing bacteria is present in the soil in contact with the seed. But the non-leguminous crops including the grasses, corn, cereals, and most vegetable crops must secure their nitrogen from the soil. An abundance of nitrogen results in the lush, dark green, rank growth of these crops, that is, providing adequate supplies of the other elements of plant food are present and growing conditions are favorable.

The supply of nitrogen in our cultivated crop land should be largely maintained through the growing of legumes in the rotation. The feeding of these legumes and the return of manures produced to our cultivated fields add further to the nitrogen supply in our soils. But on much of our crop land in the Midwest we have been "cashing in" on the nitrogen and organic reserves of our soils. This has taken place over the period of 50 to 100 years we have cropped these soils. The available reserves of nitrogen and organic matter are "petering out" on thousands and thousands of acres where the combined effect of erosion and legume failures have left these fields in a nitrogen-starved condition. Farmers can, however, maintain a fairly adequate level of nitrogen in their cultivated fields by the growing of legumes in rotation. The plowing under of clovers, soybeans, and even crops of non-legumes such as timothy, brome, and other grasses, or cereal crops is recommended from time to time as a means of maintaining the organic matter reserves in our crop land.

Sources of Nitrogen for Permanent Pastures

But what about our permanent pastures? What is the source of nitrogen here? Very few farmers apply stable manure to their pastures. It is true that the native white clovers and other legumes do supply some nitrogen to native grasses. Lespedeza in latitudes 100 miles south of Wisconsin is an important pasture legume that is now being grown as a companion crop with pasture grasses. Not only do these legumes supply protein feed, but indirectly do supply some nitrogen to the pasture grasses as the roots and nodules of these legumes decay. We know, however, that in Wisconsin—in fact it is true in other Midwestern states—that white clover and other natural legumes are fickle and not too dependable. They do not supply sufficient amounts of nitrogen to make possible the abundant growth of our grasses.

A small amount of nitrogen is added each year in the rain-waters. In the virgin state, where our prairies had built up a good reserve of humus and organic matter and where legumes flourished, the nitrogen supply was a sort of revolving fund. When we started the practice of heavy grazing, the reserves of nitrogen and organic matter were gradually reduced. Evidence of this lack of nitrogen is seen on pastures in the spring where those dark green patches of lush grass are so much in evidence. These urine spots in our pastures are good demonstrations of this almost universal lack of nitrogen.

Nitrogen fertilizers have been used by European farmers in pasture improvement for many years. In our own country particularly in the eastern states, the top-dressing of grassland pastures in the spring with nitrate, cyanamid, or ammonium sulphate had become an established practice prior to World War II. This war has given us an additional capacity for the produc-

Here is a renovated pasture on the Aldis Arnsmeier farm at Darlington, Wisconsin. This picture was taken in August of the same year it was seeded. A liberal application of lime and fertilizer (0-20-20 at 400 lbs. per acre) was applied before working up the seedbed in the spring. Alfalfa and red clover made a luxuriant growth and the field was ready for grazing by late August.

tion of nitrogen fertilizers in this country. A total of some nine large factories were built for the production of synthetic ammonia. In fact, four synthetic ammonia plants were built in Canada. During the war these plants turned out vast quantities of ammonium nitrate and other nitrogen compounds which were used in the manufacture of explosives. Strange as it may seem, this same ammonium nitrate and other nitrogen compounds used during the war in the manufacture of gun powder for the killing of men and the destruction of property can now be used as a fertilizer to produce protein feeds. This increased capacity for the production of synthetic ammonia in this country looms up as a new and great opportunity in our potential capacity for the production of food and fiber.

When fertilized with nitrogen, early pasture grasses have been found to contain from 18 to 22% crude protein on the dry matter basis. Not only is this early pasture grass rich in digestible protein, but it is also rich in the minerals and vitamins so essential to a well-balanced ration. Well-fertilized pasture grass when three to five inches in height compares favorably in feeding value with bran, pound for pound, on the dry basis.

One pound of nitrogen applied as fertilizer to grass, if all recovered, would produce about six pounds of grass protein. Under favorable soil moisture conditions it is possible to recover in the form of protein feed about 75% of the nitrogen applied. On this basis, an application of 100 pounds of ammonium nitrate carrying 33 pounds of nitrogen would produce about 150 pounds of crude protein. This is equivalent to the protein contained in 1,000 pounds of bran containing 15% protein. Therefore, 100 pounds of ammonium nitrate costing about $3.00 applied to good bluegrass pasture could reasonably be expected to produce the feed equivalent to 1,000 pounds of bran which at $50 a ton has a value of $25.00.

If rainfall in the spring is insufficient to make possible the conversion of all this nitrogen, it normally remains in

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Dairy cattle belly deep in renovated pasture of the Hoard's Dairy farm at Ft. Atkinson. This pasture was plowed, fertilized, and reseeded with a mixture of alfalfa, red clover, and brome grass.

Increased Quality of Products Is Answer to the Problem

By Charles H. Gould

County Agent, Camden, New Jersey

I AM looking at this problem from the standpoint of the increased production of quality products.

It has been repeatedly pointed out that quality products must be offered if our New Jersey farmers are to meet the competition from other areas. This competition is becoming increasingly evident. To be sure, many constructive sales measures have been taken, and more will be taken in the near future, to uphold the dignity of New Jersey farm products on the market. But these marketing programs will not be effective unless quality crops are grown. I believe fertilizer is an important factor in the production of top-grade fruit and vegetables, grain and hay, and pasture.

Much of the argument in favor of the use of fertilizer is focused on the attendant increase in yield. Increased yield and quality go hand in hand; therefore, use more fertilizer and better quality will follow, other things being equal. True to an amazing degree!

I travel over the county and see corn plants with scorched edges and marginal leaf burn, the sign of potash deficiency; in another field, the purplish tinge showing low phosphorus. I see sweet potato fields with peroxide blonde foliage—starving for either nitrogen or magnesium. I see tomato fields that need a dose of epsom salts; I am called into corn fields to explain why the ears are not well filled—"Never happened before; always had good corn in this field." I am implored to wave a magic wand over a pickle field to correct nitrogen and potash starvation among the wry-necked specimens. Soybeans are drying up because of drought—no, they are hunting around for potash they cannot find. Spinach has something wrong with it—manganese has been reduced to a minimum. An apple crop of small, undersized, poor colored fruit, spindly tree growth, weak buds, is calling for attention.

These symptoms indicate a neglect, not intentional, but brought about through a repetition of practices that have not supplied adequate amounts of N, P_2O_5, or K_2O.

What Analysis and How Much?

I have asked several farmers in the country—"How do you know what analysis fertilizer to buy, and how much to use?" The answers form a variety of patterns.

First, there are those who say, with a gospel finality—"I buy what the fertilizer agent tells me to."

Second, there is the group which says: "Oh, I don't know, but I think I need a little more phosphorus and potash, so I buy a 5-10-10, and of course, manure."

Third, there is the class that figures out its need from Station recommendations, and acts accordingly.

Fourth, there is the group that buys the cheapest grade, regardless, and the least possible amount.

Fifth, believe it or not, there is an increasing number who bring soil samples to its county agent for rapid tests to discover the fertility level of various fields, with requests for recommendations to overcome deficiencies. The soil-testing services provided by the Station and commercial concerns are heavily patronized, particularly by those growing specialty crops, and the idea is spreading among producers of other crops.

Soil samples sent to my office have tripled since 1938. The number of farmers submitting samples has nearly doubled. I do not think these farmers are using soil-testing services just for fun. I think that they realize that if properly used, they are an aid to better production of quality produce, and these men have sensed the need of literally looking into the soil for facts to guide them in a fertilizer program.

Hestor reveals that in 1941 a survey of 108 tomato growers showed those growing over 10 tons per acre had an average grade of 74% No. 1, and that those who produced less than 5 tons per acre had an average grade of 61% No. 1. (The latter presumably did not employ soil tests.) He concludes that soil testing "pays in quality." Again in 1944 he shows that in one county in Pennsylvania, tomato growers who tested their soil averaged 7.46 tons per acre, "whereas those without soil tests produced only 4.26 tons per acre."

Research and Practices

Do not get the idea that I believe mere soil testing itself results in increased yields. It is the facts that come to the surface, and the research that such exposures stimulate, that eventually produce results which can be translated into practices that really count—such as Hestor's determination to find out whether increased potash would produce high quality tomatoes. He concludes: "It has been observed that the fruit on plants getting a large amount of potash, mature dark red and carry a high amount of sugar and acid, which is a factor in quality."

Similar results have been noted in Delaware, where they had the hunch that potash might be the limiting factor in tomato production. Libby, McNeil & Libby, in cooperation with the Delaware Experiment Station and Extension Service, came to the conclusion that in 1940 "the use of 200 lbs. of muriate of potash per acre, above the regular fertilizer treatment, increased our quality from 12 to 16%." Average gain per 200 lbs. muriate per acre was 62 baskets, or over a ton per acre.

Wolf has associated the dollar returns per acre with the various amounts of different nutrients for asparagus. Over a two-year period, he asks us to "witness the 1942 returns of $225 per acre, where soluble P_2O_5 content of surface soil was over 30 lbs. per acre, as compared with $125 returns for those soils having less than 15 lbs. soluble P_2O_5 per acre.

"Also, the returns of $240 per acre when the soluble K_2O was between 300-400 lbs. per acre, as compared with $170 per acre for those fields containing 100-200 lbs. soluble K_2O per acre."

In my thinking, this reflects quality in the asparagus. It means better grades at the packing house. Wolf further found that asparagus growers who planted on rather infertile ground, poorly prepared soil, and who skimped on lime and fertilizer, consistently got low returns, and, I might add, undoubtedly low quality.

This low quality stuff is what we cannot put up with in New Jersey; it will not meet competition. If 2,000 lbs. of 5-10-10 on a soil well supplied with P_2O_5 and K_2O, as a result of previous good management, will produce the extra quality, there's a point for asparagus men to consider. My point is that the increased amount of fertilizer is demanded by the asparagus crop for quality production and that the increased amount is justified on the basis of demonstrated plant and soil needs.

My argument is that the successful use of fertilizers depends, in part, upon correctly tracking down the one or more deficiencies that are limiting production. That is what our New Jersey producers need to do, and there is a definite trend in that direction.

Stepping into the alfalfa field, we find that Bear, after a third degree applied to the agronomy specialists of the East designed to bring out some

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Does it pay to mineralize? The right side of the picture had lime, phosphate, and potash. The left side had no minerals and no clover was the result.

Year-round Grazing

By W. R. Thompson

Agronomy Department, Mississippi State College, State College, Mississippi

ANY farmer in Mississippi who wants year-round grazing for his work stock, cattle, hogs, sheep, or poultry has it within his reach. He can find grazing crops that will grow each season. In fact, the pasture seasons are divided according to the time certain grazing crops will grow.

The secret of profitable pastures is a spread of grazing during the four seasons in place of a feast one season and a famine the next. One can visit the Mississippi Experiment Stations and demonstration farms and get a new hold on life as far as pastures are concerned. It's hard to believe what can be seen.

By planning for each pasture season, a Mississippi farmer can have winter grazing from November 1 to March 1; spring grazing from March 1 to June 1; summer grazing from June 1 to September 1; and fall grazing from September 1 to November 1. On the average, he will need about two acres of land in pasture for each animal unit on his farm. By an animal unit we mean a 1,000-pound cow, five sheep, five shoats, a sow and litter, three 300-pound calves, or 200 hens.

Winter Grazing

We usually think of the winter grazing season from November 1 to March 1 as the time when plants won't grow. But, many grazing crops will grow profitably in Mississippi during these months. R. H. Means of the Mississippi Experiment Station reports gains on beef calves all during the winter comparable to summer gains, with no supplemental feed. It is almost like a mirage to see cattle standing knee-deep in oats during December and January and really fatter than summer grazing cattle.

Sheep can be kept on winter grazing every day. They are not heavy enough to bog. Demonstration flocks of sheep in Mississippi are being wintered on oats or oats and clovers with no extra feed. Sheep can graze oat fields where grain is to be harvested until March 1 without harming the oats. An acre of oats will give three to five sheep constant grazing.

Hogs on oats and legumes or Italian rye grass respond as any other animals on the farm to winter grazing. Farmers report about the only time hogs stop grazing is to take on grain. They eat far less grain than they would if they didn't have grazing. One farmer spent $230.25 on five acres of winter grazing for his hogs. Starting October 23 he charged 5¢ a day for each hog grazed. By January 1 he had liquidated the cost of minerals, preparation, and seed. He fed only half as much grain as he would have on dry-lot feeding. On January 1 he figured he had four more months of grazing and four years' supply of minerals—all profit.

In all sections of Mississippi an area in reach of hens in the laying house will give poultry winter grazing. The grazing is grown the same as for livestock. The method of grazing may change.

Farmers can give more land for each animal unit during the winter. Oats can be grazed and still grain yields will not be reduced if the correct minerals and nitrate are used.

Two areas of winter grazing land should be prepared in the summer, one on cultivated land to use for dry weather grazing, and the other area on sod land so it will not be too boggy to graze during wet and rainy weather. Part of the winter grazing on sod land gives a chance to renovate and get minerals into the soil. Payment for doing the job comes through oat grazing. Grain can be cut from the sod land the same as on cultivated land. The sod land will not be needed for grazing during oat-ripening period. Clovers are available at this time.

By planning, two and oftentimes three crops can be obtained from grazing crops planted. Oats on cultivated land will give three real crops in nine months—four months of winter grazing, a grain crop in June, and a hay or seed crop or more grazing from lespedeza interplanted in February. All of these crops will come off in time to plant oats back for winter grazing again.

Plant Food Needed

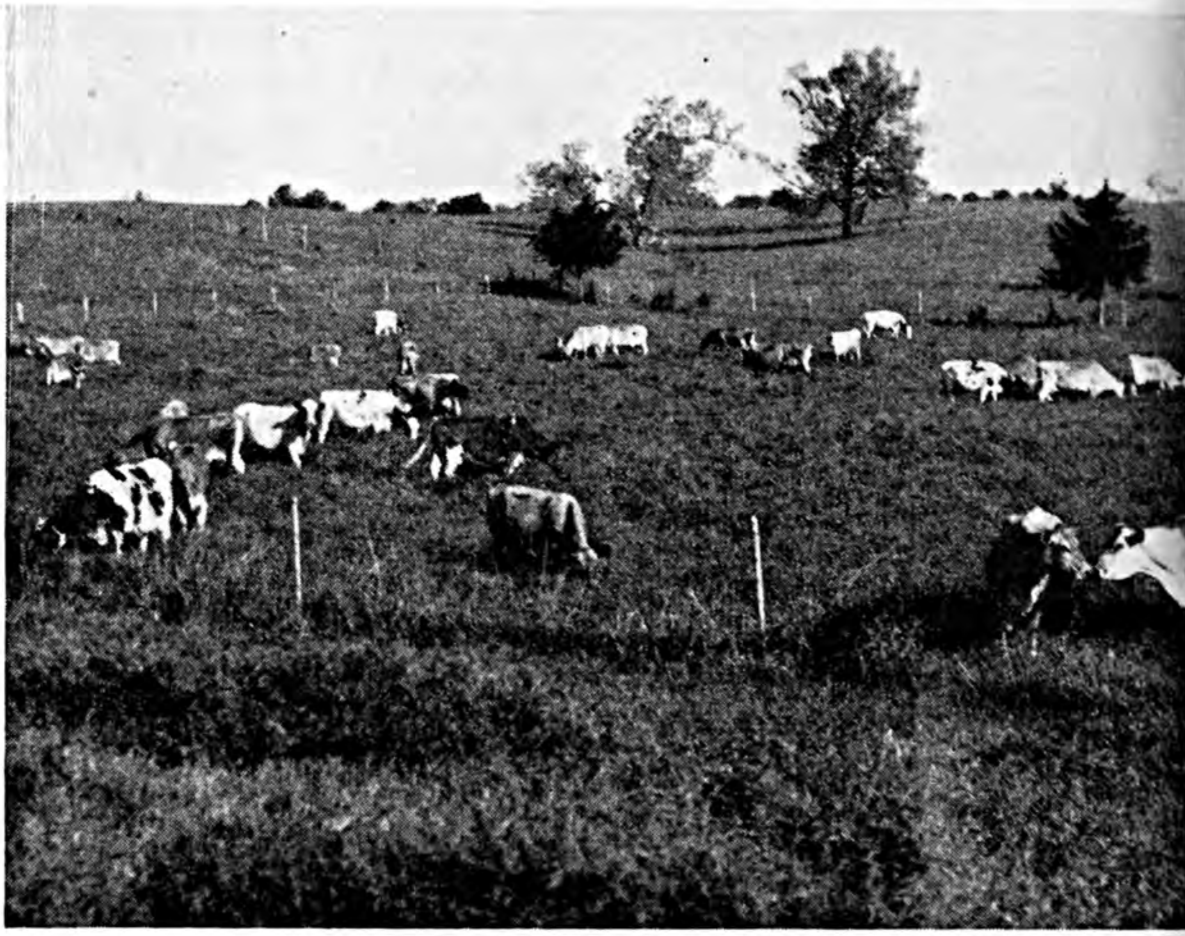
Most Mississippi soils need lime, phosphate, and potash for winter legumes and nitrate for oats. A soil test is the best way to know how much minerals to use. Not enough minerals will sometimes run the cost above the actual needs. The general recommendation for minerals is 2 to 3 tons lime; 250 pounds a year or a 4-year application at the 250-pound yearly rate of 20 per cent superphosphate; and 100 to 200 pounds of potash. Oats to be grazed should receive 30 pounds of nitrogen. Some farmers are using more nitrogen and making a profit.

Cultivated land to be used for grazing should be prepared well after applying minerals and nitrate to get them into the soil. Sod land should be disked thoroughly, but not as deep as cultivated land.

One hundred to 125 pounds of oats to the acre drilled do best. A system of drilling half of the seed one way and half in the other direction is being used. This gives better protection from erosion and a better grazing bed when wet. The last week in August and the first two weeks in September are the dates to plant oats for grazing. A cultipacker should be run over the planted seed. This packing often makes possible the grazing of oats during wet weather. The results of cultipacking are being watched by many farmers. It almost seems like backing up to tell

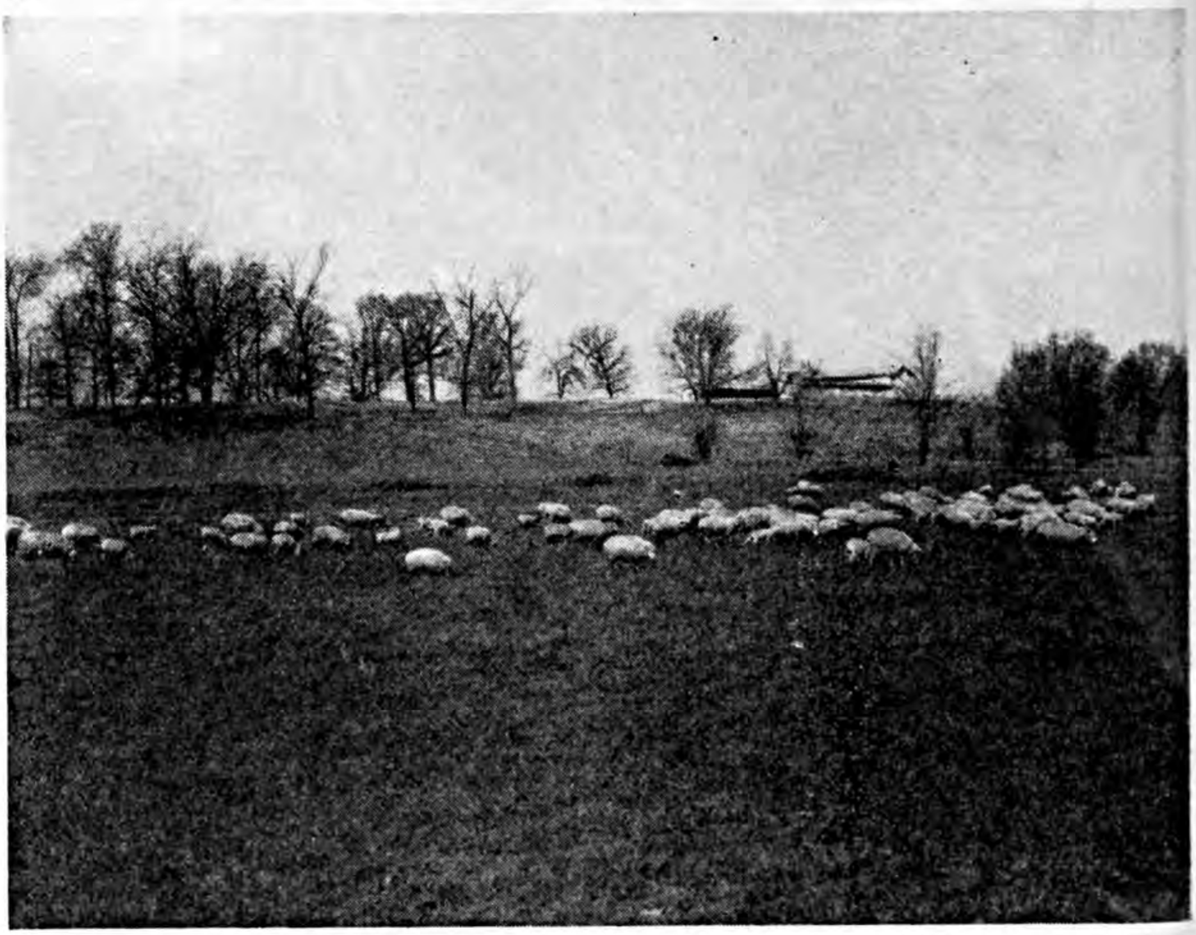
(*Turn to page* 46)

This is typical of what can be obtained from pasture limed and fertilized on the brown loam soils of Mississippi.



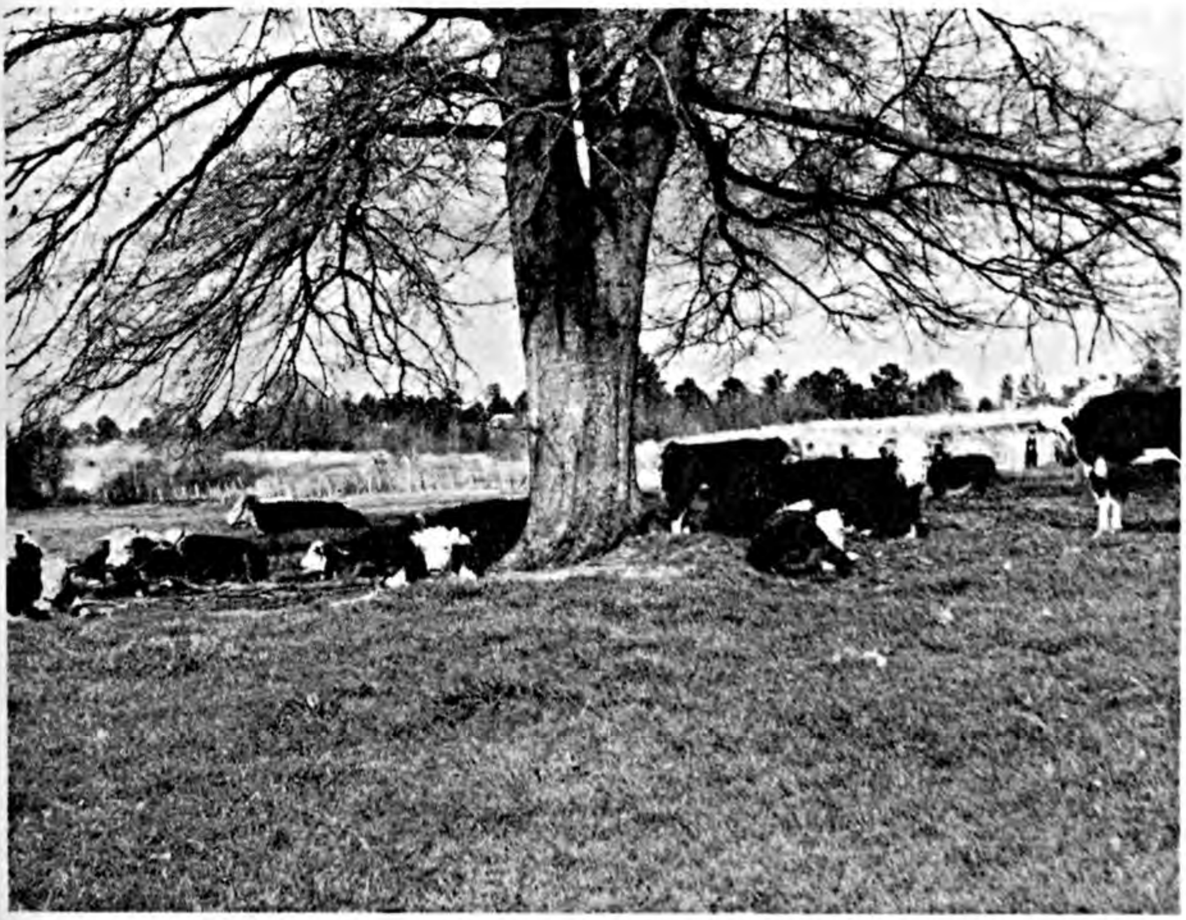
Above: **Temporary grazing from vetch and oats took care of this dairy herd during the winter and spring.**

Below: **Sheep do well on oats for winter grazing. Sheep in Mississippi can be pastured all during the year.**



Above: **This farmer had grazing for all livestock. Two acres of white clover were provided for brood sows and pigs.**

Below: **Oats and vetch carry cattle through the winter in slaughter condition. This picture was taken in February.**



Above: **Unimproved, unfertilized wire-grass pasture furnishes a small amount of grazing from hop clover in the spring.**

Below: **Fertilized with lime, phosphate, and potash and seeded to oats and crimson clover the same pasture as above carried a cow per acre all winter.**

The Editors Talk

How to Charge Off Fertilizer Costs

From time to time a question comes up as to how much of the cost of the fertilizer should be charged to the crop to which it is applied and how much of it might be assignable, from the residual effect, to later crops. This question not only is a factor in determining farm management practices and in figuring costs of production and profit but is important in settling terms of leases. The matter is becoming increasingly pertinent now that fertilizer applications universally are much higher than formerly and their cost can be a considerable item in determining both the cost of production of the crop and cost of capital investment in soil fertility. In European countries where farm tenancy is much more stable, rather exact procedures in allocating fertilizer costs have been worked out.

It is, therefore, gratifying to note in a recent press release from the Illinois College of Agriculture the ideas of J. B. Cunningham, farm management specialist, and A. L. Lang, chief in soil experiment fields, on how to charge off fertilizer costs. One plan should suffice for all purposes, these specialists concur, and the plan when once adopted should not be changed from year to year.

They recommend charging off the cost of a normal application of nitrogen, phosphate, and potash, applied either singly or in combination, in one year when used on field crops, and a heavier than average application in three years. For accounting purposes a normal application is:

1. Less than 100 pounds per acre of total plant food (nitrogen, phosphoric acid, and potash) in a mixed fertilizer, such as 2-12-6, 3-12-12, 8-8-8, and 0-20-20. For example, 300 pounds of 2-12-6 contain 60 pounds of plant food.
2. Less than 60 pounds per acre of plant food (phosphoric acid) in superphosphates, such as 0-20-0 and 0-45-0.
3. Less than 100 pounds per acre of plant food (potash) in potash-fertilizing materials, such as 0-0-50.
4. Any amount of nitrogen fertilizer.

A heavy application is more than the amounts listed.

Charging off the cost of limestone in five years and the cost of rock phosphate in ten years is suggested. This does not necessarily mean that all the benefits are obtained from the limestone in five years nor from the phosphate in ten. This plan has been used by most account keepers in Illinois for more than 25 years, with variations, of course, justified under certain conditions.

In these recommendations the specialists distinguish between outlays for plant-food materials which increase productivity over a period of years and those from which the benefit is of short duration. The former are considered capital investments to be charged off over a period of years. The latter are expenses to be charged off the year the fertilizers are applied.

Productive Pastures

Centuries of pasturing with no return of plant-food elements other than deposits of liquid and solid manure by grazing animals has resulted in a state of soil fertility that seriously threatens the livestock industry. The seriousness of the situation was first sensed in Europe by far-sighted scientists who took definite steps to effect a desirable change. Systems of pasture management which involved both rotational grazing and the replacement of minerals by application of commercial fertilizers were devised. Because of the relative newness of our country and the room for expansion, the efficient grazing of livestock did not become a problem here until, by comparison, recently. Fortunately American farmers are now being rapidly awakened to the need for pasture improvement through the efforts of research workers, extension people, and other agencies.

In this issue of the magazine are to be found two articles on pasture management—one, "Efficient Management for Abundant Pastures" by C. J. Chapman, of the Wisconsin College of Agriculture, and the other, "Year-round Grazing" by W. R. Thompson of Mississippi State College. Both show the progress which is being made in rebuilding soils for the support of livestock.

The fact that the above-mentioned articles happen to have come from the North and the South does not mean that the pasture problem is not national in scope. In recognition of how widespread was the need for arousing interest in better grasslands, a National Joint Committee on Grassland Farming was formed in 1944 under the sponsorship of the American Society of Agricultural Engineers, American Society of Animal Production, American Society of Agronomy, American Dairy Science Association, the National Fertilizer Association, National Association of Silo Manufacturers, Farm Equipment Institute, and the Soil Science Society of America.

The objectives of this Committee were determined as:

1. To promote cooperative research efforts among men in animal production, agricultural engineering, agronomy, chemistry, nutrition, and equipment manufacture, directed toward the solution of the problems of production, harvesting, processing, storage, and utilization of forage crops.

2. To promote correlation among experimental agencies, of research work completed, in progress, or contemplated.

3. To provide workers with information and ideas, to give opportunity for constructive criticism of methods and results, and to stimulate and arrange for necessary regional tests.

4. To assist in the development of equipment for producing, processing, handling, and storing of forage crops on various sized farms.

5. To act as a central clearing agency in the gathering of grassland data on materials, production, equipment, methods, and nutrition.

6. To release and disseminate clear information to the farm public on proven methods for the economic handling of all kinds of forage crops.

In connection with the latter, the Committee has published a well-illustrated, question-and-answer booklet entitled "Green Fields Are Gold." This may be obtained from member organizations or by writing to the Executive Secretary of the Committee, Box 30, Norwich, N. Y.

It is to be hoped that the Committee will "bear the fruit intended." When a problem becomes national in scope, we need a head or clearinghouse in which to center all information tending to its solution. The objectives of this Committee are particularly sound since they would bring together in cooperative effort the strivings not only of research men working in the interest of our soil maintenance, but of industries whose welfare depends upon the welfare of our agriculture.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1920...........	15.9	17.3	125.3	141.7	61.8	182.6	16.46	25.65	....
1921...........	17.0	19.5	113.3	113.1	52.3	103.0	11.63	29.14	....
1922...........	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923...........	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924...........	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925...........	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926...........	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927...........	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928...........	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929...........	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930...........	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931...........	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932...........	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933...........	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934...........	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935...........	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936...........	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937...........	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941...........	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942...........	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943...........	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945...........	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
February.....	23.01	33.9	146.0	223.0	111.0	155.0	15.80	50.30	....
March.......	22.70	31.9	157.0	236.0	114.0	158.0	16.30	47.50	....
April.........	23.59	42.9	162.0	245.0	116.0	158.0	15.00	48.00	....
May.........	24.09	43.0	157.0	251.0	135.0	170.0	14.80	49.60	....
June.........	25.98	59.0	147.0	251.0	142.0	174.0	14.70	51.50	....
July.........	30.83	56.7	148.0	275.0	196.0	187.0	15.00	60.00	....
August......	33.55	48.6	143.0	280.0	180.0	178.0	15.10	59.10	....
September...	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	....
October......	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November....	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December....	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	....
1947									
January......	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	...
Index Numbers (Aug. 1909—July 1914 = 100)									
1920...........	128	173	180	161	96	207	139	114	....
1921...........	137	195	163	129	81	117	98	129	....
1922...........	185	228	95	114	116	109	98	135	....
1923...........	231	190	133	137	129	105	110	183	....
1924...........	185	190	98	170	166	141	107	147	143
1925...........	158	168	245	188	109	163	108	140	143
1926...........	101	179	189	134	116	138	112	98	139
1927...........	163	207	146	124	132	135	87	154	127
1928...........	145	200	76	134	131	113	95	152	154
1929...........	135	183	189	133	124	117	92	137	137
1930...........	77	128	131	123	93	76	93	98	129
1931...........	46	82	66	83	50	44	73	40	115
1932...........	52	105	55	62	50	43	52	46	102
1933...........	82	130	118	79	81	84	68	57	91
1934...........	100	213	64	91	127	96	111	146	95
1935...........	90	184	85	80	102	94	63	135	119
1936...........	100	236	164	106	163	116	94	148	104
1937...........	68	204	76	93	81	109	74	87	110
1938...........	69	196	80	83	76	64	57	97	88
1939...........	73	154	100	85	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	107	117	107	81	211	129
1942...........	153	369	168	136	143	124	91	202	163
1943...........	160	405	188	232	174	154	125	231	245
1944...........	167	420	214	219	170	160	138	234	212
1945...........	181	435	199	228	178	169	127	230	224
1946									
February....	186	339	209	254	173	175	133	223	275
March.......	183	319	225	269	178	179	137	211	283
April.........	190	429	232	279	181	179	126	213	282
May.........	194	430	225	286	210	192	125	220	177
June.........	210	590	211	286	221	197	124	228	185
July.........	249	567	212	313	305	212	126	266	163
August......	287	486	205	319	280	201	127	262	162
September...	285	488	184	255	269	202	130	256	154
October......	304	530	175	238	266	213	136	293	151
November....	236	438	176	228	198	214	145	399	207
December....	242	435	181	239	190	217	149	406	166
1947									
January......	240	390	185	251	188	216	147	401	238

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
February	1.75	1.42	7.81	5.77	4.86	6.71
March	1.75	1.42	7.81	5.77	4.86	6.71
April	1.75	1.42	7.81	5.77	4.86	6.71
May	1.75	1.42	9.08	6.10	4.86	7.30
June	1.88	1.42	10.34	6.42	4.86	7.90
July	1.88	1.42	11.62	8.15	5.34	9.60
August	2.22	1.46	16.88	8.14	6.07	12.14
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
Index Numbers (1910-14 = 100)						
1922	113	90	173	132	140	142
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
February	65	50	223	163	144	191
March	65	50	223	163	144	191
April	65	50	223	163	144	191
May	65	50	259	173	144	207
June	70	50	295	182	144	224
July	70	50	332	231	158	273
August	83	51	482	231	180	345
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14.........	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1922............	.566	3.12	6.90	.632	.904	23.87	....
1923............	.550	3.08	7.50	.588	.836	23.32	....
1924............	.502	2.31	6.60	.582	.860	23.72	....
1925............	.600	2.44	6.16	.584	.860	23.72	....
1926............	.598	3.20	5.57	.596	.854	23.58	.537
1927............	.525	3.09	5.50	.646	.924	25.55	.586
1928............	.580	3.12	5.50	.669	.957	26.46	.607
1929............	.609	3.18	5.50	.672	.962	26.59	.610
1930............	.542	3.18	5.50	.681	.973	26.92	.618
1931............	.485	3.18	5.50	.681	.973	26.92	.618
1932............	.458	3.18	5.50	.681	.963	26.90	.618
1933............	.434	3.11	5.50	.662	.864	25.10	.601
1934............	.487	3.14	5.67	.486	.751	22.49	.483
1935............	.492	3.30	5.69	.415	.684	21.44	.444
1936............	.476	1.85	5.50	.464	.708	22.94	.505
1937............	.510	1.85	5.50	.508	.757	24.70	.556
1938............	.492	1.85	5.50	.523	.774	15.17	.572
1939............	.478	1.90	5.50	.521	.751	24.52	.570
1940............	.516	1.90	5.50	.517	.730	24.75	.573
1941............	.547	1.94	5.64	.522	.780	25.55	.570
1942............	.600	2.13	6.29	.522	.810	25.74	.205
1943............	.631	2.00	5.93	.522	.786	25.35	.195
1944............	.645	2.10	6.10	.522	.777	25.35	.195
1945............	.650	2.20	6.23	.522	.777	25.35	.195
1946							
February......	.650	2.20	6.40	.535	.797	26.00	.200
March.........	.650	2.20	6.40	.535	.797	26.00	.200
April..........	.650	2.20	6.40	.535	.797	26.00	.200
May...........	.650	2.20	6.40	.535	.797	26.00	.200
June..........	.650	2.30	6.45	.471	.729	22.88	.176
July...........	.650	2.60	6.60	.471	.729	22.88	.176
August........	.700	2.60	6.60	.471	.729	22.88	.176
September.....	.700	2.60	6.60	.471	.729	22.88	.176
October........	.700	2.60	6.60	.471	.729	22.88	.176
November.....	.700	2.60	6.60	.535	.797	26.00	.200
December.....	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January.......	.700	2.60	6.60	.535	.797	26.00	.200

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash in bags	Sulphate of potash magnesia	Manure salts
1922............	106	87	141	89	95	99	....
1923............	103	85	154	82	88	96	....
1924............	94	64	135	82	90	98	....
1925............	110	68	126	82	90	98	....
1926............	112	88	114	83	90	98	82
1927............	100	86	113	90	97	106	89
1928............	108	86	113	94	100	109	92
1929............	114	88	113	94	101	110	93
1930............	101	88	113	95	102	111	94
1931............	90	88	113	95	102	111	94
1932............	85	88	113	95	101	111	94
1933............	81	86	113	93	91	104	91
1934............	91	87	110	68	79	93	74
1935............	92	91	117	58	72	89	68
1936............	89	51	113	65	74	95	77
1937............	95	51	113	71	79	102	85
1938............	92	51	113	73	81	104	87
1939............	89	53	113	73	79	101	87
1940............	96	53	113	72	77	102	87
1941............	102	54	110	73	82	106	87
1942............	112	59	129	73	85	106	84
1943............	117	55	121	73	82	105	83
1944............	120	58	125	73	82	105	83
1945............	121	61	128	73	82	105	83
1946							
February......	121	61	131	75	84	108	83
March.........	121	61	131	75	84	108	83
April..........	121	61	131	75	84	108	83
May...........	121	61	131	75	84	108	83
June..........	121	64	132	66	76	95	80
July...........	121	72	135	66	76	95	80
August........	131	72	135	66	76	95	80
September.....	131	72	135	66	76	95	80
October........	131	72	135	66	76	95	80
November.....	131	72	135	75	84	108	83
December.....	131	72	135	75	84	108	83
1947							
January.......	131	72	135	75	84	108	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities †	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1922	132	149	141	116	101	145	106	85
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
February	207	185	156	97	57	175	121	78
March	209	187	158	97	57	175	121	78
April	212	188	160	97	57	175	121	78
May	211	192	162	99	57	189	121	76
June	218	196	163	100	60	203	121	70
July	244	209	181	103	60	230	121	70
August	249	214	187	116	67	293	131	70
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	233	126	69	359	131	78

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Since June 1941, manure salts are quoted F.O.B. mines exclusively.

**** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizer Analyses and Registrations, 1946," Div. of Feed and Fertilizer Control, St. Paul, Minn.

"Fertilizer and Lime Recommendations for New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 503, Dec. 1946.

"Analyses of Commercial Fertilizers, Manures, and Agricultural Lime, 1945," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Insp. Series 21, April 1946, Charles S. Cathcart.

"The Inspection of Commercial Fertilizers and Agricultural Lime Products for 1946," Rel. Service Div., Univ. of Vt., Burlington, Vt., Rept. 4, Nov. 1946, L. S. Walker and E. F. Boyce.

"The Use of Nitrogenous Fertilizers in the Production of Virginia Field Crops," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 397, May 1946, T. B. Hutcheson and M. H. McVickar.

"Report of Inspection Work: Commercial Fertilizers," Dept. of Agr., Charleston, W. Va., Bul. (n.s.) 49, July 31, 1945.

"The 1946-47 Fertilizer Program," Production and Marketing Admin., U.S.D.A., Washington, D. C., Jan. 1947.

Soils

"Physical Land Conditions in the Matanuska Valley, Alaska," Soil Cons. Serv., U.S.D.A., Washington, D. C., Phys. Land Survey No. 41, 1946, W. A. Rockie.

"Studies in Soil Structure: VI. Water Bound by Individual Soil Constituents as Influenced by Puddling," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Tech. Bul. 110, June 1946, T. F. Buehrer and D. G. Aldrich, Jr.

"Soil Survey of Cumberland County, Nova Scotia," Dominion Dept. of Agr., Truro, N. S., Canada, Rpt. No. 2, Oct. 1945, G. B. Whiteside, R. E. Wicklund, and G. R. Smith.

"La Reaccion del Suelo su Importancia Y Control," Editorial "Neptuno," S.A., La Habana, Cuba, Neptuno 559, Jose L. Amargos, M.A.

"Effects of Soil, Soil Treatment, Seasonal Variation, and Variety on Yield and Composition of Corn Crops Grown on Kentucky Soil Fertility Plots," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 485, May 1946, M. E. Weeks and E. N. Fergus.

"Report of the Chief of the Soil Conservation Service, 1946," U.S.D.A., Washington, D. C.

"Soil Survey—Kings County, California," U.S.D.A., Washington, D. C., Series 1938, No. 9, Oct. 1946, J. L. Retzer, R. A. Gardner, L. F. Koehler, and R. C. Cole.

"Soil Survey—Fulton County, Indiana," U.S.D.A., Washington, D. C., Series 1937, No. 17, Aug. 1946, O. C. Rogers, A. P. Bell, T. E. Barnes, Sutton Myers, and A. T. Wiancko.

"Soil Survey—Bucks County, Pennsylvania," U.S.D.A., Washington, D. C., Series 1936, No. 25, Oct. 1946, R. T. A. Burke, R. K. Craver, R. B. Alderfer, and E. C. Dunkle.

"Soil Survey—Hamblen County, Tennessee," U.S.D.A., Washington, D. C., Series 1940, No. 1, Oct. 1946, A. R. Aandahl, J. T. Miller, C. B. Beadles, M. E. Swann, and Foster Rudolph.

Crops

"Ninth Progress Report, 1942-1943," Agr. Exp. Sta., Univ. of Alaska, College, Alaska.

"Report of the Minister of Agriculture for the Dominion of Canada for the Year Ended March 31, 1946," Dept. of Agr., Ottawa, Canada, 1946.

"Seventy-First Annual Report of the Ontario Agricultural College and Experimental Farm, 1945," Dept. of Agr., Ontario, Canada, 1946.

"Frameworking Fruit Trees," Dominion Dept. of Agr., Ottawa, Canada, Publ. 781, F.B. 136, 1946, R. J. Hilton.

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"Ornamental Trees," Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla., Bul. 95, Rev. July 1946, Harold Mowry.

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"The Florida Home Garden," Agr. Ext.

Serv., Univ. of Fla., Gainesville, Fla., Bul. 131, Dec. 1946, F. S. Jamison.

"Fifty-second Annual Report: Wartime Agricultural Research," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Bul. 264, July 1945.

"Fifty-seventh Annual Report, Year Ending June 30, 1944," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind.

"Growing an Orchard in Kansas," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Bul. 330, Aug. 1946.

"Report of Progress for Year Ending June 30, 1945," Agr. Exp. Sta., Univ. of Maine, Orono, Me., Bul. 438, June 1945.

"Small Grain Variety Trials, 1932-1945," Agr. Exp. Sta., Univ. of Maine, Orono, Me., Bul. 445, July 1946.

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"Nut-Growing," College of Agr., Cornell Univ., Ithaca, N. Y., Ext. Bul. 701, Sept. 1946, L. H. MacDaniels.

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"Annual Report, 1944," Ext. Serv., Texas A & M, College Station, Texas.

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"Snap Beans for Marketing and Processing," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1041, Oct. 3, 1946, W. H. Friend.

"Introducing Three New Berry Varieties of the Ness Family," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1043, Oct. 31, 1946, S. H. Yarnell.

"Strawberry Growing in the Lower Rio Grande Valley," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1044, Oct. 31, 1946, W. H. Friend.

"Fruits for Home Use and Local Markets," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1045, Oct. 31, 1946, W. H. Friend.

"Report of the College of Agriculture, University of Vermont, July 1, 1945-June 30, 1946," College of Agr., Univ. of Vt., Burlington, Vt., A.R. No. 2, Dec. 1946.

"Vermont Agriculture, 1945-1946," Dept. of Agr., Montpelier, Vt., 23rd Biennial Rept.

"The Culture of Aromatic (Turkish) Tobacco," Va. Polytechnic Inst., Blacksburg, Va., Cir. 397, May 1946, H. W. Jackson.

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"Growth and Rubber Accumulation in Guayule as Conditioned by Soil Salinity and Irrigation Regime," U.S.D.A., Washington, D. C., Tech. Bul. 925, Nov. 1946, C. H. Wadleigh, H. G. Gauch, and O. C. Magistad.

Economics

"Cattle Ranching in Western Canada," Dept. of Agr., Ottawa, Canada, Publ. 778, Feb. 1946, C. W. Vrooman, G. D. Chattaway, and Andrew Stewart.

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"The 1947 Agricultural Conservation Program Handbook for: SRB-1101-Ala.; SRB-1101-Ark.; SRB-1101-Fla.; SRB-1101-Ga.; SRB-1101-La.; SRB-1101-Miss.; SRB-1101-Okla.; SRB-1101-S.C.; SRB-1101-Tex., U.S.D.A., Washington, D. C.

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"Kentucky Handbook of Conservation Practices, 1947," ECR-1101-Ky., U.S.D.A., Washington, D. C., Sept. 30, 1946.

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Radioactive Research

USING radioactive iodine supplied by "Manhattan District," Oak Ridge, Tenn., three U. S. Department of Agriculture scientists report experiments with a synthetic radioactive chemical that gives new light on 2,4-D as a weedkiller. These tests are explorations in working out answers to some of the many "what?" "how?" "where?" and "why?" questions that puzzle science in connection with 2,4-D and other growth-regulating substances. This new research tool is identified by the initials, "INBA"—the first standing for the iodine.

Applied to a leaf of a young bean plant the INBA moves through the plant and concentrates in partly expanded leaves at the growing point and severely checks their growth. Applied similarly to a barley plant, INBA likewise concentrates in the young leaves but apparently does not injure the plant much. The radioactivity makes it possible to use a delicate instrument—an electrometer—to trace the INBA moving in the plant in a manner similar to that used to trace iodine and other elements in animals.

In some respects INBA acts similarly to 2,4-D, which has developed in a few years from a laboratory novelty to have enormous practical value, particularly as a weedkiller. Like 2,4-D, the INBA has a selective effect, injuring the broad leaf beans but having only slight effect on the grassy barley.

In applying this by-product of atomic bomb research to plant study, the investigators are looking forward to the possible use of INBA and other closely related growth regulators in practical crop production. Fortunately INBA is fairly easy to synthesize in the laboratory, and radioactive iodine can readily be obtained. Radioactive iodine has a "half life" (loses half its radiant power) of 8 days, which is longer than many radioactive chemicals.

But quick work and use with young and rapidly developing plants are necessary to make effective use of the radiation in following out the results of INBA treatments.

The immediate object is to gain new information leading to a better understanding of this relatively new field of plant research on "growth-regulating substances." Broadly it should help in explaining and suggesting new studies of the physical, chemical, and biological results that are brought about by the action of vitamins, enzymes, hormones, viruses, genes, and microscopic quantities of some minerals.

Farm System Decides Fertilizer Needs

"HOW much fertilizer should I use in grain and livestock systems of farming?" is a common question being asked agronomists at Purdue University this winter.

G. P. Walker, extension agronomist,

bases his answer on results obtained from the long-time operation of these two systems on two Purdue experimental fields. In the livestock system on the Soils and Crops Farm located near Lafayette, 300 pounds of 2-12-12 fertilizer on wheat and 100 pounds of 0-12-12 in the hill for corn in combination with eight tons of manure have produced an average of 78 bushels of corn and 40 bushels of wheat per acre during the past six years, in a rotation of corn, wheat, and clover. The same amounts of 2-12-20 fertilizer with manure have produced yields averaging 90 bushels of corn and 30 bushels of wheat per acre in the same rotation on the gray silt loam soil of the Jennings County Experiment Farm near North Vernon.

In the livestock system of farming, all the phosphate and about 55 to 60 per cent of all the potash removed in the harvested crops have been returned to the soil. The profits over costs, during this period, have been larger from these treatments than from any which restored less phosphate and potash to the soil.

In a straight grain system of farming, corn, soybeans, and wheat (with sweet clover intercrop), the agronomist points out that on the Lafayette farm, yields averaging 76 bushels of corn, 30 bushels of soybeans, and 36 bushels of wheat per acre were produced during the same period. The fertilizer used was 300 pounds of 3-12-12 on wheat, 100 of 0-12-12 in the corn hill, 60 pounds of potash plowed under for corn, and 20 pounds of nitrogen broadcast on wheat in April. Under this system of fertilization, the equivalent of all the phosphate and potash removed in the harvested grains was also returned to the soil and likewise produced larger returns over costs than were obtained from comparative studies where lesser amounts of fertilizer were applied.

Increased Quality of Products Is Answer to the Problem

(*From page* 24)

facts concerning the whimsies of alfalfa, "gathered from their replies that the important thing was to keep the crop so well fed that it could ward off disease, and hold its own in competition with other grasses." Then he goes on to show that even "if alfalfa got half its food from soil reserves, you still would have to use a ton each of superphosphate and potash to sustain a 4-ton alfalfa crop over a 10-year period."

Ten pounds of borax increased a spinach yield by 6,534 lbs. in Passaic County. The grower's income was increased $230 per acre by a small investment of time and money.

Sixty pounds of manganese sulphate per acre produced a marked difference in quality when applied to a Camden County spinach patch last September. The manganese deficiency was discovered by a soil test and was verified by a plant-tissue test.

You have noted that many of the instances I have cited call for the use of fertilizer materials in excess of the usual recommendations. This may be comforting to fertilizer salesmen looking for increased commissions. It may be disturbing to producers who feel their fertilizer bill is high enough as it is. But researchers have apparently uncovered enough facts which point to the necessity of feeding crops what they really need, in order to produce quality goods. Producers might well consider that increased returns stand ready for those who are awake to the significance of Scarseth's statement that in 1945 "if all the phosphate used in the nation went only to corn land, the corn would be fairly well fertilized," and that "returning to the soil just the phosphate the grain takes off would be supplying only half as much as is agronomically and economically sound." . . . "In 1946," he says, "we are returning to the land only about 2 to 5% of the potash lost by crop removal and erosion."

"Hunger Signs in Crops," to borrow a title of a very good book, might well have been the heading for this discourse.

Should we overlook these signs? This sign language of the plants tells an exceedingly significant story. I think that we as agricultural agents could well spend much more time in the detailed study of these hunger symptoms, their cause, identification, and remedy, so that we can more specifically point out to growers the cause and treatment for these troubles which they find interfering with quality production.

A wealth of research has been done on these matters. Experiment Station workers, the American Society of Agronomy, the National Fertilizer Association, processing companies, and the U. S. Department of Agriculture have brought together a vast store of information of a real practical nature, which is simply crying for dissemination among a clientele which I believe is ready to receive it.

This information is not for the sole edification of the scientists who produced it. It has dollar and cents value to growers, to fertilizer men, and eventually to society at large, which, whether it knows it or not, has its very existence bound up in the profitable production of healthy plants.

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Sugar Beets Require Adequate Soil Aeration

(*From page* 10)

to why it is so essential for adequate aeration during the production of sugar beets following the growth of a leguminous crop.

Summary

The results obtained in this greenhouse experiment suggest that adequate aeration of the soil is very necessary for the production of sugar beets. Compaction alone of the soil, as used in this experiment, was much more detrimental than an application of excess water alone; but used in combination, the effects were even much more pronounced. Compaction of the soil alone and in combination with excess water resulted in marked disturbance of the

TABLE 3. YIELD OF SUGAR BEET TOPS.

Physical treatment	Mean[1] dry weight of sugar beet tops for			Series average grams
	Alfalfa series grams	Corn series grams	Sweet clover series grams	
1. Normal	27.6	20.6	30.3	26.2
2. Aeration	27.9	16.7	32.6	25.7
3. Compaction	3.4	9.2	2.7	5.1
4. Aeration and compaction	12.7	11.8	6.3	10.3
5. Excess water	31.4	24.2	29.2	28.3
6. Excess water and aeration	33.9	16.1	33.7	27.9
7. Excess water and compaction	.5	.6	1.3	.8
8. Excess water, aeration, and compaction	4.6	4.5	6.0	5.0
Average for all treatments	17.7	13.0	17.8	16.2

[1] Mean of four replicates.

normal oxidation and nitrification processes which occur in the soil. Inadequate aeration apparently was more injurious to sugar beets following legumes than to beets following corn.

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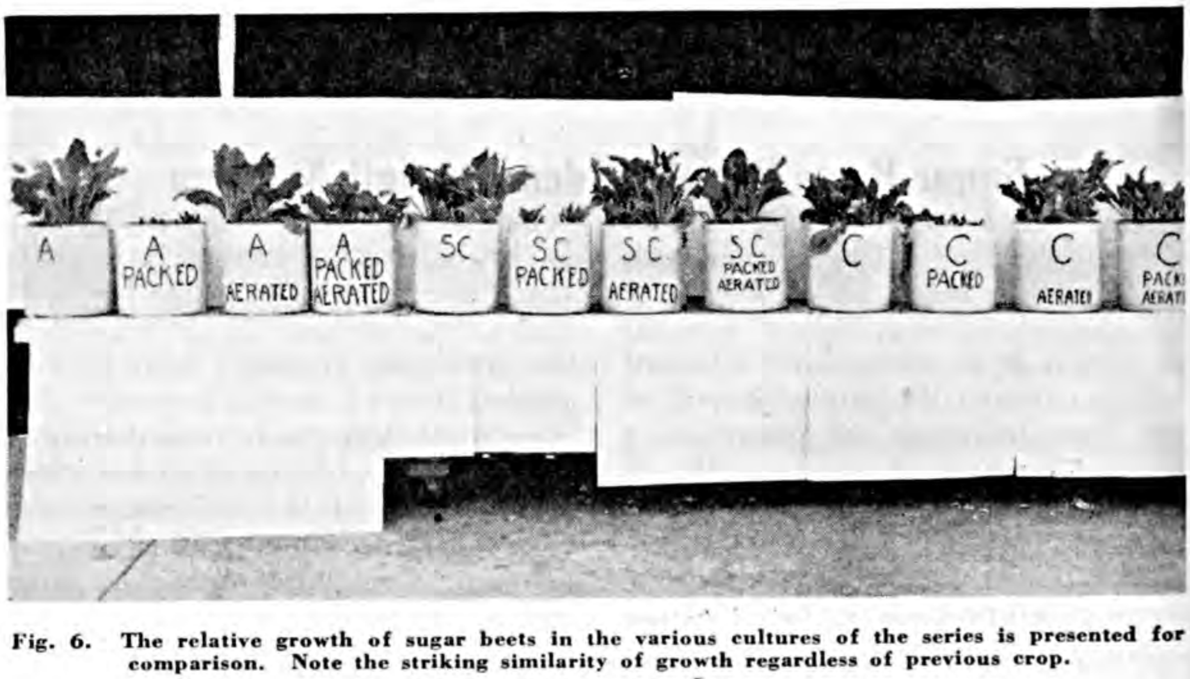


Fig. 6. The relative growth of sugar beets in the various cultures of the series is presented for comparison. Note the striking similarity of growth regardless of previous crop.

Efficient Management for Abundant Pastures

(From page 22)

the soil and becomes available with late summer and fall rains, or may even be carried over to the following spring.

Lime-Phosphate-Potash Supply Must Be Maintained

It is true the increased growth of grasses due to nitrogen fertilization will quickly use up the supplies of readily available phosphate, potash, and lime in our soils, and it soon becomes necessary to use mineral fertilizers on our pastures. In fact, we recommend the liming of acid pasture lands at the outset. A basic treatment of phosphate and potash is also recommended for most pasture lands along with the nitrogen fertilizer. The application of from 300 to 500 pounds per acre of such mixtures as 0-20-10 or 0-20-20 every four years is suggested. On the more fertile pasture lands nitrogen fertilizers alone may be used for a period of two or three years before it becomes necessary to replenish the phosphate-potash reserves of these soils.

Nitrogen fertilizers are grass fertilizers and should not be used on pastures where clover or other legumes predominate. Legumes fix most of their own nitrogen.

Profits Shown in Demonstrations

Numerous trials and demonstrations have been conducted to determine the actual returns which can be expected from the use of nitrogen fertilizers on permanent grassland pastures. In most of the demonstrations carried out by the writer, the response to treatment with nitrogen fertilizers was measured in terms of milk production. In these demonstrations uniform pasture fields were divided in equal halves. One half of each was treated with a nitrogen fertilizer. Records were kept of the number of days the cows grazed on each half and also the pounds of milk produced.

In the spring of 1945 a demonstration was set up on the Wells Himsel farm at Paoli (Dane County, Wisconsin). A 23-acre creek bottom pasture was selected. It was divided in half with an electric fence. Ammonium nitrate (33% nitrogen) was applied at the rate of 200 pounds per acre on the west half of this pasture. The entire herd of 20 dairy cattle was turned into the fertilized half on May 19. They were rotated back and forth from the fertilized to unfertilized portions for a period of 4 months and 26 days. The experiment was terminated October 10.

The fertilized half was ready for grazing a good week earlier than the unfertilized and for the period from May 19 to the middle of July there was a tremendous difference in the amount of grass on the fertilized as compared to the unfertilized half. One notable observation made during the July-August period was the great difference in weed infestation. The unfertilized portion became badly infested with white top daisy and other weeds. There were very few weeds in the fertilized half due apparently to the early vigorous and rank growth of the grass. This lush growth of grass, as well as the weeds in this early stage, was grazed off. There was a noticeable difference during the entire summer in the thickness of the turf—the fertilized half produced a matted sod where the unfertilized half was always thin and sparse.

Except for a period of 14 days (September 4 to 18) this 23-acre pasture furnished all of the feed for the whole herd the entire summer. (During the period September 4 to 18 the herd had access to a stubble field of new seeding clover as a supplement to the feed furnished from the fertilized half. One-half of the milk production was credited to the extra feed furnished from the field of new seeding clover.) The results are shown in Table 1.

TABLE 1. RESULTS OF FERTILIZED-PASTURE DEMONSTRATION ON WELLS HIMSEL FARM.

Number of pasture days for entire herd on fertilized area	96
Number of pasture days for entire herd on unfertilized area	50
Pounds of milk produced while on fertilized half	31,479
Pounds of milk credited to new seeding clover (14 days) (½ of total production for period September 4–18)	1,580
Total net pounds of milk credited to fertilized pasture	29,899
Total pounds of milk produced while on unfertilized pasture	16,678
Pounds of milk increase resulting from fertilizer	13,221
Value of 13,221 pounds of milk at $3.25 per cwt	$429.68
Value of pasture for 3 heifers, 3 dry cows, and 1 bull (46 days)	$ 15.00
Total value of increased production due to fertilizer	$444.68
Cost of ammonium nitrate used on fertilized half	$ 48.00

This and many other demonstrations have proven without question that nitrogen fertilizer can be used profitably on much of our better permanent pastures in Wisconsin. A handsome profit has been shown in this demonstration. The increase in milk production was due not only to the larger amount of grass but also to an improvement in the quality as well. Analyses for the protein content of the grass from each area were made in the early stage of growth (May 20th). Oven-dried samples from the fertilized portion yielded 23.1% protein as compared to 17.5% for the unfertilized grass. Mr. Himsel's cattle grazed the tender, lush, fertilized grass with apparent eagerness and relish.

But again I wish to point out that the available supply of essential minerals (lime, phosphate, and potash) must be maintained at reasonable levels in our pastures in order that the nitrogen fertilizers may produce maximum increases. Adequate supplies of these minerals are essential in the synthesis and building of the organic constituents of the forage produced on these pastures. In turn, lime and phosphorus are important in the animal body-building and maintenance functions and are needed in abundance by dairy cattle in the production of milk. Potash is said by some authorities to play an important role in connection with the synthesis of vitamin A. Where these mineral elements are lacking in a soil the forage will be deficient in them and in turn these deficiencies will be reflected in the health of our livestock. And so it is important to lime acid pasture land and apply phosphate and potash fertilizers where soil tests indicate a need for these minerals.

Summary

1. The renovation of old established grass pastures is the number one practice recommended in a long-time pasture improvement program. The rejuvenation of these old pastures can be accomplished by the liberal application of lime and mineral fertilizers, thorough seedbed preparation, and the seeding and establishment of deep-rooted legumes and grasses.

2. The application of nitrogen fertilizer should be confined to those pastures where the moisture-holding capacity is good and where there is a fair to good turf to start with. The fertilization of thin, poor turf on droughty or grub-infested pastures is not recommended.

3. Grass pastures will be ready for grazing from five to seven days earlier in the spring providing the fertilizer is applied a good two weeks before growth starts. Best results will be ob-

tained where the fertilizer is applied early. However, fair responses have been observed even where applied up to the middle of May.

4. The production of a thick-matted turf of rank-growing grasses will choke and subdue to a considerable extent the growth of weeds such as orange hawk-weed, daisies, ragweed, and yarrow. (This is especially true where the early growth of grasses is grazed off uniformly during the early months of May and June.) The early grazing of the lush growth of grass is desirable also in order that the native white clover and other legumes be given opportunity for establishment and growth.

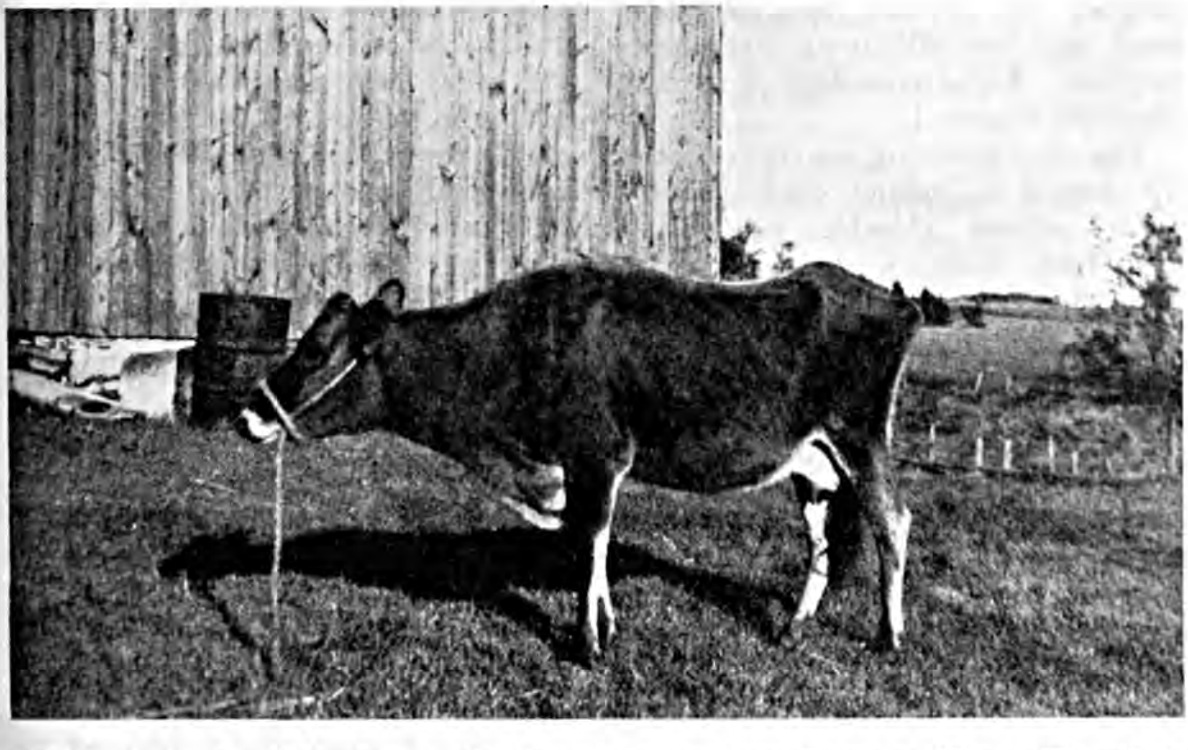
5. The continuous use of straight nitrogen fertilizer will eventually deplete the reserves of minerals in the soil (lime, phosphorus, and potash). The liming of acid pastures is recommended. Treatment with phosphate-potash fertilizers is likewise suggested on fields where soil tests show inadequate supplies of these elements.

6. Old renovated pastures, where the legumes (clovers and alfalfa) have disappeared, will respond generously to treatment with nitrogen fertilizer.

7. The application of nitrogen fertilizer in the early fall is not recommended in Wisconsin. Late fall application of nitrogen fertilizers (after growth has ceased and just before or after freeze-up) is permissible.

8. Nitrogen fertilizers are not recommended for pastures where clover or other legumes predominate. Legumes fix their own nitrogen.

Pasture improvement through the use of nitrogen and mineral fertilizers now looms up on the horizon of post-war opportunities. We must again begin to think of low unit cost production. I am convinced that there are millions of acres of pasture lands in Wisconsin and other Midwestern states where the application of nitrogen will be found highly profitable. We now have in this country a great new potential source of a protein feed in these synthetic ammonia plants which were built during the war period. This increased capacity for the production of fixed



This Jersey cow is suffering from a phosphorus deficiency disease known as "Pica." The soils in certain areas of northeastern Wisconsin, where this picture was taken, are known to be extremely deficient in available phosphorus. Liberal treatment with mineral fertilizers, such as 0-20-10 or 0-20-20, is recommended in addition to treatment with nitrogen on such soils.

nitrogen added to our normal output of ammonia sulphate and other nitrogen fertilizers plus imports of sodium nitrate should and will provide farmers with low-cost nitrogen fertilizers in the years ahead. More abundant pastures will give us low cost feed and in turn will make possible greater production of low cost milk, meat, and other food products.

Recent South Carolina Studies on Potash with Cotton

(*From page* 17)

of sodium may materially increase the yield of cotton where there is a relatively light application of potash and that certain combinations of potassium and sodium are as effective as equivalent quantities of potassium. For example, 30 pounds of potash in combination with sodium gave practically as high production as the 40 pounds of potash alone. The 25-pound application of potash plus a side-dressing of nitrate of soda produced a higher yield than the 30 pounds of potash without sodium nitrate as a side-dressing."

In the 600 pounds per acre of 5-10-0 plus sodium chloride and potassium chloride applied in these tests, the 15 pounds of nitrogen applied as a side-dressing was one-half from cottonseed meal and one-half from ammonium sulphate. Equal poundage of the two chlorides was used.

The plots receiving the equivalent of 40 pounds of sodium oxide (Na_2O) from sodium chloride yielded 46 per cent more seed cotton than the plots which did not receive sodium chloride or potassium chloride. The plots which received the equivalent of 25 pounds of Na_2O and 15 pounds of K_2O and the plots which received the equivalent of 10 pounds of Na_2O and 30 pounds of K_2O yielded 98 and 174 per cent more respectively, than the plots which received neither Na_2O or K_2O. The 40 pounds of K_2O alone resulted in a 160 per cent increase.

In his studies of the function of plant nutrients, Dr. Cooper has found experimental data to indicate definitely "that certain mineral nutrients can partly replace or supplement each other in the nutrition of plants." On this point he says:

"After supplying the quantity of a nutrient such as potassium necessary for its specific function, it is possible that another similar chemical element such as sodium or rubidium may be utilized by certain plants in maintaining a favorable ionic balance in the plant and that it will produce approximately the same growth response as an equivalent amount of additional potassium. Therefore, where both potassium and sodium are added in fertilizers, it is necessary to consider the possible growth response from the sodium after the specific requirement of the plants for potassium is met."

Year-round Grazing

(*From page* 26)

a farmer to do a good job of tearing land up and do a better job packing it down again, however the benefits of the cultipacker cannot be overemphasized.

Oats are planted in two ways for winter grazing. By one system, oats are planted alone to be followed by lespedeza in February or March. The oats are cut for grain and the lespedeza grazed or cut for hay or seed. With the other system, oats and legumes are grazed off, cut for hay or seed, and followed by Sweet Sudan or grain sorghum or Alyce clover.

Legumes to plant with oats include crimson clover, vetch, wild winter peas, and red clover. Seed crimson clover at the rate of 20 pounds to the acre and cultipack after oats are drilled. Seed 25 pounds of vetch or 40 pounds of wild winter peas to the acre at the time the oats are planted. Cultipack 10 pounds of red clover to each acre after oats are planted.

During mild winters legumes give plenty of grazing, but they grow best in the early spring. Mississippi's best early winter grazing crop is oats. Oats and legumes can be grazed off, cut for hay while oats are in dough stage, or left and legume seed and oats harvested. After legume and oat crops, summer grazing crops can be planted.

The grazing of oats can be started about October 15 or November 1 when they are six inches high. They can be grazed through the winter by turning livestock on the sod land when the ground is wet. Stop grazing oats on March 1 and move the livestock to clovers or legumes. Top-dress oats with 30 pounds of nitrogen for grain.

Interplant oats alone with 25 pounds of lespedeza the last of February or the first of March and top-dress with 30 pounds of nitrogen. Grain production will not be cut by grazing during winter. In south Mississippi, Alyce clover gives grazing during early winter and at the same time volunteer winter peas are coming up in the clover for later grazing. The black belt and delta areas use winter peas for winter grazing where farmers let seed volunteer, especially in Johnson grass fields.

Many cotton and livestock farmers are planting a legume and oats in cotton with the last cultivation. They plant 75 pounds of oats with either 40 pounds of winter peas or 25 pounds of vetch.

Spring Grazing

Spring grazing is clover and legume grazing mostly. The season runs from March 1 to June 1. Farmers should allow a third of an acre for each cow for spring grazing.

The work toward spring grazing is done in the fall. The land is prepared, mineralized, and seeded. Land should be prepared well for clovers. Either cultipack it or let rain settle it before planting. Inoculate clover seed and plant in October on top of the prepared seedbed. Plant clovers with wheelbarrow seeder or cyclone seeder.

Clovers are heavy users of the minerals—lime, phosphate, and potash. A soil test is the best way to determine the minerals needed. Generally clovers need 500 pounds of 20 per cent superphosphate, 100 to 200 pounds of potash, 2 to 3 tons lime, or 1,000 pounds of basic slag in place of the lime and phosphate.

For all sections of Mississippi white Dutch clover is best. It makes the best growth when it is planted and grown alone. To keep a balance of grasses and legumes, it is best to plant white Dutch with dallis grass or in special areas with Italian rye or fescue grass. Grasses help in bloat control.

If one-fourth of the land to be planted in white Dutch can be mineralized and renovated each year, a balance between clover and grasses can be kept and a 4-year supply of minerals on the section renovated can be applied. Bermuda and carpet grasses tend to take charge of clover fields in Mississippi in 4 to 5 years.

Dallis grass can be planted on the white Dutch area in October at the same time clovers are being planted. Drill 15 pounds of good seed before running cultipacker for white Dutch planting. A successful way to get a stand of dallis is to mulch dallis grass hay at the rate of 1 ton to 3 acres. By protecting white Dutch clover the first season, the dallis grass can become established.

Winter grazing of clovers should be

confined to established clovers and not to newly planted clover. Established clover will give oat fields relief during the winter. Graze them a few days at a time or fit them into rainy weather grazing. Start grazing a new clover area when it is 4 inches high.

White Dutch clover is planted 5 pounds to the acre, hop clover 3 to 5 pounds, crimson clover 20 pounds, subterranean clover 3 to 5 pounds, red clover 8 to 10 pounds, and black medic 5 pounds. Other legumes used for winter and spring grazing are wild winter peas and vetch. Winter peas and vetch can be grazed on cropland and later used as cover crops or used for grazing and harvested for seed.

As a general rule, Mississippi has plenty of grazing during the spring season. If farmers don't prepare for good summer grazing, they will lose clover gains on scant summer pastures. Twice during the clover-grazing period, run a spike-tooth harrow over the area to scatter the manure. If this is not done, cows will graze one area closely and let the other grow. They leave the plants because of an overbalanced condition in the plant, especially of nitrogen products.

Sometimes it pays to mow clover to keep it from maturing. Clovers do not grow after blooming out. The plants will keep growing when the old growth is mowed off. Most livestock like growing plants better than mature plants.

When cattle are moved from clovers to summer pasture, drag the harrow again and mow the area to remove any mature clover or weeds. This clover area will be ready for grazing again in 3 or 4 weeks as a summer dallis pasture. The nitrate stored by the pasture is ideal for dallis grass production.

Summer Pastures

An acre should be allowed for each animal unit during the summer pasture season from June 1 to September. The history of pastures is that the summer pasture should be the best. Farmers today are recognizing that they need to plan and care for their summer pastures more than any other. The two worst enemies of summer pastures are lack of moisture and weed growth.

The permanent pasture for summer is dallis following clovers and dallis and Bermuda with lespedeza. If this area is allowed to get a start while livestock are on spring clovers, there will be good grazing waiting when clover grazing is over.

The sod pasture which is used for planting oats for grazing will be in excellent condition for summer pasture. Lespedeza interplanted in oats furnishes ideal summer grazing.

Thirty pounds to the acre of Sweet Sudan can be planted following winter peas or oats and legumes. Nitrate at the rate of 30 pounds of nitrogen to the acre pays off on Sudan. Sudan can be grazed when it is 12 to 18 inches high. Control the grazing for best results. It is easy to graze dairy cattle two hours a day and then turn them back to permanent pasture.

Alyce clover furnishes more grazing for south Mississippi than most any other plant and fits into the spring legume and grain crop rotation. The biggest enemies of Alyce clover are grass and weeds choking it out before the plants get established. Alyce clover is planted 30 pounds to the acre.

Kudzu furnishes good grazing during August and September and helps out in conserving soil in sections where it grows well.

Weeds and grass must be controlled. One way is to plant on new land or land which had a heavy spring legume crop. The other is to graze or mow the first crop of weeds and grass. The mowing machine is one of the best tools for pasture improvement. Regular mowing controls weeds and keeps grasses and clovers balanced.

Johnson grass in the delta and black belt areas furnishes good grazing, where established. If winter peas grew in the Johnson grass during the winter and spring, they added the necessary nitrogen. Johnson grass will

Dallis grass and white Dutch clover grow well together—the dallis for summer grazing, the white Dutch for spring.

not be profitable if it is not cultivated in some way.

If summer pastures can be given a rest during the last of the summer, they will give profitable grazing in the fall. If they are grazed closely all summer, little fall grazing from summer pastures can be obtained.

Fall Pastures

Fall pastures will be good if the summer pastures are treated and managed properly. The fall pasture season runs from September 1 to November 1.

Dallis and Bermuda grass put out new growth with the first rain in the fall. Mow pasture in September to get rid of weeds and mature grass. Clipping encourages new growth. Grain sorghum fields furnish some supplemental grazing in the fall. Corn and bean fields, after the corn is harvested, will also supplement pastures.

Fall is the ideal time to apply minerals on established stands of grasses and clovers. Disk the minerals into the soil.

The secret of plenty of good pasture is allowing plenty of land, plenty of minerals, along with good preparation followed by good management.

Backtracking

(*From page* 5)

the Midwest did not savvy the systems advocated by this California prophet. But it kept the soup stirred just the same.

AS THE aforesaid national conference met, two chaps came from the Mississippi Valley with fire in their eyes. These men had been trying to make and sell a line of good farm machinery at Moline. The implements were all right and the farmers liked to use them, but hard times and distress prevented that "fair exchange value" that any red-blooded guy must have to keep on producing and keep on buying.

Beset with credit bothers resulting from just this stalemate, these two manufacturers of plows and harrows began to study ways and means of fixing things to enable willing farmers to dare risk their investment in bumper food production. Unless they found a way to untangle this twisted mess, farm machinery warehouses would be too full for comfort and dealers would quit business.

Instead of blasting their ideas into the stubborn and conservative conference going on, these two men wheedled cabinet members and the farm bloc contingent into listening to their proposals. So in a long series of executive sessions largely devoid of newspaper eavesdropping, George N. Peek and General Hugh S. Johnson laid their case before some sympathetic minds. Later some economists took a look at the implement men's program, and the first drafts of proposed laws to sketch out their dreams were written in the Department of Agriculture in 1923. Most of this backstage stuff went on with less fanfare and whoop-tedoo than would be possible today, when most newshawks scent a keen story in every angry farm confab.

All that need be said further regarding the Peek-Johnson-Wallace brain child is that the gist of its conception of remedies for stagnant agriculture was embodied in successive drafts of the laws enacted and then vetoed by President Coolidge. As everybody knows, the Congressional godfathers were Senator Charles L. McNary of Oregon and Representative Gilbert N. Haugen of Iowa. Possibly this original brief foreshadowing McNary-Haugen bills, as presented to the Farm Bureau by Peek & Johnson, may yet become a sort of Magna Charta to indicate a buried past in farm economics and the dawn of an entirely new commercial phase of farming.

ABOUT a decade later I was associated with many of the men who supported movements of a "radical" nature in regard to changing agriculture. The list includes both George Peek and Hugh Johnson (AAA and NRA chiefs, respectively) as well as Charles J. Brand, M. L. Wilson, Chester Davis, and the second Secretary Wallace. Indeed in the days just referred to, almost all farm folks had become somewhat "radical," because any kind of action was far better than taking it on the chin while lying down. Washington was full of foment and lather, and the government was the court of last resort. It was the last place of mutual faith, next to Heaven and the Promised Land, and everybody and his brother who were in trouble rushed to the banks of the Potomac—where nothing was "quiet."

The McNary-Haugen bills really outlined a minimum of real interference with existing agencies and aimed only at the separation of exportable crop surpluses so as to bring domestic farm income in line with a ratio of fair exchange value. Operations, as the bills proposed, were to be self-financed by collection of an equalization fee levied upon the first sale by farmers or the first processing of the various commodities named.

Support for these principles gained headway slowly and was most noticeable within the inner circle of the Department of Agriculture and the farm bloc. Opposition to any new drive for a different deal in meeting a farm crisis came from the agricultural colleges, old-line economists, and the industrial East as a body. Gradually, strength in support of positive action along new pathways developed among the state units of farm organizations and finally took form in the national conventions of those groups.

However, even the proponents of this departure from customary legislation did not see everything as clearly as they might. No effective protest came from the "radical" farm leaders sufficiently strong to prevent the enactment of the injurious tariff laws of 1929. The rates still further aggravated the isolated situation of this country just at a time when we had become the world's biggest money lender and source of handouts galore.

LATER during the period when the Agricultural Adjustment Administration was taking shape, I heard some of these same leaders explain that the funds to be raised by processing taxes to pay farm benefits were merely a form of protective tariff for agriculture. No move was made then or during a few subsequent years by New Deal farm spokesmen to modify the tariff wall, until the theory of reciprocal trade agreements bobbed up. Even the use of Section 32 revenues from parts of the import duties as a means of "dumping" surplus was adhered to.

During the ferments of 1924-28, the gains made by legislation mostly amounted to the Capper-Volstead law to clear cooperatives of risks under antitrust lawsuits, and the Federal Intermediate Credit Act which did not fully meet the pressing short-term credit needs of agriculture.

SOME crazy-cat bills held the limelight awhile, too. From the desperate spring wheat belt came the proposal to use Federal funds to encourage and assist grain growers of the plains to shift over into dairying—the stability of the "cow, the hog, and the hen" being laid before many audiences meanwhile. A national conference was called in 1924 to give this thing an airing, with the thought that diversification should be subsidized. This and the hiking of the wheat tariff by the President by 12 cents a bushel accomplished simply zero, with all that such temperature means.

Guiding the thought and seeking the legislation of the times were the American Council of Agriculture, set up at St. Paul in a session many of us scribes attended, and the Executive Committee of Twenty-Two, created at a governors' council of farming states, who deliberated in Des Moines in January 1926. That year also marked new unity between the West and the South, crystallized at a Memphis convention. The late Frank O. Lowden of Illinois favored giving a free hand to cooperatives in achievement of farm salvation. This idea was not acceptable to the American Council of Agriculture folks, who felt at least that co-ops would not be able to maintain a fair price level at home and also handle exportable surplus. Meanwhile, the axe of adversity had cut handsome nicks in the dairy income, too, and the boys who had called for a shift from wheat to milk at government expense took a red-faced bow.

Just when things got thickest the fair-haired city slickers took a valiant hand. They were accompanied in their flights of oratory by some Land-Grant college pronouncements, none of which struck oil.

So in 1926 the ultra-conservatives awoke to the end of their gamble on reviving farming by doing nothing. They published a neat little red-covered book on the Agricultural Problem in the United States, replete with graphs and charts and sermonizing. The report was financed by the United States Chamber of Commerce and the National Industrial Conference Board, all of which had its purpose because it lent strength to some kind of action even if the first attempt did not pan out perfectly.

To make a long story shorter, the Agricultural Marketing Act of 1929 became effective, just on the eve of the great panic in stocks. By its terms the Federal Farm Board undertook to encourage cooperative marketing associations and set up stabilization corporations owned by them. To unify the process with Federal loans, the Board had a revolving fund at its disposal amounting to half a billion dollars (just a little more than the potato crop support price deal has cost since then).

So heavy were the eventual losses taken by the Board through accumulated surplus in cooperative storages under their protecting wing that some of the members insisted that gains secured by withholding surplus supplies from the open market could be realized only in case farm production could be held down in line with actual home and foreign demand. But foreign loans had ceased and the export outlets were nil.

Dovetailing into this bitter but valuable experience was the conception by a small group of folks of what was then called the "domestic allotment plan." Chief sponsors of it were Chester Davis, John D. Black of Harvard, M. L. Wilson, now Director of Extension, and W. J. Spillman, an old employe of the Department of Agriculture. It bore no direct fruit itself as such but had much to do with the terms written into the 1933 version of the Agricultural Adjustment Act. Just a phrase or two is all the space available to explain it here:

THE part of the crop which farmers could sell in the domestic market was called the "domestic allotment," on which they were to receive certificates covering the full amount of their own share. To move any commodity into domestic consumption, processors must cover the amounts offered for sale to them with certificates bought from the farmers. The increased return was to result from the fact that the producer got the world price plus the proceeds from the sale of his certificates. Later on the Hope-Norbeck bill of 1932 cut out the certificates and provided for cash benefit payments to be realized by means of a processing tax, with limitation required on production within the domestic allotment figure.

Experience under the Agricultural Adjustment Act and the Hoosac Mills case decision that outlawed processing taxes led to the makeshift patchwork piece known as the Soil Conservation and Domestic Allotment Act of 1938. Conditional payments took the place of benefits and direct money from the Federal treasury replaced the processing taxes. Right here there appears a new angle to the whole farm-and-government relationship. Direct personal payments made from the public treasury in large volume to a class of citizens for special reasons of public welfare became established on statute books and bolstered by precedent.

Out of this has come much of the dither and doubt we face. Principles and justice are one thing and ways to bring them to pass with no harm to either consumers or producers are another thing. How to make it possible for farmers to dare to produce abundantly and produce the proper kinds of foods most needed without having things get lopsided or clear out of control is still a $64 question and will be for some time.

The principle of making direct treasury payments has been established, but in 1946 records show that farm cash income from marketings far outweighed all the government largesse then extended. That is, for every $24 of farm income last year only about 85 cents came in the form of direct individual payments from the treasury. To be sure, the other less direct government aid came through loans and support price operations under the Steagall Amendment. That these are far from fool-proof and that they often work hardships on segments of the farm industry beyond any benefits accruing to the ones that are most adaptable have been clearly stated in recent reports. Of course, the parity formula is the hurdle to be surmounted. It's what makes for this inequality.

IT'S QUEER, too, about subsidies. Originally, many of the farm spokesmen were against them, then gradually accepted them and even clamored for them. Few of these remain, it is true, but with some pressure of circumstances they could happen again.

Planned economy such as that which went awry in the potato salvage program this season and last could strike a blow at the heart of any well-considered, long-time approach to future stability. Meanwhile to blame it all on the unfortunate people obliged to carry on the details of some cumbersome project like that in the name of the government and to thereby encourage reckless speculation in food production by a class of non-farmers who let Uncle Sam hold the sack are, to say the least, demoralizing.

No, it is not all quiet on the Potomac yet. To be guilty of a pun, we still have "Hope," and as he and his colleagues think, so goes the Nation.

Ladies, Be Seated!

Two glamour girls boarded a crowded streetcar, and one of them whispered to the other: "Watch me embarrass a seat from one of the men!"

Pushing her way through the standees, she bore down on a gentleman who looked substantial and embarrassable.

"My dear Mr. Brown," she gushed loudly. "Fancy meeting you on the car. Am I glad to see you. Why you're almost a stranger. My I'm tired!"

The sedate gent looked up at the girl, whom he'd never seen in his life before, and as he rose, said pleasantly and for all to hear: "Sit down, Bertha, my girl. Don't often see you out on washday. No wonder you're tired. By the way, don't deliver the washing till Wednesday. My wife is going to the district attorney's office to see whether she can get your husband out of jail!"

Just Can't Happen

The Georgia election board was counting ballots. A Republican ticket showed up. Not finding anything wrong with it, the board put it aside as suspicious only. After several hours a second Republican ballot showed up. This was going too far. The judge said: "The son-of-a-gun voted twice. Throw 'em both out."

A Few Whinnies

VANITY FAIR

Small Boy: "Shine your shoes, Mister?"

Grouch: "No!"

Small Boy: "Shine your shoes so you can see your face in them?"

Grouch: "NO!"

Small Boy: "Coward!"

* * *

The actress married a director, longed for children and didn't have any. So she divorced him and married a producer.

* * *

SUPERSALESMAN

"Henderson is our best salesman—that guy could sell anything."

"That so?"

"Well, yesterday a widow came in to buy a suit in which to bury her husband, and he sold her one with two pairs of pants."

* * *

PROGRESS

Evolution of a man's ambition:
To be a circus clown.
To be like dad.
To be a fireman.
To do something noble.
To get wealthy.
To make ends meet.
To get the old-age pension.

* * *

There was a Romeo who said that he didn't care for his girl's bathing suit, and then added, "But outside of that she's all right."

With graceful feet, a maiden sweet was
tripping the light fantastic;
Then she suddenly tore for the dressing
room door—
You can't trust this wartime elastic.

* * *

DEFINITION

One wife to another: "My husband is an efficiency expert in a large office."

"What does an efficiency expert do?"

"Well, if we women did it, they'd call it nagging."

* * *

"I hear Marge broke up with Tom. Is she keeping those swell love letters he wrote her?"

"Well, yes and no. To be a little more exact, they're keeping her."

* * *

When a man says he's the boss in his family, he'll lie about other things, too.

* * *

MEANT IT TO LAST

A shy lad wanted to marry the girl, but he felt he would choke if he tried to mention the words, "marry" or "marriage" to her. So, after giving much thought to the problem, he asked her in a whisper one evening, "Julia, how would you like to be buried with my people?"

* * *

We heard a woman say that she felt better and looked younger, now that she was taking care of her feet instead of her face.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Better Corn (Midwest) and (Northeast)

Reprints

N-9 Problems of Feeding Cigarleaf Tobacco
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What Is the Matter with Your Soil?
II-12-42 Wartime Contribution of the American Potash Industry
H-2-43 Plant Food for Peach Profits
J-2-43 Maintaining Fertility When Growing Peanuts
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
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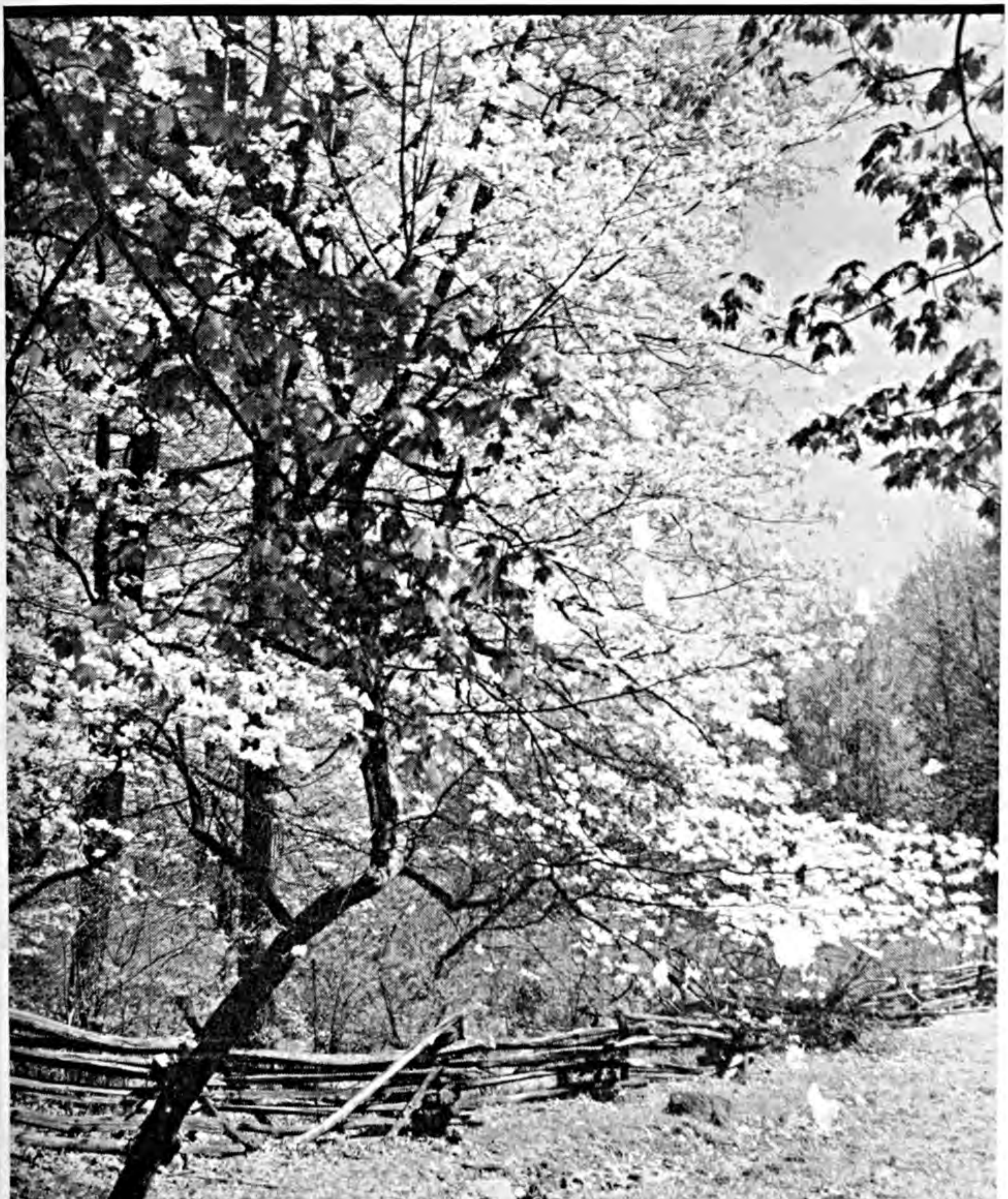

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VOLUME XXXI NO. 4

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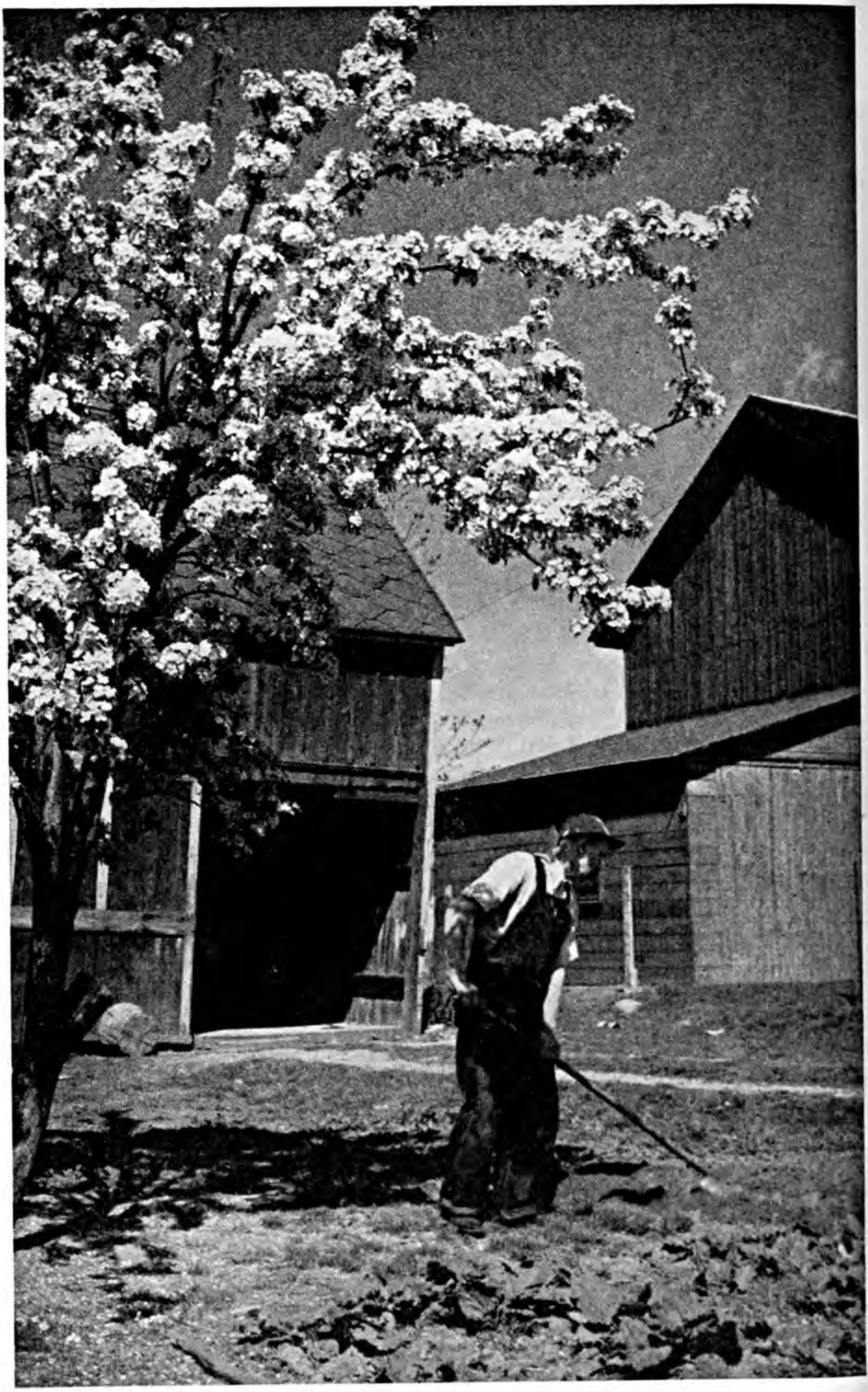

ONE OF THE "IN-BETWEEN" JOBS ON A FARM

Better Crops with PLANT FOOD

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VOL. XXXI WASHINGTON, D. C., APRIL 1947 No. 4

Uncle Sam is . . .

Making It Safer to Save

Jeff McDermid

BECAUSE so many battle-fever booms have blown up in a grand bust sooner or later, one senses a steady undercurrent of unrest and vague conjecture these days, both in the city offices and out on the land. To some extent this perplexity grooves into a measurement of what a fellow's got laid by in reserve against the normal hazards of life, either with or without the extra strain of "hard times." It has been said on frequent occasions that people seldom remember their reverses when they are enjoying gilt-edged prosperity, but this time I have a sneaking feeling that memories are longer and caution is somewhat more evident. And what makes this taking of our reserve inventory still sounder all this while is the fact that if nothing bad happens to us a streak of advance financial planning can't hurt us in the least.

Any question of thrift hitches right up to one's general attitude toward the earthly future, and saving is usually more satisfying if you know why your relations and the whole country are better off every time you make a sound investment and stick to it.

After some time spent in observation and cogitation, my hunch is that, by and large, the social and economic focus of the farmer is fixed on "parity" while that of the average city worker rests on "security." Let's pass up the old slide-rule approach to the hoary debate on parity formulas and just look at it solely for its own sake—as a word fraught with a certain class-conscious meaning. Farm folks have seldom been as much concerned with future social security in the city man's sense, as they have been with the equality fetish. This is the ingrown desire to be treated as well and as fairly as their own neighbors, or the adjacent community, or some distant metropolis.

Independence and self-reliance, improvising and pioneering, have been the basic lot of farmers, and they naturally have set up lines of thought that persist even in these modern days of thinner social walls between town and country. Farmers have sort of had a chip on their shoulders for generations in respect to their right to equality of education, privileges, civic rights, favors, class recognition, and net income, and to be treated shabbily or to be overlooked entirely was deemed an insult.

THEY expected nothing free (except the weather) and did not ask for coddling. But they darned well insisted that the march of progress should not tramp on their bunions and that the rural phalanx ought to march up front with the other big-shot delegation and carry just as bright flags past the reviewing stand.

Your city objective bore instead a mass demand for security in various ways and through sundry means—hours of labor, rates of pay, seniority of employment, union recognition, sanitary surroundings, unemployment benefit, old-age, hospital, sickness and bank deposit insurance, as well as certain forms of cooperative comforts, benevolences, and safeguards. The city was thinking of the hired man, the daily wage-earner, not the employer so much. The farmer was often unaware that the agricultural hired class had any vexations, any grievances, or any regrets. The sky was usually so blue, the air so fresh and invigorating, and the society so wholesome that a guy might even work out there for the fun of it, almost —like those city slickers who camped out sometimes on 15 acres.

The farmer shied away from any mass reforms or storm-cellar protective ideas. Even his farm co-ops were concerned mostly with getting equality (parity) for processed merchandise, at the risk of bidding up the market to get it, and so thought little about saving the individual farmer from woe and want.

It is quite easy to see why the farmer's ideals tended in that direction. Work was always staring him smack in the face the year round and jobs were usually extra plentiful. Above all, however, his reliance for a family legacy or for old age was largely in the acres he operated and their chance of becoming more valuable. We must admit that for sharecroppers and professional tenants no such picture can be painted. In many ways their needs resembled the security outlook of the city workman.

Since the second world war began I've noticed a strong leaning by many farmers toward the future welfare of themselves and their children, which has become manifest in other ways than the "jealous minded" shibboleth of "parity." They stick to the equality plank in their platform, but they are measuring the job for a new timber soon to be wedged in and bolted down fast, as a sort of springboard for the days and the years to come.

From here, that new stringer in the foundation looks suspiciously like it might have grown in the big woods of "security." It has at any rate altered their investment ideas in a big way. Where increase in the productivity and sale advantages of their farms used to be the mainspring of future investment hopes, and the old sock and the country bank once took all their ready cash, we note a shift to government bonds and life insurance policies. This means that somebody has been thinking a little mite differently and then acting on the new hunch.

I KNOW there are very many exceptions. I saw a farmer in 1943 haul out his wallet and ask his wife for hers, and together they unreeled several thousand smackers for a farm they thought they wanted. I know savings bond sales crews that can tell hoarding yarns to end all miserly romances. But I am reporting the average situation here and insist that it isn't considered cute and sharp any longer to hide your whole income in some obscure and unsafe cache, like the squirrel or the chipmunk.

Early this year a leading Midwest farm journal sought the opinion of its readers as to whether they chose to pay

less income taxes or whittle down the national debt—which now represents about $2,000 per capita and equals $180 for every $100 of annual national income. In general the response made by these farm thinkers shows a heavy majority in support of debt reduction as opposed to tax relief. It squares with their other sound program for heading off monetary inflation, which consists of widespread farm buying of gilt-edge savings and coupon bonds.

Evidently our farm neighbors have been wiser in the lore of public finance than many of us gave them credit for. It is noticeable that a plentiful supply of currency which increases faster than the national income or the supply of goods simply sets the stage for a price-kiting spree and a subsequent headache when the bubble bursts.

Smart financial doctrine backs up the rural opinion survey just mentioned, because it would be safer to transfer more of the government obligations from commercial banks and distribute them out among ordinary thrifty citizens of small means. As long as the present good rule obtains, which says that U. S. savings bonds are not saleable or tradable or useful as collateral or for speculation, just so long will we tend to escape the loss of investment and loss of confidence that followed when the liberty bond issues of the other world war were used like legal tender and negotiated at will.

Farmers know this, because I heard one of the leaders of a local co-op state with vehemence that any move to pay off the war veterans with a special government bond issue, freely negotiable by the holders, would be the worst blow which a grateful bunch of politicians could strike at the heroes of yesterday. And we might add, its effects would be chaotic to the rest of us, who wish the veterans well in a sure-footed but old-fashioned economic way, rather than to hand them a quick bonus for a fast ride to ruin.

Farmers are encouraging their sons, who have joined them once more on the old acreages, to trim their sails against future storms by a reasonable investment in capital improvements and better farm equipment, plus a margin kept for emergencies in the form of reliable U. S. savings bonds. Three years ago it was pure patriotism that outwardly swung farmers toward government bond buying, but inwardly and in a practical sense, those documents that crinkled and crackled in their hands were passports to security.

IN THE recent era of gore and glory which rocketed our national debt into the stratosphere, many of the big agricultural states formed vigilant committees to be on guard against panhandlers and speculative boomers. This defensive body was ably aided in a sound and positive way by an offense army out in the fields. There were alert and public-spirited teams who volunteered to hit the back roads and by-paths so as to reach those war-wealthy farmers before they were buttonholed and buncoed by the slippery slinks who urged the buying of more land, more oil wells, more sugar, fur and rubber bonanzas, and more

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Fertilizers for Sugar Beets

By R. L. Cook

Soil Science Section, Michigan State College, East Lansing, Michigan

THE sugar beet crop is one which necessitates a relatively high cash investment. The crop is grown on the best soil. Compared with other crops grown on the same farms, labor costs for beets are high. The market value of a good crop is relatively high, but with such a high cash investment a poor crop may be produced at a loss. Thus it seems more important with beets than with other crops that every effort be expended to produce as much sugar per acre as is possible. This is especially true with sugar scarce throughout the world.

It is essential that every grower study his soil carefully and be sure he is prepared to apply just the right fertilizer when he goes into his field to plant. Several phases of sugar beet fertilizer usage for the Eastern area may well be reviewed at this time. Most growers are not applying enough fertilizer. Others are using inefficient methods of application. Many are applying mixtures not adapted to their particular soil.

In most cases a complete fertilizer is desirable. In an experiment conducted on a Miami silt loam in Tuscola County, Michigan, the highest average yield over a five-year period was obtained from plots treated with 4-16-8 fertilizer. Even though the experiments were on a farm where the soil received manure in the rotation, the fertilizer containing potash (0-14-6) yielded, as an average, slightly more than 1¼ tons per acre more than did plots which received only superphosphate (0-16-0). The rate of application was 400 pounds in all cases.

Sugar beets require large quantities of potash. A 16-ton crop, with the tops which would weigh an additional 4 tons, would contain according to analyses recorded by Morrison (Feeds and Feeding) over 150 pounds of K_2O. From those figures it is easy to see why it is so necessary to include potash in the sugar beet fertilizer.

On the heavier upland soils, 2-16-8 can generally be recommended. If the soil is somewhat lighter, classifying as a loam or perhaps a heavy phase sandy loam, or if the organic-matter content runs rather high in spots, it may be better to apply such a mixture as 3-12-12.

Rate of Application

The rate of fertilizer application could profitably be increased on most farms. Many experiments have shown this to be true. In the Ferden rotation experiment, located near Chesaning, Michigan, in Saginaw County, one-half of each plot receives fertilizer at the rate of 1,000 pounds per acre during the rotation, while the other half receives only 400 pounds. In each case, one-half the total amount goes on the beets, in a band beside the row. The experiment has now been in progress for six years and each year the additional amount of fertilizer has resulted in greatly increased yields in all rotations. The average yields for the past five years are presented in table 1. In all seven rotations, varying with respect to sequence of crops and kind of crops, the more heavily fertilized plots yielded more than did those which received the lighter application.

Analysis of the data showed that the response of the beets to the greater amount of fertilizer did not vary among the different rotations, but it did vary from year to year. The 1945 results are

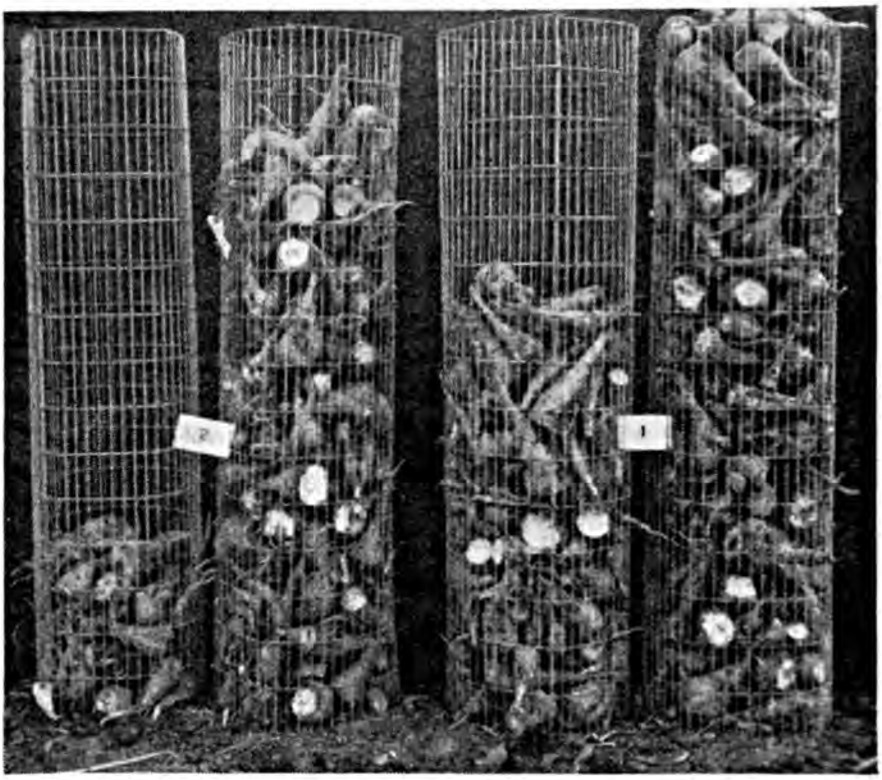


Fig. 1. Sugar beets need plenty of fertilizer. The two pairs of cylinders represent the 1945 yields from rotation 1 and 2. The smaller yield in each pair is from the side of the plot which received 200 lbs. of 2-16-8 fertilizer when the beets were planted, and the larger quantity is from the side which received 500 lbs.

illustrated in figure 1. When the plots in all rotations are averaged for the five years, the difference in yield in favor of the extra fertilizer is 1.57 tons per acre, a very good return for the extra investment.

One of the ways that fertilizer helps sugar beets is in improvement of stand. When the fertilizer is placed close to the seed at planting time, the young plants actually emerge quicker and make a faster, more thrifty growth. Naturally, seedling loss from disease or adverse weather conditions is less when the plants are thrifty. For several years, stand-counts on experimental plots on the Bobit farm near Breckenridge showed that better stands resulted on fertilized plots than on those not fertilized. The counts were taken soon after the beets were blocked. As shown by the data reported in table 2, improvement in stand occurred each year. In 1943, the number of plants on the fertilized plots was almost three times the number on the unfertilized plots.

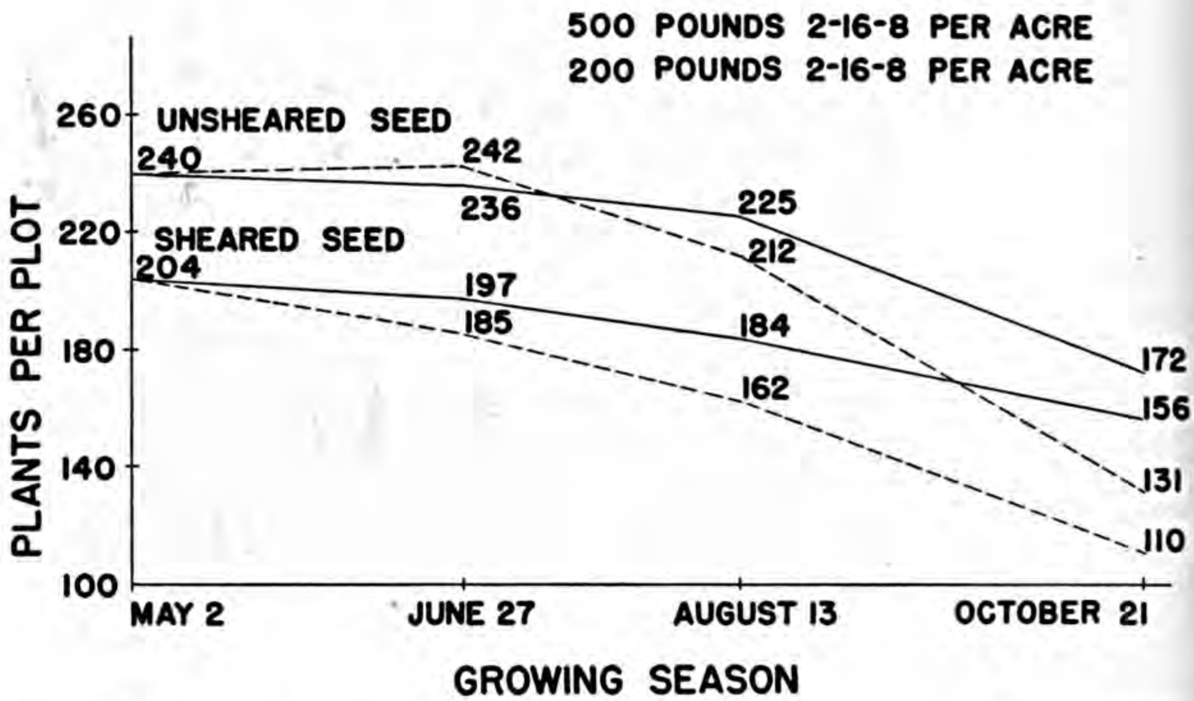
The effect of fertilizer on the stand of sugar beets on the Ferden plots in 1945 is shown graphically by figure 2. Counts were taken separately on the two halves of each plot which had been planted to two kinds of seed, sheared and unsheared. From both kinds of seed the loss of plants as the season progressed was greater on the plots which received the smaller amount of fertilizer. This is shown by the fact that the curves get farther and farther apart. It is interesting to note that while the stands at the beginning were much better where unsheared seed was planted, the final stand from sheared seed on the heavily fertilized plots was higher than from unsheared seed on the

Table 1.—The effect of high vs. low applications of fertilizer on the yield of sugar beets on the Ferden rotation experimental field. Brookston clay loam soil.

Rotation	Tons beets per acre	
	High fertilizer[1]	Low fertilizer[2]
1	10.34	8.68
2	10.88	9.16
3	10.24	9.02
4	10.45	8.59
5	10.04	8.60
6	9.64	7.93
7	10.08	8.69
Average	10.24	8.67

[1] 500 pounds 2-16-8 on beets, 1,000 pounds in rotation.
[2] 200 pounds 2-16-8 on beets, 400 pounds in rotation.

FIGURE 2
EFFECT OF SHEARING SEED ON FERTILIZER RESPONSE AND EFFECT OF FERTILIZER RATE ON STAND



plots which received the smaller amount of fertilizer.

Another interesting observation is evident from these curves. The response of the beets to fertilizer, as evidenced by stand, was greater where sheared seed was planted than where the seed was unsheared. This is shown by the fact that the spread between the curves is greater for sheared than for unsheared seed. This fact was most noticeable in the field at the time the August 13 counts were made.

On that date there was a difference of 13 in the counts from the unsheared seed as compared to a difference of 22 in the counts from the sheared seed. This difference is significant. Also at that time there appeared to be more difference in top growth between the low- and high-fertilized sides of the plots where the beets were from sheared seed than where they were from unsheared seed. This is probably due to the fact that the lesser disturbed plants from the sheared seed were able to make better use of the fertilizer.

Another soil fertility problem which should be considered is that of the need of sugar beets for nitrogen. The crop needs plenty of this important plant food. This has been shown by experiments in the greenhouse and in the field and by many observations and plant-tissue tests throughout the Michigan area. These experiments and observations indicate that it may be possible for the crop to obtain sufficient nitrogen from decomposing alfalfa provided it has not been over one year since the alfalfa was plowed under. Where sugar beets are to be planted on fields where alfalfa, clover, or sweet clover

TABLE 2.—THE EFFECT OF FERTILIZER ON STAND OF SUGAR BEETS. BROOKSTON SILT LOAM SOIL.

Treatment	Beets per 400 feet of row				
	1936	1937	1938	1939	1943
None.	278	387	318	316	104
300-2-12-6 .	343	399	360	339	. . . . .
400-2-16-8 .	. . . . .	. . . . .	. . . . .	. . . . .	280

has not been plowed under during the last year, it may be profitable to apply some extra nitrogen as a side-dressing during the growing season. Nitrogen, applied after the beets show signs of nitrogen starvation, may be very profitable. The results presented in table 3 compare the effects of alfalfa and commercial nitrogen, in the form of ammonium sulfate, on beet yields. The experiments were on two different farms but the results are interesting, nevertheless. On the Ferden farm, sugar beets following corn which followed alfalfa have averaged over a five-year period 9.52 tons per acre as compared to a yield of 8.79 tons where beets followed corn but where there was no legume in the rotation.

TABLE 3.—SUGAR BEETS NEED PLENTY OF NITROGEN

Lee Ferden farm—5-year average—Brookston clay loam

Treatment	Tons beets per acre
One year alfalfa in rotation...	9.52
No legume in rotation.......	8.79

Elmer Rader farm—1945—Brookston clay loam

No fertilizer.................	7.35
375 pounds ammonium sulfate applied as side-dressing.	8.43

On the Rader farm, beets in 1945 following three years of combined grain showed marked symptons of nitrogen starvation. They were side-dressed with ammonium sulfate at the rate of 375 pounds per acre on August 17. The color of the foliage had improved enough to photograph on September 4 and the final increase in yield was slightly over one ton per acre. Had the application of nitrogen been earlier, the increase in yield might have been still greater. This fact that sugar beets need plenty of nitrogen is not a recent discovery. Tyson and McCool* in 1930 reported very profitable results from applications of 300 pounds of sodium nitrate per acre.

Manganese Is Needed on Alkaline Soils

If soils which are to be planted to sugar beets have a pH higher than 6.8, or in other words if they are neutral or alkaline, it is advisable to apply fertilizer containing manganese sulfate. This recommendation is based on experimental results, soil tests, and observations made during the past four years. When soils are alkaline, the manganese is tied up in a form too slowly available to meet the requirements of sugar beets. This results in a light green or light green and yellow-mottled foliage which causes a decrease in yield. The appearance of such leaves is illustrated in figure 3. The color pattern of manganese-deficient beet leaves is very similar to that of many other plants. The tissue between the veins may become quite yellow but a good green color may be maintained for a short distance on either side of the veins. The symptoms show first in early summer, when there is still time to remedy the condition by a side-dressing of manganese fertilizer.

* Michigan Experiment Station Special Bulletin No. 205. 1930.

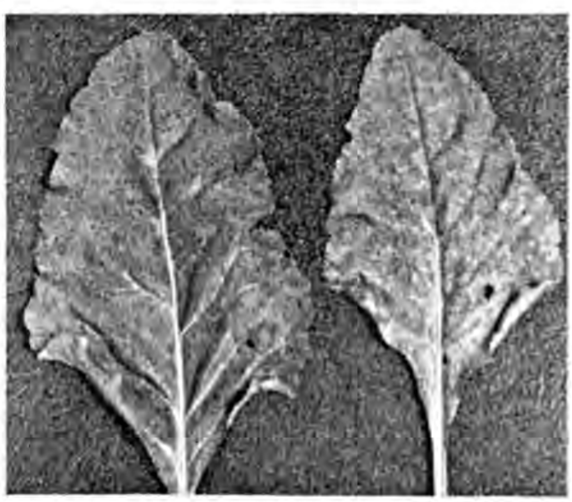


Fig. 3. Sugar beet leaves. The left leaf is normal. The right leaf is from a plant deficient in manganese. Such leaves are mottled yellow and green.

Fig. 4. Sugar beet in the last stages of heart rot. The entire crown is rotten. Growth has almost ceased. Such beets sometimes start a second growth very late in the fall. The new leaves come out around the edge of the dead heart.

The data presented in table 4 show the results obtained from such side-dressings made in 1943 and 1945. On the Ackerman farm, near Reese, manganese sulfate was applied as a side-dressing and as a spray. The side-dressing was made at the rate of 100 pounds per acre, while the spray was at the rate of 5 pounds per acre. The results from the small amount applied as a spray were almost as good as from the larger quantity applied as a side-dressing where the increase in yield was exactly seven tons per acre. The improvement in the color of the beets on this field was very marked and was noticeable within 10 days of the date of application. Color changes were also very marked in the beets on the Schroeder farm near Midland. The treatments on the two farms were made on the same day. Strangely, however, yield increases on the Schroeder farm were very slight, only one-half ton per acre, an amount within experimental error.

Cold, wet seasons seem to induce manganese starvation. This is true because manganese availability is linked

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TABLE 4.—THE EFFECT OF MANGANESE SULFATE ON SUGAR BEET YIELDS

Treatment	Tons beets per acre			
	1943 Ackerman Berrien sand alkaline	1943 Schroeder Berrien sand alkaline	1945 Kuschinsky burned-over muck alkaline	1945 DuRussell burned-over muck alkaline
None	10.8	9.4	9.2	13.4
$MnSO_4$ side-dressed*	17.8	9.9	....	....
$MnSO_4$ spray**	16.7	....	10.2	15.3

* 100 pounds per acre.
** 5 pounds per acre.

The Effects of Fertilizers on Blackland Soils of Texas

By M. F. Wichman *

Soil Conservation Service, Temple, Texas

FOR many years a stock statement of farmers in the Blacklands of Texas has been: "Fertilizers do not pay." Nevertheless, Blackland soils do need plant nutrients. The trouble has been that the methods for applying those nutrients were not known. Only recently have a few of the facts on how to add fertilizers successfully to those soils begun to seep out.

Soils of the Blackland, having high exchange capacities** and a high per cent of replaceable calcium—many possessing more than 20,000 parts per million, have not shown economical response when inorganic complete*** fertilizers were applied to such crops as cotton or corn. This may be because of sources of organic or inorganic fertilizer materials, low organic matter, fineness of the fertilizing material, free calcium, soil reaction, or any one of a number of other factors.

With phosphate and the response it brings when used on winter legumes in the Blacklands in mind, a study of soil conditions was made by the Soil Conservation Service Operations Soils Laboratory at Temple, Texas. Cooperators of the Comal-Hays-Guadalupe Soil Conservation District in the vicinity of Seguin, Texas, provided soil samples from fields which had received different applications of phosphate on winter legumes.

Roland Dueln, one of the district cooperators, realized that the productivity of his soil was being depleted; he wanted to do something about building his soil's fertility. With technical advice from the Soil Conservation Service technicians working in the district he fertilized 12 acres of a deep, fine-textured, slowly-permeable, gravelly Blackland soil with 300 pounds of 20 per cent superphosphate and planted a crop of hubam sweet clover. On five acres of the same soil and in the same field no phosphate was applied. The treatment otherwise was the same.

On the 12 acres where phosphate was applied Dueln cut 389 bales of hubam clover hay while on the five acres which did not receive phosphate he could get only 35 bales of the hay.

Soil analysis made after the hay was cut and the land broken resulted in a recommendation that Dueln apply 40 pounds of phosphorus and 21 pounds of potassium per acre on the acre which had grown the phosphated sweet clover if he wished to grow more winter legumes. Larger amounts of the fertilizers were suggested for the area which had not been phosphated. There the soil analysis showed a need for 60 pounds of phosphorus and 28 pounds of potassium per acre before planting another winter legume.

Roy Glenewinkel, a cooperator with the Comal-Hays-Guadalupe Soil Conservation District, saw that his soil was severely eroded, low in organic matter, and that there was either a plant-food nutrient deficiency or a low plant-food nutrient level.

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* The author wishes to extend due credit to James W. Lodwick, work unit conservationist for the Soil Conservation Service at Seguin. Mr. Lodwick gathered the field notes used in this study.

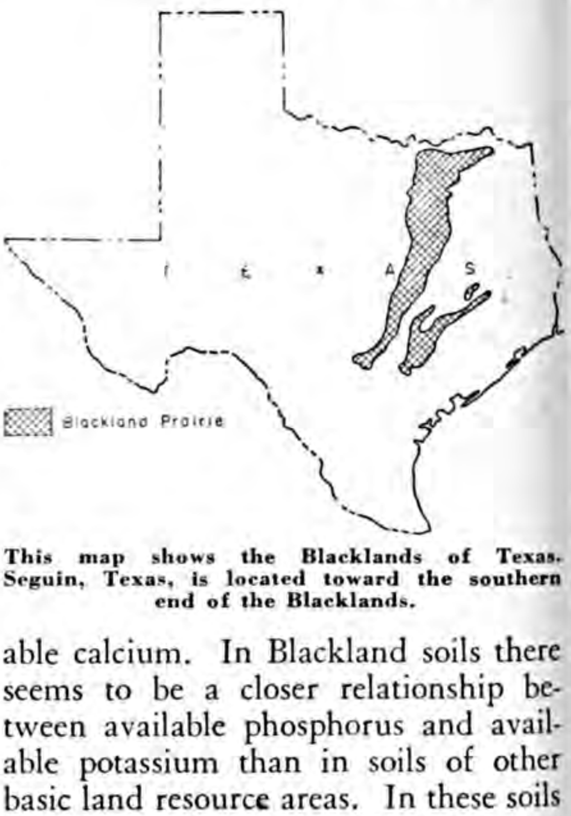
** The ability of a soil through its small organic or inorganic particles—called colloids—to hold fertilizing materials so that the plants may take them up. Often expressed in m. e. (milli-equivalents).

*** Containing potash, nitrogen, and phosphate.

Glenewinkel decided to see what phosphate would do on his deep, fine-textured, slowly-permeable Blackland soil. With suggestions from the Soil Conservation Service technicians he laid out a group of plots. On one of them he spread 250 pounds of superphosphate and planted Austrian winter peas. The peas on the area were well matted and grew to be 30 inches tall. Another plot was given the same treatment, except that no phosphate was applied under the peas. Here the peas grew thinner and reached only 15 inches in height. A third plot of soil received no legumes and no phosphate. It had been cropped to corn, cotton, and feed crops. This plot was analyzed for comparison. The laboratory recommended that Glenewinkel use the following fertilizers if he wished to grow winter legume crops on the three plots. For Plot 1, the suggestion was 60 pounds of phosphorus and 28 of potassium to the acre; plots 2 and 3 showed a need for 70 pounds of the phosphorus and 21 of the potassium per acre.

Allen Erskine of Seguin, Texas, has had experience with phosphate under hubam sweet clover. His soil, like Glenewinkel's, is a deep, fine-textured, slowly-permeable Blackland soil. Very likely his soil is an old high terrace of the Guadalupe River. On one terrace interval of his farm, he applied 200 pounds of 20 per cent superphosphate to the acre and planted hubam clover. From this area, 23,450 pounds, green weight, of hubam clover were obtained. An area alike in size and soil type on an adjacent terrace interval was treated in the same way, except that no phosphate was applied under the hubam clover. From this area 9,500 pounds, green weight, of hubam clover were obtained. The soil technician recommended use of 42 pounds of phosphorus and 21 of potassium per acre on the area which produced the heavy weight of clover if Erskine desired to grow other winter legume crops there. The area which grew the lighter weight in clover, that which had not been phosphated, needed 56 pounds of phosphorus and 28 of potassium per acre before it would grow winter legumes at its best, according to the soils analysis made there.

All of the soil analyses give a lead that needs more extensive study before more accurate recommendations can be made for soil-improving and soil-building crops on the Blacklands. Based on analyses made to date, there are indications that the plant-food nutrient level for Blackland soils should probably be: 80 to 110 parts per million available phosphorus; 120 to 140 parts per million available potassium; and around 20,000 parts per million replaceable calcium. In Blackland soils there seems to be a closer relationship between available phosphorus and available potassium than in soils of other basic land resource areas. In these soils the exchange capacities in m. e. are variable, as are the amounts of available phosphorus. The replaceable calcium and available potassium are less variable.



This map shows the Blacklands of Texas. Seguin, Texas, is located toward the southern end of the Blacklands.

On the Erskine farm where 23,500 pounds, green weight, of hubam clover were plowed under, the organic matter in the soil was 2.27 per cent. On the other area of that farm the organic matter was only 1.27 per cent. Here the amount of organic matter and prob-

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Rice Nutrition in Relation to Stem Rot of Rice[1]

By E. M. Cralley

Arkansas Agricultural Experiment Station, Fayetteville, Arkansas

THE relation of host nutrition to the prevention or amelioration of plant diseases has received considerable attention in recent years. Work on certain Fusarium wilts, for example cotton wilt (*Fusarium oxysporium f. vasinfectum*), shows in general that host susceptibility is increased by high nutrient levels of nitrogen and phosphorus and reduced by high levels of potassium. On the other hand, sclerotium rot of sugar beets (*corticium rolfsii*) and tobacco wilt (*Bacterium solanacearum*) are reduced in severity, under certain conditions, by the application of nitrogenous fertilizers. Since it is obvious that the parasite as well as the host may react variously to certain nutritional environments, a study must be made of each host-parasite complex in order to utilize, if feasible, cultural practices to reduce disease losses.

Preliminary work on the relation of host nutrition to the development of stem rot of rice has been published previously (1). The results showed, in general, that heavy applications of nitrogenous fertilizers increased stem-rot severity, whereas medium to heavy applications of potash decreased it. Since this work was done, additional opportunities have been afforded for observing the effects of potassium, alone and in combination with other elements, on the development of stem rot on different rice varieties.

In the greenhouse, observations were made on the effects of two levels of potassium on the severity of stem rot on Early Prolific, Fortuna, and Asahi rice varieties. The plants were grown

[1] Research paper No. 823 Journal Series, University of Arkansas. Published with the permission of the Director of the Arkansas Agricultural Experiment Station.

(1) Cralley, E. M. *Effects of Fertilizer on Stem Rot of Rice.* Ark. Agr. Expt. Sta. Bul. 383, 1939.

TABLE 1.—EFFECTS OF TWO LEVELS OF POTASSIUM ON DISEASE INDICES AND YIELDS OF RICE VARIETIES GROWN IN GREENHOUSE.

	Early Prolific	Fortuna	Asahi
	Disease Indices[3]		
Low potassium[1]	39.9	55.6	74.0
High potassium[2]	30.9	4.2	35.7
	Yields in Grams[3]		
Low potassium[1]	12.2	20.5	21.9
High potassium[2]	15.2	24.9	35.1

[1] 2 ppm; [2] 10 ppm; [3] Average of four replicates.

TABLE 2.—EFFECTS OF FERTILIZER TREATMENTS ON STEM-ROT SEVERITY AND YIELDS OF RICE VARIETIES, STUTTGART, ARKANSAS—1940.

Variety	Fertilizer treatments per acre [1]						
	600 lbs. 6-0-0	300 lbs. 0-0-12	600 lbs. 0-0-12	300 lbs. 6-6-12	600 lbs. 6-6-12	600 lbs. 6-0-12	No Treatment
	Disease Indices [2]						
Fortuna	66.99	44.16	42.66	49.50	56.66	59.74	50.16
Supreme Blue Rose	32.74	20.58	19.16	17.00	21.66	23.41	26.41
Kamrose	49.08	29.50	29.33	35.16	30.91	34.41	35.58
Mean	49.61	31.41	30.39	33.89	36.41	39.19	37.39
	Yields in Bushels per Acre [2]						
Fortuna	38.33	37.08	38.25	40.83	43.92	42.50	37.00
Supreme Blue Rose	29.75	23.91	24.50	27.16	31.74	30.08	25.25
Kamrose	34.99	26.91	29.33	30.91	33.58	34.16	30.83
Mean	34.36	29.30	30.69	32.97	36.41	35.58	31.03

[1] N=Ammonium sulphate; P=superphosphate; K=potassium sulphate.
[2] Means of four replications.

in sand culture using the following concentration of elements in parts per million: K, 2 and 10; N, 10; P, 8; Ca, 7.5; Mg. 2.5; and traces of Fe, B, Cu, Mn, and Zn. The results, presented in table 1, show that the disease indices (a high disease index signifies severe disease infection) were higher, for each variety tested, at the low potassium level than at the high potassium level. Also the yields were higher at the high potassium level.

During 1940 and 1946, observations were made in the field on the effect of various fertilizer combinations on stem-rot severity and yield of rice varieties. The fertilizers were applied the first week in July. The experimental plots were drained about five days before the applications were made and were reflooded in three days. In 1940 (see table 2), 600 pounds of 6-0-0 fertilizer increased the stem-rot severity on the three varieties tested, whereas 300 pounds of 0-0-12, 600 pounds of 0-0-12, and 300 pounds of 6-6-12 fertilizer per acre decreased it. The stem-rot severity was about the same on the non-treated plots as on the plots receiving 600 pounds of 6-6-12 and 600 pounds of 6-0-12 fertilizer per acre. The yields on this test were very low and showed significant increases in yield only when applications of 600 pounds of 6-0-0, 6-6-12, and 6-0-12 fertilizers per acre were made.

In 1946 (see table 3), Zenith, Prelude, Arkansas Fortuna, and Nira varieties were fertilized with 400 pounds of 10-0-0 and 10-4-10 fertilizer per acre. The Zenith variety was moderately infected with stem rot at the time of harvest when the disease notes were taken; however, no plants were lodged. With the other varieties, lodging was significantly increased when the nitrogenous fertilizer was applied and slightly decreased when the complete fertilizer was applied. Both fertilizers significantly increased yields when compared with the non-treated plots. The benefits of the complete fertilizer in compari

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From new fertilizer experiment, 1945-1946. The 8-0-16 side-dressing used contained 2½ lbs. borax per acre. Two-year average returns per acre: 1,553 lbs. at $812.41.

Fertilizer Practices for Profitable Tobacco

By E. M. Matthews

Virginia Bright Tobacco Station, Chatham, Virginia

THE value of research in improving Virginia's tobacco, a 73 million dollar cash crop in 1946, is beyond dispute. Many controllable factors contribute toward producing a highly successful and profitable tobacco crop, such as soil selection and management, varieties, fertilizer practices, spacing, topping, disease and insect control, harvesting, and marketing. However, on fields with typical tobacco soils no one factor plays quite so important a part as the fertilizer practice. Normal treatments in plant-food applications produce, at present, crop values varying widely even on the same fields and during the same season, often as much as $150 or more per acre.

Variations in fertilizer practices which produce such widely varying acre returns are of vital importance to thousands of Virginia tobacco farmers. If used by 20,000 or that half of Virginia tobacco growers who are below even the general average in acre values realized for their crops, such practice changes last year would have added an extra 11 million dollars to the income of half of our tobacco farmers.

The purpose of this article is to describe briefly these important practices, and the research projects from which they are derived.

In a rather comprehensive fertilizer experiment conducted on the Chatham Station for eight years, unfertilized flue-cured tobacco grown on the best soils produced less than $100 per acre (at present tobacco prices), while well-fertilized tobacco in 1945 and 1946 on the same field produced average values for eight replicate plots varying for different treatments from $679 to $789 per acre (see table). Duplicate plot treatments produced 2-year average values varying from $640 per acre for tobacco which received 900 pounds of 3-9-6 fertilizer per acre, not mixed in the soil before listing, not side-dressed, and spaced 24 inches in rows 4 feet apart, to $819 per acre for tobacco which received 1,200 pounds of 3-9-6 fertilizer thoroughly mixed in the furrow row with a 10-inch-shoe, single shovel plow before listing, side-dressed 20 days after planting with 100 pounds per acre of 8-0-16 side-dresser containing 2½ pounds of borax, and spaced 20 inches apart in 4-foot rows.

The project from which the above results were obtained was designed to determine: (1) The optimum rates of the best recommended fertilizer; (2) the effect on yield and quality of tobacco from several different side-dressing analyses; (3) the effect on yield and quality of spacing closer than recommended in the past or practiced by most farmers; and (4) the effect on stand, yield, and acre value of mixing heavy applications of fertilizer thoroughly in the furrow row before listing.

The purpose of this test, in general, was to gain information which would enable this Station to give sound advice to flue-cured tobacco farmers of Virginia as to the best practical fertilizer practices for obtaining maximum acre yields of good quality cigarette tobacco. Past projects on this Station, although they had answered certain phases of this question, had not been so designed as to fully satisfy the present demand for knowledge on how to produce larger yields of quality tobacco on fewer acres.

Procedure

Fifty-six 1/40-acre plots were required. Granville sandy loam soil type was used. A standard 3-9-6 fertilizer was applied at rates varying from 900 to 1,500 pounds per acre in the furrow before listing the land previous to transplanting. Side-dressings varied as shown in the following table. Seven different fertilizer treatments were used, first with the plants spaced 24 inches in rows 4 feet apart and then repeated with 20-inch spacing. All treatments were repeated four times with randomized arrangement in each replicate. In two replicates of each spacing the fertilizer was thoroughly mixed with a single shovel plow in all plots before listing, while with the other replicates all plots were listed without mixing the fertilizer.

Records of replants necessary, acre yields, and values were made in the usual manner practiced on this Station. Summaries of these are given in the following table.

Discussion of Results

Although this experiment has been conducted in its present form for only two seasons, the results which concur so closely with those obtained from several similar experiments conducted on the Chatham Station during the past 1[illegible] years are so consistent throughout the several replications that conclusions seem fairly safe.

The two-year summary of results for the 56 plots as given in the table shows eight replicate average acre values of $679.25 when 900 pounds of 3-9-6 fertilizer are used and $788.53 (or $10[illegible] increased value) when 1,200 pounds of the same fertilizer are used before transplanting and 100 pounds of 8-0-16 with 2½ pounds of borax added, are used as a side-dresser just ahead of the cultivator 20 days after transplanting.

A comparison of results for the four replicate plots each, plants spaced 2[illegible]

TABLE 1.—RATES OF FERTILIZER, SIDE-DRESSING, METHOD & SPACING TEST, CHATHAM

1945–1946—Average
(Fertilizer & Yields per Acre)

Treatment No.	Fertilizer: At planting	Fertilizer: Side-dressed 20 days	Four-plot average Spaced 24": Lbs.	Four-plot average Spaced 24": Value	Four-plot average Spaced 20": Lbs.	Four-plot average Spaced 20": Value	Eight replicate plot average: Lbs.	Eight replicate plot average: Value
1	900 lbs. 3-9-6	None	1,245	$663.53	1,317	$694.98	1,281	$679.25
2	1,200 lbs. 3-9-6	None	1,453	767.24	1,480	784.12	1,467	775.68
3	1,500 lbs. 3-9-6	None	1,485	772.28	1,525	782.84	1,505	777.57
4	900 lbs. 3-9-6	100 lbs. 8-0-16+B*	1,421	751.32	1,510	806.21	1,465	778.77
5	900 lbs. 3-9-6	100# 10-0-10+B	1,433	754.41	1,467	781.25	1,450	767.70
6	900# 3-9-6	100# 5-5-20 (com.**)	1,383	725.60	1,477	780.06	1,430	752.84
7	1,200# 3-9-6	100# 8-0-16+B	1,416	764.65	1,553	812.41	1,509	788.53
7 Treatment averages			1,405	742.68	1,495	777.41		
Average value ¢ per pound				52.8		52.5		

* 2½ lbs. borax per acre when used.
** Commercial, no borax mentioned on tag or bag.

Treatment No.	Fertilizer: At planting	Fertilizer: Side-dressed 20 days	Four-plot average fert. mixed before listing: Lbs.	Four-plot average fert. mixed before listing: Value	Four-plot average *not* mixed before listing: Lbs.	Four-plot average *not* mixed before listing: Value	Per acre loss	Replants per acre: Mixed	Replants per acre: Not mixed	% Stand at harvest: Mixed	% Stand at harvest: Not mixed
1	900# 3-9-6	None	1,341	$706.53	1,221	$652.10	$54 –	325	596	98	98
2	1,200# 3-9-6	None	1,486	784.63	1,448	766.74	18 –	503	870	97	97
3	1,500# 3-9-6	None	1,559	801.14	1,452	754.01	47 –	740	860	96	95
4	900# 3-9-6	100# 8-0-16+B	1,493	784.33	1,437	772.87	12 –	350	630	98	98
5	900# 3-9-6	100# 10-0-10+B	1,470	770.55	1,429	763.85	7 –	320	690	98	98
6	900# 3-9-6	100# 5-5-20 (com.)	1,483	764.91	1,376	740.77	24 –	280	490	98	99
7	1,200# 3-9-6	100# 8-0-16+B	1,544	797.24	1,476	779.82	18 –	470	840	99	98
7 Treatment averages			1,482	$772.76	1,406	$747.17					

inches and 20 inches apart in the rows, would indicate that for all normal fertilizer applications the 20-inch spacing in four-foot rows is about right notwithstanding the fact that the 20-inch spacing produces slightly more dead, perished type of cured leaf from the lower primings than the wider spacing does (particularly when heavily fertilized). The $35 per acre increased average value from the 20-inch spacing would seem significant.

By studying the four replicate plot average values for each of the fertilizer treatments when mixed thoroughly in the furrow before listing as compared with the same fertilizer when not mixed before listing, it can be seen how much a farmer might lose by not mixing his fertilizer in the row furrow before listing, (in the absence of a fertilizer distributor which would apply this fertilizer in bands to the sides of the plant roots). When using heavy applications of fertilizer such as 1,500 pounds per acre, this loss ran as high as $47 per acre for two years, and the average of returns for all 28 plots when the fertilizer was mixed was $26 per

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Harvey Neely, S. C. Farmer, Makes More Than 3 Bales Per A.

By H. G. Boylston

Clemson Agricultural College, Clemson, South Carolina

SIXTEEN and one-half bales of cotton produced on five acres is the yield made by J. Harvey Neely, Smith Turnout, Chester County, South Carolina. More than three bales per acre is a record certainly for this part of the cotton belt. The average of first state prize winners for the 19 years the contest has been conducted has been 12½ bales on five acres.

A major contribution to better yields of high quality cotton has been made by the South Carolina Five-Acre Cotton Contest. The most profitable practices have been proved by this contest. Some of these are narrow rows, good stands, liberal fertilization of proper balance, good seed of high-yielding varieties, use of lime, poison, defoliation, etc. Mr. Neely has probably had more experience with dairying in a great Guernsey County than with cotton production except for the past few years, but he carried out the best practices, as he thought, for his conditions and with good seasons a record was made.

Mr. Neely, standing in the field which he entered in the contest.

How did he do it? On good quality Iridel soil, commonly called black jack, he planted his contest field where cotton has followed cotton for maybe the past 20 years. But in 1946 he applied about five tons of stable manure per acre and although his type of soil does not tend to be very acid, he has applied about 400 pounds of ground limestone per acre for the past five years including 1946. No doubt the annual application of manure and some lime has contributed much to the fine condition of his soil.

The soil preparation consisted only of ripping up the old cotton stalks, broadcasting 1,000 pounds of 4-8-8 fertilizer per acre, and harrowing. Then the rows were bedded 33 inches apart the last of March. The planting of the cotton was done on April 11-13 after treating the Coker 100 Strain 8 cotton-seed with ceresan.

A good stand of cotton was secured and left about 12 inches apart.

Side applications of potash and nitrogen were made on June 3 and 17. The first was a mixture of 100 pounds of 50 per cent muriate of potash and 100 pounds of nitrate of soda; the second was 100 pounds of ammonium nitrate and 100 pounds of muriate of potash.

Some of the cotton which yielded more than three bales per acre and made a record.

Two applications of 1-1-1 sweetened poison were made on June 2 and July 11 to assist in the control of the boll weevil.

On October 1 the cotton was defoliated with an aeroplane using aero defoliant. With the heavy growth and narrow rows of heavily fruited cotton, the defoliation was found to have been of much benefit, saving many of the bolls which might have rotted and allowing all matured cotton to open quickly.

Some of the secrets of Mr. Neely's high production are: Good soil of high fertility; liberal applications of stable manure; narrow rows—33 inches with a good stand in the drill; use of liberal amounts of commercial fertilizers and side-dressing of nitrates and potash; use of an outstanding variety, Coker 100; careful attention with frequent shallow cultivation; and use of lime, defoliation, and insect control. These good practices followed by Mr. Neely have been found to be best by contestants in the years past. As one example, take the width of row. When the contest was first started in 1926 there were no contestants who had rows 34 inches or closer, while in 1946 about 20 per cent were 34 inches or less. The average yields for 19 years show the following :

22-34 width	658 lbs. lint per acre	
35-37 "	624	"
38-40 "	603	"
41-43 "	578	"
44-46 "	540	"
47-49 "	529	"

Mr. Neely's rows were 33 inches wide, which is the width showing the largest yield for entire period of the contest.

A summary of the last five years on varieties shows that there were five which had been planted each year in sufficient numbers to make a comparison. The following table gives the average yield:

Coker 100 W.R.	711
Coker 100	702
Coker's 4 & 1	637
Marett's White Gold	635
Delta Pine Land	634

Mr. Neely's contest field was planted in Coker 100.

On his contest field which won first state prize of $750, Mr. Neely had a gross value of $3,600.75 for his cotton and seed with a cost of $677.16, giving him a net return of $2,923.59.

Fig. 1. Alfalfa hay from various fertilizer treatments on a low-fertility Crosby silt loam near Lafayette, Indiana, first cutting 1942. Treatments from left to right: Lime alone; lime + phosphorus + potash; lime + phosphorus; and lime + potash.

Don't Feed Alfalfa at the Second Table

By H. E. Jones[1]

Department of Agronomy, Kansas State College, Manhattan, Kansas

ONE of the oldest alfalfa fields in the Midwest is located on the Purdue Soils and Crops Experimental Farm, Lafayette, Indiana, where alfalfa has been grown continuously since 1917 in fertility experiments on Crosby silt loam soil. The unusually high yields from these plots over a 25-year period are quite remarkable. The fertilizer treatments have been only moderate and the differences in yields between the fertilized and unfertilized plots have been relatively small.

The question as to the quantity of phosphate and potash removed from these plots by the alfalfa throughout this long period has sometimes been raised. A study of the potash situation in the soils of the plots was made in 1942. The results of the analyses are shown in table 1. It is obvious from the data shown that this experiment was conducted on a soil unusually high in potash, both available and total. There is no striking difference between the values as related to the treatments. However, there is some indication that the supply of available potash on the plot treated with lime, potash, and superphosphate is reaching the mini-

[1] Formerly Research Assistant, Departments of Agronomy and Agricultural Chemistry, Purdue University; now Assistant Professor of Soils, Department of Agronomy, Kansas State College.

TABLE 1—AVAILABLE AND TOTAL POTASH, EXPRESSED AS POUNDS K_2O PER ACRE EIGHT INCHES, IN VARIOUS PROFILE DEPTHS FROM THREE DIFFERENT PLOTS ON THE ALFALFA FERTILITY EXPERIMENT ON THE SOILS AND CROPS FARM, LAFAYETTE, WHERE ALFALFA HAS BEEN GROWN CONTINUOUSLY FOR 25 YEARS.

Depth in inches	Pounds per acre eight inches available[1] and total potash (as K_2O)					
	Lime alone		Lime, potash, check		Lime, potash, superphos.	
	Available	Total	Available	Total	Available	Total
0–8	219	45,900	331	44,300	188	48,300
8–16	385	47,200	287	44,300	242	47,400
16–24	373	43,700	259	49,300	342	55,200
24–32	294	47,400	293	49,100	262	47,700
32–40	265	51,700	299	52,300	240	46,900
Total	1,436	235,900	1,469	239,300	1,274	245,500
Ratio total available	164		162		190	

[1] Extracted with neutral normal ammonium acetate solution.

mum level for continued high production.

In table 2 it is seen that the differences in yields of alfalfa from the various fertility treatments were not great in any case. The yield of alfalfa from the untreated plot was so high that it is not reasonable to expect any great deficiency in potash or phosphate; consequently, the response to the addition of these two plant-food nutrients could be only very slight. In comparing the yield of the alfalfa on the untreated plot with the average for the State of Indiana, it is clear that the soils in the experiment were unusually fertile.

Table 3 shows that the alfalfa in this experiment has been pumping out of the ground a tremendous quantity of phosphate and, particularly, potash. The amount of fertilizer removed per acre over the 24-year period amounts to approximately 14,600 pounds of an 0-5-15 fertilizer. This would be about 600 pounds per acre per year. Allowing for phosphate and potash fixation,

TABLE 2.—YIELDS OF HAY FROM VARIOUS FERTILIZER TREATMENTS ON CONTINUOUS ALFALFA ON SOILS AND CROPS FARM, LAFAYETTE, IN COMPARISON WITH THE AVERAGE FOR THE STATE AS A WHOLE.[1]

Location and/or plot and treatment[2]	Yield (tons per acre)	
Soils and Crops Farm, Lafayette	1929–40	1917–28
Untreated plot	3.26	3.34
Lime alone	3.42	3.47
Lime and phosphate (Ppt. bone)	3.58	3.56
Lime and potash	3.88	.....
Lime, potash, and superphosphate	4.18	.....
Average for Indiana (1930–39)	1.69	.....

[1] Yields for the continuous alfalfa on Soils and Crops Farm taken from Purdue Circular 242 (revised May 1941). The average for Indiana taken from Indiana Crops and Livestock Estimates No. 206, 1942.
[2] Plots having phosphate and potash applied received 80 pounds P_2O_5 and K_2O, respectively, every two years.

about 1,125 pounds of a fertilizer such as 0-8-12 would be needed each year to replace the loss.

The available potash and phosphate supplies in most upland soils of the State are far below the quantity needed for such high yields as are produced on these plots. The experiment thus serves the purpose of demonstrating the remarkable yields that can be made when adequate minerals, proper drainage, and effective inoculation are provided. The experiment also discloses the huge quantities of available phosphate and potash that are necessary to produce such yields.

Table 4 reveals the available potash content of some of the principal cultivated upland forest soils of Indiana to be characteristically closer to 150-175 pounds per acre eight inches than the 219 pounds shown on the untreated plot of the experiment. It is interesting to note that as much available potash is present in the soils of these plots after 25 years of continuous alfalfa as is found in some of the virgin upland forest soils of Indiana. When these facts are considered in relation to the soils of the State that are low in fertility, it becomes obvious that big yields of alfalfa cannot be made or maintained unless the plant-food nutrients are added in such amounts and in effective manners as to make up the differences necessary to produce the high yields.

When alfalfa, which feeds heavily out of the subsoil through its deep root system, is first grown on a soil it may find available potash that has not been withdrawn by previous crops. A small quantity of this plant nutrient added in the upper soil in fertilizers will help the crop to get started and the roots will penetrate into the deeper soil. For some years the production may be quite satisfactory, depending upon the native fertility. Many farmers complain that where alfalfa is seeded on old alfalfa land after a prolonged period of production the performance or response with fertilizers as used in previous crops has not been like it was with the first crop. It seems reasonable that the soil, particularly the subsoil, has been somewhat exhausted by the previous crops.

Alfalfa, along with other legumes such as sweet clover, lespedeza, and soybeans, has been termed a soil-building crop. Statements in bulletins and in farm papers as follows can be found:

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TABLE 3.—PHOSPHATE AND POTASH REMOVAL BY ALFALFA HAY, EXPRESSED AS POUNDS PER ACRE P_2O_5 AND K_2O, FROM THE VARIOUS PLOTS IN THE CONTINUOUS ALFALFA FERTILITY EXPERIMENT ON THE SOILS AND CROPS FARM, LAFAYETTE, DURING THE 24 CROP YEARS 1917-40.

Treatment [1]	Phosphate and potash removed from plots by the hay [2]					
	Lbs/acre P_2O_5 removed			Lbs/acre K_2O removed		
	12 years (1917–28)	12 years (1929–40)	24 years (1917–40)	12 years (1917–28)	12 years (1929–40)	24 years (1917–40)
Untreated	353	344	697	1,064	1,041	2,105
Lime alone	369	361	730	1,109	1,091	2,200
Lime, phosphate as ppt. bone	376	379	755	1,136	1,145	2,281
Lime, potash	....	408	....	....	1,238	....
Lime, potash, superphosphate	....	442	....	....	1,333	....

[1] Potash was added to the treatments in the fall of 1928 so there are no yield data showing the effect of potash in the treatments prior to 1929.

[2] Yields were taken from Purdue Circular 242 (revised May, 1941). They are shown in table 2. Per cent composition of P_2O_5 and K_2O in alfalfa hay taken from Purdue Bulletin 468.

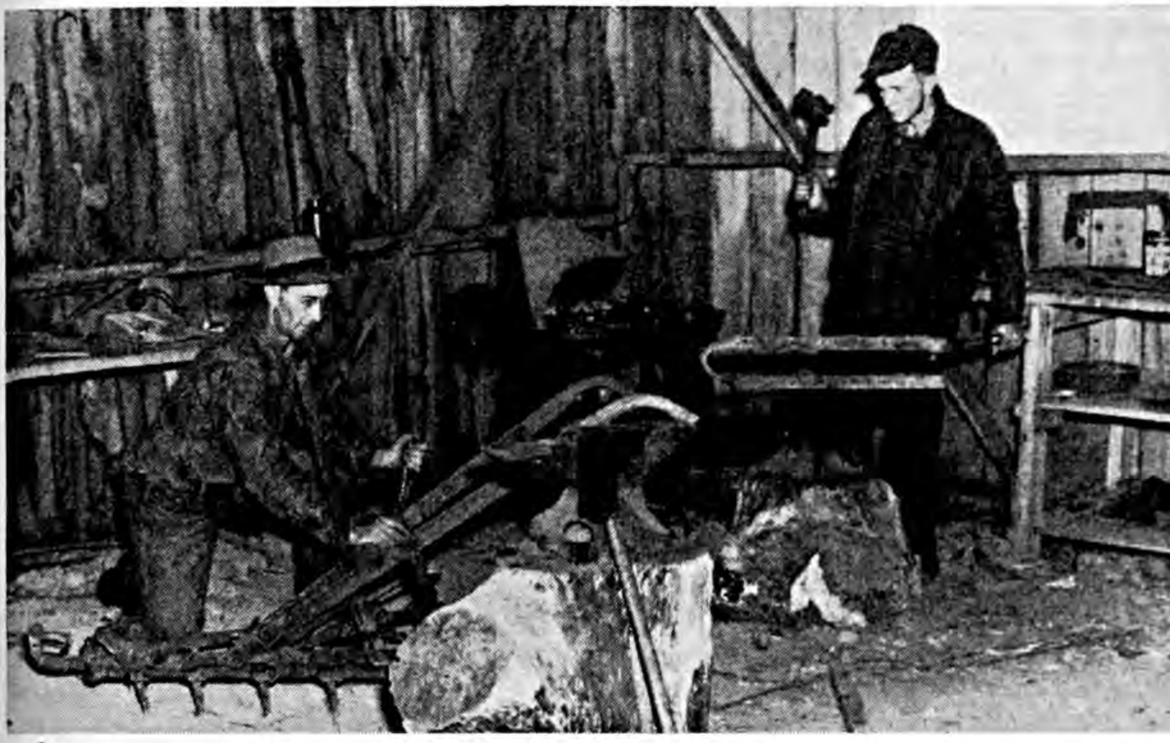

Fig. 1. A community equipment repair shed was the idea of the Leesburg community in Washington County. The shop and tools were available at all times for use by anyone in the community, and machinery was kept running during the period when it was scarce and badly needed for all-out production.

Community Improvement Contests

By S. Fletcher Sweet

Agricultural Extension Service, University of Tennessee, Knoxville, Tennessee

COMMUNITY improvement through concerted community action is on the march in Tennessee, with more than 25,000 farm families in organized improvement contests last year. The State is now covered by such contests, and both the sponsors and the contestants agree that the sky is scarcely the limit.

Improvement contests in Tennessee are relatively new, although the community organization is now a grown-up baby of the Agricultural Extension Service, University of Tennessee. With a majority of communities in every county of the State already organized, the strong green light was thrown upon community improvement when civic clubs in various trade areas started giving prizes for the best improvement jobs.

This started in 1944, through cooperation of 10 civic clubs and organizations of Knoxville. These groups, realizing what a dressed-up East Tennessee would mean with respect to the millions of visitors coming to the Smoky Mountains National Park, now leading the country in the number of visitors, offered the first community prizes. The East Tennessee Community Improvement Contest was on its way, covering the hills and valleys from the Smokies to the Cumberland Mountains.

The following year the Farmers' Club of the Nashville Chamber of Commerce started a similar contest, covering 38 counties of the Central Basin, with its rolling lands, dairying, tobacco growing, and generally diversified farming. And in 1946 the civic organizations of

Chattanooga launched the Lower East Tennessee Improvement Contest, covering 11 Tennessee counties and two in Georgia. Since the Memphis Commercial Appeal had sponsored the Plant-to-Prosper contest in the cotton lands of West Tennessee for some years, the State was now covered with an organized upsurge for improved living—better homes on better farms.

Sectional and local sponsors contribute a total of about $10,000 in prizes for county and area winners. It works this way: An elimination race is sponsored by some local organization in each county. The winner from each county is then entered in the area contest to compete with winners from other counties for the various prizes and the sweepstakes.

Here is how community leaders feel about such contests, as expressed by Ralph Shanlever, chairman of the Dutch Valley community organization in Anderson County: "Cash prize or no cash prize, we should enter the contest," young Shanlever, a real dirt farmer, said. "We have found that our community must work together to get anything it wants. The improvements we make in our homes and on our farms will be lasting gains, whether we win a prize or not. I'll put the idea before the group for a vote at our next meeting."

The Dutch Valley group of about 50 families voted unanimously to enter the contest; and although 1946 was their first year in the race, they placed high among the 21 competing counties of their area.

Since scoring in the contests is based upon improvement in farms and homes, the Tennessee Agricultural Extension Service cooperates closely with communities in improvement programs which the organizations themselves draw up. Many Extension specialists help with judging throughout the State.

Here is the contest pattern adopted by the Knoxville civic organizations, in launching the East Tennessee Community Improvement Contest in 1944: Scoring is based upon 1,000 points, divided as follows: 200 points on home food supply; 200 on maintenance

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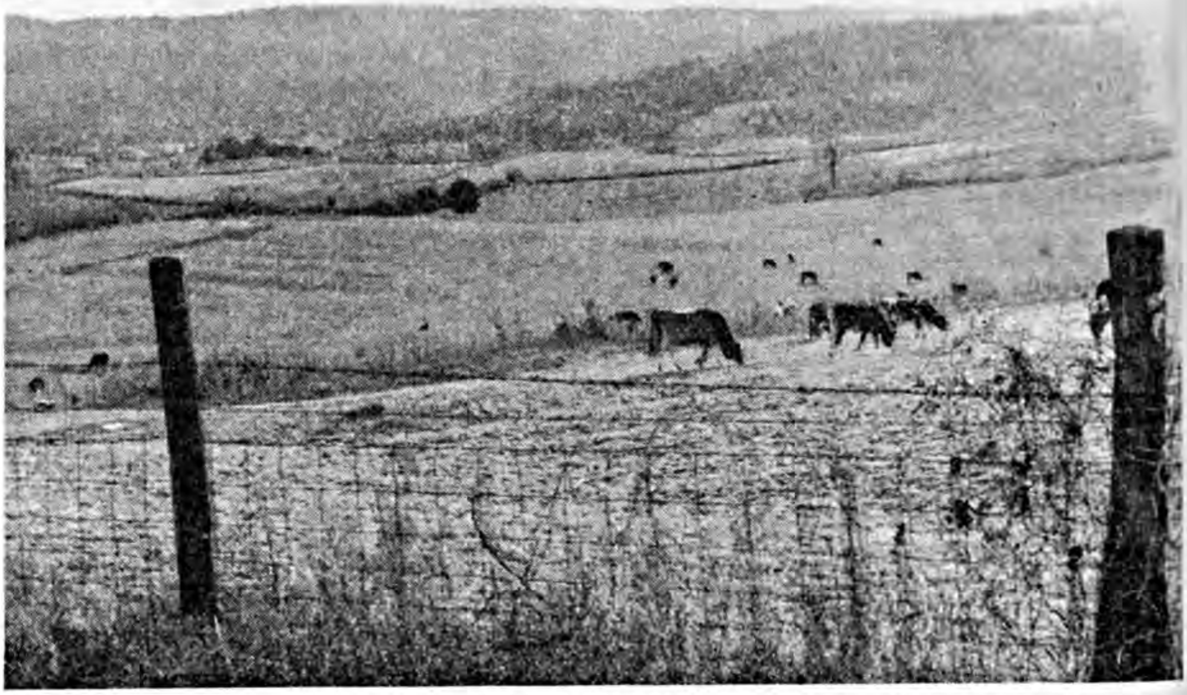

Fig. 2. Winter pastures were one of the improvement features stressed in plans of the Cedar Grove community in Van Buren County. Cattle seen in the fields above will spend most of the winter outside the barn and away from hay ricks.

The Search for Nutrient Deficiencies in Farm Crops

By R. E. Stephenson

Department of Soils, Oregon State College, Corvallis, Oregon

PLANTS require from the soil, air (oxygen), water, and nutrients. All these must be accessible to the root system. In the best soils, the root systems of common agricultural crops will occupy and function in 6 to 10 feet or more of soil depth. And unless the root can develop and function normally, yields will be correspondingly limited.

The capacity of the soil to furnish the root system with a renewed supply of oxygen depends upon an important physical property, the soil structure. Air circulates through the larger open channels in the soil, such as wormholes, openings left by decaying roots, and all the larger spaces left when gravity removes excess water. The important soil organisms, as well as the crop, require oxygen. The oxygen of the air is used by the root system of the crop for oxidizing carbohydrates to obtain energy for vital process. As a result of the oxidation, carbon dioxide is eliminated from the root into the soil. Good soil aeration provides for the ready passage of the carbon dioxide produced by the roots of plants and the organisms of the soil into the outside atmosphere, and the renewal of the oxygen supply within the soil. Unless these aeration processes can go on unhampered, the plant will suffer.

Water is needed in large quantities by all plants, and this moisture must come from the capillary supply of a well-drained soil. The soil moisture supply is controlled by natural precipitation or by irrigation practice. Where irrigation is not practiced, the crop must depend upon moisture that is stored in the deep soil and accessible to the roots. Without irrigation there is nearly sure to be periods when the plant does not get enough water for maximum growth, thereby reducing the yield. The growth rate of the plant becomes slower as the moisture in the soil is reduced, and is often considerably slower while there is yet an appreciable amount of water in the soil above the wilting point. A renewed supply of moisture before the soil is too dry is important for best plant growth.

Nutrients which plants need for growth are liberated by chemical and biological actions in the soil. While the dry matter of plants is usually more than 90 per cent carbon, hydrogen, and oxygen coming from air and water, the nutrients coming from the soil are none the less important because of their relative lack of abundance in the plant. Anything which the plant uses for growth is important, however minor the amount.

Soil Deficiencies Are Becoming More Common

There are eleven, or possibly more, essential nutrient elements coming from the soil, any one or more of which may be deficient in available form and thereby reduce the yield of crops. New deficiencies are constantly appearing as more crops are taken from the land.

Increasing appearances of nutrient deficiencies may result from humus depletion following excessive cultivation and intensive cropping practices. Humus contains in various combinations an appreciable portion (sometimes the major portion) of the minor elements essential for plant growth. These include especially zinc, copper, manganese, boron, sulfur, and others. Humus is a no less important source of the major elements (N-P-K). All the nitrogen and sometimes more than half the total phosphorus is in organic combination. The elements contained in the humus are likely to be more available to the plant than the more inert forms of the mineral soil. Loss of humus, therefore, means a real loss of many nutrients that plants must have and reduction in the biological processes necessary for their liberation.

Humus is important for producing solvents which attack the minerals. These solvents include carbonic acid, nitric, sulfuric, and phosphoric acids, which result from the oxidation of organic matter. Humus itself has been shown to be an important purveyor of nutrients, attacking such minerals as anorthite to remove the calcium and transfer it to a form more available to the growing plant.

Erosion and leaching, both of which are likely to increase when land is long under cultivation, provide another cause for nutrient deficiencies. Cultivation increases erosion and bare soils permit greater leaching losses. The top soil which is removed by erosion contains more humus and often more of other nutrients than the deeper soil. Loss of surface soil, therefore, is a heavy drain upon fertility, and particularly upon those nutrients that are most available to the plant.

The increased use of commercial fertilizer, while a desirable practice to produce bigger and more profitable yields, results in a heavier drain upon nutrients not supplied in the fertilizer. Bigger crops take more out of the soil, thereby exaggerating deficiencies. The supply of a nutrient sufficient for 40 bushels of corn may become entirely inadequate for an 80-bushel yield. Therefore, new deficiencies appear as yields are increased by better farming practices. As the pressure of population compels the production of more food to feed an increasing number of hungry mouths by increasing yields and perhaps by farming poorer land, an increase in the prevalence of nutrient deficiencies in the soil may be expected.

Tracking Down Nutrient Deficiencies

The most obvious indication of a deficiency is the appearance of the plant and the yield at harvest time. Foliar diagnosis has come to be a recognized method for spotting nutrient deficiencies. While often providing a valuable clue, this method of diagnosis has its limitations. Two or more symptoms may look so much alike that not even an expert may be sure from appearances. Often there is a mixture of symptoms that cannot be distinguished.

The increasing appearance of virus diseases, manifesting their presence in foliar symptoms, makes diagnosis of nutrient deficiencies increasingly difficult. Neither soil scientist, plant physiologist, nor pathologist can distinguish all the virus symptoms from nutrient deficiency by plant appearances alone.

Chemical methods are helpfully used upon both the soil and the plant for diagnostic purposes. But chemical methods also have limitations. Chemical methods help, but are far from accurate in indicating how much of a given element any particular plant is able to obtain from a soil. Analysis of the plant indicates what the plant contains, but there are no satisfactory standards differentiating deficiency and abundance of many of the elements for

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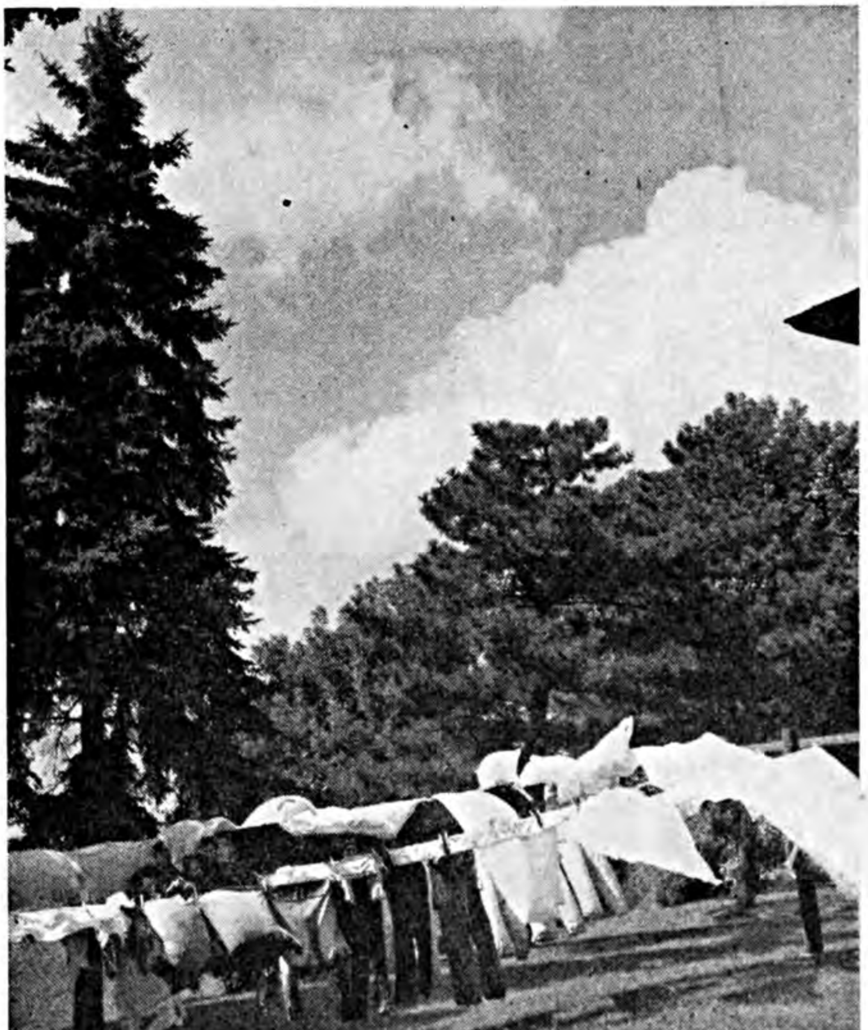
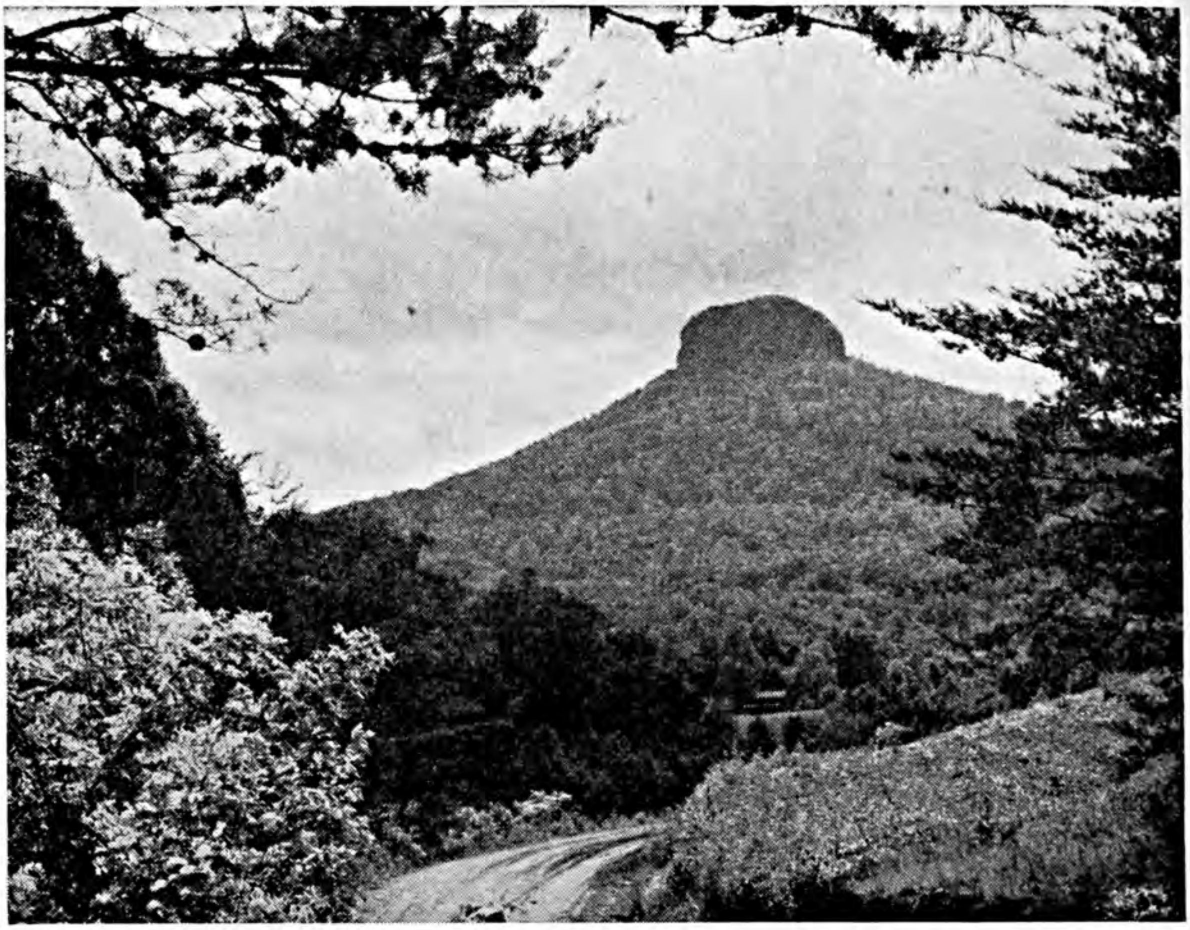
PICTORIAL

THE PROMISE OF AN APRIL HORIZON



Spring Wash-outs

Spring Planting



Above: **One of the approaches to Pilot Mountain, North Carolina.**

Below: **A ferry boat in operation on the Mississippi River.**

The Editors Talk

Saving Soil on Rented Farms

The problem of how to charge off or apportion lime and fertilizer costs over a period of years, discussed on these pages in our March issue has had considerable attention, judging from correspondence received. For instance, I. W. Arthur, Economist of the Iowa State College Agricultural Extension Service, has sent us a statement which was worked out as a procedure to encourage conservation and the use of soil-building practices on rented farms.

"If a tenant is going to be aggressive in soil conservation work on a rented farm, he must have a guarantee from the landlord that he will receive fair compensation for the unused value in case he has to leave the farm before fully realizing his investment in soil-saving or soil-building practices," the statement says. It goes on to give four steps to follow: (1) List the soil-building practices to be started on the farm during the year; (2) List the contributions to each practice to be made by the owner and by the tenant; (3) Estimate the cost or value of the tenant's contribution to each practice; (4) List the compensation due the tenant for unused value if he leaves the farm before he has had full return on his investment.

On charging off limestone, the Iowa people have this to say:

"The rate of depreciation in value of limestone varies with the type of soil, cropping system, the hardness and coarseness of the limestone used and other factors. Under average conditions the value of limestone may be assumed to last about 10 years. In settling for unused value it may be wise to adopt a more rapid rate of depreciation than is actually believed to exist. This would be done in order to avoid misunderstandings which may arise with the passage of long periods of time. So, for the business purpose of figuring unused or unexhausted value of limestone, it may be wise to settle on the basis of skipping the first full crop year and then using a straight 20 per cent per year depreciation for the next 5 years. This will write off all unused value of the tenant's investment by the end of 6 years.

"The return in increased crop yields from limestone does not usually start until one full crop season after it is applied. Consequently it is desirable to delay one year after the limestone is applied before starting to calculate depreciation." The suggestions for raw rock phosphate are the same as those for lime.

With regard to commercial fertilizers:

"1. Commercial Nitrogen. The value of commercial nitrogen largely disappears with one crop season's use.

"2. Superphosphate, potash, or mixed fertilizers containing mostly phosphorus and potassium.

a. On Corn. (1) When used in hill or row in rates up to 150 lbs. per acre. Unused value: at end of 1st crop season 20%; 2nd season 0. (2) When applied broadcast in amounts from 150 to 300 lbs. per acre. Unused value: End of 1st year 30%; 2nd year 0.

b. When applied at rates up to 300 lbs. per acre to small grain and clover seedings. Unused value: End of 1st year 70%; 2nd year 25%; 3rd year 0.
c. When applied at rates of 300 lbs. or more per acre on alfalfa or pasture seedings. Unused value: End of 1st year 70%; 2nd year 40%; 3rd year 20%; 4th year 0.

"(*Note:* Rates of application for commercial fertilizers mentioned are for purposes of illustration and example only. For recommended rates on your farm see your county extension director.)"

It is of interest to note that in these recommendations in addition to time and method of application, the crop involved is also considered, charging off the fertilizer more rapidly when applied to some crops than when applied to others. This is an indication of the type of approach to the problem which probably should be adapted to local conditions in order to be more equitable under the highly varied cropping and soil conditions existing in this country.

The statement also carries suggestions on matters of contouring intertilled crops, constructing standard terraces, relocation of fences, and farm drainage and carries a "rider" which can be attached to existing farm leases. The attention being accorded these matters should greatly help the conservation movement as well as provide for better understandings between landlords and tenants.

Agriculture Modernizes

Interesting figures are to be found in the March 1947 Agricultural Situation published by the Bureau of Agricultural Economics, U. S. Department of Agriculture. They show, among other things, the streamlining which the American farmers are putting into their productive practices. According to the Bureau, today's farms are bigger, more mechanized, more productive than 25 years ago, or even five.

The 1945 census counted 1.1 billion acres in farmland made up of 5.8 million farms, 600,000 fewer than in 1920. The average farm is about 195 acres, a 50-acre increase since 1920 and a 20-acre jump since 1940. Only 5 per cent of the farms are over 500 acres, but account for half of the farmland. In 1920 they accounted for a third. The 180- to 500-acre farms account for a fourth of the farmland. Today there are about as many as in 1920. The number of small farms, 10 to 180 acres, are now a million fewer than in 1920, largely the result of being absorbed into other farms.

In 1944 the top tenth of the farms produced half of all the farm output, the top third produced 80 per cent. Only 5 per cent had a production worth more than $10,000 each. A fifth had products worth $4,000 or more. The average production of all the farms was between $2,500 and $4,000. Over half of the farms had products worth less than $1,500. From 3,000,000 farms came only a tenth of the record farm output in 1944, when it was a third more than before the war.

Frederick Vieweg

1888-1947

Late President of the American Potash & Chemical Corp., and

Charter Member, Board of Directors, American Potash Institute

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1920	15.9	17.3	125.3	141.7	61.8	182.6	16.46	25.65	....
1921	17.0	19.5	113.3	113.1	52.3	103.0	11.63	29.14	....
1922	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
March	22.70	31.9	157.0	236.0	114.0	158.0	16.30	47.50	....
April	23.59	42.9	162.0	245.0	116.0	158.0	15.00	48.00	....
May	24.09	43.0	157.0	251.0	135.0	170.0	14.80	49.60	....
June	25.98	59.0	147.0	251.0	142.0	174.0	14.70	51.50	....
July	30.83	56.7	148.0	275.0	196.0	187.0	15.00	60.00	....
August	33.55	48.6	143.0	280.0	180.0	178.0	15.10	59.10	....
September	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	....
October	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	....
1947									
January	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	....
February	30.56	31.9	131.0	228.0	123.0	199.0	17.50	82.20	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1920	128	173	180	161	96	207	139	114	....
1921	137	195	163	129	81	117	98	129	....
1922	185	228	95	114	116	109	98	135	....
1923	231	190	133	137	129	105	110	183	....
1924	185	190	98	170	166	141	107	147	143
1925	158	168	245	188	109	163	108	140	143
1926	101	179	189	134	116	138	112	98	139
1927	163	207	146	124	132	135	87	154	127
1928	145	200	76	134	131	113	95	152	154
1929	135	183	189	133	124	117	92	137	137
1930	77	128	131	123	93	76	93	98	129
1931	46	82	66	83	50	44	73	40	115
1932	52	105	55	62	50	43	52	46	102
1933	82	130	118	79	81	84	68	57	91
1934	100	213	64	91	127	96	111	146	95
1935	90	184	85	80	102	94	63	135	119
1936	100	236	164	106	163	116	94	148	104
1937	68	204	76	93	81	109	74	87	110
1938	69	196	80	83	76	64	57	97	88
1939	73	154	100	85	88	78	67	94	91
1940	80	160	78	97	96	77	64	96	111
1941	137	264	116	107	117	107	81	211	129
1942	153	369	168	136	143	124	91	202	163
1943	160	405	188	232	174	154	125	231	245
1944	167	420	214	219	170	160	138	234	212
1945	181	435	199	228	178	169	127	230	224
1946									
March	183	319	225	269	178	179	137	211	283
April	190	429	232	279	181	179	126	213	282
May	194	430	225	286	210	192	125	220	177
June	210	590	211	286	221	197	124	228	185
July	249	567	212	313	305	212	126	266	163
August	287	486	205	319	280	201	127	262	162
September	285	488	184	255	269	202	130	256	154
October	304	530	175	238	266	213	136	293	151
November	236	438	176	228	198	214	145	399	207
December	242	435	181	239	190	217	149	406	166
1947									
January	240	390	185	351	188	216	147	401	238
February	246	319	188	260	192	225	147	391	275

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910-14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
March	1.75	1.42	7.81	5.77	4.86	6.71
April	1.75	1.42	7.81	5.77	4.86	6.71
May	1.75	1.42	9.08	6.10	4.86	7.30
June	1.88	1.42	10.34	6.42	4.86	7.90
July	1.88	1.42	11.62	8.15	5.34	9.60
August	2.22	1.46	16.88	8.14	6.07	12.14
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
February	2.41	1.46	10.02	11.06	12.14	10.17

Index Numbers (1910-14 = 100)

1922	113	90	173	132	140	142
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
March	65	50	223	163	144	191
April	65	50	223	163	144	191
May	65	50	259	173	144	207
June	70	50	295	182	144	224
July	70	50	332	231	158	273
August	83	51	482	231	180	345
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293
February	90	51	286	313	360	289

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1922	.566	3.12	6.90	.632	.904	23.87	....
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
March	.650	2.20	6.40	.535	.797	26.00	.200
April	.650	2.20	6.40	.535	.797	26.00	.200
May	.650	2.20	6.40	.535	.797	26.00	.200
June	.650	2.30	6.45	.471	.729	22.88	.176
July	.650	2.60	6.60	.471	.729	22.88	.176
August	.700	2.60	6.60	.471	.729	22.88	.176
September	.700	2.60	6.60	.471	.729	22.88	.176
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January	.700	2.60	6.60	.535	.797	26.00	.200
February	.700	2.60	6.60	.535	.799	26.00	.200

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1922	106	87	141	89	95	99	....
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
March	121	61	131	75	84	108	83
April	121	61	131	75	84	108	83
May	121	61	131	75	84	108	83
June	121	64	132	66	76	95	80
July	121	72	135	66	76	95	80
August	131	72	135	66	76	95	80
September	131	72	135	66	76	95	80
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83
1947							
January	131	72	135	75	84	108	83
February	131	72	135	75	84	108	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1922	132	149	141	116	101	145	106	85
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
March	209	187	158	97	57	175	121	78
April	212	188	160	97	57	175	121	78
May	211	192	162	99	57	189	121	76
June	218	196	163	100	60	203	121	70
July	244	209	181	103	60	230	121	70
August	249	214	187	116	67	293	131	70
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	206	126	69	359	131	78
February	262	234	209	123	70	329	131	78

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Since June 1941, manure salts are quoted F.O.B. mines exclusively.

**** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Feed and Fertilizer Laws," Div. of Foods and Dairies, Dept. of Agr., 39 South LaSalle St., Chicago, Ill., Sept. 1946.

"Fertilizers, Fertilizer Materials and Rock Phosphate Used in Illinois During 1945," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., AG 1300, March 1946, E. E. DeTurk.

"The Effect of Time of Application and Levels of Nitrogen, Phosphorus, and Potash on the Growth of Sugar Beets with a Detailed Statistical Procedure of Confounding in a 3x3x3 Design," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Tech. Bul. 203, June 1946, J. F. Davis, W. D. Baten, and R. L. Cook.

"The Storage of Nitrogen by Different Legumes," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 126, June 1946, I E. Miles.

"Nitrogen on Pastures," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Agron. Inf. Cir. 141, Feb. 1946, W. W. Woodhouse, Jr., R. L. Lovvorn, and D. S. Chamblee.

"Fertilizer Recommendations for Oklahoma Crops," Agr. Exp. Sta., Stillwater, Okla., Bul. B-305, Feb. 1947, H. J. Harper, H. F. Murphy, F. B. Cross, and H. B. Cordner.

"Inspection of Feeds and Fertilizers," Agr. Exp. Sta., R. I. State College, Kingston, R. I. Cont. No. 681, April 1946, C. H. Stetson, Jr. and R. W. Gilbert.

"Summary of Fertilizers and Fertilizer Materials Sold in South Carolina, July 1-December 31, 1946," Dept. of Fertilizer Insp. and Analysis, Clemson Agr. College, Clemson, S. C., Feb. 25, 1947, B. D. Cloaninger.

"Commercial Fertilizers in 1945-46," Agr. Exp. Sta., Texas A & M, College Station, Texas, Bul. 684, Oct. 1946, J. F. Fudge and T. L. Ogier.

"Efficient Pasture Production Depends upon Systematic Application of the Proper Fertilizers," Agr. Exp. Sta., Logan, Utah, Mimeo. Series 327, June 1946, G. Q. Bateman.

Soils

"Soil Properties Contributing to Citrus Chlorosis as Revealed by Seedling Tests," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Tech. Bul. 112, Sept. 1946, W. T. McGeorge.

"Soil Management Practices in the Orchard," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Cir. Bul. 199, June 1946, T. A. Merrill.

"Rainfall and Irrigation in Relation to Soil Erosion," Agr. Exp. Sta., Utah State Agr. College, Logan, Utah, Bul. 326, Dec. 1946, Willard Gardner, J. H. Gardner, and C. W. Lauritzen.

Crops

"Planning and Planting Field Shelterbelts," Dept. of Agr., Ottawa, Canada, Publ. 785, F.B. 139, Dec. 1946, John Walker.

"4-H Vegetable Gardening," Agr. Ext. Serv., Univ. of Conn., Storrs, Conn., Bul. 381, March 1946, O. S. Trask, J. R. Hepler, and E. S. Nodine.

"Winter Oats as Grazing for Beef Cattle," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., P. Bul. 627, Oct. 1946, G. B. Killinger, R. S. Glasscock, and W. E. Stokes.

"Performance of Corn Hybrids in Georgia," Exp. Sta., Experiment, Ga., P. Bul. 578, Jan. 6, 1947, G. A. Lebedeff.

"Asparagus Culture," Exp. Sta., Experiment, Ga., P. Bul. 582, Jan. 31, 1947, F. F. Cowart.

"Characteristics and Performance of Six Varieties of Cotton Tested in Middle and North Georgia During the Period from 1942 to 1946," Exp. Sta., Experiment, Ga., P. Bul. 583, Feb. 1947, W. W. Ballard.

"Grafting and Layering Citrus or Vegetative Propagation of Citrus Trees," Agr. Ext. Serv., Univ. of Hawaii, Honolulu 10, T. H., Agr. Ext. Cir. 213 (Replacing Agr. Ext. Cir. 57), Feb. 1947, William Bembower.

"Fourteenth Biennial Report, 1945-1946," Dept of Agr., Boise, Idaho.

"1946 Illinois Hybrid Corn Tests," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 521, Jan. 1947, G. H. Dungan, J. H. Bigger, A. L. Lang, Benjamin Koehler, and R. W. Jugenheimer.

"Report of the Director for the Year Ending June 30, 1945," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., 58th A. R., Nov. 1, 1945.

"Extension Service in Maine Reports Busy Year," Ext. Serv., Univ. of Me., Orono, Me., Ext. Bul. 348, Nov. 1946.

"Cotton Variety Tests in the Yazoo-Mississippi Delta, 1943-45," Agr. Exp. Sta., Miss.

State College, State College, Miss., Bul. 435, May 1946, J. W. Neely and S. G. Brain.

"Grazing Beef Cattle on Winter-Growing Crops," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 125, May 1946, R. H. Means, Russell Coleman, and H. W. Bennett.

"Grafting Fruit Trees," Ext. Serv., Univ. of N. H., Durham, N. H., Ext. Cir. 267, April 1945, C. O. Rawlings and L. P. Latimer.

"How to Grow Salad Greens and Pot-Herbs in Winter," Ext. Serv., Univ. of N. H., Durham, N. H., P. Bul. 193, Dec. 1946, J. R. Hepler.

"Bright Leaf Tobacco Curing," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Bul. 346 (Rev.), June 1946, E. G. Moss and N. C. Teter.

"Science Serving Agriculture, Part I," Agr. Exp. Sta., Okla. A & M, Stillwater, Okla., Biennial Rpt., July 1, 1944-June 30, 1946.

"Science Serving Agriculture, Part II," Agr. Exp. Sta., Okla. A & M, Stillwater, Okla., Biennial Rpt., July 1, 1944-June 30, 1946.

"Strawberry Culture and Varieties," Agr. Exp. Sta., Okla. A & M, Stillwater, Okla. Bul. B-304, Feb. 1947, G. F. Gray.

"Farm Forestry in Clackamas County, Oregon," Ext. Serv., Oreg. State College, Corvallis, Oreg., Ext. Bul. 662, Feb. 1946, W. M. Fergerson.

"Tobacco Insects and Diseases, South Carolina," Ext. Serv., Clemson Agr. College, Clemson, S. C., Bul. 109, Jan. 1947, W. C. Nettles, H. A. McGee, J. M. Lewis, and J. R. Mattison.

"Citrus Orcharding in the Lower Rio Grande Valley of Texas," Agr. Exp. Sta., Texas A & M, College Station, Texas, Cir. 111, Oct. 1946, W. H. Friend.

"Cotton Variety Tests in Texas—1945," Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1047, Nov. 12, 1946, D. T. Killough.

"Biennial Report, 1944-1946," Agr. Exp. Sta., Utah State Agr. College, Logan, Utah, Bul. 327, Jan. 1947.

"Science Benefits Farmers," A. R., 1945-46, Agr. Exp. Sta., Blacksburg, Va., Nov. 15, 1946.

"Results of Hybrid Corn Yield Trials in West Virginia for 1946," Agr. Exp. Sta., W. Va. Univ., Morgantown, W. Va., Mimeo. Cir. 58, Feb. 1947, J. L. Cartledge, R. J. Friant, R. E. Strosnider, R. M. Smith, and B. J. Patton.

"Report of the Secretary of Agriculture, 1946," U.S.D.A., Washington, D. C.

"Currants and Gooseberries, Their Culture and Relation to White-Pine Blister Rust," U.S.D.A., Washington, D. C., F. Bul. 1398, Rev. July 1946.

"Summer Crops for Green Manure and Soil Improvement," U.S.D.A., Washington, D. C., F. Bul. 1750, Rev. Jan. 1947.

"Crested Wheatgrass," U.S.D.A., Washington, D. C., Leaf. 104, Rev. Feb. 1947.

"A Pasture Handbook," U.S.D.A., Washington, D. C., Misc. Pub. 194, Rev. Sept. 1946, A. T. Semple, H. N. Vinall, C. R. Enlow, and T. E. Woodward.

Economics

"Arizona Agriculture, 1947," Agr. Exp. Sta., Univ. of Ariz., Tuscon, Ariz., Bul. 206, Feb. 1947, G. W. Barr.

"1945 Citrus Production Cost Study, Lemons & Grapefruit, San Bernardino County, including Ten Year Summary, 1936-1945," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif.

"1945 Orange Production Cost Study, Navels & Valencias, San Bernardino County including Ten Year Summary, 1936-1945," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif.

"1945 Lemon Production Cost and Management Analysis, San Diego County, California," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif.

"1945 Valencia Oranges Production Costs and Management Analysis, San Diego County, California, Seven Year Average," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif.

"Production and Marketing of Cowpeas for Canning," Exp. Sta., Experiment, Ga., Bul. 252, Dec. 1946, N. M. Penny.

"1946 Summary of Fruit and Vegetable Unloads at Honolulu and Shipments to the Mainland," Agr. Ext. Serv., Univ. of Hawaii, Honolulu 10, T. H., Agr. Ext. Cir. 215, Jan. 1947.

"Illinois Farm and Home Outlook," Agr. Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 609, Jan. 1947.

"Social Aspects to Land Use Planning in the Country-City Fringe: The Case of Flint, Michigan," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Sp. Bul. 339, June 1946, Walter Firey.

"Outlook for Fruits, Vegetables and Potatoes in 1947," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Pamph. 151, Jan. 1947, R. V. Backstrom.

"Cotton Production Costs in Northeast Mississippi, 1944," Agr. Exp. St., Miss. State College, State College, Miss., Bul. 429, Feb. 1946, W. J. Edens.

"Improving Farm and Ranch Tenure in the Northern Plains," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Bul. 436, July 1946.

"The Farm Business in Southeastern Nebraska, 1940-44," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Bul. 383, Oct. 1946, W. L. Ruden.

"Corn Production Requirements, Nebraska, 1944," Agr. Ext. Serv., Univ. of Nebr., Lincoln, Nebr., E. C. 840, Sept. 1946.

"1947 Farm Production Prospects in Oklahoma," Agr. Exp. Sta., Okla. A & M, Stillwater, Okla., Mimeo. Cir. M-163, Nov. 1946.

"Oregon's Farm Price Data, 1909-1944,"

Agr. Ext. Serv., Oreg. State College, Corvallis, Oreg., Ext. Bul. 660, Dec. 1945.

"1947 Recommended Production Adjustments in Agriculture in South Dakota," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Agr. Econ. Pamph. 21, Aug. 1946.

"Preliminary Report on Agricultural Production Adjustments for Utah for 1947," Agr. Exp. Sta., Logan, Utah, Mimeo. Series 329, Aug. 1946.

"Agricultural Statistics, 1946," U.S.D.A., Washington, D. C.

"The 13th Annual Report of the Farm Credit Administration, 1945-46," U.S.D.A., Washington, D. C.

"Handbook on Major Regional Farm Supply Purchasing Cooperatives, 1944 and 1945," Farm Credit Adm., U.S.D.A., Washington, D. C., Misc. Rpt. 102, Sept. 1946, J. G. Knapp and J. L. Scearce.

Fertilizer by Airplane?

"Distributing fertilizer by airplane should not be entirely disregarded," commented Glenn A. Cumings of the U. S. Department of Agriculture, in discussing recent and rapid advances in fertilizer equipment and suggesting others likely to come. Mr. Cumings is a senior agricultural engineer in the Department.

"Even though to date the practice has not come into much competition with the use of conventional agricultural machines," he continued, "it seems reasonable to predict that airplane equipment will be more extensively used. But fertilizing from the air is likely to be under conditions which will not materially change the need for conventional machines, at least in the near future. It is likely to be a supplementary use, not a substitute use."

Fertilizers for Sugar Beets

(*From page* 10)

with oxidation processes in the soil. The season of 1945 was very cold and wet during the period of early growth. As shown by the data in table 4, increases in yield as a result of spray applications of 5 pounds of manganese sulfate amounted to 1 ton per acre on the Kuschinsky farm and 1.9 tons on the DuRussell farm. These treatments in 1945 were made on July 30. Earlier applications might have been even more beneficial.

Manganese sulfate may be purchased in fertilizer in Michigan at three different rates—100, 200, and 300 pounds per ton of fertilizer. It is recommended that the farmer purchase a quantity which, according to his rate of application of fertilizer, will apply between 25 and 50 pounds of the manganese sulfate per acre. Thus, if he plans to apply 300 to 500 pounds of fertilizer per acre, he should buy fertilizer containing 200 pounds of manganese sulfate per ton.

Boron Is Still Necessary

Farmers should not become careless and omit borax from their fertilizer. Boron is so essential as a nutrient for sugar beets that all sugar beet fertilizer should contain enough to make the application of borax somewhere between 8 and 10 pounds per acre.

Boron is essential in the production of new growth tissue. When it is not

Fig. 5. Sugar beet deficient in boron but one which has not developed the dead heart. Note the small twisted leaves and the cross-checked leaf petioles.

present in sufficient concentration, the new cells disintegrate and growth is greatly hindered. Serious deficiency symptoms are most likely to occur on strongly alkaline soils. The symptoms are noticeable from late July until harvest time, first as dead hearts and abnormally shaped leaves. The leaves may be curved because of restricted development on one side, and the upper sides of the petioles are often cross-checked. An unusually large number of

Fig. 6. Sugar beet roots from plants deficient in boron. The left portion was from a plant which had grown sufficiently to cover the dead heart. The other pieces were from beets which had almost normal tops, where the starvation for boron was indicated by the darkened tissue and external root cankers.

small leaves may be formed around the dead heart. The root tissue of deficient plants often, but not always, contains darkened areas and zones where the cells have disintegrated to form cankers. Such roots are low in sucrose content. Figures 4, 5, and 6 illustrate some of the symptoms of boron starvation.

Borax is recommended in all sugar beet fertilizers and may be purchased in Michigan already mixed in fertilizers at the rates of 50, 100, and 200 pounds per ton. The grower must select the rate which, considering his desired rate of fertilizer application, will give him the 8- to 10-pounds per acre application of borax. Somewhat more than 10 pounds of borax may be applied without danger of injury if it is not applied directly with the seed.

The Search for Nutrient Deficiencies in Farm Crops

(*From page* 26)

most of the common economic plants. Such conditions as strong acidity or alkali in the soil can be easily spotted, however.

Greenhouse trials with soils variously treated and growing different kinds of plants have been helpful in spotting deficiencies. We have found it helpful to use a small quantity of soil (about a pound), supply all elements other than the one that is being checked for deficiency, and grow an indicator crop such as sunflowers to spot deficiencies and to indicate the nutrient supplying power of the soil for the different essential elements.

By this method, enough plant growth can be obtained in eight to twelve weeks to determine what nutrient elements are most deficient in the soil. The method works better when nutrients are added to the soil in solution to stimulate quick growth, making perhaps three applications at intervals of a week or two during the growth period of the plant. By applying a liberal quantity of the essential elements except the one under study, the capacity of the soil to supply the one element is pretty well tested. One trial with a series of enough different treatments is sufficient to check the supply of all essential elements for any one soil and crop.

There are, of course, limitations to this method. The choice of an indicator crop offers a problem, in that there is a wide difference in the response of different crops growing on soils that are variously treated. What is adequate for one crop may be a deficiency for another, and it is not possible to test all crops in the greenhouse. Some plants, such as trees, are too slow growing for a quick greenhouse test.

The final test for nutrient deficiency and response to treatment is always a field trial, where the normal plant environment functions to influence the response. In the field the physical properties of the soil, the moisture supply, temperature, sunshine, and other things may become a major influence governing crop yield. Field responses, therefore, are not necessarily quite the same as previous study in the laboratory and greenhouse might lead one to predict.

Greenhouse results do give a valuable indication which should be followed up in the field. We first tracked down boron deficiency with greenhouse trials and sunflower as the indicator plant. Borax was then used in the field as a source of boron, first on cover crops with no measurable response. But when used in walnut orchards, on some soils the response to boron was phenomenal. In a few cases enormous yields of walnuts were obtained where only light crops or nothing had been obtained before the borax was used. On filberts there has been no measurable response to boron up to the present time. Boron deficiency has been found for a number of other crops, however.

In field trials reliable indications can be obtained from small plots, a few feet of row, or a few trees, before large scale treatments are made. Such trial treatments should be liberal to bring out distinct effects quickly. Economic rates of fertilization can be determined only after it is discovered what deficiencies exist and what corrective measures are needed.

After a number of preliminary trials with borax on walnuts it was found that the response was good, after two or three years, on some soils. On other soils there would be no response. Several carloads of borax have been used by walnut growers, but principally by those who have good reason from tree symptoms, or small scale trials, to expect good results. Up to 10 pounds of borax per tree at one application on big walnut trees has given good results. The same application on other more sensitive plants, however, might prove injurious. Such heavy applications probably should not be repeated two years in succession, even on walnuts.

Deficiencies of some of the minor elements—iron, zinc, manganese, and copper—are often best corrected by the use of suitable spray materials applied to the foliage or branches.

Deficiencies That Are Most Common

While both the crop and the soil must be evaluated in designating deficiencies, it is usually possible to make some general recommendations. For most Oregon soils, the humus level is sufficiently low that provision for humus renewal and nitrogen fertilization is a necessity for obtaining improved yields. In our orchard fertilizer program, nitrogen deficiency is so outstanding in many orchards that no other treatment will give a response until the nitrogen deficiency is corrected. This usually means enough fertilizer to supply 50 to 100 pounds or more of nitrogen an acre. The response is sometimes as much as 50 per cent or more increase in yield by the third year of treatment.

Phosphorus deficiency is common for those crops with high phosphorus demands. The same is true of sulfur. Gypsum is especially effective when used on legumes. Potassium may be deficient on some soils for certain crops. In Eastern Oregon, there is some well-established zinc deficiency on cherries. A satisfactory corrective for all these deficiencies is known, though not always adequately practiced. Scarcity and high prices of agricultural products result in renewed interest in corrective measures for all types of nutritional disturbances that reduce the yield or impair the quality of the crop. The use of fertilizer has recently been greatly increased.

A well-planned fertilizer program will seldom be limited to the correction of one nutrient deficiency. For example, the use of nitrogen fertilizer may increase the yield sufficiently to cause other deficiencies, not present with small yields, to appear. On valuable crops, some of which return several hundred dollars an acre, it is considered good insurance to use a complete fertilizer, supplying not only the usual N-P-K but also sulfur and in many cases boron where there is a probable deficiency. The wise use of a complete fertilizer is likely to result in soil improvement whereas the use of nitrogen only may deplete the soil fertility.

Maximum yields so far as the soil is concerned will be obtained from the correction of nutrient deficiencies where the physical properties are good. Loams, silt loams, and sandy loams that are deep, permeable, well-drained, aerated, and oxidized are favorable. The ideal structure will be sponge-like, enabling the soil to absorb and hold moisture for plant growth. Perhaps only irrigation can adequately regulate the moisture for maximum yields. A deep root zone is important in irrigation practice, but is doubly important where there is no irrigation and the crop must survive long drouth periods drawing only upon the stored moisture in the deep soil.

When the physical properties of the soil are good and moisture is adequate, the well-planned fertilizer program produces both satisfaction and good returns. No kind or amount of fertilizer can compensate for shallow depth, impervious clay-pans, poor aeration, and lack of moisture storage in the soil. An adequate diagnosis, which will lead to profitable increases in yields from the right kind of treatment must fully evaluate all these yield factors, recognizing also that disease, insect enemies, and other things influence yields and may become the controlling factor if not corrected.

Rice Nutrition in Relation to Stem Rot of Rice

(*From page* 14)

son with the nitrogenous fertilizer cannot be measured wholly in terms of yields since severe stem-rot lodging, such as occurs when only nitrogenous fertilizers are applied, lowers the quality of rice and makes harvesting difficult.

The results of experiments conducted in the greenhouse and at the Rice Branch Station, Stuttgart, Arkansas, confirm earlier observations that rice susceptibility to stem rot is influenced by host nutrition. High levels of nitrogen increase susceptibility whereas high levels of potassium reduce susceptibility. The results are sufficiently promising to warrant fertilizer tests on outlying rice farms where stem rot is known to cause severe losses.

TABLE 3.—EFFECT OF FERTILIZERS ON LODGING AND YIELD OF RICE, STUTTGART, ARKANSAS—1946.

Variety	No fertilizer		400 lbs. 10–0–0 July 5		400 lbs. 10–4–10 July 5	
	Percentage of plants lodged [1]	Bushels per acre yield [1]	Percentage of plants lodged [1]	Bushels per acre yield [1]	Percentage of plants lodged [1]	Bushel per acre yield [1]
Zenith	0.0	36.3	0.0	52.3	0	55.1
Prelude	6.0	36.4	9.0	49.2	3.5	54.0
Arkansas Fortuna	17.5	31.6	34.0	42.3	12.5	42.7
Nira	26.5	27.6	39.0	45.1	25.5	48.9
Mean	12.5	32.9	20.5	47.2	10.4	50.2

N=Cyanamid, P=superphosphate, K=potassium sulphate.
[1]Average of four replications.

The Effects of Fertilizers on Blackland Soils of Texas

(*From page* 12)

ably the phosphate applied affect the exchange capacity. On all the soils potash was recommended. After the phosphate need is met, potassium may become the limiting fertilizing element.

Tests on other soils of Texas have shown that almost identical yields of the succeeding crop have been received from applying fertilizers to the legume, and from applying it directly to the crop. If a balanced soil nutrient level is obtained for winter legumes on Blackland soils, the question of how to fertilize the Blacklands may be answered.

Don't Feed Alfalfa at the "Second Table"

(*From page* 22)

"Legumes are soil renovators in a marked degree and may be very profitably employed in building up run-down soils. Without legumes the problems of maintaining adequate supplies of organic matter and nitrogen in soils are difficult; with legumes they are simple." These statements are partly true but are misleading, for the soil is not enriched in the numerous plant-food nutrients other than nitrogen.

Since nitrogen was the nutrient element that usually became the first limiting growth factor in the poor upland soils of the Corn Belt region before phosphorus, potassium, and calcium became limiting, the increase in crop yields following the legumes led to the common interpretation that the legumes were soil-building in a broader sense than they actually are. Furthermore, it has been found that legumes are efficient producers of extra nitrogen only when all conditions, as inoculation, drainage, soil acidity, and the supply of minerals such as phosphorus, potassium, calcium, and magnesium, are adequate.

The benefits derived from deep-rooted legumes like alfalfa are not to be minimized since they do pull minerals out of the subsoil. Neither should it be minimized that the organic residues are beneficial in numerous respects; but farmers should know that alfalfa is a tremendously heavy feeder for phosphate and, particularly, potash. In table 5 a comparison is made between alfalfa and several other common crops to indicate the quantities of phosphate and potash used or removed by the crops. It is apparent that alfalfa can be extremely hard on the land if the crop is removed as hay and the phosphate and potash not adequately returned in the form of manure or crop residues.

If alfalfa and other legumes are to be fed at the "second table," it is obvious that the second table must supply adequate plant-food nutrients. The practice of adding extra phosphate and potash as fertilizer with the small grain where legumes are to be seeded is a very sound practice. It must be emphasized, however, that these extra quantities will need to be higher than those commonly used if high yields are to be expected.

During the spring of 1941, alfalfa plots were established on a low-fertility Crosby silt loam near Lafayette. All treatments were applied in triplicate. Analysis of this soil for available potash

TABLE 4.—AVAILABLE POTASH, EXPRESSED AS POUNDS K_2O PER ACRE EIGHT INCHES, FOUND IN VARIOUS DEPTHS OF SOME COMMON UPLAND FOREST SOILS OF INDIANA.[1]

Soil type	Depth in inches	No. of samples	Lbs. K_2O per acre 8 inches
Cultivated soils [2]			
Clermont silt loam	0–8	5	138
	13–20	2	165
	28–36	2	182
Crosby silt loam	0–8	4	163
	13–20	2	269
	28–36	2	152
Crosby silty clay loam	0–8	2	229
	13–20	2	346
	28–36	2	247
Miami sandy loam	0–8	2	132
	13–20	2	129
	28–36	2	138
Vigo silt loam	0–8	2	123
	13–20	2	255
	28–36	2	261
Virgin soils [3]			
Alford silt loam	1–9	1	201
	13–20	1	232
	28–36	1	237
Cincinnati silt loam	1–9	1	301
	13–20	1	149
	28–36	1	275
Clermont silt loam	1–9	1	301
	13–20	1	213
	28–36	1	288
Frederick silt loam	1–9	1	264
	13–20	1	264
	28–36	1	208
Zanesville silt loam	1–9	1	280
	13–20	1	261
	28–36	1	288

[1] Available potash extracted with neutral normal ammonium acetate.
[2] Analyses on cultivated soils from unpublished data by the authors.
[3] Analyses on virgin soils from unpublished data by Roy Weaver, assistant in agronomy, A.E.S. Purdue University.

indicated a very low supply, 160 pounds per acre eight inches, in the surface soil and considerably more, 270 pounds per acre eight inches, in the subsoil. The plots were well-limed and 1,000 pounds of 20% superphosphate and 200 pounds of muriate of potash separately and in combination were broadcast before plowing and turned under. The seed was properly inoculated to insure nitrogen fixation. No yields were taken the first summer, but plant-tissue tests indicated that the young alfalfa might be able to utilize even more fertilizer, especially potash. Therefore, an additional 500 pounds of the superphosphate and 200 pounds of the muriate were top-dressed on the plots in the fall.

Yields for the 1942 season, table 6, show that the plot supplied with both phosphate and potash in addition to lime yielded 4.35 tons per acre compared to 2.04 tons where lime alone was used, 2.48 tons for lime + potash, and 3.38 tons for lime + superphosphate. The value, at 1942 prices, of the phosphate and potash applied to the plot with lime, phosphate, and potash treatment was $27.75, with muriate of potash worth $45 per ton and 20% superphosphate $25 per ton. It may be seen that the 2.31 tons increase in hay from this plot over the plot receiving lime alone would need to sell for only

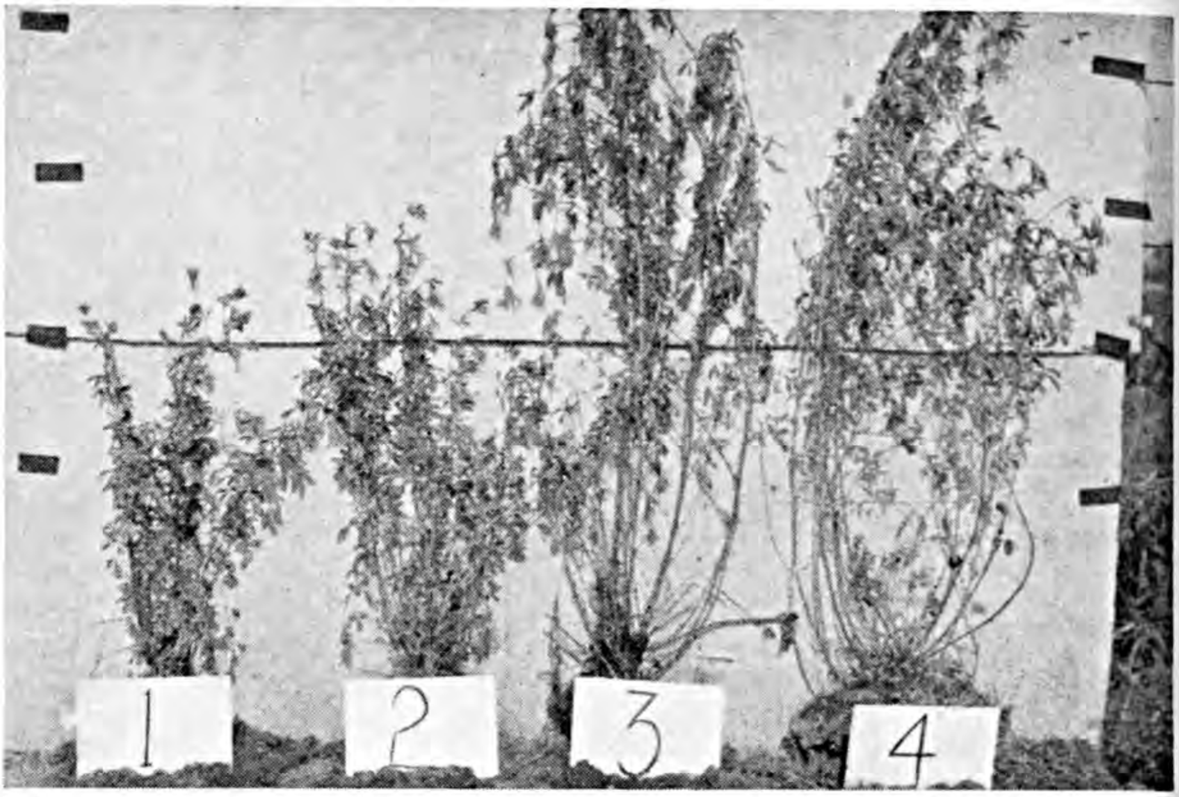


Fig. 2. Alfalfa from various fertilizer treatments on a low-fertility Crosby silt loam near Lafayette, Indiana, first cutting 1942. Treatments are as follows: (1) No treatment; (2) lime alone; (3) lime + phosphorus + potash; (4) lime + phosphorus.

$12 per ton to pay for the fertilizer used. Good alfalfa hay was selling for substantially more than that in Indiana in 1942. The entire cost of the fertilizer cannot be assigned to the first year's production since the fertilized plot will undoubtedly continue to outyield the plots without balanced fertilization or with no fertilization. Evidence of this is indicated by the extent to which weeds and grass have already reduced the stand on the latter plots and thus decreased the quality of the hay.

The importance of applying adequate fertilizers in the most effective manner in establishing stands of legumes on low-fertility soils and in the prevention of injury due to freezing and thawing in winter cannot be over-emphasized since the young seedlings must

TABLE 5.—PHOSPHORUS AND POTASH CONTENT OF SOME INDIANA CROPS, EXPRESSED AS POUNDS PER ACRE P_2O_5 AND K_2O BASED ON AVERAGE YIELDS 1930-39.[1]

Crop	Average yield 1930–39 [2]	Phosphorus		Potash	
		% P_2O_5	Lbs/acre P_2O_5	% K_2O	Lbs/acre K_2O
Alfalfa hay	1.69	0.44	14.9	1.33	45.0
Clover hay	1.10	0.43	9.5	1.54	33.9
Corn	36.2	0.55	10.8	0.40	7.8
Oats	26.0	0.91	7.8	0.92	7.9
Soybean (grain)	16.6	1.40	13.9	1.60	15.8
Tame hay (Timothy)	1.15	0.46	10.6	2.19	50.4
Wheat	17.6	0.95	10.0	0.51	5.4

[1] Per cent composition of phosphorus and potash for the various crops taken from Purdue Bulletin 468 by Lucas, Sieling, and Scarseth.
[2] Yields from Indiana Crops and Livestock Estimates No. 206, 1942, and expressed in bushels or tons per acre according to crop.

TABLE 6.—YIELDS OF ALFALFA HAY IN TONS PER ACRE, FROM VARIOUS FERTILIZER TREATMENTS ON A LOW-FERTILITY CROSBY SILT LOAM NEAR LAFAYETTE—1942.

Treatment	Yield of hay in tons per acre
Untreated	1.92
Lime alone	2.04
Lime+400 lbs. muriate of potash	2.48
Lime+1,500 lbs. 20% superphosphate	3.38
Lime+1,500 lbs. 20% superphosphate+400 lbs. muriate of potash	4.35

1,000 pounds of the superphosphate and 200 pounds of the muriate of potash were broadcast and plowed under before seeding and the remainder was top-dressed on the young alfalfa the following fall.

feed entirely from the surface soil until their roots become established in the subsoil. In some soils in Indiana the supply of phosphate and, particularly, potash is higher in the subsoil than in the surface soil. Once deep-rooted legumes are well established they can utilize some of these nutrients.

Evidence of this is shown by the yield of the plot, table 6, to which lime and phosphate but no potash had been applied. Here the yield was considerably higher than early growth would have indicated due to a supply of potash in the subsoil. However, many soils in Indiana have lost this reserve of plant nutrients through continued cropping, especially with legumes, and here the application of adequate fertilizers is particularly important.

Fertilizer Practices for Profitable Tobacco

(*From page* 17)

acre more than for the 28 plots not mixed.

Provided the fertilizer is thoroughly mixed before listing, the 1,500-pound applications are most profitable, but if the 1,500-pound applications are not mixed then they are much less profitable than the 1,200-pound rates or the 900-pound rates with side-dressing added.

Comparison of the three different side-dressings used would indicate that those containing 2½ pounds borax per acre produced average acre increases of about $90 to $100 over the 900-pound fertilizer applications without a side-dresser while the commercial 5-5-20 (which probably contained no borax) gave average increases of only about $75 per acre, or $15 to $25 less gain. (The difference in nitrogen content could have accounted for some of this difference in values.) When used following 1,200 pounds per acre fertilizer application and with 20-inch spacing, the side-dressing still gave a $28 per acre increased value. This would indicate that side-dressings containing nitrogen, potash (practically free of chlorine, and in the approximate proportion of two units of potash for each unit of nitrogen), and a small amount of boron (2½ pounds of borax per acre) pay handsome dividends where tobacco has received original fertilizer applications of only 900 to 1,100 pounds per acre and smaller profits where 1,200 pounds and more per acre of fertilizer were used.

The most profitable treatment in this experiment was the 1,200-pound application of 3-9-6 when mixed in the furrow before listing, plants spaced

20 inches in rows, and 100 pounds of 8-0-16 plus borax side-dressing used. This combination gave two-year average yields of 1,563 pounds with average values of $819 per acre.

The replants needed per acre were, on the average, approximately double where the fertilizer was not mixed in the soil before listing.

Summary and Conclusions

On typical bright tobacco soils fertilizer applications account for approximately 75% of the tobacco yields and acre values.

Average farm fertilizer practices produce, at present tobacco prices, average income values fully $100 to $150 per acre less than improved practices would give.

Twelve hundred to 1,500 pounds of 3-9-6 fertilizer per acre produce tobacco yields and values much larger than 900 pounds of fertilizer, provided the heavy rates of fertilizer are thoroughly mixed in the furrow before listing the land.

Fifteen hundred pounds of fertilizer per acre when not mixed are less profitable than 1,200 pounds, or 900 pounds plus 100 pounds of side-dresser. For normal applications of fertilizer the 20-inch spacing in 4-foot rows seems about right and is recommended.

Replants needed can be reduced by one-half by mixing the fertilizer in the furrow before listing previous to transplanting, or by using a machine to place the fertilizer in bands to the sides of the plant roots. A combination machine of this type designed and built by the writer in 1946 gave excellent results. The fertilizer distributor and row-lister were built around the chassis of an ordinary stalk cutter and resulted in a very low-cost, dual-purpose machine which saved approximately 75 per cent of the labor and team costs usually required to do these jobs. It produced results in tobacco yields and acre values never before equaled on this Station.

Two and one-half pounds of borax per acre applied either in the original fertilizer or in a side-dresser 20 days after planting give average increased acre values of $25 to $30 and are recommended.

Community Improvement Contests

(*From page* 24)

and improvement of soil fertility and feed production; 100 on development and improvement of appearance of home and farm; 100 on conveniences and liveability of home and farm; 400 on community organizations and development.

Practically the same outline is used in the contests sponsored by the Chattanooga and Nashville groups. The Plant-to-Prosper contest is based more upon individual accomplishments.

Are the results justifying the efforts and prize money? More scattered examples of the work done show that one community took as a major project the elimination of all but registered bulls on the farms of that community; another organized an unique recreation program; many built community houses; one community sponsored a State farm tour in search of better farming practices; another concentrated on reclaiming farm lands; one encouraged G. I.'s to enter farming and to develop sound farming systems. There is no full count at hand now of the schools and churches assisted and improved, the buildings painted and repaired, or the tons of fertilizer used. A few individual examples will show what this amounts to on a statewide basis.

Leaders of the Buffalo community in Grainger County sat down in January and made their plans for the year.

They listed all individual and community farm problems, and needed home improvements. Chairmen were appointed to push each phase of work. The dairy chairman checked on herds, pastures, and production; the Four-H Club leader checked on that work; and the field crops chairman worked accordingly. County and home agents were called in for advice on how to meet farm and home objectives.

As a result, Buffalo was practically self-supporting in the matter of feed, reducing the amount of hay bought bv 92.5 per cent, and the amount of other feeds bought by nearly 75 per cent—this, despite a healthy increase in the number of work stock, beef cattle, dairy cows, hogs, sheep, and poultry. It was done through increases of 9 per cent in small grains, 14 per cent in winter legumes, 40 per cent in alfalfa, and good increases of other home-grown feeds and pastures.

This community noted that 91 per cent of its families grew and conserved 75 per cent or more of their food needs. In addition to the home food supply, families filled hundreds of jars and cans for the school's hot lunch program. Buildings were painted, lawns seeded, fences built, home equipment bought, ad infinitum. Multiply this by about 400 competing communities, over the State, and the result reveals the actual progress made.

It is obvious that each community had plenty to do, since the judging was to be on improvement over the year before. Prosperous communities had no better chance of winning than less prosperous ones. Barren Plains, a well-to-do Robertson County community, reported the replacement of scrub bulls with registered sires. Barren Plains also constructed a community playground, fully lighted, and equipped for all ages.

Twin Oaks, in Putnam County, among other things furnished labor and materials to improve the school grounds, putting a good road through the premises. Twin Oaks leaders also saw to it that all barns and outbuildings were painted. A half-dozen eroded and practically waste farms were put back into cultivation.

Problems differed almost as widely as there were contestants. For example, Berry, a Wayne County community, started the shift from straight cotton with no winter cover, to a point where practically every cotton acre is in vetch. Alfalfa and small grains also were given impetus.

Then there is the prosperous community of Van Leer, in Dickson County. This group emphasized kitchen improvement and started a community cannery.

Everywhere, home improvements have been high on the list. The total adds up to a lot of communities which are now better places in which to live. It is anticipated that even more will be accomplished through the State in 1947.

Making It Safer to Save

(From page 5)

bountiful citrus groves at a bargain.

And of all these cruel temptations that beset a wallet-bulging yokel the least of them was not a hunger for land. Indeed the inner instincts of the native son of the soil cleaved to the lust for the land which many generations before his time had bred into those bucolic bones. It took a mighty lot of rapid-fire talking by those worthy bond brigades to stop some of those land expansion hankerings and wring the necks of the buzzards who proposed such investments. They failed in many cases, too, and their failure in due turn may be followed by the financial failure of the witless ones who bit on accustomed bait, forgetting the debacle of the depression days.

TOO few folks have taken time out to study the savings bond issues which the Treasury has sold to the credit of other than the commercial banking institutions. The first of these were the series A and B bonds, issued in 1935 and 1936, with the usual maturity in 10 years. They amounted to a trifle over one billion dollars in value and reached maturity in 1945 and 1946. This year the third, or C series, reached maturity.

The value of the whole series from C through G, or five separate issues, amounted to $67,979,000,000 of sales. Of this series of five issues only $17,636,000,000 have been redeemed by holders. This means that the Treasury still retains over $74 of every $100 originally invested by citizens out of the string of five issues aforesaid.

Taking the commonly popular series E issue, the amount which had been sold through January 31 of this year totaled about $45.8 billions, of which the redemptions were reported at that date as being $15.3 billions. Holders cashed in for only 33.4 per cent of their original investments, leaving the Treasury with 66.6 per cent of the investment intact.

It is also interesting to note that Series E, F, and G bonds were first offered in the spring of 1941, since which time to January 31, 1947, over $64 billions had been sold. This means that at least one-tenth of the national income has gone into this form of investment during the five-year period.

In confidential figures gathered by the Treasury a list of states with high rank in regard to low redemptions of series E bond issues presents illuminating facts. The high point in the list is where total bond sales stand at 165 per cent of the respective redemptions. The low point marks the spot where bond-holders of Series E bought only about 80 per cent of the amount they cashed.

Without breaking any seals of confidence, we can state that the big farm states of the Midwest, such as the Dakotas, Nebraska, Iowa, and Kansas maintain a unique position of merit in respect to their low rate of redemptions compared to purchases of savings bonds. I suppose someday when a final analysis can be taken of the reasons for and against retaining government issues snug in the strong-box, we shall get vital human documentary evidence that shows the interplay of economic forces. No doubt some of the low rate of redemption can be explained by a better financial reserve enjoyed by the ones best able to hang onto their wartime savings. Too many farmers went into the war price boom without the necessary fat on their ribs to help them withstand a long siege. It was a comfort to them at any rate to know that the cash they tucked under the teller's window to buy a savings bond was theirs for the asking, with a little mite of intrinsic value added.

WHILE the interest which is paid by the government on those valuable savings bonds is not huge and tempting to the rural thrifty, it is more than offset by the security involved through dealing with Uncle Sam. The reason that the interest is not very high is a story in itself. In spite of the existence of a present national debt which is 100 times the size of the Civil War Debt and 10 times that of the burden we bore collectively back in the first world war, the rise in the interest which must be paid to lenders by Uncle Sam is only about 37 per cent larger than it was after the Civil War. In funding the existing debt our government possessed powers and privileges through the Federal Reserve System that enabled us to borrow money at a low rate of interest, whereas 8 to 10 per cent interest was charged when the government was weak and uncertain of success back in the colonial times.

But when it comes to paying interest on farm land the answer is not so clear. At least there is some evidence that the rates are not down as far relatively as those the government accomplished in its own interest reduction process. Activity in the real estate market for farm properties located in nine counties of the Southeast region has been studied. The sales values for the last half of the past year were over 10 million dollars, compared to about 6 millions in 1945 and only 3 millions in 1941.

Speculation was going on, too. In this survey it was noted that 13 per cent of all the sales were of land owned less than two years by the purchaser, while two-fifths of the sales had been made within six months of original purchase, and at an apparent gross profit on resales of 36 per cent. That is, the speculators paid about $45 an acre and sold it within 6 months for $65 an acre.

IN that same region, typical of the area in general, fully 60 per cent of all land sales were made for cash. The rest were on credit and usually mortgaged for just about as much as the same land would have sold for in 1941. Interest rates varied from 3 to 10 per cent, with fully 20 per cent of the mortgages being based on rates 7 per cent and higher.

If a recession happens along unawares and dips the level of farm prices considerably below the velvet margin where ordinary folks without much skill and experience or ability can mosey along, somebody will get burned badly on skyrocket land values.

Meanwhile the neighbor who has whittled away on his farm without indulging in expansionist dreams and has laid aside some profits in the form of government bonds, or maybe some needed capital improvements or labor-saving equipment, is surely sitting in an easier seat, come what may.

JUST because the proclamation ending hostilities has been made is hardly sufficient reason for any of us to become prodigal of our financial resources and begin to run amuck, any more than to cringe and be afraid to make a reasonable amount of progress. This goes for personal affairs as well as for public welfare.

The nation spent something like $330 billions to save ourselves from defeat and misery. In doing so we lost more than 300,000 men on whose lives no price may be estimated. We also pay for disabled veterans and their educational and occupational benefits, billions for further defense and security, and a tremendous sum for interest. If we answered the roll call readily when the fighting was going on and signed up for our quota of government bonds with alacrity, then it is nonetheless vital for us to keep on investing in post-war recovery.

Along with the current bond buying must go a concerted attempt to enlist our best minds and strongest purpose in support of the United Nations charter and all the brave visions of world peace that caused the international councils to be organized—in agriculture as well as in trade. Unless these seemingly altruistic programs finally bear fruit, the long-time worth of any kind of investment, public or private, will diminish.

How fine it would have been had we been able to sell bonds for needful public works and highways and similar progressive and peaceful improvements, instead of beating the bushes to induce folks to shell out for making war and paying for it afterwards.

Lately an editor figured out what this country might have done with the $330 billions spent in war and defense. He claims that if we paved every mile of unimproved roads and alleys in the country at a cost of $50,000 per mile, it would have cost $79 billions, leaving $251 billions in the balance.

We could then give every auto owner a new car at $1,500 apiece and that would cost $52½ billions more, leaving \$198½ billions in the kitty. We could give each GI and his wife a trip over to the scenes of his former triumphs abroad, and at \$2,000 a trip this would leave us \$178½ billions to spend.

What is more astonishing, we could build a public hall or museum in every city with 25,000 or more population equal to the big marble Supreme Court edifice in Washington, and at a \$4-billion bill for it, our swag would still be \$174½ billions. We might also erect a \$10-million hospital in every place of 5,000 or more, expend \$30 billions in so doing, and have \$144½ billions in the cooler. Then, if we wanted to be real nice, we could give a \$50-per-week pension to every person over 60 years old at a total cost of \$3½ billions annually and then take 41 years of that to use up what was left in the war budget.

ONE wonders, however, if we could engender the same degree of enthusiasm for bond pledges to do such things as that as we succeeded in doing for the all-out offensive in wartime.

In conclusion, the attitude of our educational and extension agencies toward proper safeguards in savings is significant and reassuring. Four basic things to do so as to insure the future reasonably well have been emphasized often in literature and lectures by such agencies: (1) Pay unsecured debts as soon or as fast as possible; (2) Reduce farm mortgages to amounts that can be easily carried in a possible depression; (3) Make only necessary investments in machinery, buildings, and equipment to cut costs and improve efficiency; and (4) Put surplus funds into United States savings bonds.

By putting your nest-egg into safer savings through the reliable Federal bond issues, much aspirin and anacin will be left on the drug-store shelves.

PERFECT!

New Sergeant: "I'm a guy who admits his faults, only I haven't got any, see."

A Few Whinnies

A salesman taking his bride South on their honeymoon visited a hotel where they boasted of their fine honey.

"Sambo," he asked the colored waiter, "where's my honey?"

"Ah don' know, boss," replied Sambo, eyeing the lady cautiously, "she don' work here no mo.' "

* * *

A precocious three-year-old floored his parents the other day with his remark: "I'm getting t-i-r-e-d as h-e-l-l of your spelling words around me all the time!"

* * *

The tramp had just finished his repast and the lady of the house remarked: "Just as a suggestion, there's a woodpile in back."

"You don't say," said the tramp. "What a splendid place for it."

* * *

Today I met a friend of my youth who used to be an ardent socialist, filled with visions of reforming the world. He says he never got over it until he married and found how difficult it is to change just one woman.

* * *

He: (At the movies) "Can you see all right?"

She: "Yes."

He: "Is there a draught on you?"

She: "No."

He: "Is your seat comfortable?"

She: "Yes."

He: "Change places with me, will you?"

Sophomore: "Did you ever take chloroform?"

Freshman: "No, who teaches it?"

* * *

The Department of Taxation received a typed income tax return from a bachelor who listed one dependent son. The examiner returned the blank with a penciled notation—"This must be a stenographic error." Presently the blank came back with the added pencil notation, "You're telling me!"

* * *

She was insulted when somebody offered her a drink, but being a lady, she swallowed the insult.

* * *

Sympathy is what one girl offers another in exchange for details.

* * *

A man is getting along in years when he pays more attention to the food than he does to the waitresses.

* * *

The Seven Ages of Woman: The infant, the little girl, the miss, the young woman, the young woman, the young woman, the young woman.

* * *

A somewhat drunk G.I., hailed before his commanding officer, offered this excuse: "I got into bad company. I had a quart of whisky and my three buddies didn't drink."

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R. H. Stinchfield, *Editor*

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Trends in . . .

Teaching

Jeff McDermid

I KNOW a farmer who has worked an 80-acre piece fairly well, milked a small herd of cows night and morning, and besides has done a good job of teaching his own district school for nearly twenty years straight. This unusual fellow claims he didn't want to waste his teacher-college training, and he has always felt that rural schools need more men teachers. He specializes in teaching civic affairs, instructing his older students about the township government field and clear on up to the United Nations set-up. He puts about as much emphasis, too, on the personnel of the town board and the county supervisors as he puts on Marshall, Molotov, and Lie. In addition, he also has a rare way with the beginners' class.

I'm not giving his example as a plea for having more dirt farmers engage in teaching, but rather to indicate that good teachers have a "call" or an urge within themselves which is not easily blighted or discouraged by a limited wage opportunity or an inferior level of classroom equipment. My hunch is that you can't manufacture *a la* the assembly line a set of real high-class teachers, or buy them either. There must be a kind of germ inside somewhere that develops a full-bloom teacher. Naturally we must strengthen our training places for teachers and see that they get fair wages compared with other professions, but to swing the whole proposition on the dollar sign smells a trifle like tripe.

My last day spent in a public school was in June about forty years ago, which might let me off as a spellbinder on schools, but here goes anyhow. The objective of teaching is probably the same, even if the means and methods are vastly improved since then.

While the work at which I have been plugging ever since they shooed me out of school is generally covered by the term "information" and involves newspaper and magazine expression for the long suffering public, I have never regarded myself as a teacher.

The writer should, like the teacher, know his stuff and be clear and explicit in what he publishes; but unlike the teacher, he has no hands raised in an immediate barrage of anxious inquiry, when certain information has been imparted. The writer can shift his ground, back water, and avoid direct answers in case the dear public is prompted to make further inquiry on some point he has raised.

The teacher must be ready and willing at once to clear up obscurity and misconceptions and satisfy the skeptical and imaginative moods of youthful minds. The writer as a teacher is like the movie actor, who can repeat a "take" in case of error. The real classroom teacher is like the stage performer, who has only one chance to make good before a visible audience. That is why I have never claimed to be a teacher, remembering the best ones we had in those long-past school days, and knowing they surely didn't achieve such standards for the glory or the wealth involved. I like to recall their reign of authority, which helps me more now than it ever did then.

AS AN ASIDE, I might explain that your information man in any government job is a trifle nearer to the teacher in respect to being ready on short notice to review, explain, and digest much of the background springing from current official pronouncements. If you don't think so, be on the receiving end of a phone after a yarn about parity or support prices has been released. Ordinarily, though, the public writer has more time to make adjustments before the public reacts than the classroom instructor enjoys. Hence the good teacher must be soaked in his subject. For you and me to admit our ignorance to a kid is bad enough, but for a schoolma'am it is often fatal.

We who were young and ripe for tutoring away back in the gas-light era had three kinds of teachers—day school, Sunday school, and music. Aside from the more pungent and impressionable sources of facts and warnings derived from schoolmates and parents, the three sets of teachers aforesaid were our mainstay for the practical and cultural arts.

WHEN YOU LOOK back at the time spent with these three kinds of teachers, the ratio stood at approximately forty to one in favor of public school teachers over the other kinds on the hourly basis per week. When you reckon in the time actually spent at desks and blackboard against the waking hours spent with your parents within the home circle during nine months of the year, I suppose the ratio stood about forty to thirty in favor of the school teacher, with Sundays omitted and divided with the Sabbath school class. And as far as I can recall, the deportment of the kids in church school usually cut the teaching effectiveness to a mockery compared with the rigid decorum we had to maintain in day school.

With so much of our early lives spent within the classroom, it is no wonder that I can recall the features and manners of my public school principal and his bevy of subordinate "old maid" teachers almost as well as the ways of my parents.

I am led to believe by a relative who attended a good parochial school that the Sisters who guided young minds in that devout institution were stronger and more forehanded in the household crafts and domestic skills than the supervising boards of our common schools permitted to be taught at the time. Be that as it may, the two forms of public instruction were far ahead of the original select or private subscription schools which furnished the only means of teaching children outside of the homes less than a century ago in newly settled communities.

The free privilege of sending kids to a common center in charge of a hired preceptor for their basic education was indeed one of the hall-marks of quality in our newly designed democracy. You

got more for your money that way, especially when you were the parents of alert and studious juveniles.

However, it does seem strange as we review it that not a few of the old hardscrabble farmers actually resented the laws about school attendance and considered themselves regimented by compulsory enrollment of their offspring at the fountain of erudition. I have witnessed several scraps and countless bickerings over the parental right to keep his husky youngster in field or furrow while other rural juniors toted dinner pails to the one-room palladium. Maybe we went at it the wrong way—possibly a ban against attendance by small taxpayers might have aroused their zeal for a fair share of the educational dish. But when those grubby old-timers snatched too many gangling kids out of the district school, it made things tougher for the teacher and put overhead costs at wasteful levels.

Looking backward to yearning yesterdays, I recall certain old teachers with as much, or more, reverence as I bear toward some relatives with whom I have lived. At the time of my tutelage under their sovereign sway there were brief moments when I hated them, but many of those of whom I stood in dread have long since become my ideal as forthright "mental governors."

When I consult the dingy records of the school board for those departed terms, and note the fact that the best of my former teachers received hardly more than the janitor and had to pay their own expenses to teachers' institutes or lose their jobs—I then wonder if they are getting some bonus or permanent halo or a special set of marcelled wings up in that corner of the Promised Land where now they teach the cherubim.

I remember a young teacher who came a long way to join our staff and whom I found weeping in her study nook over some routine failure; another one who cared for a bedridden mother and spent many donated evenings coaching classes in rhetoric or debate; and another who was lame and homely, but who had such strong personality that her desk was always heaped with seasonal wild flowers; and of course, the principal, who seemed haughty and aloof, but who was the first stranger to enter my home at the last illness of my mother.

BEFORE I REACHED high-school age it was our custom to haunt the halls and watch the upper-class teachers wend their sedate way to the top altar of learning. There was one gaunt and firm-lipped spinster who cast her shadows before my scholastic path, and we all dreaded the fall when it would be our turn to master mathematics at her beck and call. I was never so deceived in my life, and no single teacher I ever had remains so firmly and warmly sheltered in my memory. She was an elder statesman and a philosopher combined, a grand teacher and a believer in outdoor sports and social recreation. Sometimes the youthful mind sadly misjudges, but lives to learn and long remember.

I dare say no Sunday-school class period or any single Sabbath instructor of mine has ever left me with a cleaner and more wholesome outlook than this

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Fig. 1. The right sprays applied at the right time are very important in realizing maximum profit in potato production.

Potato-Growing Developments In New England

By Ford S. Prince

Department of Agronomy, University of New Hampshire, Durham, New Hampshire

POTATO growers in 1946 witnessed the effect of a combination of favorable circumstances on potato yields. A cooler than average growing season, plenty of rain during August when the tubers were making their most growth, coupled with the wide-spread use of DDT conspired to produce the most potatoes the United States has ever grown on the smallest acreage planted since 1892.

Actually, the acre yield of potatoes in the country was 29 bushels higher than in 1945, the previous record year. Acre yields of individual growers reached almost fantastic records. More men produced over 500 bushels per acre in the New Hampshire 300-Bushel Club than in the previous 20 years of the Club's history. The State record of 535 bushels which had stood since 1941 and was held by John Jackson and Son of Colebrook was exceeded by 152 bushels per acre by John York of Kingston, whose yield was 687 bushels per acre on a three-acre tract.

How much of these large yields can be credited to DDT and how much to the effect of favorable weather can only be conjectured. Nor can we predict the weather in 1947 or any future year. But we feel fairly certain of a continued and adequate supply of DDT which has proved to be a most satisfactory control for flea beetles, leaf hoppers, and a fair control for aphids. It may be that in the very near future, spray and dust equipment will be modified so that better aphid control with DDT will be possible, or it is very likely that other new products will be developed that will show a better killing power for aphids than DDT now possesses.

Most growers realize this year, for the first time, what the control of these small insects means in relation to yields. Many of them would not have believed, probably, that such control would increase yields by 50, 75, or even 100 bushels of potatoes per acre. Yet, it is apparently possible. We predicted a dozen years ago that no one in New Hampshire would produce as many as 600 bushels of potatoes per acre until he could control these little pests which do so much damage in July and August when the tubers are forming. In 1946 for the first time potato leaves were not punched full of shot holes by flea beetles in August. It was the first year, too, in which a lot of hopper burn was not noticeable. This allowed the big, broad, uninjured leaves to do their full work in assimilating food materials, producing abundant tuber growth.

With these facts in mind, it may be well for potato growers to re-examine their whole potato program, including their rotations, their soil fertility schedule, the possibility of the need for some of the rare or minor elements on their land, the question of variety and the quality of the potatoes they produce, with the view of adjusting acreage and production to consumer demands and supplying a high quality product to consumers who are likely to be more and more discriminating.

Fig. 2. Potash deficiency (left) is indicated by a yellowish to blackish brown coloration of potato leaf margins and the tips of leaves are curled downward. Internodes are shortened giving the plant a compact or crowded appearance. A normal leaf is shown at right.

Organic Matter

There has been a tendency for the acreage of potatoes to become concentrated on farms with larger units. Oftentimes, these growers produce nothing else to sell. The tendency on these farms has been to crop the land to potatoes more than one year, and frequently for 5, 8, or 10 years in succession. We have instances in New Hampshire in which potatoes have been grown on the same land more than 20 years in succession. Constant cropping like this tends to deplete soil organic matter and leads to serious erosion, especially on the hill farms.

Working with the rotation problem in New Hampshire,[1] we have found that even in a three-year rotation of potatoes, oats, and clover, there was a loss of organic matter due to cultivation. In these rotations, the oats and first clover crop were removed, while the second clover crop was plowed under. Applications of lime tended to decrease the loss in organic matter as did fertilizers containing a high phosphorus content. This fact is doubtless due to the stimulating effect of calcium and phosphorus on root growth. According to the available data, it would take a rotation of four or five years duration with only one year in potatoes to maintain the organic matter of the soil at its original level.

Green manuring is a possibility for reducing organic matter losses in potato rotations. This is another matter under study in our State.[2] Beginning with 1940, potatoes have been grown on a Paxton soil, on small plots, to study the effects of different cropping systems on soil erosion. One series of plots has had a rye cover seeded each fall, while on the other series, no cover crop has been grown. In 1940, yields were the same whereas in 1941, a drought year, the plots on which rye had been turned under suffered from lack of moisture and failed to yield quite as many potatoes as the plots which had no cover. Since 1941, the rye plots have outyielded the bare plots from 4 bushels in the dry season of 1944 to 30 bushels per acre in 1945 and 1946. The average increase for the six-year period in favor of rye is 14 bushels of potatoes per acre.

Studies[3] on early blight last August indicated that the potatoes on the bare plots had 13.8 lesions per compound leaf while those on the rye plots showed but 3.7. This condition, of course, resulted in the earlier death of the vines on the bare plots, which no doubt accounts for the lowered yields there. Other studies conducted last summer tend to substantiate these data, indicating more early blight on potatoes in those rotations in which no attempt is made to maintain soil organic matter.

Growers have been puzzled in the past as to why potato vines often die early. Depredation by small insects has undoubtedly been one cause. But a second and very potent one probably has been lack of soil organic matter. This, then, is undoubtedly a good time for growers to overhaul their rotations and cropping practices in order to get some fresh organic matter into their soils. This may mean reduction in acreage or merely placing more emphasis upon winter cover crops. In either case, better crops in the future will result on the acreage planted.

Fertilizers

Potato growers can be said to be very conscious of plant food and the necessity for applying commercial fertilizers for the crop. Our 300-Bushel Club records show a constant and steady advance in the amount of plant food applied from about 1,900 pounds per acre 20 years ago to 3,000 pounds in 1946. These figures are calculated to a 20-unit basis. In other words, the actual amount of fertilizer applied per acre by these growers in 1946 was about 2,400 pounds of a 5-10-10 grade, which is a 25-unit fertilizer. Individual growers in this group applied as much as 3,500 to 4,000 pounds of 20-unit fertilizer.

These amounts of fertilizer, which have likely been duplicated in all the New England States, are far above the recommendations issued by agronomists and horticulturists during and since the war for use on the potato crop.

Putting aside the recommendations and looking at the experimental data, Brown,[4] in Connecticut, states that 100 pounds of nitrogen per acre for potatoes are sufficient under practically all conditions, 80 pounds are ample in many cases, and 60 pounds or even less will suffice when potatoes follow a sod crop. This worker states that seldom do potatoes respond to more than 160 pounds of phosphoric acid and that 120 pounds or even less will give optimum results under continuous culture or short rotations. He also states that in most cases, 120 pounds of potash will be adequate.

Chucka, Hawkins, and Brown[5] suggest that potato fertilizers in Aroostook County should supply, per acre, ap-

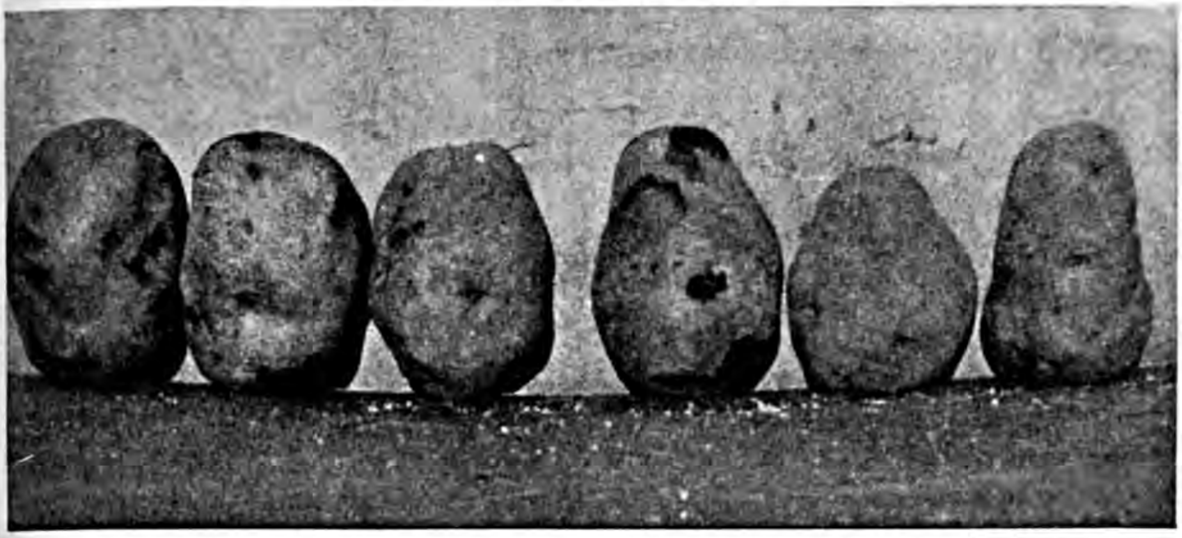

Fig. 3. Influence of manuring on the shape of potato tubers. Left: Round tubers resulted when fertilizers high in potash were used. Right: Tubers long and tapering at the crown end resulted when fertilizers high in nitrogen and low in potash were used.

proximately 100 pounds each of nitrogen and phosphoric acid and about 200 pounds of potash.

In our work in New Hampshire,[6] we have not found a need for more than 100 pounds of nitrogen per acre, although our studies indicate that in long rotations and particularly at high elevations on soils in the podzol group, we do get a response for more than 160 pounds each of phosphoric acid and potash. On soils such as these we recommend a fertilizer approximating one ton of 4-12-12 per acre which would carry 80 pounds of nitrogen and 240 pounds each of phosphoric acid and potash. If potatoes were grown a second and third year on this land, the formula could be narrowed to a 1-2-2 ratio, no doubt, because of accumulations of phosphoric acid and potash not used by the preceding crops.

Several workers have reported results of fertilizing potatoes with different amounts of fertilizer. Two of these are summarized in table 1.

Both these studies show that so far as yields are concerned, the upper limit of yields was not reached even with one and one-half tons of fertilizer, but that the rate of return per hundredweight of fertilizer declined steadily as larger amounts were applied. Obviously, when the number of bushels of potatoes produced with an extra hundred pounds of fertilizer fails to pay for the fertilizer, the limit of economy has been reached and, in fact, passed. Where this point is will always be determined by fertilizer costs and potato prices. Certain it is that the most profitable fertilizer use is somewhere in the lower rather than in the upper levels. With guaranteed potato prices and since fertilizer costs have not risen in proportion to other commodities, there hasn't been

TABLE 1—THE RESULTS OF VARYING RATES OF FERTILIZER APPLICATION ON POTATOES

Maine Results[5]

Fertilizer treatment		Yields per A., bushels	Gain, bushels	Gain in bushels per cwt. of fertilizer
None		117		
500	4-8-7	251	134	26.8
1,000	4-8-7	326	75	15.0
1,500	4-8-7	374	48	9.6
2,000	4-8-7	406	32	6.4
3,000	4-8-7	425	19	1.9

New Hampshire Results[6]

Fertilizer treatment		Yields per A., bushels	Gain, bushels	Gain in bushels per cwt. of fertilizer
1,000	4-8-7	318		
2,000	4-8-7	386	68	6.8
3,000	4-8-7	431	45	4.5

too much need for worry. But this time will soon pass, undoubtedly. For this reason, it may be well for potato growers to be thinking about the economy of their fertilizer procedure.

That there is an accumulation of plant food in potato soils, particularly of phosphoric acid and potash, has been shown by a number of investigators. Peech[7] and his associates working on the potato-growing soils of different states have recently emphasized this fact. Their studies on accumulations of plant food are now being supplemented by field tests of producing potatoes with different levels of phosphoric acid and potash in the fertilizer on soils with known levels of available soil phosphoric acid and potash.[8] The response in yield for added amounts of both elements declined as their respective levels in the soil increased.

The point is, here is a group of growers who have, by excessive fertilization, put considerably more plant food into their soils than has been removed by the crops they grew. That this has resulted in high yields there is no question. There is no question either that by doing this they have built up a reserve of plant food in their soils, which tends to limit the response they secure from further application of huge amounts of fertilizer. With changing economic conditions, here is one factor the grower can take into consideration. He can retrench somewhat in his fertilizer costs, at the same time cropping-out his phosphate and potash reserves which have been built up during the time he could afford to purchase the excess fertilizer.

Rare Elements

There is another fact which is beginning to dawn upon us and that is the need for some of the minor elements in the nutrition of the potato plant. This need doubtless has been magnified by the production of large crops of potatoes through heavy fertilization, a fact which has tended to reduce the supply in the soil of some of the so-called minor elements that are not contained in a normal fertilizer.

The evidence for the need to apply magnesium in potato fertilizers is probably better established than that of any of the other so-called trace elements. This element deficiency was first worked out in Maine by Chucka and Brown,[9] who found that the trouble could be corrected by applying available magnesium in the fertilizer or by using dolomitic limestone directly on the land.

Magnesium hunger in potatoes, when it occurs, is evidenced by a chlorotic condition of the lower leaves, which causes them to turn rusty brown or bronze in color. When it occurs, unless corrected, magnesium hunger may cause a loss in yield of from 25 to 75 bushels per acre. The trouble may have shown up in Aroostook County sooner because of intensive cropping, under heavy fertilization, in a system of farming in which no livestock is kept.

In New Hampshire, our growers have encountered magnesium hunger chiefly on intensive potato land. We have observed few cases of the trouble on dairy farms where manure is used in the rotation. Since there has been a tendency for potato growing to become concentrated on a few farms with large acreages rather than on many farms with small acreages, it is doubtless advisable to take precautions and apply magnesium in the fertilizer or use a magnesium-bearing limestone when liming is practiced. Fear of causing potato scab by using lime has tended to deplete soil magnesium more rapidly than where a sensible liming program was followed.

Boron is another nutrient element that deserves more study in connection with the potato crop. Dunklee and Midgley[10] in Vermont report that potatoes respond to boron by having more resistance to early blight and better quality in the tubers. Hawkins, Chucka, and Brown[11] reported in 1941

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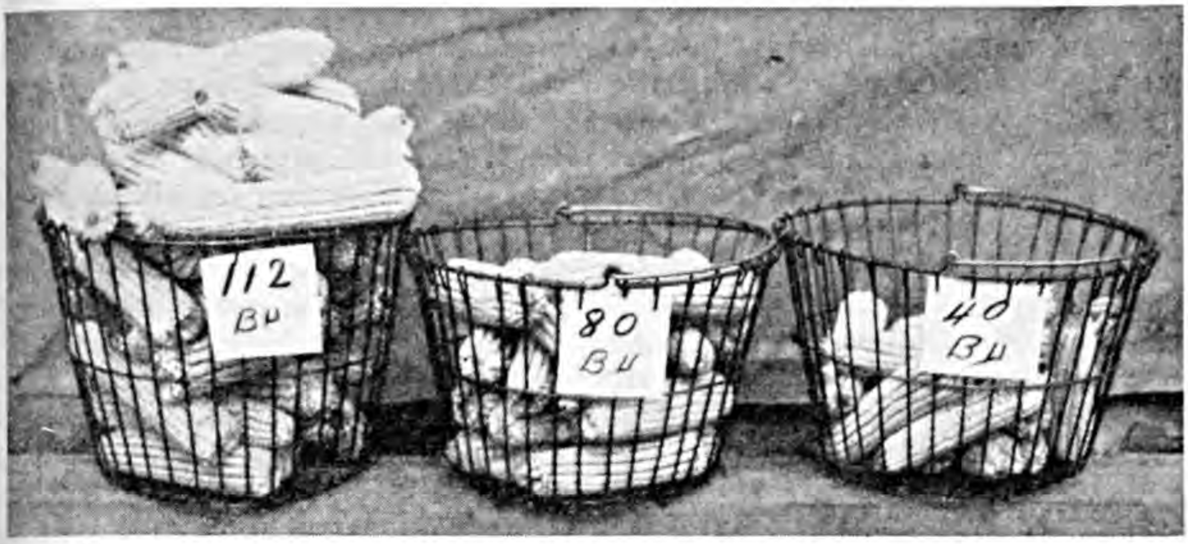

Fig. 1. Corn demonstration by Jimmie Kirk, Iuka, Miss., produced a yield of 112 bu. with complete fertilizer, 80 bu. with nitrogen only, and 40 bu. with no fertilizer.

Increasing Grain Production In Mississippi

By J. M. Weeks

Extension Agronomist, State College, Mississippi

HOW MUCH longer will Mississippi and other southeastern states continue to be deficit feed-producing areas, especially when livestock numbers are being increased so rapidly? What can be done about it, and how soon can we expect improvement in production of feed, particularly grain?

For the period 1935-44, an average of 2.9 million harvested acres of corn yielded an annual average of 44.5 million bushels. The yield per acre was 15.3 bushels, about the average during the past 15 to 20 years. The trend in acreage of corn is steadily downward, 2.4 million in 1945 and 2.2 million in 1946. Exceptional growing conditions in 1945 produced a record yield of 20 bushels per acre and a total of 48.5 million bushels. But, the yield dropped again in 1946 to 16.5 bushels and a crop of only 36.4 million bushels of corn.

The picture with respect to oats looks much better, but not yet good enough. The 1934-44 average harvested acreage was 194,000; yield per acre, 30.5 bushels; and a crop of 6.3 million bushels. The acreage has increased rapidly each year since except in 1946, which was due to extremely adverse weather conditions at planting and harvesting periods. The 480,000 acres in 1945 yielded 31 bushels per acre and a total crop of 14.9 million bushels. The 1946 crop on 360,000 acres produced 31 bushels per acre and a total of 11.1 million bushels of oats. It is estimated that about 500,000 acres were planted during the fall of 1946, another record.

These figures all add up to the fact that about a half million fewer acres of grain were harvested in 1946; and about 5.5 million fewer bushels of corn-equivalent grain were produced than

10 years ago. This is a net loss of feed grain, while livestock numbers in the State have increased about 16 per cent. Shortage of cottonseed meal and other concentrates blackens the picture still more.

Ten years ago, an average of about one million tons of hay was harvested from 892,000 acres, a yield of 1.16 tons per acre. The yield has increased to 1.38 tons per acre in 1946 to produce 1.2 million tons on 854,000 acres. This increased hay has not substituted for very much grain.

Improved pastures and grazing crops have lessened to some extent the need for grain feeds. Less than a half-million acres of improved pasture could be accounted for 10 years ago, while 1.5 million acres are now reported. The increase will be much more rapid each year.

After allowing due credit for increased production of small grain, hay, and grazing, the feed situation in Mississippi for present livestock needs is just about status quo, compared with the relative situation that existed 10 years ago. The problem in grain

Fig. 2. Dixie 11 hybrid corn yields 15 to 20 per cent more than best open-pollinated varieties.

production is largely a simple one of yields per acre, and little has been done by most farmers to increase the yields of corn and oats.

Corn has been the "stepchild" among the crops in its treatment compared with the cash crop cotton. Probably 90 per cent of the cotton acreage receives reasonably high rates of recommended fertilizer, while not more than 10 per cent of the corn receives any fertilizer at all. This difference in treatment cannot be justified on a basis of difference in returns from a dollar spent for fertilizer for the two crops.

Corn experiments in Mississippi for more than 20 years have shown that nitrogen, in all sections of the State, returns $4 to $5 worth of corn for each dollar spent for fertilizer used on it. This is the same rate of returns as received from fertilizer used on cotton.

The yield of corn could be increased from the 15-bushel average to 25 bushels if each acre were fertilized with 24 to 32 pounds of nitrogen. A 10-bushel increase in the yield on the 2.2 million acres of corn harvested in 1946 would have added 22 million bushels to the 36.4 million bushels harvested. This would have given a record corn crop of 58.4 million bushels. Similar practice for oats would have increased the 31-bushel average yield to at least 45 bushels. This would have added about 5 million to the 11.1 million bushels harvested to make a total crop of 16.1 million bushels. All of this corn and oats should satisfy the grain requirements of the live stock in the State.

While 24 to 32 pounds of nitrogen per acre are generally recommended, very poor hill soils need phosphorus and potash also for growing high yields of corn. Tests and demonstrations are pointing out possibilities of corn production through a balanced fertilizer program.

Special corn-production demonstrations were conducted in Mississippi in

1945 and 1946 with 4-H club boys and adult farmers. The American Potash Institute sponsors the 4-H corn production contest in cooperation with the Mississippi Extension Agronomy Department and county and assistant county agents. A total of 109 4-H boys conducted corn demonstrations in 1945. Complete records were sent in on the 23 demonstrations having the highest yields, for the awards offered in the contest. Eight widely scattered counties were represented. In 1946, 855 demonstrations were conducted by 4-H boys and adults in 62 of the 82 counties, and complete records were sent in on 32 demonstrations for competition for awards.

Fertilizer requirements in the demonstrations follow:

Plot	Treatment	Rate per acre
1	6–8–8 fertilizer or 6–8–4 fertilizer	500 lbs. (applied in water furrow before bedding rows for planting)
	Additional nitrogen	32 lbs. nitrogen side-dressed when corn is about knee-high
2	Nitrogen only	32 lbs. nitrogen in water furrow
	Additional nitrogen	32 lbs. side-dressed
3	Check—no fertilizer used	

Fertilizer in plots 1 and 2 was applied in the water furrow before the land was bedded for planting. These plots also received a side-dressing of 32 pounds of additional nitrogen when the corn was about knee-high.

Corn yields were estimated in the field according to a standard method. The location, general fertilizer treatment, and yields per acre reported in 1946 with average figures compared with demonstrations in 1945 are shown in table 1.

The average yield of the check plots, without fertilizer, was 34 bushels per acre. Average yield on No. 2 plots, receiving 64 pounds of nitrogen per acre, was 61 bushels, or 27 bushels more than the corn which was not fertilized.

Plots No. 1, which received the same amount of nitrogen as plots No. 2, and also phosphorus and potash, averaged 77 bushels. This yield was an increase of 16 bushels per acre which can be credited to the phosphorus and potash, and 43 bushels more than yields on the check plots. Only four demonstration records out of the 32 reports showed negative results from use of complete fertilizer. Returns from nitrogen only were generally in line with yields obtained by the State Experiment Station, approximately one bushel of corn for each two pounds of nitrogen used.

Research and demonstrations also show that maximum yields from fertilizer are obtained by growing many more stalks of corn on an acre than farmers commonly grow. Farmers in the hill areas of the State leave about 4,000 stalks per acre or an average of one stalk per hill about 3 feet apart. Possibly the fertility of the soil will usually be no more than the equivalent of 30 pounds of nitrogen or enough to grow the average of 4,000 stalks and 15 bushels of corn per acre. Where more plant food is applied, more stalks of corn can be supported, up to 8,000, 12,000, and 15,000 per acre with applications of 60, 90, or 120 pounds of nitrogen.

The 1947 standard corn demonstration requires the use of 90 pounds of nitrogen per acre on the fertilized plots. The complete fertilizer application on No. 1 plots for hill areas will be continued with no change from

TABLE 1.—1946 STANDARD 4-H CORN-FERTILIZER DEMONSTRATIONS

County, name, and address	Fertilizer used and yield per acre		
	Plot 1	Plot 2	Plot 3
	500 lbs. 6–8–8 or 6–8–4 before planting plus side-dressing of 100 lbs. ammonium nitrate or 200 lbs. nitrate of soda per acre	100 lbs. ammonium nitrate or 200 lbs. nitrate of soda before planting plus same kind and amount side-dressed	Check no fertilizer
	Bushel yield per acre		
Lauderdale:			
Donald Jolly, R 4, Meridian	45	38	10
Billy McElroy, R 4, Meridian	50	40	10
Leake:			
Benton Atkison, Carthage	58	53	24
Eugene Dabbs, Center	81	76	40
Lowndes:			
Jimmy Simpson, Caledonia	63	36	26
Madison:			
Joe Hayes, Farmhaven	69	47	20
Lewis Henderson, Madison Station	47	32	12
Hugh W. Purvis, Flora	76	52	34
Jack Kirk, Flora	70	58	28
John Endris, Jr., Madison Station	62	49	14
Eldridge Hoy, Madison Station	95	74	42
Neshoba:			
Devon Dearing, R 3, Union	62	24	15
Rankin:			
Audie Mitchell, Star	56	62	25
Arthur Harold Nash, Brandon	76	46	21
Edgar Prestage, Brandon	30	20	5
George Harris, Johns	97	58	43
Simpson:			
Joe B. Boggan, Mendenhall	104	46	36
Scott:			
Marvin E. Goss, Forest	65	44	30
Tishomingo:			
J. T. Skinner, Iuka	92	68	32
Junior Merle Hester, Iuka	100	84	40
Donald Craff, Paden	94	84	24
Frank Walker, Iuka	76	92	60
Junior Merle Hester, Iuka	108	102	80
Clovis Vandifer, Burnsville	104	90	76
James Lee Coker, Iuka	80	68	56
Harold Davis, Burnsville	80	69	41
Jimmie Kirk, Iuka	112	80	40
William Howard Osborn, Tishomingo	112	125	48
Walthall:			
Charles Henry Howell, Jayess	116	60	40
Webster:			
Glen Earnest, Eupora	64	76	54
Robert L. Crowell, Eupora	64	48	44
George Lewis, Lodi	46	43	8
Average all reports, 1946	77	61	34
Average all reports, 1945	78	61	47

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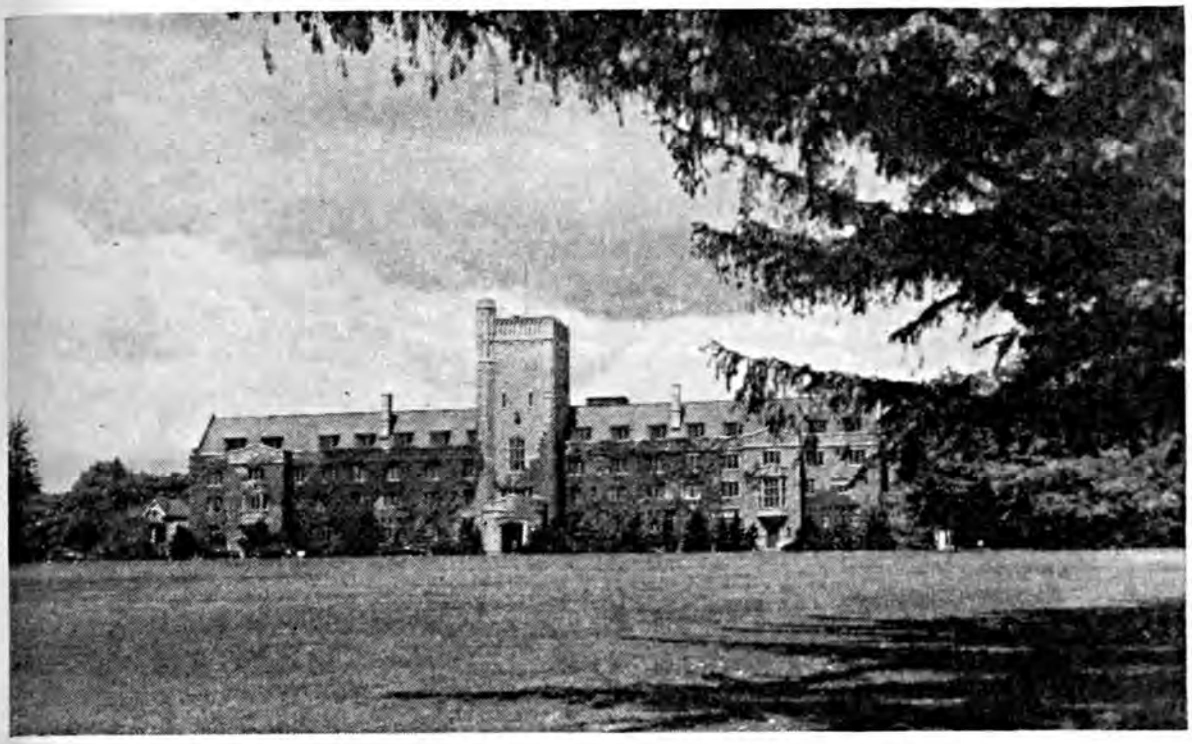

Fig. 1. Part of the campus in front of Administration Building, Ontario Agricultural College, Guelph, Ontario. This turf is kept in good condition by fertilizing to maintain fertility and spraying to control weed growth. It is not artificially watered.

Building and Maintaining Good Lawns

By R. J. Bryden

Soils Analyst, Ontario Agricultural College, Guelph, Ontario

A WELL-CARED-FOR lawn adds a great deal to the beauty of a home, either in the city or on the farm. Every year thousands of dollars are spent in building new lawns or renovating long-established stands. Whether one is starting from scratch to build a new lawn or is attempting to renovate an old one, there are certain fundamental principles that cannot be overlooked if success is to be achieved.

During the past 15 years, it has been the writer's privilege to have analysed all types of soils found in the Province of Ontario on which someone was anxious to establish a lawn. These soils varied from very light sands, sandy loams, and silty loams to clay loams, heavy clays, and highly organic soils. From the standpoint of fertility levels, the variation was just as extreme. Some soils were very high in what we consider essential nutrients, others moderately high, while still others were very low or practically void.

It is safe to assume that grass or clover of some kind can be grown in nearly any location. In other words, a lawn of some type can be established if the proper species are selected and proper adjustments made as to fertility, drainage, shade, and soil reaction. It is necessary to make a complete study of all the factors involved, and then make the necessary adjustments.

It is well to bear in mind at the outset that a lawn is put down to last a great many years, and that it must hold up under all types of weather and wear. To do this, it must have adequate drainage and sufficient plant nutrients in the proper balance. The soil at all times must be sufficiently aerated to supply the necessary oxygen to the countless bacteria that inhabit it and help to carry on the processes of breaking down organic matter, building up the nitrogen supply, and making available other essential nutrients.

Sandy soils tend to be too open and porous. They do not hold sufficient moisture to give a sustained growth and are apt to become dried out and burnt in hot weather. When one has a light soil to deal with it is necessary to incorporate what might be termed a good top-dressing soil, high in organic matter and well decomposed. This should be mixed with the sand as much as possible and not put on as a layer over the sand.

Heavy clay soils tend to bake and become hard and dry during the heat of the summer, or very wet and puddly in the spring and fall. They often lack sufficient aeration to supply the needs of the bacterial life present. This retards the development of nitrate nitrogen and causes the grasses to turn yellow. To overcome this condition it is necessary to add enough sandy material to the clay to give it greater porosity. This should be done when the clay is dry, and the sand should be thoroughly incorporated with the clay so as to avoid layering of sand and clay. Material high in organic matter will also tend to make the clay more porous.

On a good loamy soil it is much easier to establish a lawn, as loams tend to be open and therefore well-aerated. As a rule, they carry sufficient organic matter to hold an adequate moisture supply, are less leachy, and hold a greater supply of plant nutrients.

A fact that must not be overlooked when considering nutrient requirements of grasses and clovers is that approximately 95 per cent of the dry matter of nearly any plant is made up of carbon, hydrogen, and oxygen, which are obtained from air and water. If the soils are sufficiently aerated and contain enough carbon dioxide, as well as moisture, under favourable weather conditions, the plants will be supplied with these necessary elements of growth.

Soil Reaction

A factor of prime importance is the reaction of the soil; whether it is alkaline, neutral, or acid. Soil reaction is expressed in terms of pH: a neutral soil has a pH value of 7.0; an alkaline soil has a pH of over 7.0. Grasses vary as to their optimum pH needs. Some are able to withstand extreme acid conditions while others prefer less acid soils. Clovers, as a rule, tend to grow best under slightly alkaline conditions. The soil reaction has an influence on the growth and development of bacteria in the soil. It also affects the availability of phosphorus, nitrogen, and potash to the plants. A highly acid condition has a tendency to tie up both phosphorus and potash and decreases the supply of available nitrates. A highly alkaline soil depresses the availability of phosphorus. Taking everything into consideration, a soil having a reaction between pH 6.0 and 6.5 seems to be ideal for a clover-grass lawn. A slightly lower pH would be satisfactory for an all grass lawn, provided there is a sufficient supply of calcium present.

Too much acid can generally be overcome by the use of agricultural limestone or hydrated lime applied to the seedbed or to the lawn itself. The amount to use depends on the acidity of the soil and the type of soil with which one has to deal. This informa-

Fig. 2. Foreground is untreated for weed control. One hundred per cent kill in background. One week after 2-4-D was applied.

tion will be given when a soil analysis is made by the person in charge of the Soil Advisory Service. In the Province of Ontario this work is handled by the Soil Department's Advisory Service at the Ontario Agricultural College located at Guelph.

When considering the building of a new lawn or the renovating of an old one, it is advisable to have a soil test made in order to get a clearer picture of the fertility levels, the soil reaction, and the organic matter content of the soil in question. From this analysis, recommendations as to liming and fertilizer requirements can more satisfactorily be made.

For analysis, care should be given to securing a uniform sample of the soil. On an established lawn, samples of the sod itself should be taken in several places. These can be cut with a butcher knife in triangular cuttings, with 2-inch sides and to a depth of 3 inches. Subsoil samples should also be taken from a depth of 3 to 7 or 8 inches. In this way underlying fertility levels and physical conditions can be studied.

Nutrient Requirements

The levels of fertility should be such as to give an adequate supply of nitrogen, phosphorus, potash, calcium, magnesium, carbon, iron, sulphur, zinc, copper, manganese, and boron. When any of these elements are lacking they can be supplied by the proper use of commercial fertilizers, along with well-rotted manure or other organic materials, as well as soil amendments such as limestone. Care should be taken not to overfertilize, which is often the cause of unsatisfactory results. A soil that has a good physical condition with a reaction of pH 6.0-6.5 and carrying in the top 6 inches of each acre about 200 lbs. available nitrogen, 120 lbs. available phosphorus, 500 lbs. available potash, 1,000 lbs. water-soluble calcium, and about 60 lbs. magnesium oxide, plus sufficient organic matter, should be capable of growing a satisfactory lawn.

These levels of fertility should be maintained. By checking them from time to time, one can determine the fertilizers to use to maintain a good growth of grass. In short, there must be available at all times a well-balanced supply of the three essential elements—nitrogen, phosphorus, and potash. In too many cases nitrogen alone is used as a fertilizer, which tends to give too succulent a growth resulting in a prevalence of mildews, moulds, and various fungus diseases. Winter-killing, also, is often caused by an excess of nitrogen. Therefore, it is important to know existing fertility levels early in the fall, in order that sufficient phosphorus and potash may be added. This will insure a well-balanced mineral supply and minimize losses from winter-killing.

Lawn Grasses

From some of the more important species of grasses commonly used in lawns, a suitable mixture or species can be selected for any given condition.

Kentucky Blue Grass (Poa pratensis) is perhaps the most widely used and most valuable of all lawn grasses. It is hardy and spreads by means of underground rhizomes, producing under proper conditions a dense turf that wears well. It is particularly adapted to loamy, well-drained soils, and will do well on moderately acid to neutral soils.

Canada Blue Grass (Poa compressa L.) forms a rather open sod, is fairly coarse, and has a light bluish-green color. It is quite drought-resistant, will grow on poor, dry, sandy soils of low fertility, and has a place in a mixture for playgrounds and similarly roughly treated areas where moisture is relatively low.

Rough-Stalked Blue Grass (Poa trivialis S.) does well in shady, moist conditions. This species spreads by means of stolons and produces a fine, dense turf. It is suited to the same conditions as Kentucky Blue Grass.

Red Top (Agrostis vulgaris) is a rapid-growing grass. When sown alone, it forms a coarse, open sod. It thrives in moist conditions, does well under moderately acid conditions, and is also resistant to drought. It should be sown by itself.

Colonial Bent (Agrostis tenuis), also known as Brown Top, Rhode Island Bent, and New Zealand Bent, is an excellent lawn grass, producing the very finest quality lawn. It can be sown alone or in a mixture with Kentucky Blue Grass. It spreads by means of short rhizomes, producing a dense, very fine, uniform turf. This grass does well on mildly acid soils but not on very dry or very wet locations, or under dense shade. It is very susceptible to a disease known as "Large Brown Patch."

Creeping Bent Grass (Agrostis palustris) is particularly adapted to bowling and putting greens. It spreads rapidly by means of long stolons and produces a dense, very fine-leafed turf. It is very susceptible to disease and must receive disease control measures.

Velvet Bent (Agrostis canina) is the most beautiful of all turf grasses under proper conditions. It is tolerant to shade, spreads by means of rhizomes and stolons, and is particularly adapted to bowling and putting greens.

Chewings Fescue (Festuca rubra var. commutata Gaud.) is adapted to poor, dry soils and will also grow in shady locations. It produces a dense, fine turf, very resistant to wear, and tends to become bunchy or tufted. It does not spread.

Creeping Red Fescue (Festuca rubra) is adapted to the same conditions as Chewings Fescue, but has the advantage of being able to spread by means of underground rhizomes and does not bunch. It should be included in mixtures for dry, sandy locations and for shady areas.

Fig. 3. Typical farm home in Eastern Canada. Spacious lawn with spreading oak and maples adorn the landscape.

Crested Wheat Grass (Agropyron cristatum L. Beauv.) is very drought - resistent and winter-hardy. It may be used when artificial watering is not available.

Perennial Rye Grass (Lolium perenne L.) is used where quick growth is desirable. It is not very winter-hardy so is used mostly for temporary swards. (*Turn to page* 46)

Soils deficient in available potassium produce crops low in yield and deficient in potassium and other important elements. When potash is applied to these soils, the yields are greatly increased as is also the quality of the crops.

The Potassium Content of Farm Crops

By H. J. Snider

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THE POTASSIUM content of crops is by no means a constant value. It varies with the variety and stage of growth of the crop and also with soil and seasonal conditions. Within certain limits, crops take up potassium in direct proportion to the amount available in soils. It is not apparent that crops take up too much potassium, although it is sometimes claimed that they do. This apparent excess of potassium taken up by farm crops has been frequently referred to as luxury consumption, and this reference at times has taken the form of a slogan. A late president of the University of Illinois once said that he disliked the use of slogans because they tended to keep people from thinking. The luxury consumption idea may be placed in this same category when applied to plant nutrition.

The potassium content of most farm crops should be somewhere around 1.5 to 2.0% in order to have high yields and desirable quality in the crops. This range in percentages would apply more especially to the leaf and stem portions of crops. It is not likely that most grain and seeds will come within these limits. Corn grain is usually considerably below, while the stalks at maturity may be within these values. Oat grain is usually slightly below, while oat straw may be within the limit or often above 2%. Wheat grain is, as a rule, below this and under most conditions wheat straw may be slightly below 1.5% potassium. Soybeans at maturity are usually within this limit, but the straw is usually below.

This range, as a desirable percentage of potassium, has considerable support from various sources. The potassium content of various crops in the tables offers strong support of this range in percentages as an optimum. Another bit of interesting data in support of this was sometime ago presented by Dr. H. P. Cooper. Along this line, Dr. Cooper quoted some results on the composition of pasture plants in Great Britain. The plants which were readily eaten had a potassium content of approximately 2% with other quality elements proportionately high. Those plants not eaten by livestock had a potassium content of approximately 1.25% and other desirable elements were proportionately low.

Potassium is not generally credited directly with adding much to the feeding quality of crops. It is, however,

TABLE 1.—POTASSIUM CONTENT OF CORN FROM SOILS WITH AND WITHOUT POTASH TREATMENT.

Pounds in stalks—grain and cobs per 100 bu. of grain

Year	No potash	Potash applied
Ewing	*Lbs.*	*Lbs.*
1942	85	159
1944	155	218
1945	91	141
Joliet		
1944	94	129
1945	129	138

Ewing 90 lbs., Joliet 200 lbs. available potassium in the untreated soil.

TABLE 2.—POTASSIUM CONTENT OF GRAIN AND STRAW OF WHEAT AND OATS FROM SOILS WITH AND WITHOUT POTASH TREATMENT.

Field	No potash	Potash applied
Wheat Grain	*Per cent*	*Per cent*
Sparta (80)	.75	.81
Ewing (90)	.88	.72
Joliet (200)	.68	.68
Wheat Straw		
Toledo (80)	.55	1.08
Newton (70)	.41	1.02
Oat Grain		
Sparta (80)	1.14	.72
Toledo (80)	.98	1.14
Minonk (280)	.72	1.20
Oat Straw		
Sparta (80)	.85	1.56
Toledo (90)	1.08	2.48
Minonk (280)	2.28	2.44

Sparta oats a winter variety. Figures in parentheses represent pounds an acre available potassium in untreated soils.

generally found associated with certain elements which in turn possess high nutritional value. This characteristic of potassium has been presented many times during the past 20 years by Dr. H. P. Cooper. On this particular point, Dr. Cooper says of Kentucky bluegrass, "It is soft and palatable and grows best on soils which are well supplied with relatively soft elements such as potassium, calcium, phosphorus, and other elements with relatively high oxidation-reduction potentials." He explains further that the harder and less palatable plants, which include poverty grass and sedges, are likely to dominate on acid soils and these harder plants probably utilize some of the harder elements. These elements include magnesium, aluminum, manganese, iron, silicon, and others which have relatively low oxidation-reduction potentials. Redtop is rather a prominent grass in Illinois and may also be placed in this latter group. This grass flourishes on the light-colored, acid soils of southern Illinois and here serves a worthy purpose. Redtop hay is unpalatable, and composition results show that it contains relatively large percentages of some of these hard elements.

Few folks realize fully how quickly and to what extent new and improved chemical methods change the course of fundamental research. In Dr. C. G. Hopkins' textbook, published in 1910, the potassium content of stalks, grain, and cobs of 100 bushels of corn was placed at 73 pounds. This value was given with a note of finality and since Dr. Hopkins was a very forceful teacher, this figure came to be accepted and widely quoted. Previous to 1910, and for a time after this date, potassium in crops and soils was determined largely by the platinic chloride method. This method is complicated, slow of operation, and unless in the hands of a highly specialized chemist, is likely to give erroneous results. In 1928 Professor Truog began work on the cobaltinitrite method for the determination of potassium in soils and crops, and from that time on, potassium determinations have been speeded up and have reached a high degree of accuracy. Along this line another method which has added speed and accuracy to potassium determinations in crops was the nitric-perchloric acid method of destroying organic matter in plant material. At present the accumulated data on potassium in its relation to the production of crops are of enormous value. They are quite reliable and frequently differ radically from those of former years. This is only one of the many lines of work which have contributed substantially to our knowledge of the production of crops.

TABLE 3.—POTASSIUM CONTENT OF ALFALFA HAY FROM SOILS WITH AND WITHOUT POTASH TREATMENT.

Field	No potash	Potash applied
	Per cent	*Per cent*
Raleigh	.62	.88
Ewing	.88	1.80
Oquawka	.75	1.04
Joliet	1.80	2.28

All low-potash soils except Joliet. (200 lbs.)

TABLE 4.—POTASSIUM CONTENT OF SWEET CLOVER FROM SOILS WITH AND WITHOUT POTASH TREATMENT.

Part of plant	No potash	Potash added
	Per cent	*Per cent*
	Ewing—May 15	
Tops	.95	2.13
Roots	.51	2.12
	Raleigh—May 16	
Tops	1.04	1.32
Roots	.75	.75
	Kewanee—April 19	
Tops	2.18	2.95
Roots	1.14	.83

Ewing 90 lbs., Raleigh 90 lbs., Kewanee 220 lbs., available potassium an acre in untreated soils.

The amounts of potassium which go into the production of 100 bushels of corn (stalks-grain-cobs) vary apparently with the season and with soil conditions. Some of the lower amounts in table 1 are considerably above the 73 pounds given in the Hopkins' text of other years, and the higher amounts are nearly three times this value. Where potash was applied, the corn crop contained amounts of potassium ranging from 129 to 218 pounds per 100 bushels of corn. The increases were largest on the potassium-deficient soils of the Ewing field. These larger amounts of potassium were accompanied by a greatly increased yield of corn. Potash treatment on these deficient soils has averaged about a 50% increase in corn yield. The very wet season of 1944 caused a relatively large uptake of potassium on soils both with and without potash treatment on the Ewing field. The 1944 crop on the Joliet

TABLE 5.—POTASSIUM CONTENT OF SOYBEANS FROM SOILS WITH AND WITHOUT POTASH TREATMENT.

Part of plant	No potash	Potash applied
	Oblong (90 lbs.)	
Beans	1.61	1.90
Straw	.37	.51
	Joliet (200 lbs.)	
Beans	1.81	1.87
Straw	.55	.87

field showed no unusual effect of this season on the potassium content. This field is located some 250 miles north of Ewing and represents a rather high level of soil fertility along with a probable difference in weather conditions.

The effect of potash treatment was not so marked on the composition of grain as on straw. Wheat and oat grain did not, in all comparisons, show an increase in potassium content where potash was added to the soil. Both wheat and oat straw had relatively large increases in potassium content where potash treatment was used, especially on deficient soils.

Alfalfa hay had considerable increase in potassium content where potash was added to the soil. There were very low percentages in the hay on the low-potash soils (60 to 100 lbs.) and a

TABLE 6.—POTASSIUM CONTENT OF RED AND ALSIKE CLOVERS FROM SOILS WITH AND WITHOUT POTASH TREATMENT.

Analysis made at usual haymaking time 1944.

Field	No potash	Potash applied
	Per cent	*Per cent*
Red Clover		
Easton (80 lbs.)	1.47	1.92
Dixon (170 lbs.)	1.30	1.70
Alsike Clover		
Toledo (90 lbs.)	1.01	2.61
Brownstown (100 lbs.)	2.00	3.39

relatively high percentage in the hay from high-potash soils (200 lbs.) without potash treatment. The hay from the four fields in table 3 represents the first cutting of the season.

Sweet clover tops and roots at plow-under time had considerable increase in potassium content due to potash treatment. The Kewanee field, which is located in northern Illinois, had an earlier plow-under date (April 19) than did the Ewing and Raleigh fields (May 15-16), which are located in southern Illinois. This difference in

TABLE 7.—POTASSIUM CONTENT OF HAY CROPS AND CORN STOVER WITH AND WITHOUT POTASH TREATMENT.

Analyses were made at the customary hay stage for each crop.
Corn stover represents the full dent stage.
Sparta Experiment Field.

Crop and year	No Potash	Potash applied
	Per cent	*Per cent*
Red Clover . . . . . . 1945 . .	1.04	2.18
Lespedeza . . . . 1943 . .	.81	1.01
Lespedeza . . . . 1945 . .	.88	1.34
Vetch (winter) . . . 1944 . .	1.66	3.10
Vetch (winter) . . . 1945 . .	1.70	1.90
Cowpeas . . . . 1943 . .	.98	1.66
Cowpeas . . . . 1944 . .	1.37	1.47
Timothy . . . . 1945 . .	1.33	1.82
Corn stover . . . . . . 1942 . .	1.01	2.00

Available potassium 80 lbs. an acre in untreated soil.

stage of growth accounts partly for the high percentages in the tops, 2.18 and 2.95% on the former field.

Soybeans are relatively high in potassium and on deficient soils the amount in the beans was increased by potash treatment from 1.61% to 1.90%, an average of five years. The straw was relatively low in potassium, apparently because of the large concentration of this element in the beans at maturity of the crop (table 5).

Red and alsike clovers had an increased potassium content where the

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Fig. 1. Here is a pasture showing small humps of dark, vigorously growing plants. The humps are spots where the grass is growing well because of droppings or excretions from livestock.

More Palatable Grass Is More Nutritious

By M. F. Wichman and R. A. Harling

Soil Conservation Service, Fort Worth, Texas

THERE have been a lot of tests run to show that forage varies in its palatability and food value. The cow, in her position as one of the prime consumers of forage, indicates without resort to chemical analysis the quality of plant foods at any given time by her willingness to graze where the grass is most nutritious. As a result, she yields more pounds of beef and milk than she would if she nipped on the poorer spots all the time.

Here's an example of her selectivity in daily diet. You have probably noticed small humps of dark, vigorously growing plants in pastures and fields, particularly in small grains. The humps actually are spots where the grass is growing well because of droppings or excretions from livestock. If you've paid attention to the spots, you've noted that she either grazed the spots as close as possible or left them alone almost entirely. The latter instance is usually a sign that the livestock droppings are a little too concentrated. They need spreading by a section harrow with a heavy piece of chain attached to scatter the manure piles uniformly. If the droppings are spread after one or two good rains, you can usually find her grazing small spots formerly occupied by droppings. Those spots will be supporting tall dark-green vegetation.

The tall growth of plants around these spots where manure was dropped does not tell the whole story of the feeding value present. Some seasons of the year the droppings and excretions may cause the soil solution to become more concentrated than the plant solution. If that happens the plants die. Cattle don't graze there. In areas of high rainfall or in areas of low available nitrogen this doesn't happen often.

The question of just what are the food values of plants growing where manure had lain arose recently in the course of pasture development work in the G. R. Canada ranch near Anahuac on the Gulf Coast of Texas. Mr. Canada is a supervisor of the Trinity Bay Soil Conservation District.

He asked why the areas right out in the middle of his native unimproved pasture were so closely grazed. He understood that the grass from those darker spots was generally better than other grass away from the manure area, but he didn't know that there was a great difference in the chemical content of the plants benefiting from the excretions and droppings.

Last summer we took two samples of grass which cattle were eating in an area less than six feet square. One sample was from a dark green spot where the Bermuda grass was less than an inch and a half tall. The other sample was taken from normal Bermuda grass three to four inches tall. We found that the dark green probably was caused by urine, which of course is a source of nitrogen and potash.

Back in our Soil Conservation Service operations laboratory, we tested and found the Bermuda grass from the dark green area contained 2.74 per cent nitrogen and 17.1 per cent protein. The normal Bermuda grass contained 1.66 per cent nitrogen and 10.3 per cent protein.

That information, naturally, told us why the cattle were grazing the green

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Fig. 2. Pasture improvement work on the Canada ranch. A fertilizer distributor is at work in the background. At left is native pasture which carries one head of livestock on 10 to 15 acres. The improved pasture will carry a cow to two acres when established. The dark spots showing up in the native pasture are wax myrtle, an invading plant which has forced Mr. Canada to fertilize his pasture in self-defense. He uses limestone, superphosphate, and potash.

Ten Years of Soil-Building In Vermont

By Thomas H. Blow

County Agent, Caledonia County, St. Johnsbury, Vermont

TEN years of Agricultural Conservation program practices in Vermont have done much to raise the standards of fertilization, the use of lime, and the production of more and better crops, hay, and pasture. On the State level in 1935 before the program started, Vermont farmers were using 3,500 tons of lime per year. In 1944, the tonnage used under the program reached a high of 118,035 tons and a total of 668,309 tons for the period 1936 through 1946. The story was similar for superphosphate, as the figures showed 3,366 tons used in 1935; in 1944, which was also a high year for superphosphate, 41,118 tons used; and for the period 1936-1946 inclusive, a total of 327,610 tons. In 1943, the only year in which a mixed grade of fertilizer was offered under the program, 13,489 tons of 0-14-14 were used.

Handicapped through the shortage of potash, the dairymen of the State have had to curtail the use of high-potash fertilizers, and it has cost them money and production to do so.

Starting out in 1936 the program set five objectives as goals of accomplishment for rebuilding Vermont soils. These were as follows:

1. To increase soil fertility by increasing the mineral content of the soils which are known to be deficient in calcium, phosphorus, and potash.
2. To prevent soil erosion and to conserve water resources by permitting a thick grass sod cover.
3. To protect maple sugar orchards from grazing, thus promoting growth of young maples.
4. To protect and improve forest cover by reforestation, selective cutting, and other forestry improvement practices.
5. In cooperation with the Extension Service, to assist in developing farm leaders.

In some counties of the State, soil tests have been used as guides in making recommendations. Typical of these were the tests made in 1937 in Caledonia County on more than 900 samples taken in every town in the County. In this particular County, the need for potash was even greater than that of phosphorus, as shown by the soils in the low and very low groupings. A comparison of these two ingredients 10 years ago showed up as follows: For phosphorus, 377 tests were in the low group while 492 were in the low group for potash; in the very low group, phosphorus showed 137 tests as compared to 161 for potash. This was taken as an indication that in this particular County the need for potash was even greater than for phosphorus. On many dairy farms where extra potash was used, the results in its favor have been very clear cut.

In reporting to the Agricultural Conservation committees in Caledonia County on 10 years of the program, the county agent and writer brought out the following details and made specific recommendations for the future.

Past Results

Farmers from a low of 660 to a high of 1,297 in the County, have participated since 1936. In dollars and cents return, this period of years has actually put into their pockets a total of $813,155.61. But it has done something more than just that. It has replaced some of the much needed minerals which have been both crop-used and leached through the more than 150 years of farming and cover removal. Acres and acres of much better hay land have been grown, and field after field of legumes has replaced the less valuable grasses. Seedings which previously had been made with no complete fertilizer and only manure as plant food have been receiving partially adequate applications of minerals.

In support of this, the 1945 census figures in the County show 37,055 head of livestock as compared to 31,949 in 1940. In milking cows, 22,049 were kept in 1945 as compared to 19,766 in 1940; and in milk production 14,635,-378 gallons were produced in 1945 as compared to 11,527,842 gallons in 1940. Not all of the credit for these increases should go to the Conservation program or to the use of fertilizer, but without a doubt these played their part in bolstering soils for greater production and allowed dairy farmers to follow a very intensive soil-mining program during the war emergency period.

The Years Ahead

In Caledonia County, the 1945 census shows 2,185 farms with an average size of 152.8 acres. The total cropland involved is 95,421 acres, of which 6,249 acres are pastured. The total land and building valuation is nearly nine million dollars, and it takes approximately two million dollars worth of machinery to operate the investment. In all, some 7,455 persons are living on the farms of the County and of this number 2,188 are under 14 years of age. These are the folks that are definitely concerned with the farm and soil heritage that will be passed down to them by the present operators. There is a real challenge to the farmer in providing a good living for those on the farms and leaving the soil in a better condition than it was when he took it over. If these things are done, the livestock and crop production end of the business will take care of itself.

What Can Be Done

As pointed out, considerable progress has been made with growing more and better hay, but with pasture management the surface has not been scratched. In Caledonia County alone, some 205,-000 acres of land are pastured by the cattle of approximately 1,861 farmers, yet of this number only 196 farmers used 6,000 acres of cropland in a pasture rotation system. This is where management of pastures must play a large part in the economic success or failure of dairying in the years ahead.

In June 1946, the Caledonia County Agricultural Conservation committeemen visited several practical dairy farms in central Maine, and it was interesting to see how these dairymen carried on. The committeemen saw Fred Nutter at Corrina, Maine, carrying some 80 Holstein milkers and not using one acre of old, rough pasture land in his set-up. He top-dressed his crop and pasture land with 8-16-16 at about 500 lbs. per acre once a year, turned in his dairy animals when the grass was five to eight inches high, kept them there for four to five days, and then moved them to a new field. The waste grass on the former area was then clipped and the sod given a rest until it was again ready to be fed off.

Don Corbett at Winslow, Maine, another Holstein breeder, was handling his herd of 35 to 40 milkers in much the same way and had five small fields of approximately five acres each devoted to his rotational pasture system. The same story was true at the Harold Shaw farm at Sanford, Maine, and in not one instance did old, rough, worn-out pasture sods enter the picture. Good ladino and white clover sods along with brome and bluegrass, were providing the feed that made economical milk production for these Maine farmers. Back of these productive sods was a strong, sound fertilization program

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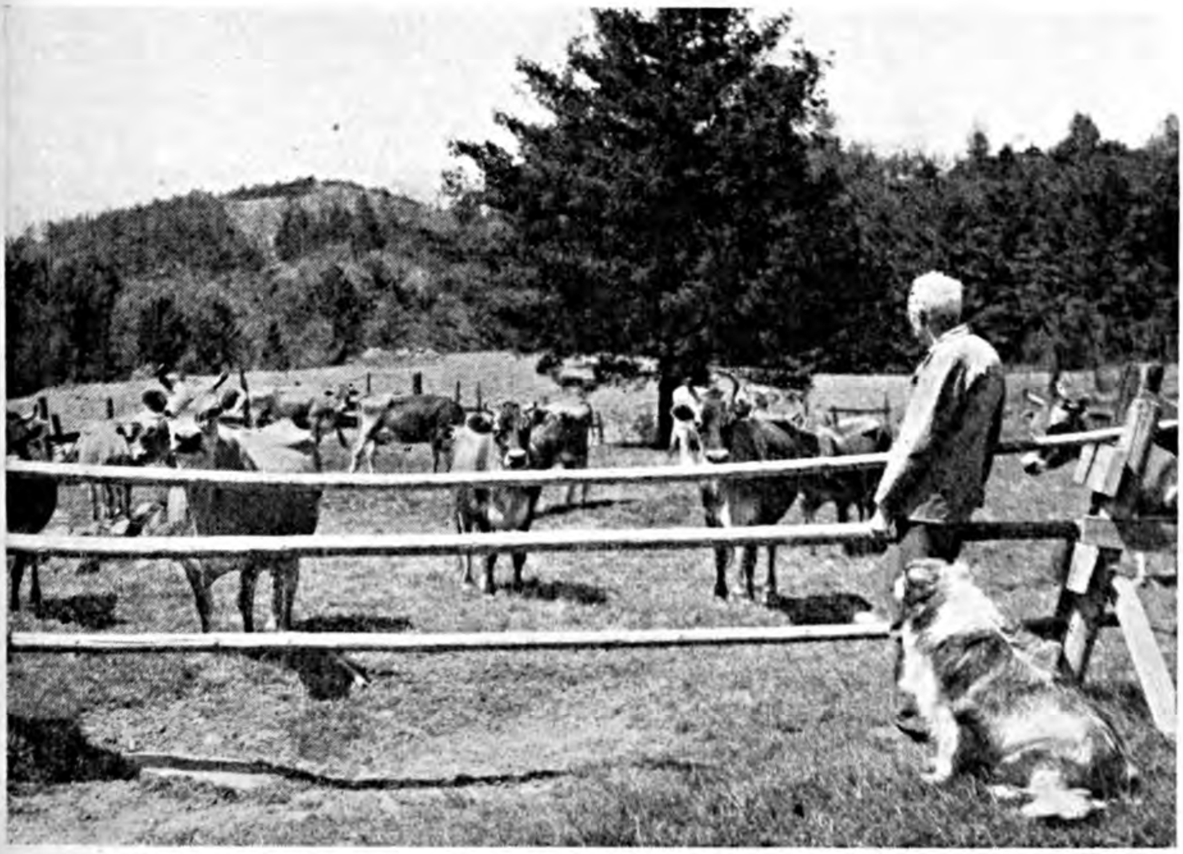
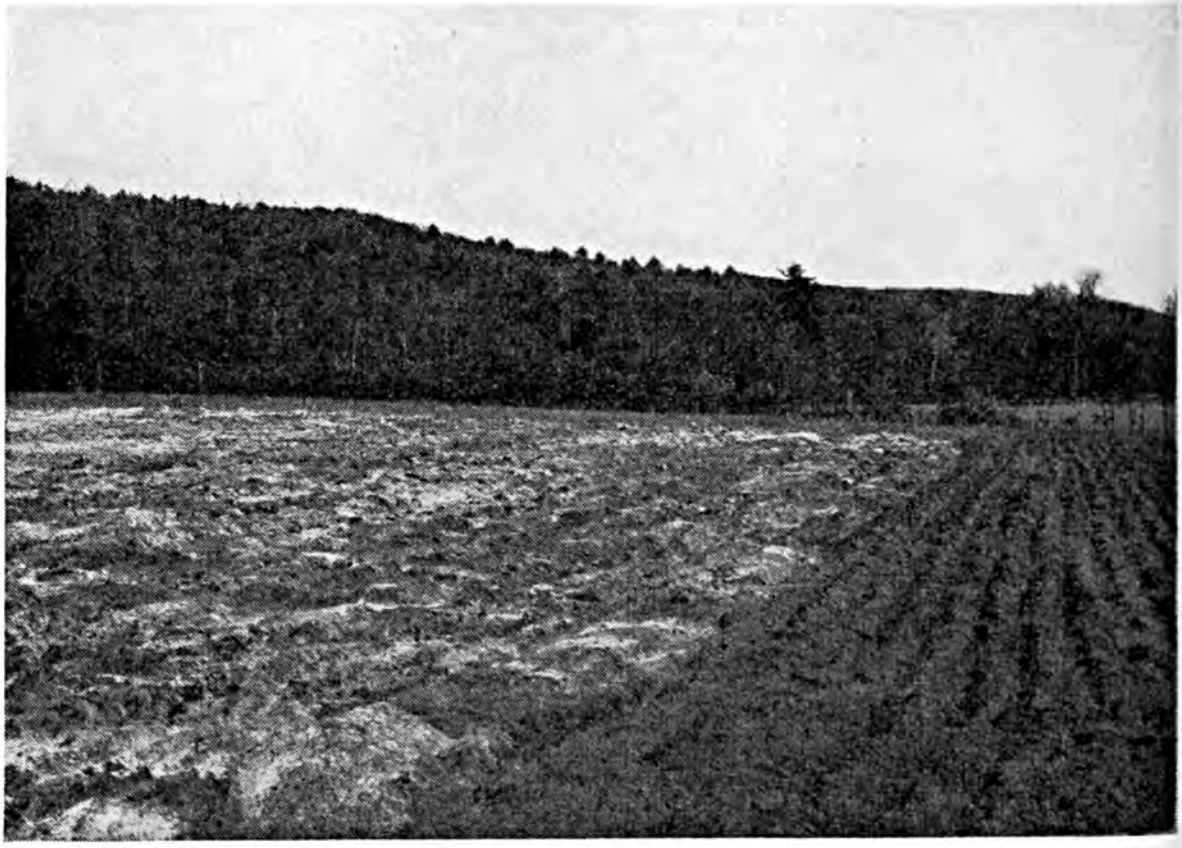
Above: **A Vermont heritage—the dairy farm snuggled in the Green Mountain Hills. Farms such as these must be passed along in at least as productive a capacity as when they were taken over.**

Below: **The Jersey herd on the farm of John Lenton, Passumpsic, Vt. This farm has maintained good Jerseys, good pastures, and had good farm management by the Lentons for over half a century.**



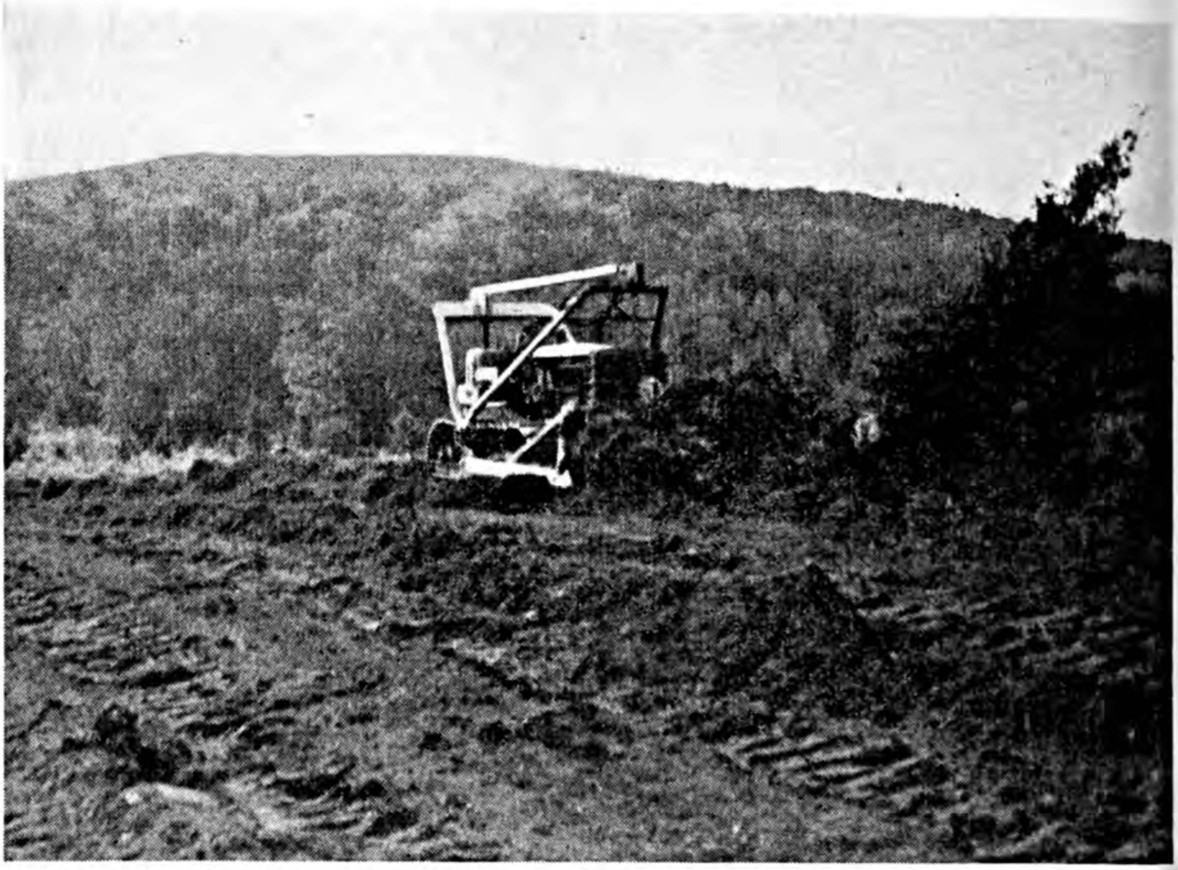
Above: The completion of a 1,000-ft. ditch on the Guy Labay farm at West Burke, Vt. This large meadow had been wet and the grass was running out. It will be top-dressed with complete fertilizer.

Below: The foundation of a good seedbed on a Ryegate farm. Lime was applied under the Agricultural Conservation Program.



Above: **Paul Morrison, Barnet, Vt., hauls in an excellent crop of completely fertilized hay with his "buck rake."**

Below: **The Caledonia County A.C.P. committeemen visit the Don Corbett dairy farm at Winslow, Maine. Here the herd is on one of the rotated cropland fields which had been top-dressed with 8-16-16 fertilizer.**



Above: **Forty acres of former permanent pastureland were put back into shape with a bulldozer on the Simpson farm at Waterford, Vt. A 4-16-20 fertilizer and a seeding of ladino and brome grass now provide excellent pasture for fifty or more milkers.**

Below: **Eighty Holsteins on 8-16-16 top-dressed cropland at the Fred Nutter farm, Corrina, Maine. Caledonia committeemen were very much impressed with the excellent production being secured both in grass and milk pail at the Nutter Farm.**

The Editors Talk

Fertilizers and Bugs

We have heard much about the preference of cattle for well-fertilized pastures over grass that had not been fertilized. Now comes the disclosure that insects too may show a similar discrimination.

In work conducted at the Florida Citrus Station at Lake Alfred, Entomologist W. L. Thompson has found that when the numerous major and minor nutrients were applied to citrus in the combinations to give the best growth and yield the infestations of certain insect pests were also increased. The trees lacking the proper fertilization did not present much of a spray control problem, but neither did they present much of a harvest problem due to poor yields. By working out a spray program adapted to the properly fertilized trees the insects were brought under control and at the same time the trees made remarkable improvement in vigor and yield.

Other cases where the properly nourished plant will be much less susceptible to insect attack and injury have been reported and in all probability this is likely to be more common. The work at Lake Alfred, however, shows that such will not always be the case and only by a well-rounded program of proper nutrition and insect pest and disease control can the maximum results be produced.

The entire citrus research program at Lake Afred under the direction of Director A. F. Camp is an extraordinary integration from the viewpoint of overcoming soil deficiencies, disease, pest infestations, weather hazards, and other problems incidental to the growing of the crop in Florida. A highly practical and effective program has been worked out based on research and observations over a period of years. Dr. Camp says, "The philosophy upon which the programs were based is a reversal from the older idea of waiting until trouble showed up and then correcting it, which might reasonably be called a philosophy of correction. Following this philospohy a grower did not spray for rust mites until they became numerous, or for scales until they started to do serious damage, or apply copper until dieback became serious. In contrast to the philosophy of correction, we have consistently followed a philosophy of prevention in which the program is designed to prevent the occurrence of those things which we have found reasonably certain to become problems in the average grove. While it might be true that in occasional groves unnecessary things will be done under such a general program; nevertheless, if this group of unusual groves constitutes less than 5 per cent of the acreage, then we have considered that it would be better to outline the program on what 95 per cent of the growers might expect. Some growers will undoubtedly rise up in indignation at the idea that any general program practice has indicated that such a program can fit their particular grove, but actually it is workable when based on sound soils information. Obviously we cannot see every grove owner and recommend corrective measures, but we can recommend a program which should avoid the necessity of corrective measures. Moreover we have found that by the time corrective measures are obviously needed production has fallen off. . . . Finally our program is based not on one year's performance but on the production of consistently large crops of good quality fruit, and at the same time it maintains the tree in excellent condition, able to resist drought and cold to the maximum."

In contrast to the fertilizer recommendations in most states where nitrogen phosphoric acid, and potash are the only plant foods recommended, often in Florida the fertilizer analysis regularly contains six figures in the order of nitrogen, phosphate, potash, magnesium, manganese, and copper since it has been found that the latter three secondary or minor nutrients are needed for practically all conditions. Zinc is usually recommended, but applications are frequently more effective when applied in the spray.

The all-over fertilizer analysis recommended for citrus is 3–4% N, 6% P_2O_5, 8% K_2O, 2–3% MgO, 1% MnO, and ½% CuO. In some cases this same analysis might be used in all three applications during the year while in other cases analyses may be varied seasonally but the total at the end of the season should approach the ratio mentioned above. Dr. Camp says, "It should be kept in mind at all times that the attainment of high efficiency in the utilization of nitrogen or any other element is dependent upon high production. The presence of any deficiency in any appreciable degree results in reduced yield and makes the attainment of high efficiency impossible."

In looking over the large experimental groves, one cannot help but be impressed with the contrasts between the blocks of trees receiving the treatments which have been found to be most effective and the trees not receiving the well-rounded program advised by Dr. Camp and his associates. The amount of damage due to cold injury this last season was very great on the blocks not properly fertilized whereas the effects on the trees receiving the recommended fertilizers and spray program now are scarcely noticeable.

This work has been of untold value to the citrus growers not only in Florida but in nearly all other sections of the world where the crop is grown. Dr. Camp's advice and personal consultation are in constant demand from foreign as well as domestic growers because of the proven results of the well-balanced program for citrus production which he has developed.

DISCUSSING the rapid rise in the use of fertilizers during the war, and the need for further increases in the future, W. A. Minor, assistant to the Secretary of Agriculture, has stated:

"We know that even though we are using far more lime and fertilizer than ever before, we are not using nearly enough to maintain, restore, and improve the soil. We have never developed farming systems for the Nation as a whole that would replace soil fertility as fast as we used it. That situation should and must be corrected.

"We have much to learn about the relation between the use of plant-food materials on the soil and the nutritional value of the products grown on the land. But we do know that there is a definite connection, and as we increase our knowledge of nutrition and gradually develop our food-buying habits on the basis of that knowledge—which we are doing more and more—greater emphasis undoubtedly will be placed on the use of plant-food materials."

Mr. Minor said that Department of Agriculture records show that, compared with the prewar averages, the 1945 use of fertilizer nitrogen was up by nearly 75 per cent, the use of phosphorus up 90 per cent, and the use of potash nearly doubled.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1920...........	15.9	17.3	125.3	141.7	61.8	182.6	16.46	25.65	....
1921...........	17.0	19.5	113.3	113.1	52.3	103.0	11.63	29.14	....
1922...........	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923...........	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924...........	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925...........	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926...........	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927...........	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928...........	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929...........	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930...........	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931...........	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932...........	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933...........	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934...........	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935...........	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936...........	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937...........	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941...........	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942...........	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943...........	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945...........	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
April.........	23.59	42.9	162.0	245.0	116.0	158.0	15.00	48.00	....
May.........	24.09	43.0	157.0	251.0	135.0	170.0	14.80	49.60	....
June.........	25.98	59.0	147.0	251.0	142.0	174.0	14.70	51.50	....
July.........	30.83	56.7	148.0	275.0	196.0	187.0	15.00	60.00	....
August......	33.55	48.6	143.0	280.0	180.0	178.0	15.10	59.10	....
September...	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	....
October......	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November....	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December....	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	....
1947									
January.....	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	....
February.....	30.56	31.9	131.0	228.0	123.0	199.0	17.50	88.20	....
March.......	31.89	33.6	139.0	235.0	150.0	244.0	17.40	88.00	....

Index Numbers (Aug. 1909—July 1914 = 100)

1920...........	128	173	180	161	96	207	139	114	....
1921...........	137	195	163	129	81	117	98	129	....
1922...........	185	228	95	114	116	109	98	135	....
1923...........	231	190	133	137	129	105	110	183	.
1924...........	185	190	98	170	166	141	107	147	143
1925...........	158	168	245	188	109	163	108	140	143
1926...........	101	179	189	134	116	138	112	98	139
1927...........	163	207	146	124	132	135	87	154	127
1928...........	145	200	76	134	131	113	95	152	154
1929...........	135	183	189	133	124	117	92	137	137
1930...........	77	128	131	123	93	76	93	98	129
1931...........	46	82	66	83	50	44	73	40	115
1932...........	52	105	55	62	50	43	52	46	102
1933...........	82	130	118	79	81	84	68	57	91
1934...........	100	213	64	91	127	96	111	146	95
1935...........	90	184	85	80	102	94	63	135	119
1936...........	100	236	164	106	163	116	94	148	104
1937...........	68	204	76	93	81	109	74	87	110
1938...........	69	196	80	83	76	64	57	97	88
1939...........	73	154	100	85	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	107	117	107	81	211	129
1942...........	153	369	168	136	143	124	91	202	163
1943...........	160	405	188	232	174	154	125	231	245
1944...........	167	420	214	219	170	160	138	234	212
1945...........	181	435	199	228	178	169	127	230	224
1946									
April.........	190	429	232	279	181	179	126	213	282
May.........	194	430	225	286	210	192	125	220	177
June.........	210	590	211	286	221	197	124	228	185
July.........	249	567	212	313	305	212	126	266	163
August......	287	486	205	319	280	201	127	262	162
September...	285	488	184	255	269	202	130	256	154
October......	304	530	175	238	266	213	136	293	151
November....	236	438	176	228	198	214	145	399	207
December....	242	435	181	239	190	217	149	406	166
1947									
January......	240	390	185	351	188	216	147	401	238
February....	246	319	188	260	192	225	147	391	275
March.......	257	336	199	268	235	276	147	390	299

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11-12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16-17% ammonia, Chicago, bulk, per unit N
1910-14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
April	1.75	1.42	7.81	5.77	4.86	6.71
May	1.75	1.42	9.08	6.10	4.86	7.30
June	1.88	1.42	10.34	6.42	4.86	7.90
July	1.88	1.42	11.62	8.15	5.34	9.60
August	2.22	1.46	16.88	8.14	6.07	12.14
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
February	2.41	1.46	10.01	11.06	12.14	10.17
March	2.41	1.46	11.98	11.06	12.50	10.50

Index Numbers (1910-14 = 100)

1922	113	90	173	132	140	142
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
April	65	50	223	163	144	191
May	65	50	259	173	144	207
June	70	50	295	182	144	224
July	70	50	332	231	158	273
August	83	51	482	231	180	345
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293
February	90	51	286	313	360	289
March	90	51	342	313	370	298

Wholesale Prices of Phosphates and Potash **

	Super-phosphate Balti-more, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1922	.566	3.12	6.90	.632	.904	23.87	....
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
April	.650	2.20	6.40	.535	.797	26.00	.200
May	.650	2.20	6.40	.535	.797	26.00	.200
June	.650	2.30	6.45	.471	.729	22.88	.176
July	.650	2.60	6.60	.471	.729	22.88	.176
August	.700	2.60	6.60	.471	.729	22.88	.176
September	.700	2.60	6.60	.471	.729	22.88	.176
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January	.700	2.60	6.60	.535	.797	26.00	.200
February	.720	2.60	6.60	.535	.799	26.00	.200
March	.740	2.77	6.60	.535	.797	26.00	.200

Index Numbers (1910-14 = 100)

	Super-phosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1922	106	87	141	89	95	99	....
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
April	121	61	131	75	84	108	83
May	121	61	131	75	84	108	83
June	121	64	132	66	76	95	80
July	121	72	135	66	76	95	80
August	131	72	135	66	76	95	80
September	131	72	135	66	76	95	80
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83
1947							
January	131	72	135	75	84	108	83
February	134	72	135	75	84	108	83
March	138	77	135	75	84	108	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1922	132	149	141	116	101	145	106	85
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
April	212	188	160	97	57	175	121	78
May	211	192	162	99	57	189	121	76
June	218	196	163	100	60	203	121	70
July	244	209	181	103	60	230	121	70
August	249	214	187	116	67	293	131	70
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	206	126	69	359	131	78
February	262	234	209	124	70	329	134	78
March	280	243	216	128	70	354	138	78

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] **Since June 1941, manure salts are quoted F.O.B. mines exclusively.**

** **The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Agricultural Mineral Sales as Reported to Date for Quarter Ended December 31, 1946," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., FM-140, March 26, 1947.

"Commercial Fertilizer Sales as Reported to Date for Quarter Ended December 31, 1946," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., FM-141, March 26, 1947.

"Topdressing Small Grains," Ga. Exp. Sta., Experiment, Ga., P. Bul. 581, Jan. 27, 1947, J. G. Futral.

"A Study of the Effect of Fertilizers on Various Characters of the Cotton Plant," Agr. Exp. Sta., La. State Univ., Baton Rouge 3, La., Bul. 406, Aug. 1946, H. B. Brown.

"Maryland Fertilizer Facts for 1946," State of Md. Insp. and Reg. Serv., College Park, Md., March 14, 1947.

"Fertilizer Grades and Ratios for Minnesota," Agr. Ext. Serv., Univ. of Minn., St. Paul 8, Minn., Ext. Folder 143, Feb. 1947, C. O. Rost, Paul M. Burson, and E. R. Duncan.

"The Dairy Cow as a Conserver of Soil Fertility," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 730, Sept. 1946, Firman E. Bear, Willis A. King, and Carl B. Bender.

"Fertilizer Sales in Ohio in 1946," Dept. of Agron., Ohio State Univ., Columbus 10, Ohio, March 10, 1947.

"Recommended Fertilizer Practices for 1947," Agr. Ext. Serv., Utah State Agr. College, Logan, Utah, M. S. 689, March 1, 1947, D. W. Thorne and H. B. Peterson.

"Fertilizer Tonnage Sales Survey Report for Washington for July 1, 1945 to June 30, 1946," Inst. of Agr. Sciences, State College of Wash., Pullman, Wash., Cir. 43, March 1947, S. C. Vandecaveye.

Soils

"Soil Treatment to Improve Permanent Pastures," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Cir. 310, Oct. 1946, Arnold W. Klemme.

"Erosion Control Methods," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Publ. 299, April 1946, G. E. Martin.

"Economic Land Classification of Pulaski County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 398, June 1946, W. L. Gibson, Jr., and Farrar V. Shelton.

"Economic Land Classification of King William County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 399, July 1946, G. W. Patteson and Z. M. K. Fulton, Jr.

"Wheat Production and Properties of Palouse Silt Loam as Affected by Organic Residues and Fertilizers," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. 476, Sept. 1946, Henry W. Smith, S. C. Vandecaveye, and L. T. Kardos.

Crops

"Eight Points for Arkansas Dairymen," Ext. Serv., College of Agr., Univ. of Ark., Fayetteville, Ark., Leaf. 75, March 1946, Paul Carruth.

"Results of Experiments, 1937-1945," Dominion Exp. Substa., Dept. of Agr., Delhi, Ontario, Can. 1947.

"Better Legumes and Grass Seedings," Ext. Serv., College of Agr., Univ. of Conn., Storrs, Conn., Ext. Folder 10, Feb. 1947, J. S. Owens.

"Extension in Connecticut," Agr. Ext. Serv., Univ. of Conn., Storrs, Conn., A. R. 1945.

"Citrus Industry of Florida," State Dept. of Agr., Tallahassee, Fla., A. F. Camp, Robert C. Evans, and L. G. MacDowell.

"Ladino White Clover for North Georgia," Ga. Exp. Sta., Experiment, Ga., Cir. 153, Jan. 1947, Orien L. Brooks and Guy D. Buice.

"Growing Lettuce in North Georgia," Ga. Exp. Sta., Experiment, Ga., Bul. 579, Jan. 17, 1947.

"Grape Growing in the Mountain Section of Georgia," Ga. Exp. Sta., Experiment, Ga., Bul. 580, Jan. 17, 1947.

"Centipede Grass for Lawns," Ga. Coastal Plain Exp. Sta., Tifton, Ga., Mimeo. Paper 48, March 1947.

"Hawaii Extension Reconverts, 1945-46," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, T. H., Bul. 44, Jan. 1947.

"Essentials for Growing Alfalfa," Dept. of Agr. Ext., Purdue Univ., Lafayette, Ind., Ext. Bul. 242 (2nd Rev.), 1947.

"The Story of Wheat Improvement in the Pocket Area," Dept. of Agr. Ext., Purdue Univ., Lafayette, Ind., First Annual Report, 1946, H. R. Lathrope.

"Eaton Oats," Exp. Sta., Michigan State College, East Lansing, Mich., Art. 29-21, Feb. 1947, E. E. Down and J. W. Thayer, Jr.

"Supplementary and Emergency Crops for Minnesota," Agr. Exp. Sta., Univ. of Minn., St. Paul 8, Minn., Bul. 390, June 1946, A. C. Arny, Ralph Crim, and R. O. Bridgford.

"Seasonal Grazing Recommendations for Yazoo-Mississippi Delta," Agr. Exp. Sta., Miss. State College, State College, Miss., Serv. Sheet 402, Aug. 1946.

"Growing Strawberries in Missouri," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Cir. 311, Jan. 1947, T. J. Talbert and A. D. Hibbard.

"4-H Projects for Missouri, 1947-1948," Agr. Ext. Serv., Univ. of Mo., Columbia, Mo., Manual 40, Oct. 1946.

"Root Crops," Ext. Serv., Univ. of N. H., Durham, N. H., Cir. 266, Jan. 1945, J. R. Hepler, M. C. Richards, and J. G. Conklin.

"Standards for Classifying Peach Characters," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 728, Oct. 1946, M. A. Blake and L. J. Edgerton.

"Planning the Pasture Program," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 501, Sept. 1946, C. S. Garrison and Gilbert H. Ahlgren.

"Sixty-Fifth Annual Report, 1946," N. Y. State Agr. Exp. Sta., Geneva, N. Y.

"Small Fruit Culture," Agr. Exp. Sta., Wooster, Ohio, Spec. Cir. 74, Feb. 1947, Wesley P. Judkins.

"Science for the Farmer," Agr. Exp. Sta., State College, Pa., Suppl. 2 to Bul. 480, March 1947.

"The 1946 Cotton Contest for Higher Yields and Better Quality," Agr. Ext. Serv., Clemson Agr. College, Clemson, S. C., Cir. 295, Jan. 1947.

"Keys to the Protein Feed Problem," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Publ. 300, W. P. Tyrrell.

"A Summary of the 1946 Texas Corn Performance Tests," Agr. Exp. Sta., Texas A. & M., College Station, Texas, P. R. 1051, Dec. 20, 1946, J. S. Rogers, D. H. Bowman, J. W. Collier, and R. G. Reeves.

"Maturity Studies with Canning Peas," Agr. Exp. Sta., Utah State Agr. College, Logan, Utah, Bul. 328, March 1947, L. H. Pollard, E. B. Wilcox, and H. B. Peterson.

"The Vermont Agricultural Experiment Station, Its Accomplishments, Program and Needs," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt., Dec. 1946.

"Fruit Varieties in Middle Virginia," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 402, Nov. 1946, W. S. Flory, Jr. and B. G. Anderson.

"1946 Varietal Tests," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 403, Dec. 1946.

"A Primer on Hybrid Corn—How It's Produced," Ext. Serv., Univ. of Wis., Madison, Wis., Sten. Cir. 248, Oct. 1946, E. D. Holden.

Economics

"Arizona's Agricultural Wealth," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 205, Oct. 1946.

"Origin and Destination of Fruits and Vegetables Produced in Maryland," Agr. Exp. Sta., Univ. of Md., College Park, Md., Misc. Publ. 54, Dec. 1946, P. R. Poffenberger and S. H. DeVault.

"Wheat-Flax-Soybean Outlook, Looking Ahead in 1947," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Pamph. 152, Feb. 1947, D. C. Dvoracek.

"Problems in Farm Management and Production Costs on 40 Farms in Northeast Mississippi," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 431, June 1946, W. J. Edens.

"Prospective Income from Average Size Farms on Grade 2 Missouri Land," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 497, June 1946, Ramey C. Whitney.

"Negro Farm Families Move Ahead in Tennessee," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Publ. 298, G. C. Wright.

"Efficient Use of Farm Labor in Tennessee," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Publ. 301, March 1947, James L. Anderson.

"Economic Aspects of Cotton Production, Henry and Madison Counties, Tennessee, 1942," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Mono. 208, Sept. 6, 1946, H. J. Bonser and C. C. Mantle.

"Costs and Returns in Growing Corn, Henry and Madison Counties, Tennessee, 1942," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Mono. 209, Oct. 5, 1946, H. J. Bonser and C. C. Mantle.

"Comparison of Different Methods of Harvesting Cotton," Agr. Exp. Sta., Texas A & M, College Station, Texas, Bul. 683, Oct. 1946.

"Vermont Farm Outlook for 1947," Agr. Ext. Serv., Univ. of Vt., Burlington, Vt., Feb. 1947, Roy S. Beck.

"World Food Situation 1946-47," Office of Foreign Agr. Rel., U.S.D.A., Washington, D. C., Third Preliminary Report, WFP 3-46, Nov. 4, 1946.

"World Food Situation 1946-47," Office of Foreign Agr. Rel., U.S.D.A., Washington, D. C., Fourth and Final Report, WFP 1-47, March 3, 1947.

Some Recent Books on Agriculture

The Nature and Properties of Soil by T. L. Lyon and H. O. Buckman. (Macmillan Company, New York. 4th edition, 1943. $3.50.)

This has long been the standard college textbook on soil science in this country. Frequent revisions keep the subject matter well abreast of the latest developments and thoughts in this rapidly developing field. It is a scientific book, but soils are considered primarily from the crop-producing standpoint, with technical phases well explained. The book covers soil formation and composition; physical, chemical, and biological properties; and soil fertility relationships.

Soils and Fertilizers by F. E. Bear. (John Wiley & Sons, New York. 3rd edition, 1942. $3.50.)

Written by one of the leading soil scientists of the country, the first part of this takes up the origin and the chemical, physical, and biological properties of soils. The middle section is devoted to soil management for the production of crops and the maintenance of soil fertility. The latter part covers the production and use of fertilizers and lime.

Field Crops by H. C. Rather. (McGraw-Hill Book Company, New York, 1942. $3.75.)

This is a textbook covering practically all the commonly grown field crops. The crops are described and pertinent information is given on their adaptation and cultural practices. Varieties, diseases, and pests of individual crops are discussed. Chapters on silage, pastures, soil conservation and management, tillage, haymaking, and feed production are included.

The Nature and Prevention of Plant Diseases by K. S. Chester. (Blakiston Company, Philadelphia, Pennsylvania. 1942. $4.50.)

Descriptions and control methods are given for the diseases of most of our economic plants. Other chapters are devoted to aspects of nutrient deficiencies, parasitic seed plants, and nematodes. The subject matter is arranged by the causal organism or factor rather than by crops. While the book thus is written primarily as a textbook, a complete index makes it suitable as a reference.

A Practical Guide to Successful Farming edited by W. S. Moreland. (Halcyon House, Garden City, New York. 1943. $3.95.)

An extraordinary amount of information about nearly everything connected with farming in its many aspects is contained in this volume. Selecting and financing a farm, soil management, production of crops and livestock (including goats and beeves), farm structures, marketing, and rural-life problems are among the broad subjects covered. Thirty-seven chapters written mostly by experts of the New Jersey Agricultural Experiment Station give practical, accurate, and highly useful information on individual subjects. While it is written mainly from the viewpoint of northern agriculture, much of the information will apply anywhere. This book could well be on the table for ready reference by farmers, county agents, and teachers.

Vegetable Gardening in Color by D. J. Foley. (Macmillan Company, New York. 1943. $2.50.)

Prepared primarily for the small gardener, this is an attractive book. Brief descriptions and cultural notes are given for nearly all common and many uncommon vegetables, small fruits, and herbs, along with general cultural information. Separate chapters are included on general cultural directions, planning a garden, pests and diseases, and storing and cooking vegetables. Numerous illustrations in color give rise to the title of the book.

Artificial Manures by A. B. Beaumont. (Orange Judd Publishing Company, New York. 1943. $1.50.)

This is a practical book furnishing background information on organic matters in the soil and discussing a preparation of artificial manures and composts as well as the use of green manures and cover crops. It would be useful to the small gardener, truck-crop grower, and general farmer.

Fertilizer Bands For Home Gardens

Home gardeners find it easy to apply practically one of the important findings of research on the application of commercial fertilizers—the desirability of placing the fertilizer in a band two or three inches to the side of the seeding row and two inches below the level of the seed in the row. This makes the fertilizer readily available for feeding the young plants but keeps it away from the seeds while they are germinating and might be injured by the chemicals of the fertilizer. In large scale tests the fertilizer specialists of the U. S. Department of Agriculture and of the State experiment stations have proved this in field tests with many crops, including most vegetables.

General farmers who have not the special fertilizer equipment needed for placing fertilizers in bands have difficulty in making use of this improved method. The home gardener, however, can get the good effects easily—by using his hoe. It is only necessary to first lay out the planting row—usually with a cord stretched between two stakes. Then gouge out with the hoe a trench parallel to the cord and about three inches to the side and three inches deep. Place the fertilizer at the bottom of this trench and replace the earth. Next, open the planting row along the cord and plant as usual.

For placing the band of fertilizer in the bottom of the trench, it is convenient to use either a tin can with a hole about a half inch in diameter punched in the bottom or a clay flower pot that has a drainage hole. With a little practice it is easy to train hand and eye to move the pot or can along the trench just fast enough to allow the fertilizer to run out at the rate suggested for each ten feet of planting row. To shut off the flow, put a finger over the hole.

Ten Years of Soil-Building in Vermont

(*From page* 26)

which for the most part was high-analysis, double-strength materials. These dairymen had long since learned that to stay in the milk production race, year in and year out, such a plan of pasture provision and management paid them good dividends.

The Caledonia County committeemen saw much in their three-day visit to Maine that could be brought back and put into practice in their own communities. In no instance were the Maine farmers visited trying to do the impractical or making their accomplishments on soils that were better than those in Vermont. That this was true was evidenced through the discussions en route. All were of the opinion that we really had the edge, when it came to a comparison of natural soil resources. In other words the Vermont dairyman just had to be convinced, or otherwise sold, on the idea of better pastures through a management program.

From the best figures obtainable in Vermont as a whole, it is estimated once our hay and pasture soils are brought up to a pH of 6 that 200,000 tons of ground limestone will be needed annually to maintain such a condition. With phosphorus, once the optimum level is obtained, it will take 100,000 tons of superphosphate annually. With potash, after 100,000 tons are used to bring the hay and pasture soils up to an optimum level, it will take at least 50,000 tons of 60% potash annually to maintain such a condition.

In addition, additional fertilizer could be used on the 112,000 acres of land that should be cleared for new pasture development. Also with drainage work being carried on, another 100,000 acres of land could be put into shape for better cultivation and fertilization through the construction of open ditches and tile drainage.

The more adequate conservation and use of the farm manure supply can and should work hand in hand with our entire plan of dairy farm management. Whether this will be along the line of manure pits, liquid collecting tanks, or such labor-saving devices as gutter cleaners, new type spreaders, etc., remains to be developed, but the next few years undoubtedly will bring along many changes in the handling of manure.

Such a program is by necessity a long-time program. It will take time, money, fertilizer, machinery, and much good management. However, it is not beyond the impossible to do it, providing we lay the groundwork now and keep in mind that the heritage challenge that presents itself is one of vision and is needful of common sense consideration.

Potato-Growing Developments in New England

(*From page* 10)

that a 20-pound application of borax depressed the yield of potatoes on two farms in Maine to a significant degree, that a 10-pound application reduced the yield, and that even a 5-pound application reduced the yield on one farm and caused no increase on another.

It is barely possible that Aroostook soils are better supplied with boron than certain other New England soils. It is also an undisputed fact that boron is toxic to many crops if applied in even moderate quantities, so that if the soil on which an investigator is working has a fairly good level of boron, the addition of more boron in the fertilizer might prove to be toxic. Our work in New Hampshire appears to indicate a need for borax on potatoes on a soil near Colebrook. As a two-year average, the 5-pound application has increased yields significantly, whereas the 20-pound application has given better yields than the check but not so good as the 5-pound amount, suggesting we may have passed the limit of efficiency for borax with the 20-pound amount on the potato crop.

We have noted that the potatoes produced with boron have a little better appearance and that they remain whiter after cooking for a longer period than those not grown with boron. We believe that boron merits further study in connection with the potato crop.

We have been giving some attention in New Hampshire to calcium and sulphur as plant nutrients, applied in

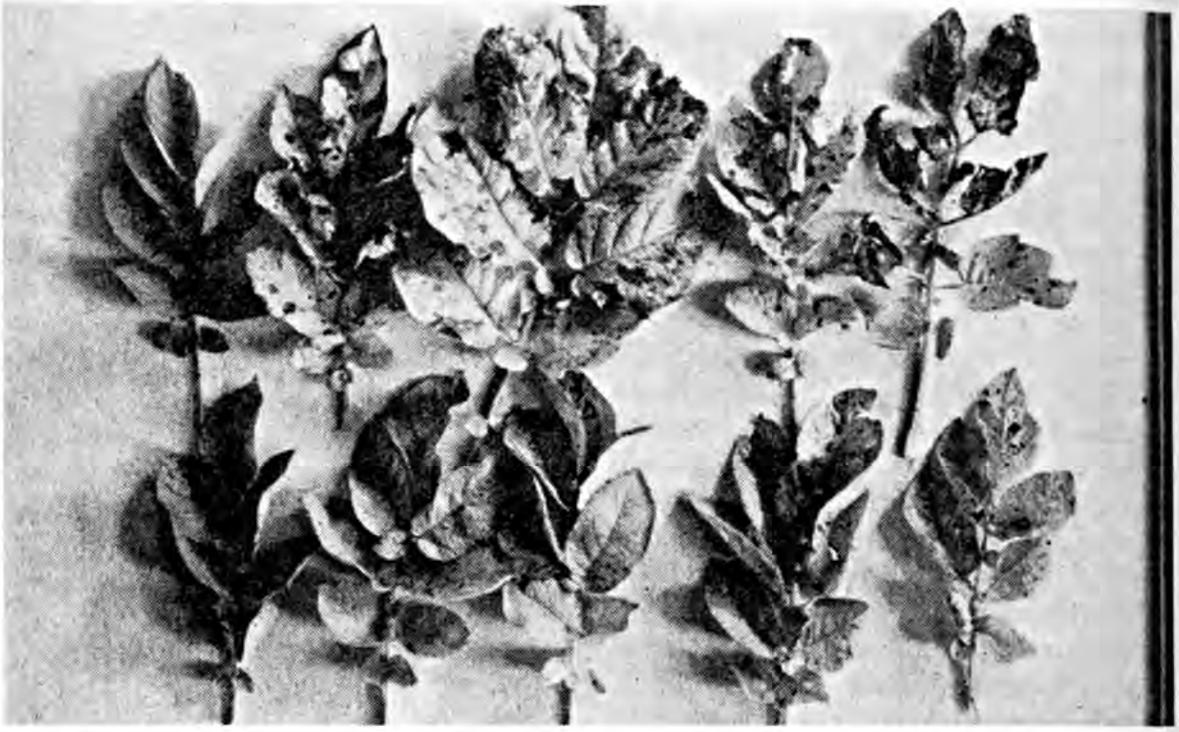


Fig. 4. Potato leaves showing magnesium deficiency. Healthy leaves are on extreme left in both rows. Going toward the right, magnesium deficiency is shown in progressive stages.

the form of gypsum. The need for calcium might arise on soils which have never been limed and which have reached a pH value of 5.0 or below. This is the same condition, of course, which might forecast a magnesium deficiency. The need for sulphur would be intensified on soils low in organic matter, such as would be found in potato rotations, or on land fertilized over a long period with double-strength fertilizers. Low-analysis superphosphate which is used in compounding ordinary fertilizers contains both calcium and sulphur in gypsum which is developed in the manufacturing process. High-analysis fertilizer has very little gypsum in its make-up.

Working in the greenhouse with a soil low in calcium and sulphur, Kardos and Blood[12] found a definite stimulation to potatoes from both these elements. Calcium appeared to be more involved in increasing the set of tubers while sulphur increased their size. The evidence in this greenhouse study shows the need for these elements as nutrients and their possible function, but field results have not shown consistent increases for gypsum, or for either calcium or sulphur applied in other forms. It would appear that fertilizers probably carry sufficient calcium and sulphur for temporary needs of the crop.

Studies in Maine, reported by Hawkins, Chucka, and Brown,[12] showed no advantage for using copper, iron, manganese, nickel, or zinc added to the fertilizer as sulphates. Nickel, like boron, may be toxic if applied in too large amounts.

Evidence that chlorine has a depressing effect on starch formation is accumulating in New Hampshire. Chlorine is a component of potassium chloride (muriate of potash) and this substance is commonly employed as the carrier of potash. Since the starch content of the potato has a direct and favorable influence upon mealiness in the potato, anything that depresses starch formation reduces the cooking quality. Tests in 1946 seem to indicate that the starch content of potatoes already high in starch is influenced more by using potassium sulphate instead of the chloride than those which have a lower inherent starch content.

It is doubtful if the public is discriminating enough to pay more for potatoes fertilized with the more expensive sulphate, since at the moment potatoes are bought mainly on their size and outward appearance rather than upon their starch content or cooking quality.

Varieties

The need for new varieties of potatoes has been felt for some time, and this need, thanks to the effort being placed upon plant breeding, is now coming to fruition. To be specific, the Green Mountain potato, long the favorite of New England growers and the best cooking variety so far at our disposal, suffers more and more in reputation because of its susceptibility to net necrosis. Its place in popular favor has been taken over by the Katahdin, a much better looking potato, with a higher percentage of marketable tubers, and one which does not exhibit net necrosis. But it is inferior to the Mountain in cooking quality. This is true, also, of Chippewa, Houma, and Sebago, three other varieties each with other faults besides poor cooking quality, each susceptible to something or other—Chips to leafroll, Houma to late blight, and Sebago to black leg. Popular on the market and with growers at present, we do not believe they are the potatoes our farmers will be growing in 1960.

The Mohawk potato promised to supersede Green Mountain. Shaped like an Idaho baker, with a high percentage of marketable tubers, smooth skin, and equal to the Mountain for cooking, this variety has proved to be susceptible to leafroll and shows net necrosis in the tubers. In fact, all the good-cooking, mealy varieties exhibit net necrosis, which leads to the conclusion that this trouble is always coupled with a relatively high starch content. If this is true, then the potato that finally takes the place of the Green Mountain must have as one of its attributes an inherent resistance to leafroll. We feel sure that the plant breeders will come through on this one.

There are other special situations that need new varieties. Resistance to scab is one of them. Potato growers have been hampered in their soil fertility program by not being able to lime their soil because of the danger of potato scab. In New Hampshire, our growers are so fearful on this score that they use no lime until clover absolutely fails to grow.

Thanks to plant breeders, the Ontario potato, which seems to be quite resistant to scab, has been developed. This variety may not be the final answer to the scab problem but it does indicate what can be done. We grew the Ontario in 1946 by the side of the Pawnee variety, the latter showing about 20 per cent scab while the Ontario was scab free.

Blight-resistant varieties are appearing, too, and may cheapen potato costs because of the necessity of applying fewer sprays and less material. Three of these were grown in New Hampshire in 1946. All stood through a severe blight infection in August while other varieties on adjacent plots went down. Needless to say, the three had high yields in '46, the highest in our tests. In a year in which late blight does not occur, other varieties might equal them in yield. But these instances show the possibilities that lie ahead for the potato grower now that the plant breeders are vitally interested in his problems.

Keeping Abreast

We can expect constant changes in the potato industry. To keep abreast of them, growers must keep informed. DDT may cause some reduction in potato acreage. Judicious and not extravagant fertilization should be the watchword in the coming period, during which time growers should accept the opportunity to adopt better rotations to renew their organic-matter supplies reduced by heavy cropping.

Supplies of the minor elements in our soils are in delicate balance. Magnesium is already a must on potato farms; boron doubtless soon will be in certain areas. Others in this trace group may become necessities before long. Above all, we must keep our eyes on new varieties and choose those that are developed to suit our specific purposes and markets.

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More Palatable Grass Is More Nutritious

(*From page* 24)

areas into the ground. They were simply getting more nutrition per mouthful there, and were smart enough to do their eating where the menu was good.

Field observation and laboratory tests have told us a number of things about adding nitrogen and other amendments to the soil. An application of nitrogen on pure stands of grass will increase the weight of total forage. It will also increase the protein content. The more protein, the more palatable and nutritious the grass. Adding nitrogen also helps grass produce better seed crops.

But although the urea helped increase the feeding value of the grass considerably, nitrogen alone should not be supplied to grazing lands like Mr. Canada's. He has been able to develop grass and legume pasture which has put more than a pound of beef per day on cattle, stocked at the rate of more than one animal unit per acre. His Dallis grass, white Dutch clover, Bermuda grass, and common lespedeza pastures were developed by adding lime, phosphate, and potash. The amounts applied per acre have varied. The heaviest applications have been 3 tons of limestone, 600 pounds of superphosphate, and 100 pounds of 60 per cent muriate of potash. Nitrogen was supplied by the winter-growing clovers, which put the expensive fertilizer into the ground so that it was available to the Dallis grass when it germinated the following spring. He applied the amendments after Soil Conservation Service technicians assigned in his district helped him with a complete soil analysis made in the Soil Conservation Service operations laboratory.

After developing 120 acres of grass and legume pasture which cost about $15 per acre, Mr. Canada asserted that the type of pasture development he was following as part of the coordinated soil conservation program on his place was entirely economical. He is currently in the process of building another 100 acres of the improved pasture and figures an acre and a half of improved pasture is the equivalent of 15 acres of native pasture. Besides the immediate cash gains, he points out that stock diseases are less prevalent and that he raises a better crop of quarter-bred colts

Fig. 3. Bob Harling, Soil Conservation Service technician assigned in the Trinity Bay Soil Conservation District, inspects a drainage ditch built on the G. R. Canada ranch. Engineers from Mr. Harling's office helped Mr. Canada lay out the ditch lines as part of the soil conservation program being installed on the ranch.

from mares running on the improved pasture.

Here's a bit of 1946 grazing history on Mr. Canada's improved pasture:

He had 150 head of native sheep on the field during the late winter and early spring of 1946. They were in poor condition before he turned them on the pasture, but in 60 days all the ewes developed excellent flesh while suckling young lambs.

The sheep were taken off the pasture March 15, 1946, and five days later 20 brood mares with colts and 14 two-year-old quarter horses were put on the area. April 8, 1946, he turned 80 head of weaned heifer calves on the pasture together with 12 yearling horses. Altogether, he has had 20 mares with colts, 12 yearling horses, 14 two-year-old horses, and 80 calves on the pasture since April 8, 1946.

The quarter horses are doing exceptionally well; the colts are slick and fat. The heifers have been weighed every month and have made exceptional gains for the area. Several of the heifers have been drenched for stomach worms and Mr. Canada believes the entire lot would have made better gains if he had followed a systematic worming program.

The average weight of the heifers has been as follows:

April 8	400 pounds
May 9	418.8 pounds
June 9	432.8 pounds
July 9	469.7 pounds
Aug. 9	491 pounds
Sept. 9	not weighed
Oct. 9	550.4 pounds

The pasture is located adjacent to the Gulf Coastal Marshes, one of the largest wintering grounds for geese. In late October, the large Canadian ringneck geese were attracted to the tender green clover pasture. All during the winter around 500 geese can be found on the pasture any time. Since the pasture is the only spot of green vegetation for miles around, it is impossible to keep the birds driven off. Because of the geese eating the vegetation, Mr. Canada's stock get very little winter grazing from the pasture.

From April 8, 1946, to October 9, 1946, the pasture produced 101 pounds of beef per acre on 80 yearling heifers. Additional gains were produced on the 66 horses which grazed the pasture together with the yearling heifers. Usually the native prairie pasture of the area produces good weight gains from the time the grass puts out in the spring until the middle of June. Mr. Canada's improved pasture, of course, is beating that a long way.

A drainage-conservation program on his ranch preceded the pasture improvement work. The improved pasture is on land which is getting the benefit of well-designed drainage ditches which carry off the water. Soil Conservation Service technicians in the Trinity Bay Soil Conservation District helped with his drainage, pasture improvement, and other conservation measures.

The Potassium Content of Farm Crops

(*From page* 22)

soils were treated with potash. The alsike hay on the Toledo field had a high of 2.61% and that on the Brownstown field was up to 3.39% potassium. These high percentages and relatively large increases were probably due to the very wet season of 1944 in southern Illinois where these two fields are located (table 6).

Six different crops from the Sparta experiment field had a potassium content which ranged from .81% up to 3.10%. This rather wide range was due partly to difference in crop variety, part to seasonal effect, but the larger part of the difference may be attributed to potash treatment of the soil. This field is located on the light-colored, deficient soils of southern Illinois (table 7).

In practically all of these field tests the land without potash treatment had limestone and phosphate treatment. When potash was added it was used in addition to limestone and phosphate. In most cases the crops on these experiment fields were in a four-year rotation. Approximately 400 pounds of muriate of potash per acre were applied during the rotation. Usually the corn crop received 200 pounds, the wheat crop 100 pounds, and the clover, alfalfa, or other hay crop got 100 pounds per acre. The amounts of muriate of potash applied to the soils were substantial but not excessive. Over a period of years there has been some slight build-up of available potassium in the soils where potash treatment has been regularly practiced.

Building and Maintaining Good Lawns

(*From page* 18)

White Clover (Trifolium repens L.) becomes established quite rapidly. Grass growing in association with it benefits from the nitrogen fixed by the bacteria which form the nodules on clover roots. White Clover tends to stay green during warm, dry weather. It frequently winter-kills, leaving bare patches in the lawn.

In most cases a mixture of seeds rather than a pure species should be sown in lawns. Many people who are acquainted with the beautiful greens maintained by most golf and bowling clubs, desire the same type of lawn. It must be pointed out that these bent grasses take a great deal more care in every way and are more susceptible to disease. For the average home-owner, therefore, a well-chosen mixture suit-

General Fertilizing Schedule
For Established Lawns

Time	Fertilizer	Amount per 1,000 sq. ft.
Early April..........	Sulphate of Ammonia................20% or Nitrate of Soda......................16% or Nitraprills..........................33%	3 lbs. 4 lbs. 2½ lbs.
June 15.............	Nitrogen fertilizers as above if turf has not been growing too well	as above
September 1–15......	4–12–6	4–5 lbs.
October 15..........	A good time to apply top-dressing of composted soil, well-rotted manure, or fine black peat (if necessary)	1 cu. yd.

General Remarks: Before applying fertilizers, rake lawn well both ways. Apply fertilizer and rake well again both ways. If necessary, give a light watering to prevent burning and to help wash fertilizer into soil for quick action.

able to the environment encountered should be selected.

Fertilization

Where fertility levels are moderately low, a fertilizer such as 4-12-6 applied at about 25 lbs. per 1,000 sq. ft. of lawn would be a satisfactory foundation application. The fertilizer can be applied broadcast at the time the seedbed is prepared. To get uniform distribution it is advisable to mix the fertilizer with an equal volume of clean, dry sand and sow one-half the mixture each way. The fertilizer should be well raked into the surface soil. The new seedbed should be firm with just enough loose material on top to give the seed good coverage and allow for sufficient aeration.

Seeding

The best time to seed a new lawn in most parts of Eastern Canada is from August 15 to September 15, depending somewhat on the location. When a soil is prepared at this time the late seeding of weeds is avoided and the new grass seedlings have sufficient time to develop a good root system with enough top-growth with which to go into the winter. Then in spring the new lawn makes an early growth before the hot, dry summer weather arrives. If seeding must be done in the spring it should be done as early as possible, and on a seedbed prepared the fall before. The amount and kind of seed to sow depend on the type of lawn desired. As a rule, 3 to 5 lbs. of seed are required for 1,000 sq. ft. of lawn. In sowing, an even distribution is desirable. By dividing the seed in half and sowing both ways this can be accomplished. The seed should be raked in both ways and should be well covered but not too deeply. It is well to roll the lawn after having sown the seed. Finally, it should get a light raking. A light sprinkling with a spray fine enough to avoid washing the seed out of the ground should be given if the weather is dry.

Mowing

A newly seeded lawn should not be mown too short the first season, especially in the hot weather. On the other hand, the grass should not be allowed to grow so long that it causes too much shading. The mower can be adjusted to cut at different heights. In the average, for a new lawn, about 1½ inches is the desired length to cut. This will give sufficient protection to the young grass. After a lawn has become well-established, it can be cut to about one inch, and frequently enough so as not to have to rake off the cuttings. This will help to keep up the organic matter of the soil. In the late fall a sufficient top should be left for the winter, but if the grass goes into the winter with a heavy top it is likely to smother out if a heavy snow-covering is encountered.

Watering

Many home-owners water lawns too frequently. This should be avoided; watering once or twice a week should be sufficient, provided the lawn is given a thorough soaking at the time. Light, frequent waterings tend to dry out the upper layer of soil during the hot, dry weather. New lawns should receive a light, even spray, but not too frequently. Early morning is the proper time for watering in hot muggy weather. This will give the grass time to dry off before evening. Evening or night watering tends to cause fungus diseases to develop.

Weed Control

In establishing a new lawn, if the seedbed has been thoroughly prepared, weeds will have been eradicated prior to seeding. Only the highest grade, weed-free seed should be used. High soil fertility will encourage quick development of the grasses to the detriment of weed growth. It is advisable to go over newly seeded lawns and spud out any weeds as soon as they appear.

For general purposes, lawn weeds may be divided into two classes: the annuals, which complete growth and reseed in one year; and the perennials, which live for several years. By preventing the annuals from going to seed, they can be easily disposed of. In the case of the perennials, it is necessary to destroy the whole plant. Many of the perennials possess underground root stalks in which a reserve food supply is stored, and from which, even though the tops are destroyed, they have the power to grow new plants. Most of these perennials can be elimi-

SEED MIXTURES FOR DIFFERENT CONDITIONS

(Per cent by weight)

Condition	Kentucky Blue Grass	Red Top	Colonial Bent	Creeping Red Fescue	Rough Stalked Blue	Canada Blue Grass	Crested Wheat	Rate of seeding Lbs. per 1,000 sq. ft.
Fertility high, adequate moisture	75 80 70	10 20	25 10 10					3–4 3–4 3–4
Fertility low, dry	20	20		40		20		5
Fertility high, moist, shaded	30	10	10		50			4
Fertility medium, dry, shaded	10	20	10	60				5
Fertility good, semi-dry, no artificial watering	20			20		10	50	5

White clover can be added to any of these mixtures, except shaded areas, up to 5% if desired.

nated by some of the new chemical weed-killers.

Turf Diseases

The demand for better lawns has increased the use of finer-leafed grasses. These grasses appear to be more susceptible to some of the common diseases.

A disease known as Brown Patch is very common. It appears during the hot, humid, sultry weather of the summer or early autumn and it is caused by the same organism responsible for Rhizoctonia in potatoes *(Rhizoctonia solani)*. Brown patches appear very suddenly as various-sized, discolored areas. New spots in the morning may be covered over by a fine cobweb-like growth which is the mycelium of the fungus. Around the edges of a new spot a dark ring or smoke screen frequently will be found. The grass within the ring has the appearance of being scalded.

The disease known as Dollar Spot also appears suddenly during the growing season. The spots are 1 to 2 inches in diameter. The grass in these spots takes on a withered, bleached appearance.

Snow-Mould appears early in the spring. The fungus causing this disease is Fusarium nivale. The disease progresses favorably at near-freezing temperatures with an abundance of moisture. It appears as irregular circles less than a foot in diameter, having a dirty white, gray, or even green cast.

These diseases can be readily controlled by the use of various commercial fungicides when they first appear. Precautionary measures can be taken to prevent them during the warm months. Care in watering is of prime importance in the control of diseases during hot summer weather.

Maintenance

Once a satisfactory lawn has been established a little care can keep it in a strong and vigorous condition, provided a few simple rules are followed:

1. Keep up a well-balanced fertility level by following a fertilizer schedule.
2. Maintain a good physical condition by keeping up organic matter and spiking when necessary.
3. Practice care in watering.
4. Mow at the proper time and height.
5. Control weeds.
6. Remove, in the fall, leaves and other material that may be thick enough to smother grass during winter.
7. Eliminate excess shade by properly pruning trees to let in as much light as possible.
8. Re-seed when necessary.
9. Keep off lawn as much as possible during winter and early spring.
10. Rake lawn well both ways in spring and fall.

Increasing Grain Production in Mississippi

(*From page* 14)

1946. Nitrogen only, with thick spacing, will be used on soils in the Delta area.

Early plantings of corn generally produce higher yields than late plantings. Plantings made in late March to the 10th of May usually produce 40 to 60 per cent more corn than plantings made in late May and June, especially on upland soils. Wet bottom lands generally cannot be planted until late May or June.

Newly developed and adapted corn hybrids should also contribute to higher corn yields in Mississippi. Dixie 11 and Dixie 17 are two new hybrids developed by the Mississippi Experiment Station. Tests indicate yields which are 15 to 20 per cent higher than yields of the best open-pollinated varieties. In 1946, 170 bushels of Dixie 11 were distributed to county extension workers for demonstration purposes. More than 1,000 bushels of this seed have been allocated to the agents for distribution to farmers in 1947. Single-crossed seed has been distributed to a few farmers for planting 200 acres for production of double-crossed seed of Dixie 11. Seed of Dixie 17 will be available for demonstrations over the State in 1948.

It should be recognized that a 20 per cent increase in a 15-bushel yield is only 3 bushels of corn, and 8 bushels for a yield of 40 bushels. The use of hybrids will be expected to spread only as the corn yields are increased through the basic fertility practices.

Hundreds of experiments and demonstrations are determining and pointing out improved practices which increase production of grain. Heavy fertilization, early plantings, thick spacing, use of adapted hybrids or varieties, and proper cultivation will produce more corn. As soon as these practices become routine with most of the farmers, we may grow plenty of grain feed.

How long will it take to establish this happy state, and how can the rate of progress toward the goal be speeded up? Do we still have a selling job to do? Farmers are now recognizing their problems and are ready to tackle them. Fertilizers will be made available in a year or two in much larger quantities. If we are inclined to become discouraged, it should be recognized that fertilizer tests and demonstrations for cotton were continued for 15 to 20 years in making the use of fertilizer a routine practice. It should not take so long for corn and oats if we really want livestock.

The rate of spread of desired practices by farmers in grain production can be speeded up. Ample nitrate materials must be made available, along with complete fertilizers. Leadership must be informed, motivated, and activated. Continuous wide-spread field demonstrations must be visited by many farmers. Most farmers "know more than they do." It takes the "seeing" of demonstrations to "inspire" many of them to action on their own farms. These and all of the other common tools used in education may be employed in a more intensive way. They will speed up the spread of practices which will produce more grain in Mississippi for more livestock.

Teaching

(*From page* 5)

tall, forbidding lady who probably never got more than sixty dollars a month wages in her whole teaching career. Those things of course are seldom openly measured or used to attract recruits to the teaching profession. You can't exist on some pupil's fond memories after your bones have mouldered away. Yet I can't help feeling that one who takes a little of the reward in respect and reverence is not entirely missing the bus.

My hunch is that the wages and the honors were too meager to be reckoned as the reason why our generation had such excellent teachers. It seems to me that a deeper feeling for public service as such and a greater inner light to impart knowledge must have animated the best of our teachers back then. Of course, the sum total of accumulated facts and the field of knowledge man possessed in our school days do not compare in complexity or in magnitude with the whole realm of wisdom and science which teachers must touch upon today. This reason may well call for better paid teachers to compete with commerce, but it cannot explain the deeper philosophy which makes the good teacher function as powerfully as a good parent—and often even better.

ON every hand these days reports come to me about the scandal of the era showing up in the dearth of teachers of any kind—good, bad, or indifferent—and the many schools which are obliged to close for lack of instructors. Some states and counties have sent out SOS calls for the oldsters of the teaching craft, the ones who started out in our day and quit the profession to get married and raise pupils for somebody else to teach. They give these folks a hasty once-over and plug them into gaps with a temporary certificate, hoping they won't do too much harm or become too fuddled over new subjects.

Much wiser and better is the plan to encourage recruits to the teaching craft by an organized and systematic effort; a system of selection while the trainees are in the formative school period, and a gentle pressure exerted to that end by their teachers and associates. Literature has been issued and distributed to hasten this hunt for the finest available timber, and campaigns are under way to enlist these top layers of the youth crop.

It deserves to succeed. I hope it succeeds at a faster clip than the parallel drive now afoot to get more students to devote their lives to library work and nursing and dental occupations. Librarians are just about as few and far between as teachers—less than a hundred being graduated in all the library schools of the country last year. The gentle duties of the nurse are not regarded with youthful fervor, and the young men anxious to clean and fill molars are scarce.

Those who are spearheading the teacher recruiting drive use plausible arguments. They recognize the disadvantage of low salaries relative to other professions, but these handicaps are being steadily reduced by an aroused public opinion, they state. The emphasis is placed on the personal satisfactions of teaching and the opportunity for a place of civic honor and social prestige, with vacation for travel, study, and relaxation. In other words, the idea is that other jobs have received so much glamour that the role of the teacher in making the country better has been sidetracked, perhaps in favor of jobs that entertain and amuse.

It strikes us that much can be done in country communities to encourage this recruiting of the best one-third of the available young people to enter the teaching profession through thorough organization, including the homes and social gatherings. But the high percentage of these talented and attractive personalities eventually seek a home and a family life of their own, so the turnover is rapid and the present campaign must be continuous and persistent. The women soon yearn for wifely duties not always compatible with teaching, and the men recruits get restless and often enter other lines which seem to offer better pay and more exciting experiences.

IT must be a continuous program from now on. Official reports reveal that out of the twenty-seven million school pupils in this country fully two million depend for their leadership and their daily instruction upon persons unable to qualify for even the very lowest standard of teaching certificates.

Moreover, about five million more pupils get lessons from teachers with less than a four-year college course behind them. It is also known that more than five million children of school age are not attending school at all, part of this being because of a scarcity of teachers available at the prices offered.

The war years did something to our teaching staff, as well as to the rate of training for teaching jobs. Last October only 71,000 men and women enrolled in teacher colleges for full-time work. Just before the war broke out, the average attendance at these preparatory schools was over 90,000.

It also develops upon close scrutiny of these 71,000 enrollees that a good percentage of them have no intention to teach classes as a profession. They are going to these institutions because they could not find room elsewhere.

YES, there are a larger number of men enrolled in these colleges than there were before the war. But let's not get fooled by that situation. The idea is to enter the teacher-training courses while waiting for a chance to enroll in some liberal arts college or university. About 60,000 veterans are studying in this way at the various teacher colleges of the country, but that represents less than three per cent of the enrollment under the G. I. bill of rights act.

Since 1941 the country has lost 350,000 qualified teachers over and above normal expectations. This leaves 75,000 positions either entirely abandoned or left vacant. There are over 100,000 persons with emergency licenses engaged in daily teaching. Of the total enrollment in all colleges and universities, about seven per cent claim they intend to teach school upon graduation. Twenty years ago the percentage was about twenty-five per cent expecting to teach school following their college course.

Higher guaranteed salaries, with room for advancement to superior performers, plus a sensible adjustment of the teaching load to a point where every pupil has a closer relation with his teacher are among the broad remedies proposed.

Your doctor or lawyer has his education and personality to bargain with as he begins his career, just like the teacher does. But the teacher often chafes because he has so little power to increase his income and build up his financial reserves; and he notices that his college chum who entered the legal or medical world gets ahead faster. Budget economy campaigns come swooping along in the aftermath of war or in a depression period, and the teacher must defer his reward to a distant day. Hired for some public service too often poorly appreciated, the servant of the town or city or state has to take what the politicians hand him and keep mum.

Naturally, the average harassed teacher fails to check the other less rosy side of the picture for the brethren engaged in personal body services or court-room tangles. He often overlooks the long hours, the ungodly midnight calls, the dull procedure in preparation of cases, and the nervous tension of such callings; and likewise he forgets that there are overdue accounts and bad collections involved. At least the teacher has some time to himself, does not worry overmuch about other people's physical or mental ailments or crimes, and usually gets his check on time without recourse to any pressure.

I presume no influence is greater or more charged with potent power for future things than the influence that deals with developing minds. It almost scares one to think this over and to know that only when ignorance is done away with and we can see through sham and greed are we going to govern our nations in the ways of peace and harmony.

RIGHT and wrong often scale down to common sense versus stupidity. So if we can teach kids to see clearly and weigh fairly and get sufficient background to uphold the dignity of man and avoid senseless and useless prejudices, it sort of seems like we could brush off a lot of the things that cause friction and start wars.

Teachers in common schools have a chance to reach the big majority of the people who run this country in later life. Many of the citizens of this day and age never went beyond eighth grade or high school. This doesn't mean that we don't need teachers who have high-class college degrees. Your teacher should always be a mile or so ahead of the pupil in educational attainments. That is, he should be unless the teacher gets snooty and snobbish through too many false notions about educational superiority. Rather than see that happen I'd go back to Mark Hopkins and his hollow log and sit on one end of it until Domesday.

I am for any approach to the teacher problem which puts emphasis upon human relations and companionship and the open mind. If we have to economize on facilities let's be cheap about the frills and furbelows of the classroom, and even about the books and globes and charts, rather than to set up a gaudy modern assortment of tools and find ourselves without a good teacher to handle them.

EDUCATION is taking a much larger share of the real estate tax bill than it did forty years ago, but is it wrong to say we are probably getting that money back with interest? Kids are not so neglected these days when they are a trifle goofy or out of adjustment. They learn faster because teachers know how to teach better. We all benefit by school improvements, even us old codgers who haven't put foot into a schoolroom for a decade. The last war showed us how blamed smart those youngsters were when put up against a sad world-blunder. That didn't just happen, because it came after good years of schooling. If schools can train kids to be better soldiers and sailors and battlefield mechanics and flyers and grease monkeys, maybe the same teachers can do something yet to stave off another catastrophe.

So I guess there's something basic about this teaching business after all, and we can't pass the buck much longer. What can you do to recruit better teachers? Go back to school and find out.

Two months after he had run over a girl, a North Carolina motorist married her. If that sort of thing were made compulsory, there'd be less reckless driving.

* * *

There was a young chap named
McComb,
Who was cleaning his pants in his
home;
He used gasoline—
That's the last that was seen
Of McComb or his pants or his home.

* * *

Joe: "Do you know what one cigarette said to the other?"

Bob: "No, what?"

Joe: "I hope I don't get lit tonight and make an ash of myself."

* * *

In the ninth grade English class the teacher was discussing etiquette. When she finished, she asked Bobby how he would ask a girl to dance.

Bobby replied: "Come on, worm, let's wiggle!"

* * *

The tourist had stopped to change tires. "I suppose," he remarked to a native on-looker, "that in these isolated parts the necessities of life come pretty high."

"Yer right, stranger," the native replied gloomily, "an' it ain't worth drinkin' when ye git it."

"Pardon me, Mrs. Astor, but that never would have happened if you hadn't stepped between me and that spittoon."

* * *

Indisposed

"I hear you got a girl, Sam."

"Yes."

"What's her name?"

"Belle."

"Seen her lately?"

"No."

"What's the matter—had a fight with her?"

"No, I went to her house last night and there was a sign on the door, 'Bell out of order,' so I didn't go in."

* * *

"Pappa, vat iss a guardian?"

"A guardian, mine son, iss somevone vot takes your fodders place."

"Mine goodness, pappa, den I got five of dem."

* * *

DARNED SAFE

"Yer know, no matter where I keep me money, the missus allus finds it."

"My wife never finds mine. I keep it in the basket with me undarned socks."

* * *

"I wish we'd get a few shipwrecked sailors washed ashore," mused the cannibal chief. "What I need is a good dose of salts."

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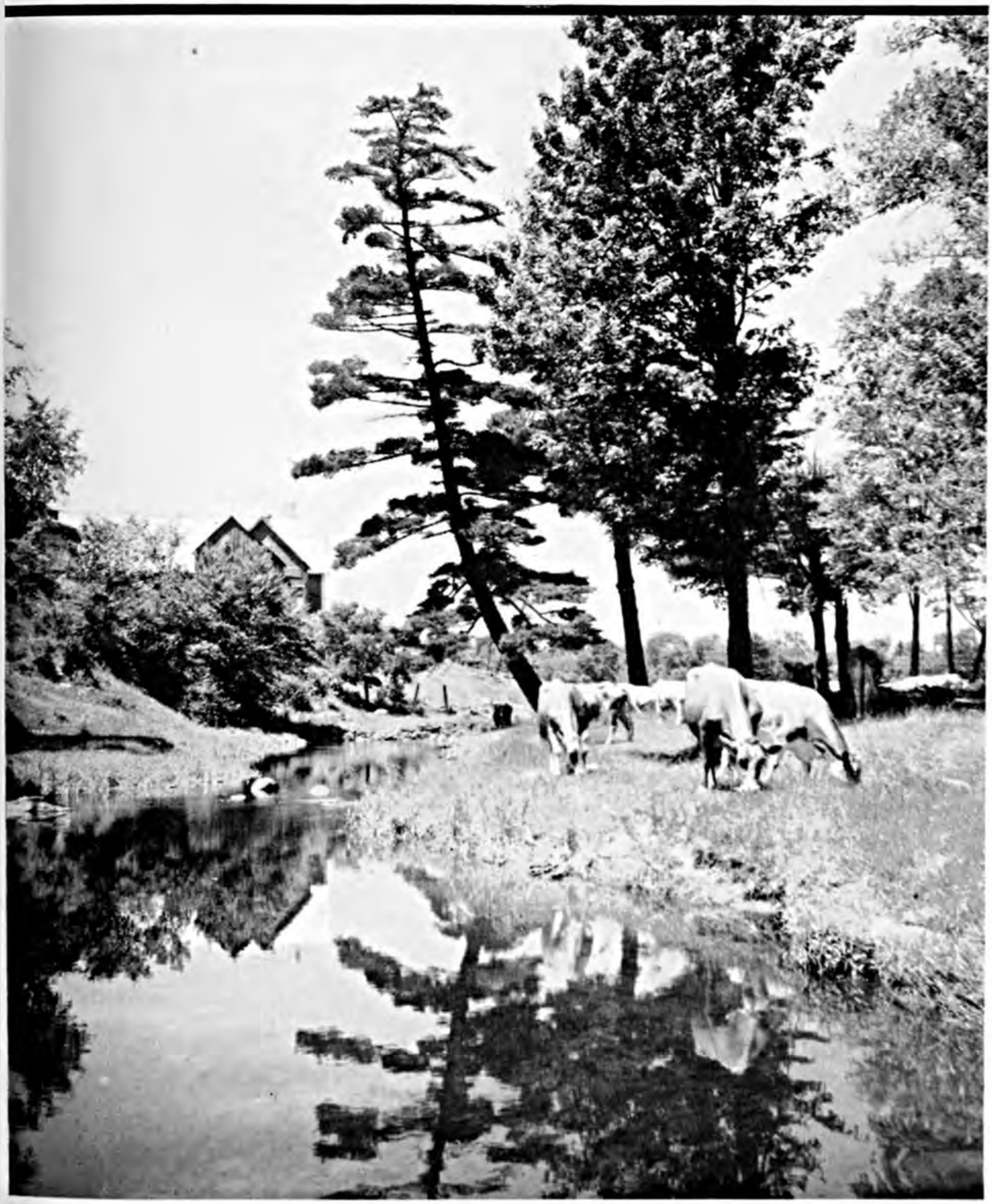

The Pocket Book of Agriculture

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

VOLUME XXXI NO. 6

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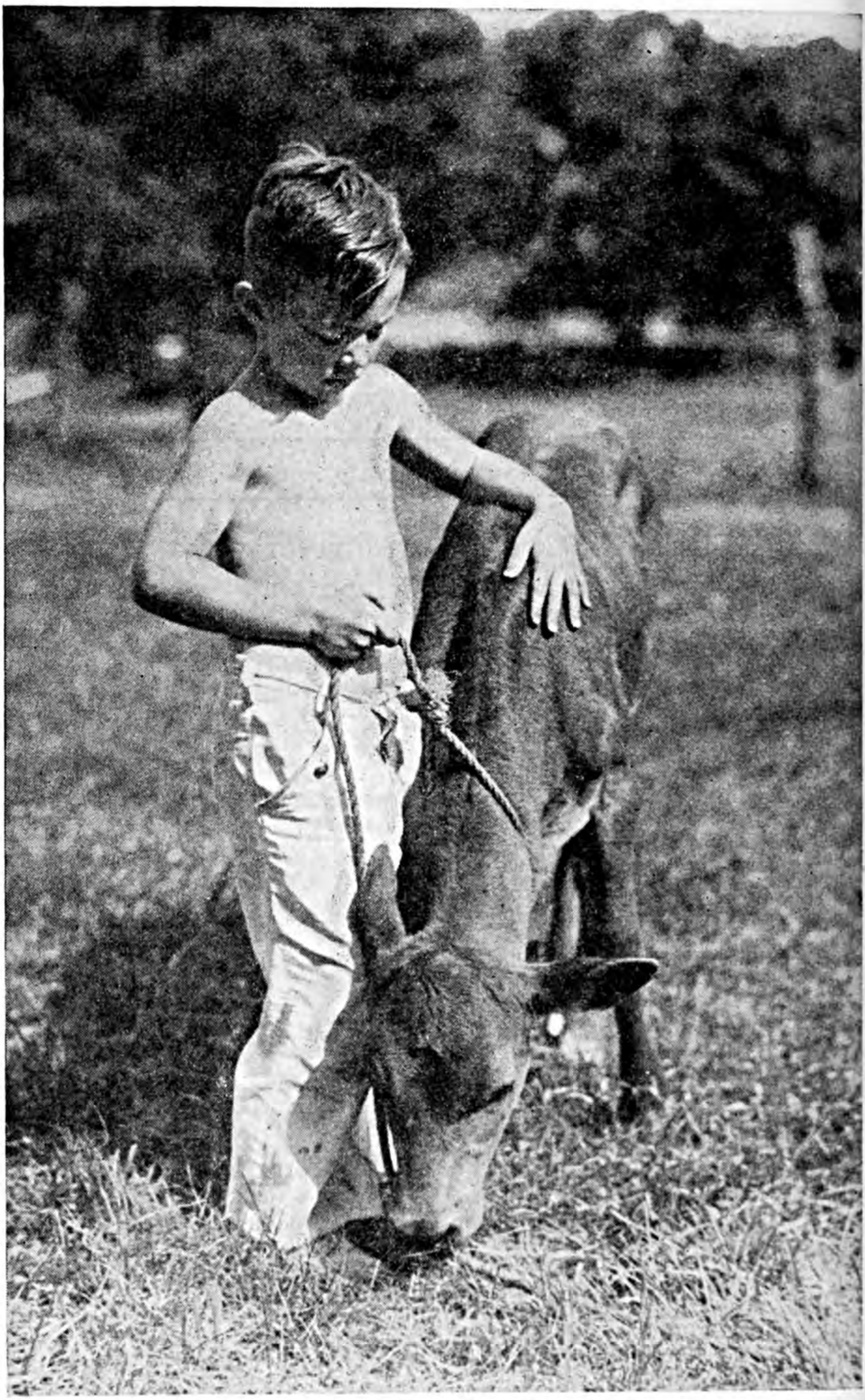

CONTROLLED PASTURING?

Better Crops with Plant Food

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Vol. XXXI WASHINGTON, D. C., JUNE–JULY, 1947 No. 6

Memories of . . .

Motor Meanderings

Jeff McDermid

AFTER driving motor cars fully 400,000 miles in twenty years, I've not had my hands on a steering wheel for thirty months—and do not seem to miss it much. Last week I rode with a friend along a dizzy, busy highway on a main artery southward, and I got panicky thinking how I had been able to escape a crash landing in all those years I piloted a car under various hazards, such as weather, breakage, and my own or someone else's blundering.

My very first experience of responsibility on the open road was behind a gentle bay mare, and being young and only recently graduated from holding the extreme ends of the reins back of my father's hands, I was pretty skittish and jumpy. The driver's seat of the high, old buggy seemed to be at an enormous elevation above the lumbering equine power generator with which I was entrusted for guiding and commanding.

I looked down along her broad back to see if all the straps and buckles were snug, peered over at the tugs and scanned the singletree, and hoped the wheel bolts were tight. Whenever I saw a cloud of dust ahead I yanked the right-hand rein long before the approaching wagon met me, townward bound. In similar fashion I gave more than my entitled half of the gritty turnpike at the sound of some clattering vehicle coming up from the rear.

No hindsight mirror enabled me to detect the teams drawing abreast of me, and I was braced and tense lest some careening runaway outfit should catch up and smash us or snap off our running gear. Sitting upright and stiff like one of the tin-man drivers on my circus-wagon toy, I grasped the lines until my knuckles were white and braced both feet against the dashboard. The mere sight of the frayed whip in its leather socket at my right made me tremble. I was in no mood for "acceleration," but I sure hoped the buggy brakes were working. It was at least two months before I relaxed like the mare herself and jogged forward through summer lanes enjoying the views on either side.

Runaways of those days were bad enough sometimes to instill all this fear and trepidation. Just previous to my initiation as a horse persuader, I had stood well back from the village curb and gasped in horror at a first-class runaway. The fear-crazed driver was an old man, standing with shaking legs and bulging eyes, sawing vainly at the bit of a fractious colt doing a speedy mile down the dusty street lined with nags and vehicles at the hitching racks.

At the narrow corner near the canal the colt missed the turn and smashed the light wagon against the stone wall, throwing the feeble farmer twenty feet in the air and cracking his skull on the wood-block pavement like an egg-shell. It was a wonder that this vision of sudden death did not condition me forever against driving anything.

HEAD-ON collisions were not as common in the old runaway age as they have since become with motor demons. Rear-enders and side swipes were more frequent, but the chances of any outfit being involved other than the one which the terrified horse was hauling were risky enough anyhow. Brakes didn't do much good either, because a scared animal would snake a stoneboat to perdition if it had to.

I presume there are no accurate available records assembled to inform us of the relative accident rates, comparing the horse-drawn era with modern gas-propelled travel. The number of vehicles on the highways was only a small fraction of those we have today, the "open road" was not so open, and the racing of those simple days was mostly pre-arranged, prepared for, and premeditated. Of course, the drunken driver had his awful innings back there too, and I have often helped pull scores of sodden wrecks from weedy ditches and recovered lost horses for them.

AFTER I left home to earn my own board and keep there came an interval of a few years when I remained afoot, having no conveyance to drive or any reason for driving one. During this period the horse entered the eclipse, and by slow degrees the livery stable and its back-yard counterparts underwent a slow demise. The socket-wrench and the starting crank replaced the harness and the hames.

Many of my old boyhood chums had yielded to the new mode of transportation and they talked wisely of Reo's Cartercars, Maxwells, Marmons, White Steamers, Locomobiles, and Fords; and chatted in a strange jargon about carburetors, manifolds, and grease-guns. But I resumed my plodding on a small stipend, shoe leather being my chief overhead for locomotion. A few of them gave me rides, while I held onto my hat and wondered if they could "ever stop her."

Within two years after I had found the right life partner, our mutual yen for open country rambles bloomed forth at last in the shape of a third-hand four-cylinder Ford hack, that model with the extra broad rear and the high top, a car which moved up, down, and sideways almost as consistently as it rumbled forward.

I tried it once around the block and was too scared to make another attempt, the foot work being too complex for my slow comprehension. The fact that the old car came to us direct from a good Methodist minister did not mend my morale. It still carried a sly hint of the devil in it, to my wary eyes. My courage waned.

So the job of chauffeur to the family rested with my young wife. She took me along for company and a possible puncture. Her eyes were aglow with pride at the ownership of such a gorgeous buggy, and she meant to enjoy it whether or no. It took some courage on her part, considering the age of the relic we rode in, the scarcity of repair shops in those days, and the narrow, rutty roads. Moreover, she had never been a horsewoman and traveling the open road was new to her. I have never sneered since then at (1) women's driving or (2) husbands who let their wives pilot the family car invariably.

Presently my wife had her first baby. While she was in the hospital I resolved to sell the old ministerial marvel and secretly buy a brand new Chevrolet. Inasmuch as lying-in fees were not as inflated then as now and we had good local credit established, I was not conscience-smitten by the undertaking thus contemplated. Anyhow the miracle happened and I took a few lessons on the sly, being doubly determined not to be timorous in this, as long as she had been so brave in "that."

SO the bright morning came when the Doc had dated the new Mother to return to our nest with the new prize package. I carried the baby out, with a nurse trailing along beside my wife. At first sight of the shiny new car, my wife stopped in her tracks and asked whose auto I had borrowed, and what on earth had happened to "old invigorator."

The thrilling story was soon told, the joyful tears were on tap as expected, we bundled everything in, and away we all sailed on that very first of many pleasant family jaunts taken in that bus and four of its successors. On the next Sunday we took Grandma and Uncle Rupert and the new baby on a wonderful outing amid the fields of summertime, doing, as I recall with bated breath, at least 35 miles an hour where the gravel road was level. We called on a group of relations who owed us many a meal, and thereby received some immediate interest on our investment.

I used to get sentimental over Black Beauty, and later about some of our numerous nags, but I never imagined myself getting that way about an old senseless, mechanical contrivance like a greasy motor car. Yet I solemnly swear that on each occasion when I turned in a car in trade on a new one, and as I sorted out things of my own from its pockets and compartments, it made me feel regretful, just like losing an old friend. I have even patted the hood of such a vehicle that had carted me around unscathed for 60,000 miles, and muttered to it, "Goodbye and a good operator for you," as I handed over the keys.

For you know from similar experience that a driver and his automobile finally become somewhat synchronized and harmonious, a sort of mysterious connection existing between the man and the machine. Any slight defect or maladjustment in the mechanism is instantly translated to the driver's hands and feet; and by the same token, the weakness or inattention of the driver quickly affects the gears and gadgets of which he is almost a part. But it takes a few hundreds of miles of driving to fix that relationship firmly after a new car is bought.

Many of my business trips have been

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Fig. 1. A soybean experiment located on a Norfolk sandy loam low in available nutrients, particularly potash. The average State yield can be tripled with the use of a good liming and fertilization program along with good stands of adapted varieties.

Profitable Soybean Yields in North Carolina

By W. L. Nelson and E. E. Hartwig

Agricultural Experiment Station, Raleigh, North Carolina

SUCCESSFUL production of soybeans in the Southeast is largely dependent upon an adequate supply of plant nutrients and a good stand of an adapted variety (fig. 1).

The 1939-44 reported yield of soybeans in North Carolina was 10.9 bushels per acre. Yields such as these are not profitable. As a rule, little fertilizer or lime is used on soybeans or on the crops in rotation with soybeans. Soybeans, however, require potash and phosphorus just like cotton, tobacco, corn, or any other crop (fig. 2). While the amounts removed by soybeans vary with location, season, and variety, it should be noted that approximately twice as much K_2O as P_2O_5 is removed.

Experimental work conducted in North Carolina the past few years shows that yields of 30 to 40 bushels per acre can be regularly expected if proper production practices are followed. These important practices were found to be as follows:

(a) Liming the soil with dolomitic limestone in accordance with its requirements as shown by soil tests.

(b) Fertilizing with adequate amounts of potash and phosphorus.

(c) Planting and securing a good stand of an adapted variety.

Experiments

In order to show more clearly the importance of these practices in the successful production of soybeans, nine tests were located in the Coastal Plain of North Carolina in 1946.

Dolomitic limestone was broadcast in February on the lime plots with the normal rate being one ton per acre. Plots with no fertilizer and with 400 pounds per acre of 0-10-20 were located on the limed and unlimed blocks. The 400-pound rate was selected because a 40-bushel crop of beans will remove at least three-fourths of this amount. The 0-10-20 analysis was used because, as shown by figure 2, soybeans require twice as much potash as phosphorus, and other crop response data indicated that this would be a desirable ratio. In addition, potash alone and phosphorus alone were applied on the limed plots. The fertilizer was placed in bands to each side of the seed. The Ogden variety was planted at a rate sufficient to give 10 to 12 seeds per foot in a 3- or 3½-foot row.

Results

The results obtained in these experiments reveal the importance of lime and fertilizer very clearly (fig. 3). An average of all the tests showed the following yields: no lime or fertilizer, 22.0 bushels; lime alone, 24.8 bushels; fertilizer alone, 27.2 bushels; lime and fertilizer, 34.4 bushels (table 1 and fig. 3). These results show that the addition of lime alone or fertilizer alone is not sufficient. Attention must be directed toward both factors if maximum yields are to be reached. In addition, both phosphorus and potash were necessary in most of the experiments (table 1). As shown by the average yields, phosphorus alone increased yields 2.2

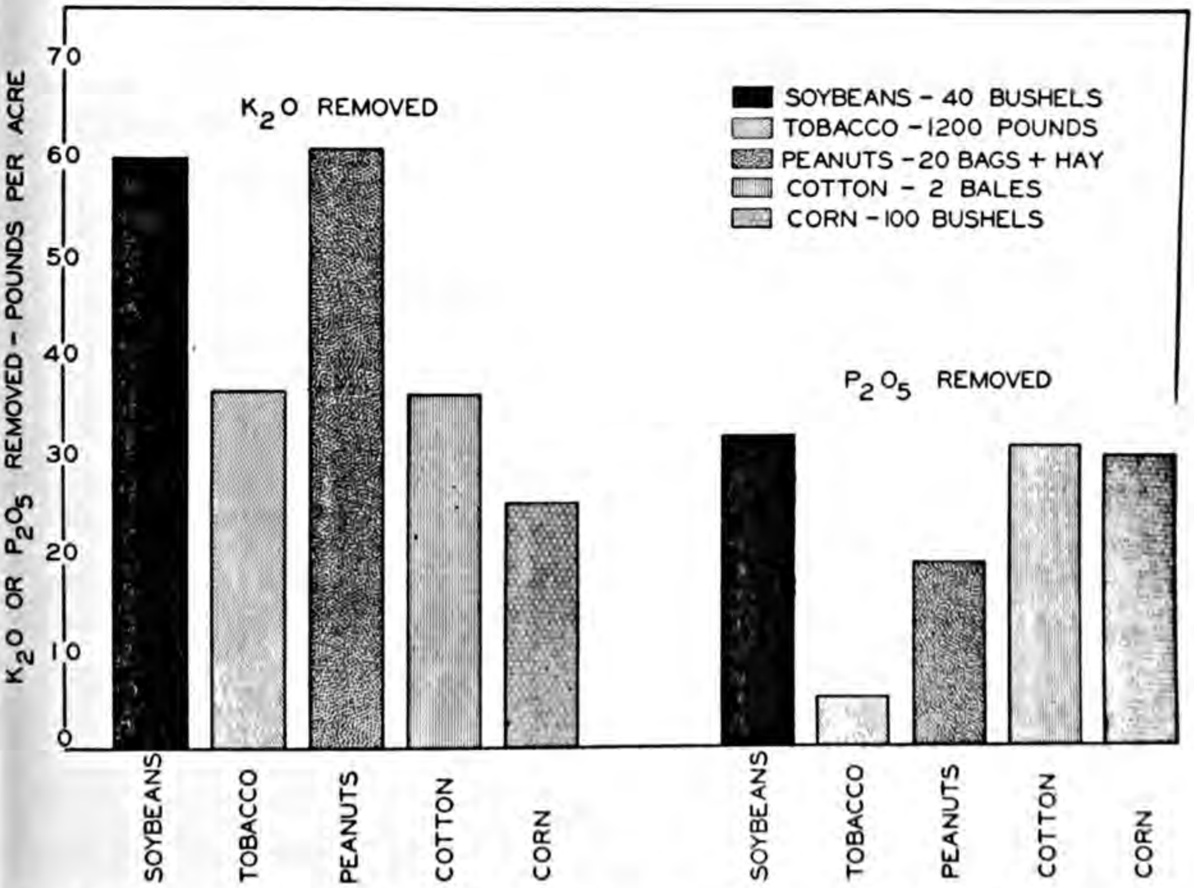

Fig. 2. Soybeans require phosphorus and potash just like other crops. (K_2O and P_2O_5 removed in harvested portion.)

TABLE 1. YIELD RESPONSE FROM LIME AND FERTILIZER ON OGDEN SOYBEANS

County	Soil Type	No Lime		1 Ton Lime[1]				Least significant difference (.05)
		No fertilizer	400 lbs. 0–10–20	No fertilizer	200 lbs. 0–20–0	160 lbs. 0–0–50	400 lbs. 0–10–20	
		Bu/A	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A
1. Edgecombe (Whitehurst)	Norfolk loamy fine sand	5.0	22.1	2.6	4.9	19.8	31.9	2.0
2. Edgecombe (Satterthwaite)	Wickham sandy loam[2]	18.7	17.8	16.0	20.9	19.3	22.6	1.9
3. Halifax (Garner)	Norfolk sandy loam	29.0	31.3	32.5	31.9	32.4	39.3	2.8
4. Halifax (Pierce)	Wickham sandy loam	25.7	26.8	30.1	29.9	30.8	31.6	2.7
5. Jones (Duval)	Craven very fine sandy loam	25.3	27.8	22.8	26.0	26.7	33.1	1.8
6. Beaufort (Slack)	Portsmouth sandy loam	18.2	33.2	22.4	21.9	32.6	33.3	2.2
7. Beaufort (Bragg)	Portsmouth sandy loam	11.3	17.4	21.6	30.9	24.4	31.5	1.8
8. Duplin (Wells)	Dunbar fine sandy loam	22.5	22.4	32.8	34.2	37.7	37.7	1.8
9. Pasquotank (Harris)	Elkton silt loam	42.4	46.3	42.0	42.1	44.1	48.3	2.7
AVERAGE YIELDS		22.0	27.2	24.8	27.0	29.7	34.4	
Increase for treatment		....	5.2	2.8	5.0	7.7	12.4	

[1] Two tons lime on experiment No. 7.
[2] Very dry.

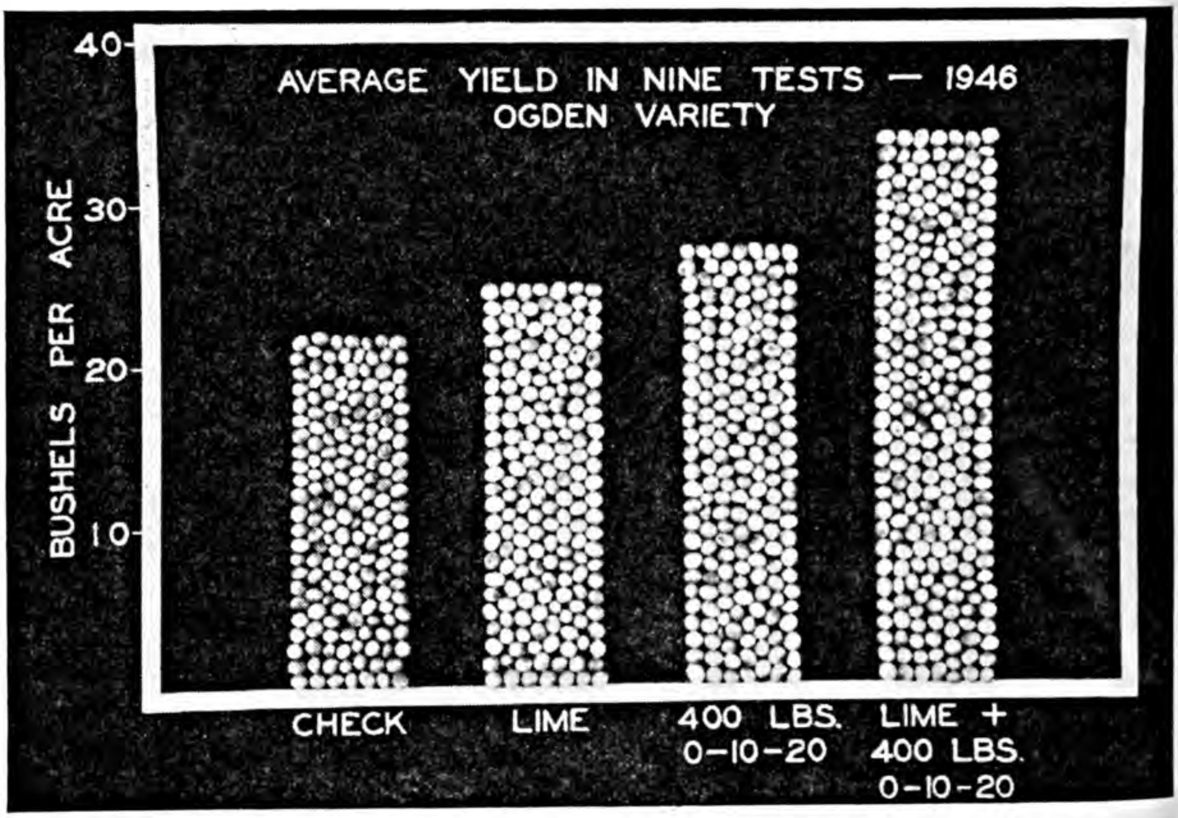

Fig. 3. Lime and fertilization with 400 pounds 0-10-20 per acre increased the yields of soybeans to 34 bushels per acre. (Average of nine experiments in 1946.)

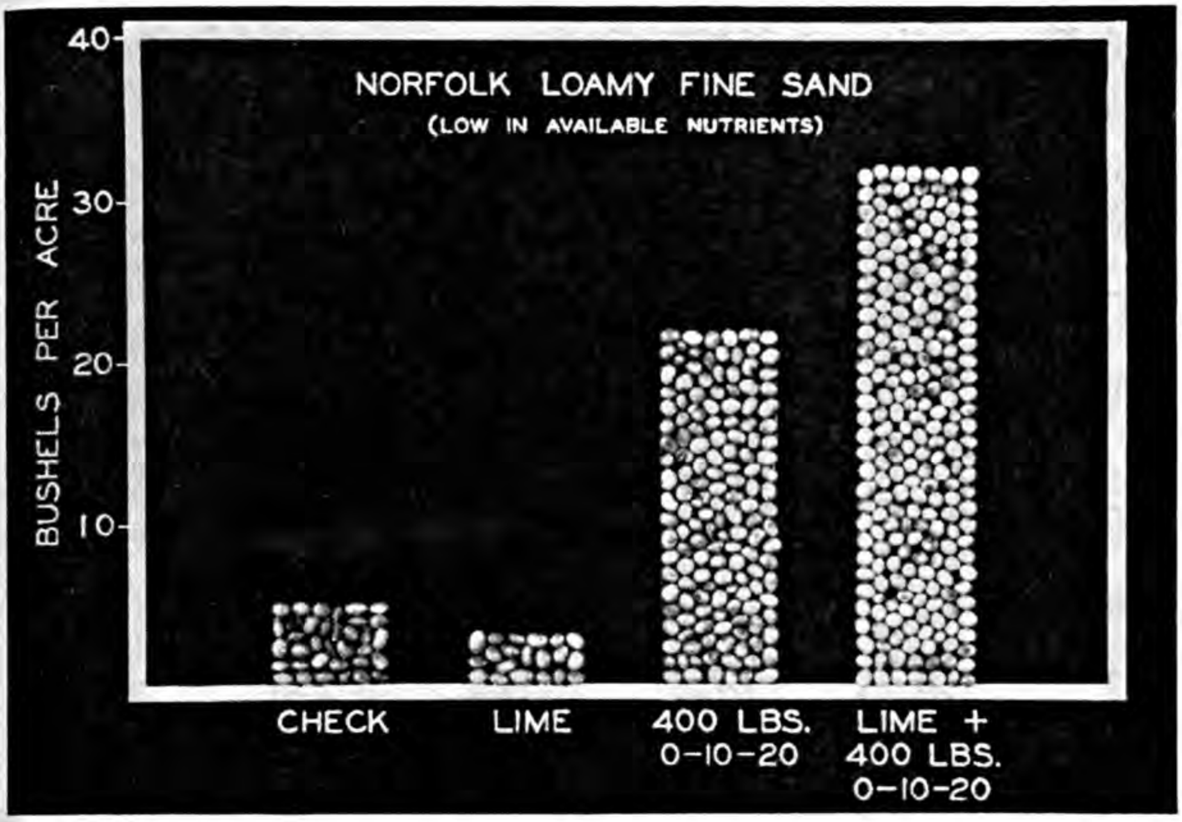

Fig. 4. Soybean yields were increased from 5 bushels per acre on the check plot to 32 bushels when lime and fertilizer were applied on this infertile Norfolk loamy fine sand. (Same location is shown in Fig. 1.)

bushels, and potash alone, 4.9 bushels; but both of them together increased yields 9.6 bushels.

The response of soybeans to applications of lime, phosphorus, and potash on any particular soil is of course related to the amounts of nutrients in that soil. The soil analyses are given in table 2. At location No. 6 there was no response to dolomitic limestone. The soil at this location contained the highest amounts of calcium and magnesium. In general, the greater the amount of phosphorus and potash in these soils, the less the yield response of soybeans to applications of these nutrients. Other environmental factors complicate this relationship, however.

Soils now producing very low yields will produce well if treated properly. For example, in the experiment in Edgecombe County on a Norfolk loamy fine sand very low in plant nutrients, particularly potash, a yield of 5.0 bushels per acre was obtained with no fertilizer or lime (fig. 4). With lime and fertilizer, 31.9 bushels were produced. The quality of the beans was also much improved by the lime and fertilizer. Past results have shown that this effect on quality is due principally to the potash.

In the experiment in Pasquotank County on Elkton silt loam, a yield of 42.0 bushels was obtained with no lime or fertilizer (fig. 5). Ordinarily it would be thought that with a yield such as this there would be no response from additional nutrients. When lime and 400 pounds of 0-10-20 were applied, however, a yield of 48.3 bushels per acre resulted. This soil contained the highest amounts of exchangeable potash and available phosphorus.

The returns in dollars from the average yields of soybeans in the experiments are given in figure 6. The greatest opportunity for profit comes with adequate liming and fertilization. The returns on Portsmouth sandy loam (Bragg) are shown in figure 7. With no treatment, this soil yielded 11.3 bushels or very close to the State average. With lime and fertilizer, the yield

TABLE 2. SOIL ANALYSES IN SOYBEAN TESTS

Experiment No.	pH	m.e. per 100 gm.				Sol.P ppm
		Ex. Cap.	Ex. Ca	Ex. Mg	Ex. K	
1..........	5.83	2.0	0.75	0.28	0.025	37
2..........	5.67	2.0	0.59	0.20	0.030	37
3..........	6.15	1.3	0.58	0.35	0.057	36
4..........	5.87	1.5	0.69	0.20	0.025	65
5..........	5.50	3.6	0.73	0.29	0.080	32
6..........	5.63	11.6	3.27	1.04	0.029	22
7..........	5.15	11.0	1.14	0.30	0.037	24
8..........	5.2	7.2	2.02	0.51	0.10	33
9..........	5.2	9.1	1.41	0.27	0.18	72

was nearly tripled and a net return of $47.35 per acre was obtained.

Deficiency Symptoms

Symptoms of starvation for plant nutrients, particularly potash, are common on soybeans. When these signs appear it is not too difficult to convince the soybean grower to apply what is needed. Unfortunately, for every acre of soybeans that shows these outward signs of deficiency there are many other acres that have no visible deficiency symptoms but nevertheless are suffering from want of plant nutrients. An example of this is in the Duplin County experiment in which there were no visible deficiency symptoms or even growth responses at any time during the active growing season. The untreated beans, however, yielded 22.5 bushels per acre while lime and fertilizer increased the yields to 37.7 bushels. In most of the 1946 experiments there were no definite recognizable symptoms of deficiency.

If soybeans are grown on a deficient soil, fertilizer must be added in order to get a good crop. On the other hand, if soybeans are grown on a soil well supplied with nutrients, reasonably high initial yields may be obtained. However, the continued growing of soybeans on such a soil without additions of fertilizer will eventually deplete the soil and unprofitable yields of soybeans will result.

Hence, the safest practice for the

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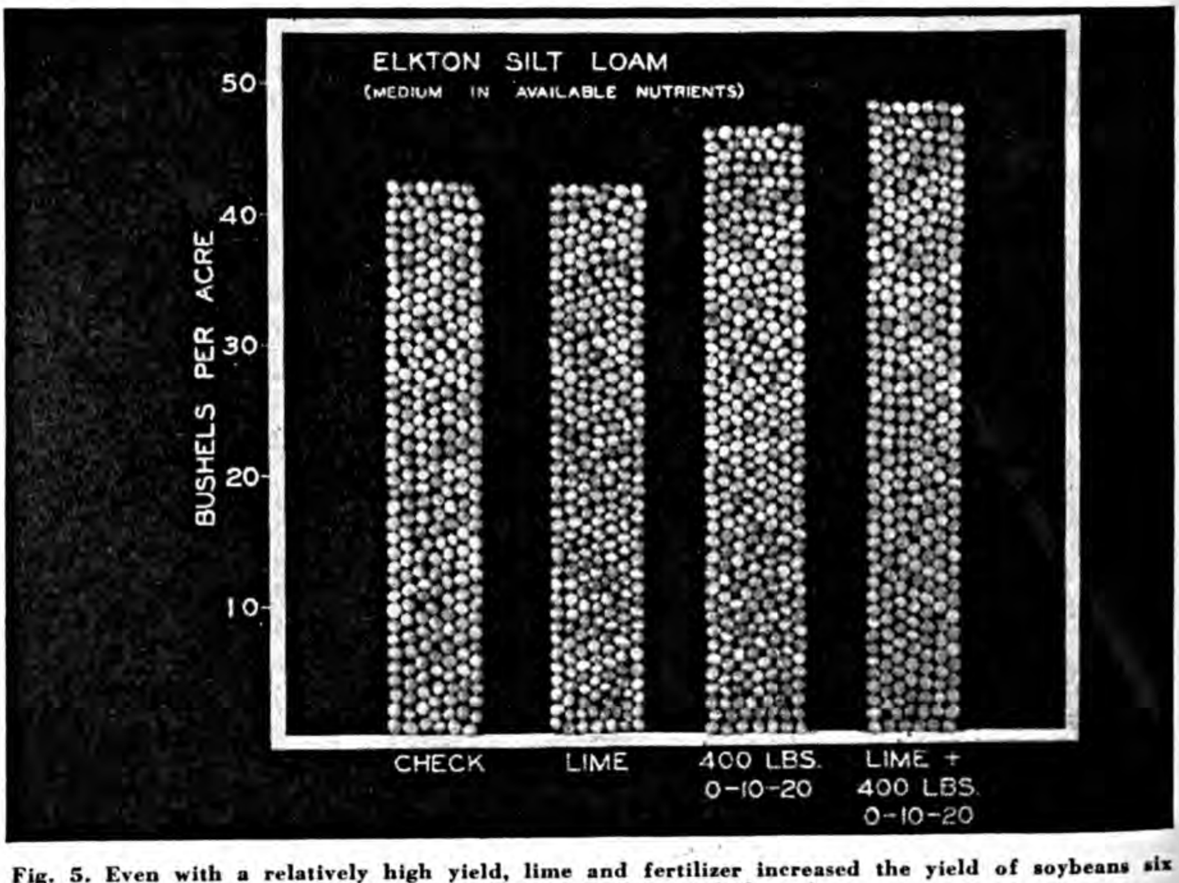

Fig. 5. Even with a relatively high yield, lime and fertilizer increased the yield of soybeans six bushels per acre. (Elkton silt loam.)

Fig. 1. Grassland farming, started nearly 30 years ago by Mr. Wheelock, is now being continued by his son, Wilder, Jr. This year the Wheelocks plan to start reclaiming over 20 acres of marshlands.

The Wheelocks of Vermont Grow Grass

By Jack Spaven

Extension Service, University of Vermont, Burlington, Vermont

A PAIR of ice-skates, an early spring thaw, and a neighbor's cornfield all played a part in convincing Wilder Wheelock, Vermont dairyman, that grassland farming pays off in greenbacks.

It was nearly 30 years ago, long before soil conservation as we know it had started, that Mr. Wheelock noticed the results of the plow. He had taken one of his youngsters down to the farm pond for an hour of ice-skating. The skates were never used, however, because the ice on the pond was covered with a generous layer of rich topsoil eroded from his neighbor's cornfield.

There goes part of Jim Dykes' farm, he thought. The same thing is happening to my land. The rains, spring thaws, and floods are stealing the best soil on these farms. In the spring his cornfield was seeded to grass. After that the Wheelocks' plow stood idle. As the dust on the plow thickened, so did the Wheelock's faith in grassland farming grow.

Today not one of the 180 acres is turned by the plow. The farm is in permanent pastures and haylands. What are the results? Mighty good, say the

Wheelocks, and their farm account books prove it.

Last year they produced 10 pounds of milk for every pound of grain bought. In other words, the 30 milking cows produced 200,000 pounds of milk and only 10 tons of grain were bought. This year they hope to stretch the ratio to 12 pounds of milk from each pound of grain—an unusually high goal, but right now it looks as though they will make that figure.

The elder Mr. Wheelock and his son, Wilder, Jr., keep about 30 milking cows and 20 head of young stock on what they call their "mineralized hay."

"We use plant food and plenty of it," they say, "and the results speak for themselves."

An example of the potency of this so-called "mineralized hay" is shown by the fact that recently the Wheelocks sold 15 tons of hay to a neighbor who milks 60 head of dairy cows. In a few days, the neighbor's milk production jumped 200 pounds a day.

Hay and grass ensilage samples tested at the Agronomy Department of the University of Vermont and State Agricultural College show that they are exceptionally high in protein. Tested on a dry-matter basis, the samples rated about four per cent digestible protein, which makes it good feed.

The Wheelocks use a good supply of lime, superphosphate, complete fertilizers, and some straight nitrogen.

"We always leave check plots in our pastures and meadows, small plots where no fertilizer is used. It makes us feel as though we are getting more than our money's worth when we can see the difference between the check strips and the fertilized pastures and haylands," points out Wilder, Jr.

"We raise our crop of grass just as we would potatoes, corn, or grain. Even in a dairy state like Vermont, too many farmers use their poorest land for pastures and do not do anything to keep the pastures in high production. We find that grassland farming is much easier than growing corn and other crops. Our labor needs are reduced, we spend less on machinery, and we can harvest our ensilage in spite of the weather. If some farmers would take part of the money they put in big grain bills, invest it in fertilizers, and concentrate more on growing better grass, they'd be further along than they

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Fig. 2. This early hay crop was used as grass ensilage. The Wheelocks are known throughout Vermont for their "mineralized hay."

Fig. 1. Soil conservation began to spread fast in the Fork Shoals Road community after District Supervisor S. B. Huff called this meeting of his neighbors at his home.

Community Cooperation in Soil Conservation

By James H. Talbert

District Conservationist, Spartanburg, South Carolina

SOIL conservation builds community action, and community cooperation speeds soil conservation. I've seen it working both ways in the three South Carolina Piedmont soil conservation districts which I serve as a district conservationist for the Soil Conservation Service.

So successful has been the group approach to soil conservation in one community in each of the three districts that hundreds of farmers, agricultural leaders, and many visitors from foreign countries have gone to the communities during the past year to see the results for themselves.

Then William A. Townes, publisher of the Spartanburg, South Carolina, *Herald-Journal*, heard about the communities, studied them, and liked the idea so well that he wanted to encourage other communities to use the same methods of saving and building their lands. To do that, his newspapers offered $7,248 in equipment prizes to groups of farmers in a two-year soil conservation contest in cooperation with district supervisors. Several weeks before contest entries closed, 72 different groups of 10 to 20 farmers in three districts joined the competition.

But that is getting ahead of this story.

Let's go back to the beginning in February 1944.

At that time the supervisors of the Broad River Soil Conservation District, covering Union, Spartanburg, and Cherokee Counties, invited the supervisors of the Greenville and Laurens Districts and agricultural workers to meet with them to discuss ways to speed soil conservation work. E. C. McArthur, a supervisor of the Broad River District and now President of the National Association of Soil Conservation District Governing Bodies, proposed that each district assist farmers on a community basis to establish a pattern of conservation farming. This pattern, he explained, would serve as a "show window" to encourage other groups of farmers.

S. B. Huff of the Greenville District reported that his own community of Fork Shoals Road already had done some mighty fine soil conservation work and that he would like for the other supervisors to see it.

In May when the contour strips of ripening grain and young cotton and corn were making a beautiful pattern of soil conservation, the three boards of supervisors, Soil Conservation Service technicians, county agents, and vocational agriculture teachers went to the Fork Shoals Road community in Greenville District. There they found 40 different farms grouped closely together where practices had been carefully planned and applied to fit the land and improve the soil. They visited the farms of Supervisor Huff and of W. M. Kellett. On each of these farms, the owner and Soil Conservation Service Technician H. Granade explained the district farm plan and pointed out the changes in land use and the various types of treatment applied.

Huff explained how it came about: "A few farmers, including Mrs. Nelle K. Hopkins, W. M. Kellett, and I had a pretty fair soil conservation program started on our farms as a result of help from the Soil Conservation Service CCC Camp. When we farmers organized our soil conservation district in 1940, I was elected a supervisor. Hugh Dowdle, who was our District Conservationist then, and Granade talked to me about inviting my neighbors to my

Fig. 2. Here is the new soil conservation pattern on the farm of Mrs. Nelle K. Hopkins, one of the first Fork Shoals Road farm-owners to make the change with help from the Greenville Soil Conservation District.

house to hear the district program explained and to study the practices on my own farm. We had this meeting in May 1940 with 15 farmers present and decided to have another meeting on an unplanned farm for the purpose of planning it together. After this second meeting, all the group had a pretty good knowledge of a soil conservation district plan. This started the ball rolling, and now we are proud to say that we have 40 farmers in this one community cooperating with our district."

All the supervisors went home convinced of the need of having at least one community to serve as a "show window."

Midway Community in Cherokee County was chosen by the Broad River Board, Hopewell by the Laurens Board, and, quite naturally, Fork Shoals Road was selected by the Greenville District Supervisors.

Further Organization

The next step was for the supervisors of each district to invite farmers from the selected community to a meeting where they explained the plan and offered all the assistance available from the district in helping them to get this new pattern of conservation applied on a community basis as rapidly as possible. Supervisors and farmers discussed what soil conservation farming would mean to the community and to each individual.

In every case, the farmers voted to start a community soil conservation program. Each group elected its own leader: C. F. Swofford in Midway, W. P. Dickson in Hopewell, and Drayton Hopkins, son of Mrs. Nelle K. Hopkins, in Fork Shoals Road.

After they had formed their own organizations, 26 farmers in Midway, 30 in Hopewell, and 35 additional farmers in the Fork Shoals Road community applied to their district supervisors for farm conservation plans. In each community the Soil Conservation Service technician kept in close contact with the community leader and helped him to determine the need for various types of meetings. Both the Hopewell and Midway groups visited the farmers in Fork Shoals Road to see first hand the pattern of conservation farming there. Soon there was rivalry among the groups to see which could make the best record. In each community, the leader called meetings where representatives of various agricultural agencies discussed different soil conservation practices, showed slides and motion pictures, and explained the meaning of a complete soil conservation farm plan. Within a short while every farmer had made a plan with help from the technician and the plan was going on the ground.

Farmers were encouraged by the praise they received from leading business men, including newspaper editors, bankers, farm machinery dealers, and others. For example, the Campbell Limestone Company of Gaffney and the Production Credit Association of Clinton each published a half-page advertisement in local papers congratulating the farmers in these communities. Soon many visitors began going to each community.

In 1945, a group of farm magazine editors visited the Hopewell and Fork Shoals Road groups. One of the editors asked a farmer what had happened to bring about all the soil conservation farming he'd seen. The farmer's answer was "A 'Granade' burst in this community"—meaning, of course, H. Granade, the technician.

In Fork Shoals Road W. M. Kellet's store is the meeting place for farmers in the community. This rural store owner sells soil conservation with practically every bill of groceries. Let Mr. Kellett tell the story from the beginning:

"I used to run a lot of terrace lines for my neighbors. One of them is Mrs. Nelle K. Hopkins, who is a widow. Nearly every winter I would run terrace lines, and the tenants on

Fig. 3. M. W. Goforth, leader of the High Point conservation group in Cherokee County of the Broad River District, and I. B. Webber, SCS technician, discuss conservation farm planning. Mr. Goforth then helped to take this information to the members of his group participating in the Herald-Journal district contest.

her farm would throw up little ridges. By the time winter came around again, these little ridges would be broken. Finally I told Mrs. Hopkins—'your farm is gone—it's just washed away.'

"I don't know how Mrs. Hopkins heard about Granade, but one day she had him out there on her farm making a soil conservation plan.

"The first real difference I noticed on the Hopkins farm was when they put a big machine into the fields and built some real terraces. Kudzu was planted in the swags where the terraces ended. They ran the rows with the terraces. Then they planted the fields in strips of small grain and strips of row crops like cotton or corn. I noticed there was a lot less cotton and a lot more small grain on the farm, and the small grain was overseeded with lespedeza.

"I didn't know this fellow Granade, but I went to Greenville and looked him up. About all I could think of at the time was a bale of cotton, and I was scared to death that the plan we made would cut me out of a bale of cotton. I was growing 40 or 45 acres of cotton every year, making 24 or 25 bales. The rest of my fields were in corn and a little bit of small grain.

"My soil conservation plan called for about 25 acres of cotton, and the rest in small grain overseeded with lespedeza.

"I was still thinkinig about a bale of cotton, and I didn't follow the plan very closely the first two or three years. I did just enough of it to keep Granade helping me. Pretty soon my cotton yields began to go up, and I kept on cutting down the land in cotton. Last year we harvested 28 bales on 25 acres, and we had grain and lespedeza extra. That was more cotton than I used to make on 40 or 45 acres.

"Well, you see that's just the way it went. Each farmer watched to see what the other farmer did, and it wasn't long until we organized a group so that we could help ourselves while the district helped us. And now we have 80 farms under soil conservation plan with the district, and most of these farms touch another farm in the group somewhere."

Other Examples of Success

Last summer Mr. Huff reported the increased yields on his farm when a group of Federal Land Bank officials visited him: Cotton from 300 to 400 pounds an acre, corn from 15 to 25 bushels, oats from 20 to 40 bushels, wheat from 15 to 25 bushels. These increases, he explained, were mainly due to good terraces and the rotation of small grain with lespedeza on the land in contour strips every other year. He added that he is now growing 15 acres of sericea and three acres of kudzu in draws where terraces empty and on steep areas. From the 40 acres of annual lespedeza he said he was getting a ton of hay to the acre, or 400 pounds of seed an acre. And he climaxed his report to the bank officials with this comment, "Gentlemen, your clients are going to have to practice soil conservation or you are going to have to go out of business."

Drayton Hopkins' records show these changes in crops grown, acreages, and yields:

As for strip-cropping, which is a new practice on the farm, Mr. Swofford commented: "It is not a question of liking it or not liking it. My purpose in farming is to make a living, and some money if possible, and at the same time protect my land. And if it takes strip-cropping to do it, that's what I am going to do."

	ACRES		ACRE YIELDS	
	Before	After	Before	After
Cotton	134	100	290 Lbs.	500 Lbs.
Corn	183	50	10 Bu.	30 Bu.
Oats	80	120	20 Bu.	75 Bu.
Wheat	7	20	10 Bu.	25 Bu.
Barley	None	20	None	40 Bu.
Annual lespedeza seed	None	140	None	500 Lbs.

Two new crops on this farm don't fit very well into a table, because of their multiple uses. Hopkins' 30 acres of sericea lespedeza produce a ton of hay and 300 pounds of seed an acre from 16 acres, and the other 14 acres are used for grazing. Fourteen of the 25 acres of kudzu produce two tons of hay an acre, and the remaining 11 acres are used for grazing.

Mr. Swofford, the Midway leader, has done an outstanding soil conservation job on his own farm and at the same time has helped his neighbors. He modestly tells visitors that he is now making 90 bales of cotton on 60 acres and explains it this way:

"I haven't used a turn plow in 15 years. Before I got a tractor and a scarifier last year, I used to cross break my land with a bull tongue plow. My reason for doing away with the turn plow was that I noticed where litter is left in the first inch or more of the soil, the land is soft like a new ground, and where I turned the litter under, the land was hard on top and didn't hold moisture as well. I also find that since using lespedeza and not turning my land, I have very little crabgrass because the lespedeza shades out the grass."

Visitors to Midway community always stop at the E. C. McArthur farm, which is probably among the best examples of soil conservation farming to be found anywhere. Every acre is being used properly and treated according to its needs. Assuming that anybody can see the program on the land, Mr. McArthur talks about the soil conservation district program while the visitors are looking. He always emphasizes the need for other communities in districts to get similar programs under way, and in every case he offers his assistance.

Agricultural workers are finding it easier to help more farmers each year when the farmers have formed their own organization, as Midway, Hopewell, and Fork Shoals Road have. Wayne LeMaster, Soil Conservation Service technician in Cherokee County since the beginning of the district program in 1937, said that it is easier now for him to assist 80 additional farmers each year than it used to be to work with 25 new farmers in a year.

Farmers in the Hopewell community, reported H. A. Ropp of the Laurens County Field Service Branch (AAA), earned 98.7 per cent of their 1945 AAA allotments as compared with the county average of 75.9 per cent. And he added that the Hopewell farmers were shooting for a perfect score in 1946; they signed up for practices which would earn 100 per cent of their allotment.

When W. P. Dickson, Hopewell leader, and Ryan Lawson, a district supervisor living in the community, call a meeting, they can be assured of a good attendance. Why? One farmer answered, "We know that it will be our own meeting and that we can speak as we please. We also know that we are going to get our favorite fish stew, or some other mighty good dish cooked by one or more of our own neighbors."

All these flowing reports of community success with soil conservation make it appear to be an easy job. But the accomplishments didn't happen by accident; they resulted from sound and careful planning by district supervisors and other farm leaders, from the cooperation of agricultural workers, from the community spirit developed by group action and from hard work on the part of individual farmers.

Not every man in each community was at first convinced of the need for either complete farm soil conservation or for group action. For example, a tenant farmer frankly told his neighbors at a meeting of the Fork Shoals Road Soil Conservation Club last summer: "I would like to say that I am sorry for the things that I have said against the soil conservation program. I would like to say here and now that I was wrong. Since carrying out these practices, it has been a great benefit to me and my family, making better yields and improving the land."

But the tenant who can see the better methods across the fence in most cases has been ready to team up before his landlord who lives at a great distance from the farm. For example, in Midway community there was a farm owned by a man living in California. He had held back until last summer when he visited in the community. Everywhere he turned he heard praise for soil conservation and good land use; more than that, he could see it. After a few days he went to the district su-

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Fig. 4. W. M. Kellett (left), who runs a country store and sells soil conservation with every bill of groceries, examines lespedeza in small grain stubble on the farm of his son, J. P. Kellett. They live in the Fork Shoals Road community and grow as much cotton as they used to harvest, but on half the land.

Fig. 1. Typical desert area before reclamation.

Corrective Measures for The Salinity Problem In Southwestern Soils

By W. T. McGeorge

Agricultural Experiment Station, University of Arizona, Tucson, Arizona

THE salinity problem met in the farming of Southwestern soils is one of major proportions in this section of the United States. Agricultural operations are confined largely to the alluvial valleys where the soils have been built up by rock debris eroded from the surrounding mountains. Except in the case of the large rivers, the waters which brought about this erosion either spread out in alluvial fans and went underground or deposited their salts in the soil by evaporation. In a semi-arid climate, such as exists in the Southwest, all virgin soils are therefore more or less saline and alkaline and must usually be reclaimed before cropping. Likewise, since rainfall and irrigation

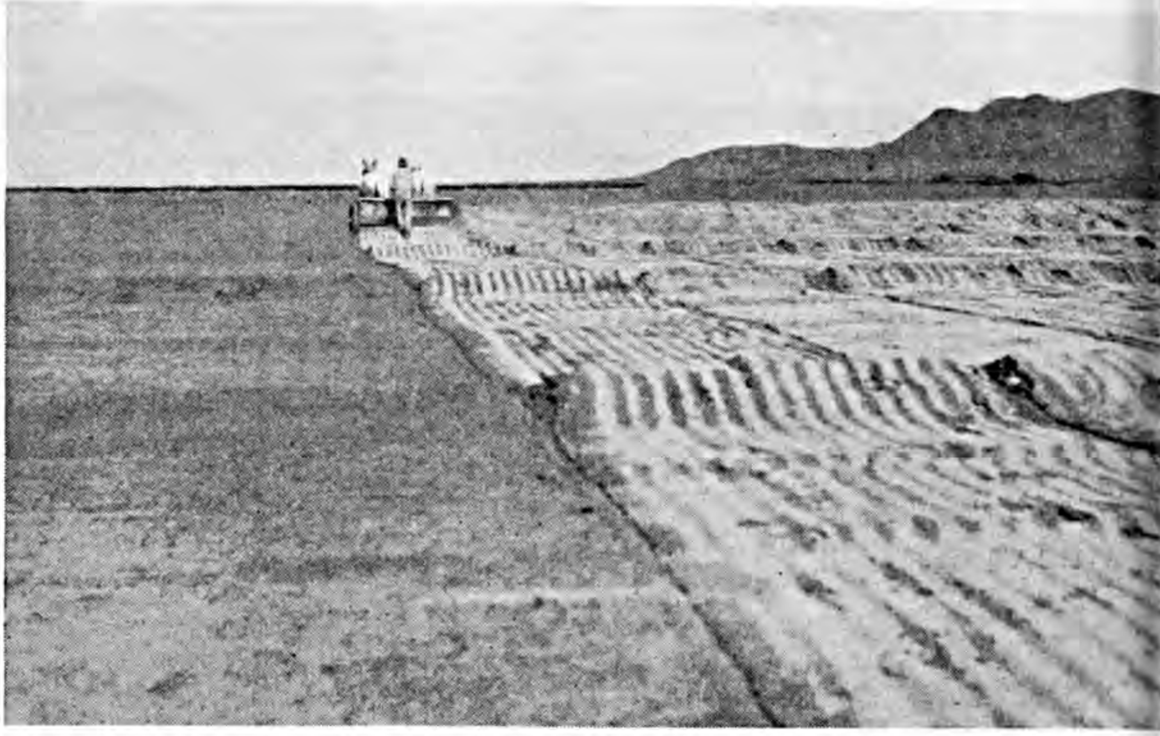

Fig. 2. Application of gypsum during reclamation.

add water to the soil under conditions where there is a high evaporation rate, salt accumulation will continue when these lands are put under irrigation unless a cultural program is adopted to control this hazard.

What Is Alkali?

As applied to semi-arid soils, the term alkali has no precise meaning for it covers too many conditions. Hilgard's early classification of alkali soils into white alkali and black alkali is still used by farmers. White alkali refers to the soils which contain an excess of neutral soluble salts, usually chlorides and sulphates. The term black alkali is applied to soils which contain an excess of sodium carbonate or adsorbed sodium. The former is identified in the field by an efflorescence of white salt and the latter by a black color of organic matter, humus being soluble in an alkaline soil solution. Recently in technical literature the terms saline and salinity have been used with reference to white alkali soils and the term alkali reserved only for those soils in which the pH is high enough to classify them as definitely alkaline.

Relation Between White and Blacl Alkali

At one time the white and blacl alkali soils were treated as totally dif ferent problem types more or less un related. Since both white and blacl alkali salts are soluble in water, recla mation was looked upon as a simpl leaching operation. The fact that som of these soils could not be made produc tive by simple leaching was noted bu could not be explained. Now we know the reason for these exceptions wa simply that sodium salts react with th clay minerals to form alkali mineral salts which are not soluble in water and, therefore, cannot be leached out of the soil. In brief, base exchange studies disclosed that white and black alkali types are closely related in that an excessive adsorption of sodium by the clay minerals, from white alkali salts, will produce a sodium clay mineral which readily hydrolyzes to sodium hydroxide and ultimately may change to sodium carbonate. From this it is obvious why such soils cannot be reclaimed by simple leaching. An excess of soluble calcium must be present in the soil if all alkali soils are to be successfully reclaimed by leaching and maintained in a permanently productive state.

Salinity-Alkali-Soil Relationships

Thanks to research in soil science we now have a thorough understanding and knowledge of the fundamentals regarding the formation of alkali soils, their reclamation, how to maintain them in a productive state, and finally the manner in which crop growth is affected by the chemical and physical properties which are characteristic of these soil types.

As already stated, saline and alkaline soils are closely related if sodium salts predominate in the soil solution or in the irrigation water being used. If the salines are calcium salts in major part, the salinity problem is a simple one. In these soils toxicity and high osmotic concentration of the soil solution are the only two undesirable conditions that can exist and these can be easily corrected by simple leaching. Calcium salts are strong flocculants and tend to maintain soils in a good physical condition. The troublesome alkaline or saline soils are almost entirely the soils in which an excessive adsorption of sodium, from the respective salts, has taken place. In rare cases soils are found in which an excessive adsorption of magnesium has occurred and, while these are not always alkaline, they have a poor structure.

When the adsorbing capacity of the clay minerals in the soil is in most part satisfied with sodium, the soil is classed as a black alkali soil even though an excess of white alkali may also be present. Practically all neutral salts are flocculants for the clay fraction of the soil. These salines can be washed out of the soil by simple leaching operations. But when these salines are present in excess in the soil, they tend to suppress the hydrolysis of sodium clay. Therefore when the salines are leached out, sodium hydroxide will be formed by hydrolysis, the soil colloids will swell and assume a gel-like structure, and the farmer is worse off than when the salines were present. This can be avoided by having soluble calcium salts present during leaching—a little matter of sodium:calcium ratio in the irrigation water, the soil solution, and the clay minerals.

Fig. 3. Leaching operation following the incorporation of gypsum in the soil.

Fig. 4. Showing capillary salt line on a cantaloupe bed. Planting is made below the salt line.

While it is true that the high pH characteristic of black alkali destroys the root tissue, this toxicity is not the major problem which alkaline soils present. That is, excessively alkaline soils must be reclaimed before any attempt is made to profitably crop them. It is the harmful effect of only traces of sodium carbonate or adsorbed sodium on the soil structure that is of greatest concern to the farmer who farms these alkaline lands. Such soils become dispersed and puddle easily, rate of water penetration is reduced, and the soils become water-logged. When water-logged, aeration is impaired and, in the absence of air, the bicarbonates change to normal carbonates with increases in pH. Under water-logged conditions, calcium carbonate, which is present in varying amounts in all these soils, may reach its full pH of 9.6. Root growth and therefore foraging activities are impaired because of the colloidal dispersion, structural deterioration, and high pH. Clay pan tends to form as the dispersed colloids elutriate downward and accumulate to form a dense subsoil horizon, and the micropopulation of the soil becomes largely anaerobic. In short, the soil becomes entirely unsuited for crop growth.

Salinity-Alkali-Plant Relationships

Before discussing some of the practical corrective measures employed in the husbandry of alkaline and saline soils, it may be advisable to discuss the ways in which the crop itself is affected by the salts. Briefly, these ways are nutritional, chemical, and physical.

Nutritionally both salinity and alkalinity, high pH, disturb the normal process of uptake and utilization of essential nutrient elements. Excessive salinity, which is usually accompanied by an excessive uptake of sodium, chloride, and sulphate ions, is definitely toxic. This toxicity is progressive depending upon the degree of severity—marginal burning of the leaves, defoliation, and complete collapse may be mentioned as three major degrees of severity. Alkalinity, high pH, affects the plant somewhat differently. Most crops feed best in soils which have pH values that closely approximate neutrality, pH 7.0 $\pm$ 0.5. Within this pH

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Higher Corn Yields For Alabama

By L. O. Brackeen

Agriculture Extension Service, Auburn, Alabama

CORN is Alabama's biggest crop and her farmers are finding that per-acre yields can be much bigger.

During 1946, hybrid corn came more into the spotlight. Alabama test demonstration farmers made yields ranging from 30 to 131 bushels per acre, the majority making 60 to 80 bushels, on more than 400 farms scattered over the State. These crops were planted on land formerly producing only 15 to 25 bushels of open-pollinated corn.

From these tests farmers realize that corn yields can be doubled and tripled by use of more fertilizer, winter legumes, crop rotations, better varieties, and by planting on better land at the right time.

Three Alabama farmers who followed these practices in 1946 are J. P. Hannon, G. A. Swearingen, and A. D. Ray of Shorter, Alabama. They produced an average of 61.4 bushels of corn per acre on 113 acres. If all Macon County farmers had used the same method in producing their corn last year, the County's corn production would have been increased about 2½ million bushels, according to the estimates of M. F. Whatley, County Agent. With corn selling at $1.50 per bushel, the increase in corn income would have been $3,750,000.

Never before have Alabama farmers throughout the State showed such fine interest in doing a better job of growing corn as they are showing this year. Last year corn projects were carried out with the purpose of fully utilizing findings of the Alabama Experiment Station's exhaustive research on corn.

Results from experiments conducted at the Station located in Auburn show that if corn does not follow a good crop of winter legumes or well-fertilized cotton, an application of 200 to 300 pounds of 4-10-4 or 4-10-7 per acre should be made at planting time. Also it should be side-dressed with an application of nitrogen equivalent to 150 to 225 pounds of nitrate of soda, 120 to 180 pounds of ammonium sulphate, or 75 to 115 pounds of ammonium nitrate per acre.

If corn follows a good crop of winter legumes, the Station recommends that no additional fertilizer be used. If it follows well-fertilized cotton or other crop, only a side-dressing of nitrogen is recommended.

When a hybrid is planted, it is recommended that it be spaced more thickly than open-pollinated varieties. A suggested spacing for hybrids is 15 to 24 inches apart in the row with rows 3½ feet apart.

The Station has conducted a number of tests with high rates of fertilizer and different hybrids and varieties. The results of these tests are not conclusive. However, they do indicate that spacing 12 to 18 inches apart in the row and high rates of fertilizer are essential for larger yields of corn. Thick spacing is very important for the early maturing hybrids.

These facts found by the Experiment Station and supplied to the farmer by the Extension Service, Alabama Polytechnic Institute, created so great an interest in corn that 400 demonstrations using high-fertilizer and thick spacing resulted last year. It is now estimated that 2,300 adult and 4-H corn demonstrations will take place in 1947 compared with only 400 last year.

All demonstration plots are one acre or more. Experiment Station recommendations were used by the demonstrators. The amount of fertilizer used was 600 pounds of one of the following: 4-10-7, 4-10-4, or 6-8-4, depending on condition of soil at time of planting. Four hundred pounds of nitrate of soda or equivalent nitrogen from other sources were used 35 to 40 days after planting. Corn was planted 18 inches apart in 42-inch rows. One of the following hybrids was used: Funk's G-714, Tennessee 10, Louisiana 1030 and 1031, Florida W-1, or Pfiester and U. S. 13 in north Alabama. Most demonstrators using an open-pollinated variety planted either Mosby, Douthit, or Neal's Paymaster.

To show how a few of the Alabama farmers succeeded in a big way in growing more corn per acre last year, J. C. Lowery, API agronomist, gives the following facts:

In Walker County, Frank Estes produced 101 bushels per acre by growing pure Graham's Mosby corn and fertilizing with a complete fertilizer mixture and side-dressing with a heavy application of nitrate of soda.

C. S. Gatlin, Rt. 2, Ardmore, Limestone County, produced over 100 bushels of corn per acre. He planted the corn 16 inches apart in 3½-foot rows, applied 400 pounds of 4-10-7 fertilizer, planted Tennessee 15 hybrid corn, and side-dressed it with 200 pounds of ammonium nitrate.

John B. Moore, another farmer of Elkmont, Rt. 1, Limestone County, made over 100 bushels of corn per acre by applying 500 pounds of 4-10-7 fertilizer, planting Tennessee 10 hybrid, and side-dressing with 100 pounds of ammonium nitrate.

Jack Butler, a graduate of Alabama Polytechnic Institute, Auburn, and now a farmer in Fayette County, produced 922 bushels of corn on 14 acres, averaging 67 bushels per acre. Part of the field made as high as 96 bushels per acre.

Melville Sledge made 95 bushels of corn per acre in his corn production demonstration carried out on Black Belt soil in Hale County. Sledge used 600 pounds of 4-10-7 and planted a hybrid, Funk's G-714, on April 16. He side-dressed May 20 with 400 pounds nitrate of soda per acre.

In Winston County, H. E. McNutt averaged 91.2 bushels per acre on six acres. He applied 500 pounds of 4-10-7, planted his corn April 20, and side-dressed on June 1 with 175 pounds of ammonium nitrate. His land had been built up for several years by growing and turning vetch and crimson clover.

Other Winston farmers reporting high yields included W. R. Jones, J. N. Bailey, and H. L. Wilson, all of whom planted Funk's G-714 between May 1 and May 15. They used a complete fertilizer and side-dressed with nitrate of soda.

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Bennett Owen, Rt. 2, Enterprise, a 4-H Club member, in his one acre of hybrid corn. This Chilton County boy used 500 pounds of 4-10-7 and 500 pounds of nitrate of soda. Planting date was May 1. The hybrid corn was plowed three times.

Determining New and Better Fertilizer Ratios[1]

By A. C. Caldwell

Division of Soils, University of Minnesota, St. Paul, Minnesota

THE question has sometimes been asked, are the present fertilizer ratios meeting the needs of the soils and crops of today? It seems, upon investigation, that many of the present fertilizer ratios, like Topsy, "just grew," and it is difficult to find the scientific basis upon which many common ratios are formulated. In Minnesota, for example, the following fertilizer grades, among others, have been used on corn: 0-20-20, 0-20-10, 0-20-0, 4-24-12, 3-12-12, and 2-12-6.

Unquestionably, there are areas and farms on which any one grade would be found to be most suitable, but very often these fertilizers have been bought on price and availability of supply mainly, with not sufficient regard to soil type, past management, present cropping practices, soil conditions, and other factors which would appear to be important considerations in using fertilizers.

It is manifestly impossible to fashion a fertilizer which would be exactly right for each individual farm, or even small areas. However, it should be possible to suggest fertilizer ratios which would be more adaptable to crop needs, soil type, and cropping history than some which are in common use today. It was with these considerations in mind that a start was made in 1944 on determining suitable fertilizer ratios for corn on some of the soils of southern Minnesota.[2]

Factorial Plot Design

The problem was how best to determine the proper ratios for corn. While it might be suspected that some kind of a complete fertilizer would be found to be most suitable, it was thought that it might prove interesting to investigate the effects of individual nutrients and combinations of nutrients and their interactions, and to measure the relative importance of the major plant-food elements, nitrogen, phosphate, and potash. The general class of experiment known as "factorials" provides a plot set-up designed to facilitate the procurement of answers to the questions just mentioned.

R. A. Fisher (1) and F. Yates (2) have worked out plot designs and statistical analyses for a large number of types of factorial designs. The one selected for this study was a 3x3x3 design in which three fertilizers were used—nitrogen, phosphate, and potash—at three levels, in all possible combinations, yielding in all 27 different fertilizer combinations. This design was modified somewhat by what the statisticians call "confounding," a process in which the plots are so arranged that precision of estimating complicated effects is sacrificed in order to enhance the precision with which the main effects can be estimated.

An example of a ratio or two might help those who are not too familiar with statistical analysis to understand the scheme a little better. One fertilizer combination used was $N_0P_1K_2$ which represents a combination of no

[1] Paper No. 2331 of the miscellaneous journal series, Minnesota Agricultural Experiment Station, St. Paul 1, Minnesota.

[2] This investigation is supported by funds provided by the Hormel Institute, Austin, Minnesota.

TABLE 1. TREATMENTS AND RATIOS OF FERTILIZERS, AND YIELD AND MOISTURE CONTENT OF CORN IN A 3x3x3 FACTORIAL EXPERIMENT ON SIX FIELDS.

Plot number		Treatments Pounds plant food*			Fertilizer yield**		Increase	Moisture content	Increase or decrease
		Nitrogen	Phosphate	Potash	Ratio	Bu/Ac	Bu/Ac	%	
25......	$N_2P_2K_1$	32	64	32	1-2-1	68.8	18.1	38.3	−4.2
26......	$N_2P_1K_2$	32	32	64	1-1-2	68.2	17.5	39.1	−3.4
27......	$N_2P_2K_2$	32	64	64	1-2-2	68.2	17.5	38.2	−4.3
18......	$N_1P_2K_2$	16	64	64	1-4-4	65.7	15.0	39.3	−3.2
16......	$N_1P_2K_1$	16	64	32	1-4-2	65.3	14.6	39.3	−3.2
17......	$N_1P_1K_2$	16	32	64	1-2-4	65.0	14.3	39.4	−3.1
24......	$N_1P_1K_1$	32	32	32	1-1-1	64.2	13.5	39.7	−2.8
9......	$N_0P_2K_2$	0	64	64	0-1-1	63.2	12.5	39.3	−3.2
15......	$N_1P_1K_1$	16	32	32	1-2-2	62.7	12.0	39.9	−2.6
7......	$N_0P_2K_1$	0	64	32	0-2-1	61.7	11.0	39.9	−2.6
21......	$N_1P_2K_0$	32	64	0	1-2-0	59.6	8.9	39.1	−3.4
8......	$N_0P_1K_2$	0	32	64	0-1-2	59.6	8.9	40.7	−1.8
6......	$N_0P_1K_1$	0	32	32	0-1-1	58.6	7.9	41.3	−1.2
20......	$N_1P_1K_0$	32	32	0	1-1-0	58.4	7.7	39.1	−3.4
3......	$N_0P_2K_0$	0	64	0	0-1-0	57.6	6.9	39.7	−2.8
11......	$N_1P_1K_0$	16	32	0	1-2-0	57.3	6.6	39.6	−2.9
12......	$N_1P_2K_0$	16	64	0	1-4-0	57.1	6.4	40.2	−2.3
4......	$N_0P_0K_1$	0	0	32	0-0-1	55.5	4.8	42.4	−0.1
23......	$N_2P_0K_2$	32	0	64	1-0-2	55.5	4.8	43.2	+0.7
22......	$N_2P_0K_1$	32	0	32	1-0-1	55.4	4.7	43.6	+1.1
2......	$N_0P_1K_0$	0	32	0	0-1-0	54.9	4.2	40.0	−2.5
13......	$N_1P_0K_1$	16	0	32	1-0-2	53.8	3.1	42.6	+0.1
14......	$N_1P_0K_2$	16	0	64	1-0-4	53.5	2.8	44.4	+1.9
5......	$N_0P_0K_2$	0	0	64	0-0-1	53.4	2.7	43.0	+0.5
10......	$N_1P_0K_0$	16	0	0	1-0-0	52.2	1.5	42.8	+0.3
1......	$N_0P_0K_0$	0	0	0	0-0-0	50.7	....	42.5	....
19......	$N_2P_0K_0$	32	0	0	1-0-0	50.1	−0.6	43.4	+0.9

* Pounds plant food per acre applied in hill at planting time.
** Yield based on 15.5 per cent moisture.

nitrogen, phosphate at one level, and potash at a second level. The ratio $N_2P_2K_1$ would be a combination of nitrogen, phosphate, and potash at levels indicated by the subscripts. The levels, or in other words, rates, of individual nutrients can be chosen arbitrarily, and they need have no relation to one another. In this study nitrogen at the "one" level (N_1) meant an application of 16 pounds of nitrogen per acre; P_1 indicated 32 pounds of phosphate, and K_1 was 32 pounds of potash per acre; N_2 meant 32 pounds of nitrogen, P_2 was 64 pounds of phosphate, and K_2 denoted 64 pounds of potash per acre. $N_0P_0K_0$ indicated no fertilizer at all, of course.

Soil Types Investigated

This type of experimental design was used in quadruplicate on each of three farms in 1944 and 1945. The soil types on which these plots were placed was a Rockton silt loam, which consists of up to three feet of Iowan till over limestone, and Carrington silt loam, also formed on Iowan till. Both are black prairie soils. Tests indicated that these soils were quite acid in reaction, around pH 5 in the top foot. The nitrogen content varied around 0.2 per cent, and quick tests showed phosphate to be low generally and potash low to medium.

The corn was planted and fertilized by hand-operated machines. Plots were thinned to a uniform stand, and hills with the same number of stalks were harvested.

Yields and Moisture Contents

While soil types and past history varied in the six fields (three in each

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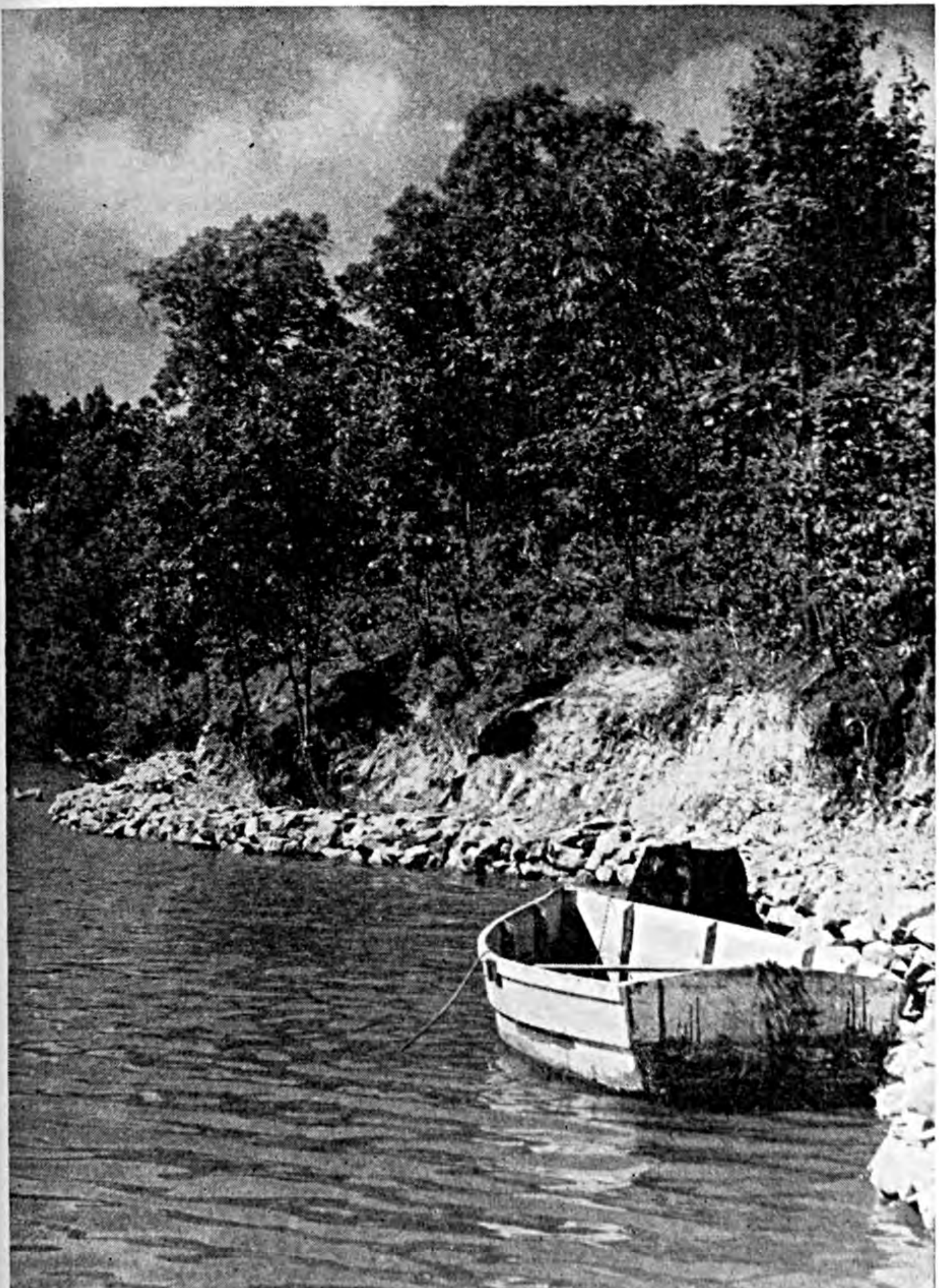
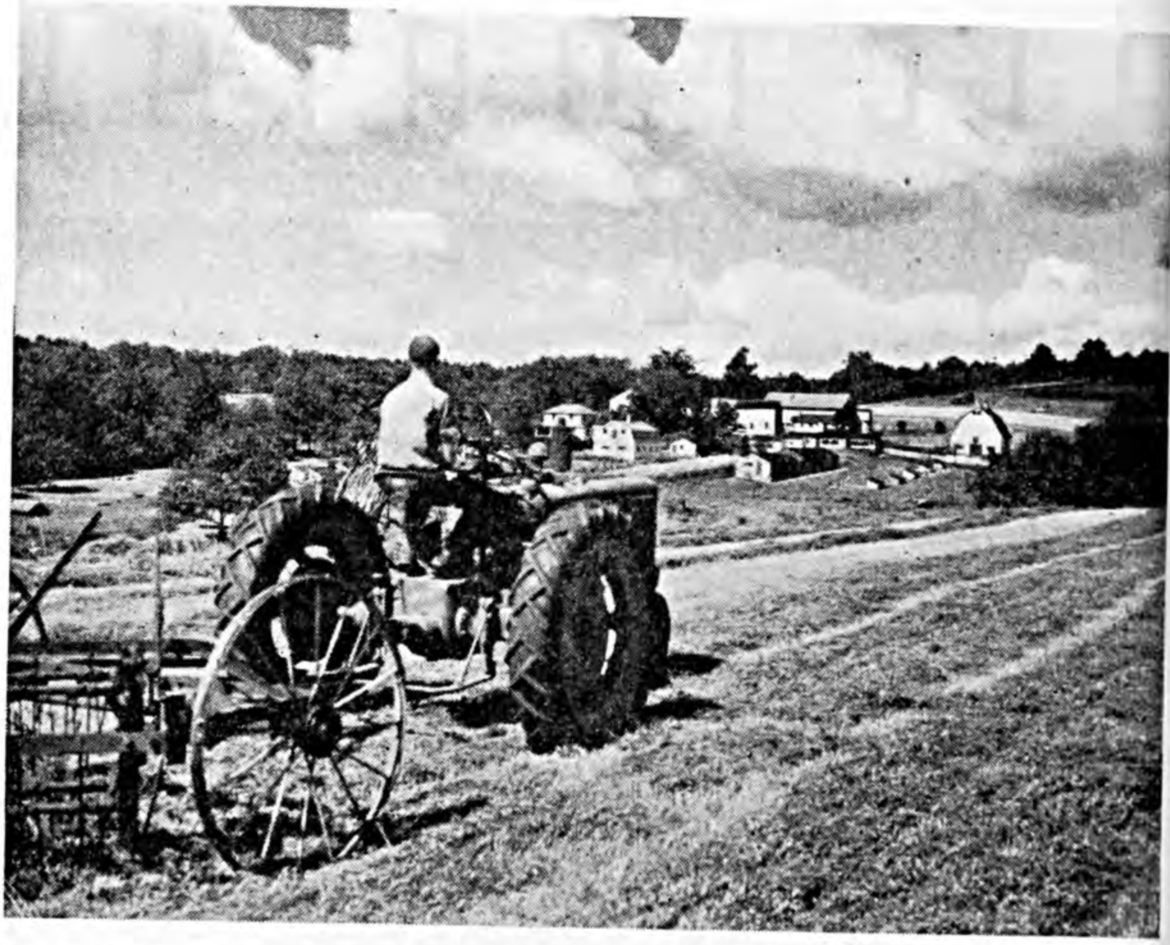
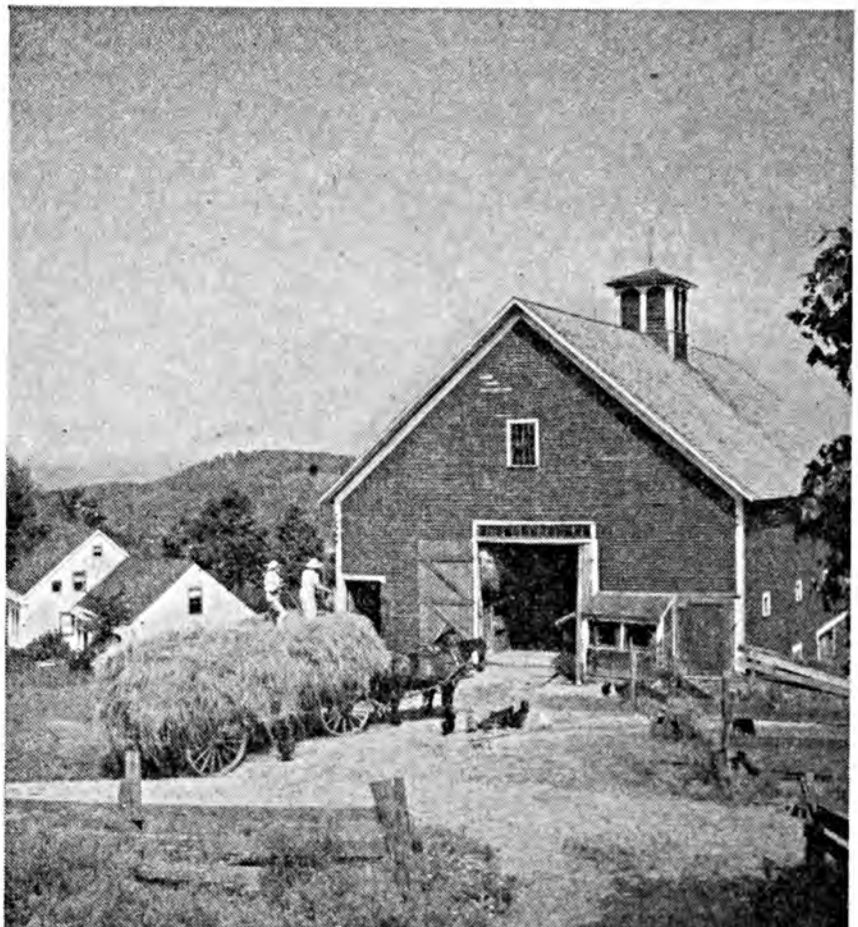
PICTORIAL



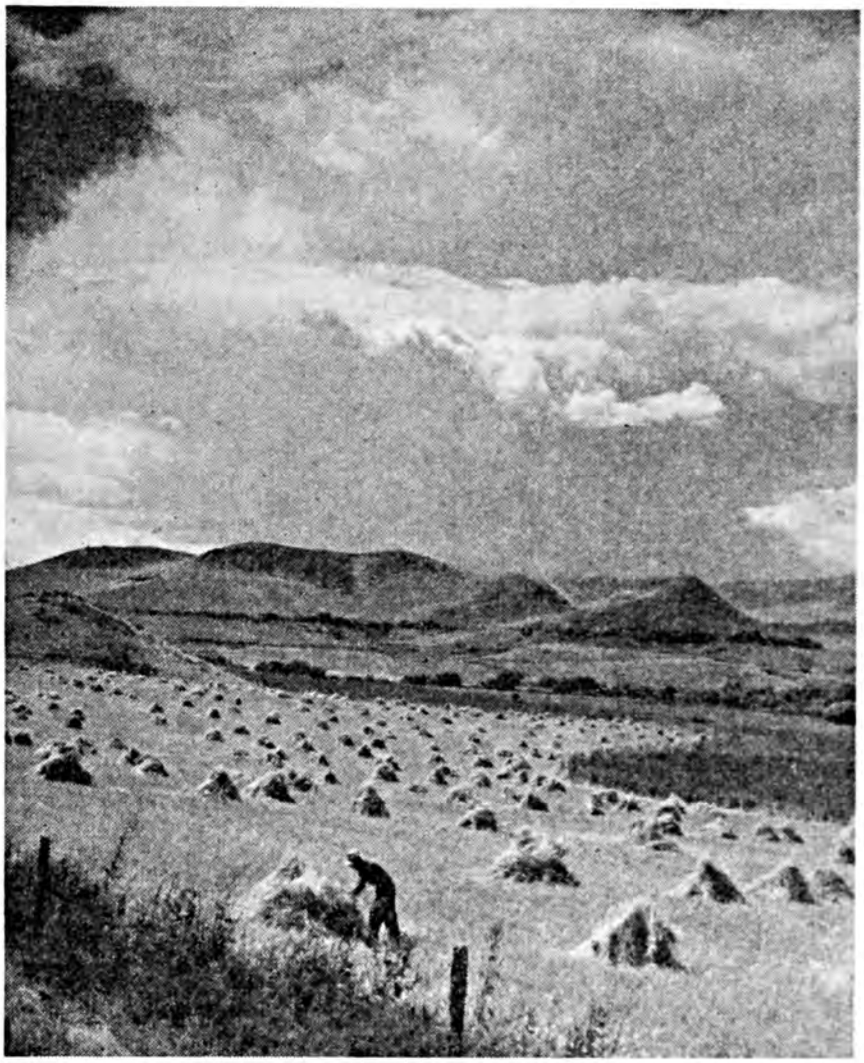
A SILENT INVITATION





Haying

Harvesting



HIGHWAYS AND BYWAYS

The Editors Talk

Land Fever

Economists in the U. S. Department of Agriculture, Land-Grant Colleges, and financial institutions, all of whom have a deep interest in the American economy, have been issuing warnings on the rapid increase in land values. Having in mind the catastrophe that resulted from the land boom during and following World War I, Secretary of Agriculture Clinton P. Anderson at the suggestion of President Truman called on June 9 a conference of representatives of farm organizations, lending institutions, and government agencies to consider the problem of land inflation. In addressing this meeting Secretary Anderson said:

"To see the problem in its real significance I feel that we must see it in terms of human values, in terms of what it does to farm families, their communities, and the nation as a whole. . . . Basically the picture today is this: Farm land prices have risen every year since the war began, and now as of March 1, our latest report, they are 192 per cent of the prewar prices. . . . Speculators—both farmers and non-farmers—think they see a gambler's chance to make a rapid profit and this helps to bid up prices. Farm income has been high relative to land prices, thus adding to the attractiveness of farm ownership. Young tenant farmers, returning veterans, newly unemployed war workers, and similar groups are anxious to acquire farms now. You frequently hear them making statements such as this, 'I want to start farming now when prices are high rather than wait until they go down to a point where a man can't make anything off a farm.'

"I think those young men should be able to acquire farms and I want to make it absolutely clear that I am in favor of safeguarding credit for such farmers when they can find land at prices which reflect its normal earning value. There's a stage in life where, if a man is going to be a farmer, he should start buying a farm. People continue reaching that age regardless of economic cycles. One of the possible tragedies of the present situation is the disastrous effect which it may have on these young men if we don't help protect them.

"For most farmers the payment for a farm is a lifetime proposition and the most important business transaction in their lives. If they make an unwise purchase they are cutting down their income for years to come. Once the mistake is made, it has far-reaching implications. When farm prices start down, the farmer with a heavy fixed indebtedness is always the first to suffer. The soil suffers too. With the ever-occurring necessity to meet the mortgage payments, farmers tend to mine their land, concentrating on cash crops which deplete the soil."

The over-all financial condition of American farmers is exceptionally good. The demand for their products is high and is likely to remain so for some time to come. Sound investments in land at this time in all probability can be made. The warning is directed at those who are misled by present-day conditions into failing to use good judgment. Before purchasing, prospective buyers could well consult agricultural officials on the soundness of local values. A little care exercised now may prevent tragedy in the future.

Soil or Climate

Remarkable soil characteristics, usually including a great natural fertility, most often are brought to one's attention in the famous crop-producing sections of the various states. In southern Florida, around Homestead, however, is an area in which it would appear that climate is the prevailing factor to the extent that unbelievable measures are taken to provide some base in which the plant can grow so as to take advantage of the excellent climatic conditions. In the strict technical sense of the word there are practically no soils existing in this part of the State, since the geological formations are too young to have evolved into soils. Nevertheless there is here a lot of vegetative growth and a highly developed agricultural industry.

There are two predominant types of material in which the plants are grown and which due to habit and as a matter of convenience are termed soils, to the consternation and dismay of our soil survey authorities. One of these general types of soils consists of a marl deposit on limestone while the other is a soft limestone itself. The marl soil does not appear at first observation to be particularly unusual since it has the appearance of soil, although upon examination it will be found that the material is an almost impalpable powder. Much more striking is the agriculture established on the soft limestone material. In its natural state it is grown up with trees and underbrush which over the course of time have provided a thin layer of organic matter on the surface. The roots were able to push through the soft stone in their search for moisture and plant food and thus establish channels which introduced organic matter into the rock at various depths.

In order to utilize these soils the growth is removed and heavy equipment reminiscent of the machines used in building roads go over the deposit crushing the limestone to a depth of 8-10 inches and leaving what looks like and really is a bed of crushed stone with practically no evidence of any fine soil. Acres and acres of citrus and avocado trees can be observed planted in such material and it is reported that some vegetables are grown as inter-crops. Even more remarkable is the fact that the plants seem to get along very well. Naturally fertilization has to be rather heavy and frequent since there is nothing in the soil to hold material by absorption or supply very much available plant food except calcium.

This is a case where growers are willing to invest up to $300 per acre in preparing the land for planting so as to take advantage of the highly favorable climatic conditions even though there would appear to be no natural soil fertility involved. It is easier to supply soil fertility than climate.

James Benton Grant

1888-1947

Late Chairman of the Board of the Potash Company of America and Charter Member, Board of Directors, American Potash Institute

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1920...........	15.9	17.3	125.3	141.7	61.8	182.6	16.46	25.65	....
1921...........	17.0	19.5	113.3	113.1	52.3	103.0	11.63	29.14	....
1922...........	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923...........	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924...........	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925...........	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926...........	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927...........	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928...........	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929...........	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930...........	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931...........	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932...........	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933...........	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934...........	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935...........	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936...........	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937...........	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941...........	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942...........	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943...........	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945...........	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
May.........	24.09	43.0	157.0	251.0	135.0	170.0	14.80	49.60	....
June.........	25.98	59.0	• 147.0	251.0	142.0	174.0	14.70	51.50	....
July.........	30.83	56.7	148.0	275.0	196.0	187.0	15.00	60.00	....
August.......	33.55	48.6	143.0	280.0	180.0	178.0	15.10	59.10	....
September...	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	....
October......	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November....	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December....	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	....
1947									
January......	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	....
February.....	30.56	31.9	131.0	228.0	123.0	199.0	17.50	88.20	....
March........	31.89	33.6	139.0	235.0	150.0	244.0	17.40	88.00	....
April........	32.26	30.1	147.0	233.0	163.0	240.0	17.20	88.00	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1920...........	128	173	180	161	96	207	139	114	....
1921...........	137	195	163	129	81	117	98	129	....
1922...........	185	228	95	114	116	109	98	135	....
1923...........	231	190	133	137	129	105	110	183	....
1924...........	185	190	98	170	166	141	107	147	143
1925...........	158	168	245	188	109	163	108	140	143
1926...........	101	179	189	134	116	138	112	98	139
1927...........	163	207	146	124	132	135	87	154	127
1928...........	145	200	76	134	131	113	95	152	154
1929...........	135	183	189	133	124	117	92	137	137
1930...........	77	128	131	123	93	76	93	98	129
1931...........	46	82	66	83	50	44	73	40	115
1932...........	52	105	55	62	50	43	52	46	102
1933...........	82	130	118	79	81	84	68	57	91
1934...........	100	213	64	91	127	96	111	146	95
1935...........	90	184	85	80	102	94	63	135	119
1936...........	100	236	164	106	163	116	94	148	104
1937...........	68	204	76	93	81	109	74	87	110
1938...........	69	196	80	83	76	64	57	97	88
1939...........	73	154	100	85	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	107	117	107	81	211	129
1942...........	153	369	168	136	143	124	91	202	163
1943...........	160	405	188	232	174	154	125	231	245
1944...........	167	420	214	219	170	160	138	234	212
1945...........	181	435	199	228	178	169	127	230	224
1946									
May.........	194	430	225	286	210	192	125	220	177
June.........	210	590	211	286	221	197	124	228	185
July.........	249	567	212	313	305	212	126	266	163
August.......	287	486	205	319	280	201	127	262	162
September...	285	488	184	255	269	202	130	256	154
October......	304	530	175	238	266	213	136	293	151
November....	236	438	176	228	198	214	145	399	207
December....	242	435	181	239	190	217	149	406	166
1947									
January......	240	390	185	351	188	216	147	401	238
February....	246	319	188	260	192	225	147	391	275
March.......	257	336	199	268	234	276	147	390	299
April........	260	301	211	265	254	271	145	390	295

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910-14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
May	1.75	1.42	9.08	6.10	4.86	7.30
June	1.88	1.42	10.34	6.42	4.86	7.90
July	1.88	1.42	11.62	8.15	5.34	9.60
August	2.22	1.46	16.88	8.14	6.07	12.14
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
February	2.41	1.46	10.01	11.06	12.14	10.17
March	2.41	1.46	11.98	11.06	12.50	10.50
April	2.41	1.51	11.72	10.79	12.75	11.39

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish scrap	Tankage	High grade ground blood
1922	113	90	173	132	140	142
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
May	65	50	259	173	144	207
June	70	50	295	182	144	224
July	70	50	332	231	158	273
August	83	51	482	231	180	345
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293
February	90	51	286	313	360	289
March	90	51	342	313	371	298
April	90	53	335	306	378	324

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1922	.566	3.12	6.90	.632	.904	23.87	....
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	..
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
May	.650	2.20	6.40	.535	.797	26.00	.200
June	.650	2.30	6.45	.471	.729	22.88	.176
July	.650	2.60	6.60	.471	.729	22.88	.176
August	.700	2.60	6.60	.471	.729	22.88	.176
September	.700	2.60	6.60	.471	.729	22.88	.176
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January	.700	2.60	6.60	.535	.797	26.00	.200
February	.720	2.60	6.60	.535	.799	26.00	.200
March	.740	2.75	6.60	.535	.797	26.00	.200
April	.740	2.97	6.60	.535	.797	26.00	.200

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash in bags	Sulphate of potash magnesia	Manure salts
1922	106	87	141	89	95	99	....
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
May	121	61	131	75	84	108	83
June	121	64	132	66	76	95	80
July	121	72	135	66	76	95	80
August	131	72	135	66	76	95	80
September	131	72	135	66	76	95	80
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83
1947							
January	131	72	135	75	84	108	83
February	134	72	135	75	84	108	83
March	138	76	135	75	84	108	83
April	138	82	135	75	84	108	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1922	132	149	141	116	101	145	106	85
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
May	211	192	162	99	57	189	121	76
June	218	196	163	100	60	203	121	70
July	244	209	181	103	60	230	121	70
August	249	214	187	116	67	293	131	70
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	206	126	69	359	131	78
February	262	234	209	124	70	329	134	78
March	280	240	216	128	70	354	138	78
April	276	243	215	129	71	354	138	78

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

1 Since June 1941, manure salts are quoted F.O.B. mines exclusively.

**** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

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"Bush Berry Culture in California," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif., Ext. Cir. 80 (Rev. Jan. 1947), H. M. Butterfield.

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Stepping-Up Corn Yields

Last year 98 per cent of Indiana's 2,169 Five-Acre Corn club members whose yields were checked in 84 counties used fertilizer on their corn, according to reports released today by Purdue University agronomists. This compares with the 60 per cent who were fertilizing corn ten years ago.

Eighty-two per cent of the growers applied all the fertilizer in the row or hill with a fertilizer attachment on the corn planter. Fourteen per cent of the growers plowed under fertilizer, most of whom also used a starter fertilizer. A very small number broadcast the fertilizer.

More fertilizer is being applied in the row at planting than ever before. Twenty-nine per cent of the growers used between 150 and 200 pounds per acre in the row in 1946, while six years ago only six per cent used more than 150 pounds. Only one-third of the growers used 100 pounds or less per acre in the hill last year while this was the common practice a few years back.

The fertilizer practices reported by the best Indiana growers conform closely with Purdue experimental results. In a fertilizer experiment conducted at Lafayette for seven years it was found that fertilizer was most efficient when applied in bands by the hill. Fertilizer dropped in the hill is more effective than when drilled in the row either on drilled or checked corn with modern equipment. Drilled corn is more responsive to fertilizer drilled in the row than is checked corn, but in either case more fertilizer is required to give the same yield increase than when the fertilizer is hill-dropped. Broadcasting the fertilizer on the surface was the least efficient method of application. Later experiments have shown that larger fertilizer applications than 150 pounds in the hill or 250 pounds in the row, should be plowed under or placed in bands on the "plow sole." Fertilizer for plowing under should be high in nitrogen on upland soils.

Corn responds to both phosphate and potash, in row fertilization, and except on well manured land an analysis such as 0-12-12 is recommended. The use of the quick soil test for available phosphate and potash is a helpful guide to the proper fertilizer analysis to use for corn.

Profitable Soybean Yields in North Carolina

(*From page* 10)

grower is to lime his soil according to its requirement and fertilize his soybeans every year. An exception to this is with soybeans grown after Irish potatoes or some other heavily fertilized truck crop. In this case the supply of phosphorus and potash in the soil is sufficient to take care of the soybean needs.

Proper Placement of Fertilizer Important

A word of caution should be given here in regard to the proper placement of the fertilizer. Soybean seeds are easily injured by the soluble salts in the fertilizer and poor stands may result if the fertilizer is placed in contact with or too near the seed. The fertilizer should be placed in bands to the side and slightly below the level of the seed. Many farmers have suitable combination distributors and planters. If this equipment is not available, mix the fertilizer thoroughly with the soil in the row and bed before planting.

Recommendations

In summary, the recommendations for profitable production of soybeans are as follows:

1. Apply dolomitic limestone to the soil in accordance with its requirements as shown by soil tests. Too much lime makes manganese and some of the minor elements in the soil less available and deficiencies may result, particularly in soils high in organic matter.

2. Fertilize with 400 pounds per acre of 0-10-20 or its equivalent at planting. Place the fertilizer so that it does not injure the seed. An exception is after Irish potatoes or other heavily fertilized truck crops in which case the supply of phosphorus and potash in the soil is usually sufficient to take care of the soybean needs.

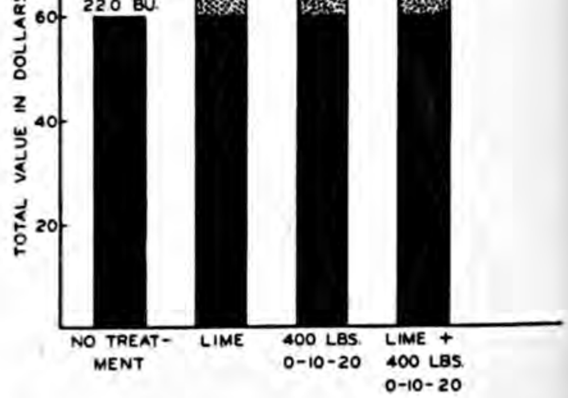

Fig. 6. Returns in dollars from average yields in nine soybean experiments. Soybeans were valued at $2.75 per bushel. Treatment cost includes cost of phosphate and potash applied plus $1.20 per acre for the lime application.

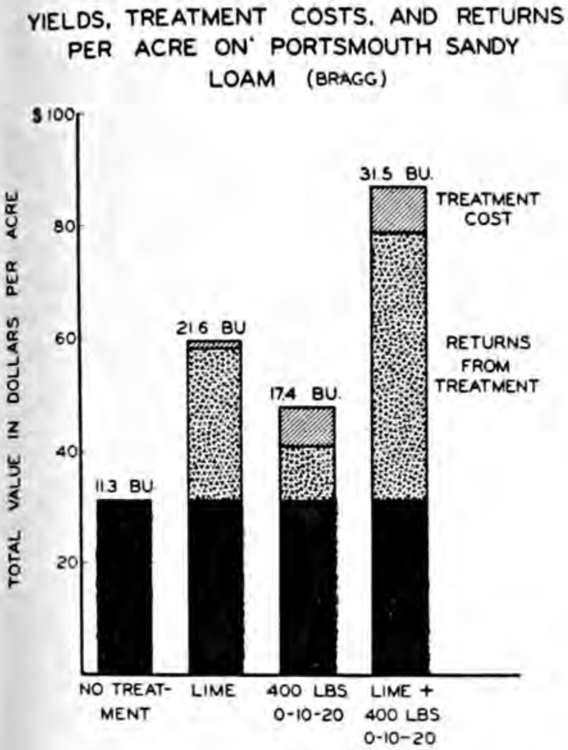

Fig. 7. With no treatment, the yield was near the State average, yet the net return from lime and fertilizer was $47.35 per acre.

3. Plant recommended varieties of soybeans at the rate of 10 to 12 seeds per foot of row or approximately one bushel per acre. In North Carolina, Ogden and Roanoke are suggested. The Roanoke variety does well in the Upper Coastal Plain and in the Piedmont. Good stands of vigorous plants greatly aid in controlling weeds.

1947 County Soybean Demonstrations

An active extension program under the supervision of Dr. E. R. Collins, in charge of Agronomy Extension, is under way to make the 10- to 12-bushel State average a thing of the past. In 1947 each County Agricultural Agent in the Coastal Plain area and some in the Piedmont will have at least one demonstration acre putting the best production practices known into use. The yield of this acre will be compared with that obtained by the farmer's usual practice.

The Wheelocks of Vermont Grow Grass

(*From page* 12)

are today. Grass is an easy crop to grow. In fact, some years when we have exceptionally wet springs, other farmers are planting corn for silage when we are filling our silos with grass ensilage. We also have a good sod to work on. This is mighty good footing compared to wet, plowed land.

"On a grass farm such as ours, we feed our cows a mixture of grasses and legumes and during the winter supplement this with some grain."

The Wheelocks' herd goes on pasture in early April and gets nothing but pasture until late in October. These Vermont farmers are convinced that cows are, by nature, "hay-burners" and say that the cows would rather have the succulent legumes and grasses than grain.

One way for keeping the cows in A-1 condition is to change the herd to new pastures as soon as they drop below a certain point in milk production. The grasslands are so productive that they can be alternated as pasture and hayland. One 13-acre plot in 1946 produced 32,000 pounds of milk in two grazings by 30 cows and then yielded 25 tons of high quality timothy and white clover hay.

The use of the right amounts and the right kinds of plant foods is of top importance in the Wheelock plan of grassland farming. The entire grass acreage is gone over every two years with eight loads of manure per acre. This manure is supplemented with phosphate. In addition to manure, 400 to 500 pounds of 5-15-20 or 8-16-16 are applied on each acre. The use of superphosphate in the stable gutters has been carried on for more than 20 years.

Father and son agree that potash is their number one need right now and they plan to apply it heavily as soon as they can obtain more fertilizers rich in this plant food. Lime is used at the rate of about a ton an acre every three years. During 1946, they used the following amounts of fertilizer: 32 tons of lime, 5 tons of 60 per cent phosphate, 25 bags of 60 per cent potash, and 15 bags of 5-15-20.

"Mineralized hay" and pastures have reduced the production cost on this Vermont farm so that the Wheelocks' farm account books show that milk is being produced for about two dollars a hundred less than that by many of the dairymen in this big milk-producing area.

Determining New and Better Fertilizer Ratios

(*From page* 26)

of two years), for the purpose of this paper, yields and moisture contents of the corn from similar plots have been summed and averaged (table 1). It is recognized that much information may be lost by averaging, and individual differences are obscured. Despite differences in soil type and management, however, the reoccurrence of certain ratios as the best was rather remarkable. Table 1 presents the data on yield per acre of corn in bushels (based on 15.5 per cent moisture) and the moisture content of the corn at harvest time as affected by the 27 different fertilizer treatments used. The figures on yield and moisture represent an average of 24 plots. Significance levels were run on individual fields but no attempt was made to analyze statistically the six fields as a unit. Rough calculations would indicate, however, that differences in yield of 6.0 bushels and above would be significant, below 4.0 bushels not significant, and between this range in the doubtful class. Similarly, differences in moisture content of two per cent and above are probably significant.

Yield Results

It is apparent that, in general, a complete fertilizer with fairly narrow ratio of nitrogen, phosphate, and potash has given the best response. Phosphate is the predominantly lacking element, because it was necessary in all fertilizers which gave increases of 6.0 bushels and above. Potash and nitrogen, alone, and in combination, did not give significant increases over the check. However, to get balance in the fertilizer with high amounts of phosphate and moderate amounts of nitrogen, potash was necessary, and as a matter of fact, in the top four fertilizers potash was equal in requirement to phosphate.

It would appear from the stand used (3 or 4 stalks per hill), that amounts of plant food of about 130 pounds were sufficient to give maximum yield increases.

Moisture Results

A complete fertilizer, again in general, resulted in greatest moisture reductions, but other fertilizers also lessened moisture in the corn almost as much. The combination of nitrogen and phosphate as in treatments 21 and 20 gave substantial moisture reductions of over three per cent. Nitrogen and potash alone, and in combination, have not hastened the maturity of corn, but on the contrary may have an opposite effect.

TABLE 2. RATINGS OF THE 10 BEST RATIOS USED IN 2-YEAR FERTILIZER TRIALS ON CORN.

Treatment No.	Pounds plant food per acre (applied in hill)			Fertilizer ratio	Relative fertilizer ratings as percentages of:			
	Nitrogen	Phosphate	Potash		The maximum increase in yield (100 = 18.1 bushels)*	The most expensive fertilizer	The greatest net profit	The maximum decrease in m isture (100 = 4.5%)
26....	32	32	64	1-1-2	97	78	100	81
25....	32	64	32	1-2-1	100	89	99	97
27....	32	64	64	1-2-2	97	100	87	100
17....	16	32	64	1-2-4	79	59	85	73
16....	16	64	32	1-4-2	81	72	80	76
18....	16	64	64	1-4-4	83	83	76	82
24....	32	32	32	1-1-1	75	67	73	65
15....	16	32	32	1-2-2	66	50	71	60
9....	0	64	64	0-1-1	69	66	65	75
7....	0	64	32	0-2-1	61	55	60	61

* Explanatory note: The best treatment, No. 25, gave an increase over the check of 18.1 bushels, and this was rated as a 100 per cent increase. Plot 18, for example, gave an increase of 15.0 bushels, 83 per cent of 18.1, hence has the rating of 83. The percentage figures in the other columns were derived similarly.

Ratings of the Ten Best Ratios

In table 2 a somewhat new approach has been attempted in rating the 10 best fertilizer ratios as determined by 2-year trials. In this table, the ratios are rated according to their effect on yield increase, moisture decrease, cost, and the greatest net return. The ratings are based on the best or cheapest fertilizer rating 100, and the others rank on down according to their increase in yield or decrease in moisture compared to that obtained from the best fertilizer application.

No figures for fertilizer cost and net profit have been given in the table because relative ratings of fertilizer cost were based on manufacturers' costs and these figures would give an erroneous idea of the probable actual profits from the fertilizer application.

Except for 1-1-1, the narrower ratios have proven to be the best in the trials. Ratios like 1-1-2, 1-2-1, and 1-2-2 run very close in yield and net profit. The 1-2-2 ratio would rank even higher in value due to decreased moisture content if commercial drying of field corn ever became practical. The fertilizers which have returned the greatest net profit have, in general and fortunately, been the most efficient in hastening maturity.

An examination of the table shows that the ratios of some of the commonly used fertilizers for corn do not rank particularly high. A fertilizer such as 3-12-12, which has a 1-4-4 ratio, ranks fourth in increasing yields but only sixth in profitableness. Fertilizers with no nitrogen, such as 0-20-20 and 0-20-10, which have ratios of 0-1-1 and 0-2-1, respectively, are down at the bottom of the list in both ability to increase yields and return profits. It is apparent from the facts shown that nitrogen should make up a greater percentage of fertilizers used for corn in this region. The ratio of phosphate to potash, 2 to 1, or 1 to 1, has been quite good, on the basis of the data in the table, but complete utilization was retarded by a lack of nitrogen.

Plot Set-up Applicable to Other Crops

The plot design used above is equally applicable to the determination of ratios for crops like wheat, oats, barley, alfalfa, in fact almost any crop. In Minnesota the past year, the same plot set-up was used in obtaining fertilizer ratio information for flax, wheat, oats, and corn.

More up-to-date information on fertilizer ratios for crops and soils should be of primary interest to fertilizer companies and could be used as a basis for formulating new and better fertilizers. It would appear to be largely the responsibility of the experiment stations to provide this information.

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Community Cooperation in Soil Conservation

(*From page* 18)

pervisors for help in getting the same program on his own land. After the farm plan was completed, he hired the tenant, who had been working the farm on a share-crop basis for years, on a monthly salary to apply the soil conservation practices. And the owner went a step further. He tore down some of the unsightly outhouses around the place and gave the barn and the tenant house a new coat of paint.

Supervisors of the Broad River, Greenville, and Laurens Soil Conservation Districts don't claim that they've found a royal road to soil conservation farming. But they know they are on the right road when they encourage groups of farmers to choose their own leaders and work together.

Fig. 5. One group of negro farmers entered the soil conservation contest sponsored by the Spartanburg Herald-Journal and district supervisors and patterned after the work of groups of farmers in Hopewell.

Higher Corn Yields for Alabama

(*From page* 24)

The second highest yield reported in Walker County was 83 bushels per acre of Funk's hybrid 714 produced by W. R. Taylor. He used 500 pounds of 6-8-4 fertilizer at planting and side-dressed with 200 pounds of ammonium nitrate.

R. E. Thagard, Crenshaw County farmer, produced 62.7 bushels of Indian Chief corn, 61.8 bushels of Whatley, 76.6 bushels of Funk's hybrid 714, and 78.4 bushels of L. S. U. hybrid per acre by fertilizing with 300 pounds of 20 per cent superphosphate, 100 pounds of muriate of potash, and by side-dressing with 300 pounds of ammonium nitrate.

Five Coosa County farmers conducting special corn demonstration projects produced from 63.9 bushels to 77.73 bushels per acre. The demonstrators were A. L. Neighbors, J. M. Cochran, J. M. Sellers, and Gerald Ward. They used heavy applications of fertilizer and side-dressed the corn with ammonium nitrate or nitrate of soda.

Lee Jones, UTD farmer of Rt. 1, Roanoke, Randolph County, planted two acres each of Funk's G-714 hybrid and Mosby open-pollinated corn, fertilized with 400 pounds of 4-10-7 and side-dressed with 250 pounds of nitrate of soda. His hybrid corn made 60.4 bushels per acre and Mosby averaged 48.9 bushels.

Robert Iverson, 14-year-old club boy of Graham in Randolph County, taught his father how to grow more corn per acre. He grew 59 bushels per acre by applying 400 pounds of 4-10-7 under the corn and side-dressing with 250 pounds of nitrate of soda.

Curtis Christenberry, a demonstrator located on sandy soil in the Stewart Community, Hale County, made 48 bushels per acre. He used 600 pounds of 4-10-7 per acre, planted Funk's G-714 on April 26, and side-dressed with 100 pounds ammonium nitrate on May 29.

Corrective Measures for Salinity Problem

(*From page* 22)

range a balanced uptake of positively charged calcium, potassium, and magnesium ions and of negatively charged nitrate, phosphate, and sulphate ions proceeds. At alkaline pH values above this range, plants experience some difficulty in satisfying their negative ion requirements. Our experiments have shown that if seedlings are placed in a culture solution of pH 9.0 there will be no uptake of nitrate or phosphate until the pH of the culture solution is reduced to pH 7.8. The seedlings, of course, accomplish this by evolution of carbonic acid during root respiration.

The chemical and physical alkali-plant relationships are of special interest. Originally the poor growth of crops on alkaline and saline soils was attributed entirely to chemical toxicity. Now it is believed to be largely physical in that an excessive salt concentration in the soil solution makes it very difficult for the plant to obtain sufficient water to meet the transpirational requirement. The osmotic pressure of the soil solution increases with increase in salt concentration. When two salt solutions are separated by an impermeable or semi-permeable membrane, such as the membrane which separates the soil solution and the solution within the roots, the movement of water will be toward the more concentrated solution. Obviously if the salinity of the soil solution is greater than that of the root sap, the crop will suffer a moisture stress. This is not unlike the inability of humans and animals to satisfy their thirst with sea water.

Irrigation practice contributes greatly to the hazards of the plant-salinity relationship. In irrigated agriculture, the moisture content of the soil, and therefore the concentration of the soil solution, is continuously changing. It is at the point of greatest dilution during or immediately following an irrigation and greatest concentration at the wilting point or the time just preceding an application of irrigation water. Many years ago we recommended that the salt content of the soil should be determined at the soil moisture content represented by the wilting point, for obviously the wilting point is where the salines are most injurious. This is the reason why it is necessary to irrigate more frequently on lands where a salinity problem exists and where a highly saline water is the only water available. In saline soils, crops will exhibit a moisture stress. Even though the moisture content is well above the true wilting point of the soil, this stress is similar to that shown by plants at the true wilting point where there is no salinity. In some cases this salinity may stunt the growth of the crop and yet show none of the outward symptoms such as tip or marginal burn of the leaves. Obviously crop yields may be reduced greatly by salinity and the farmer will be totally unaware of this unless there are adjacent non-saline areas for growth comparison.

Reclamation

In order to reclaim alkaline or saline soils, since saline soils are in danger of becoming alkaline when the excess of salt is leached from them, the same procedure may be followed for both types. They must be leached reasonably free of soluble salts, the soil minerals must be changed chemically by replacing the adsorbed sodium with calcium, and they must be in good structural condition when the reclamation is completed. The latter is of extreme importance and in Arizona we rate soil structure as a major growth-limiting factor, second only to water.

It should be mentioned that unless good drainage is possible and can be accomplished economically, neither a saline nor an alkaline soil can be reclaimed. In the Salt River Valley of Arizona, which is our largest irrigated area, drainage is accomplished by pumping from a water-bearing stratum. If the soil can be drained by tile, drainage canals, pumps, or other means, the next step is to provide some form of soluble calcium unless the soil solution already contains an excess of soluble calcium and the irrigation water to be used contains calcium salts in excess of sodium salts. Practically all the saline and alkaline soils of the Southwest are calcareous but calcium carbonate is not sufficiently soluble for use in rapid reclamation.

Gypsum was the first material used for large scale operations in the reclamation of saline and alkaline soils and for improving the structure of irrigated lands. It has stood the test of time for it has continued to be the most widely used soil corrective through a 75-year period. It is soluble in water to the extent of 600 parts calcium per million parts water and fortunately there are many large natural deposits scattered through the Southwest. The continued popularity of gypsum as a soil corrective is of more than passing interest. Our fundamental knowledge of alkali soil formation and reclamation has changed materially during the last 30 years, yet gypsum fits into the new conception as well as the old. Originally it was believed that gypsum neutralized black alkali. It is now known that this neutralization is only partial and therefore alkali soils cannot be re-

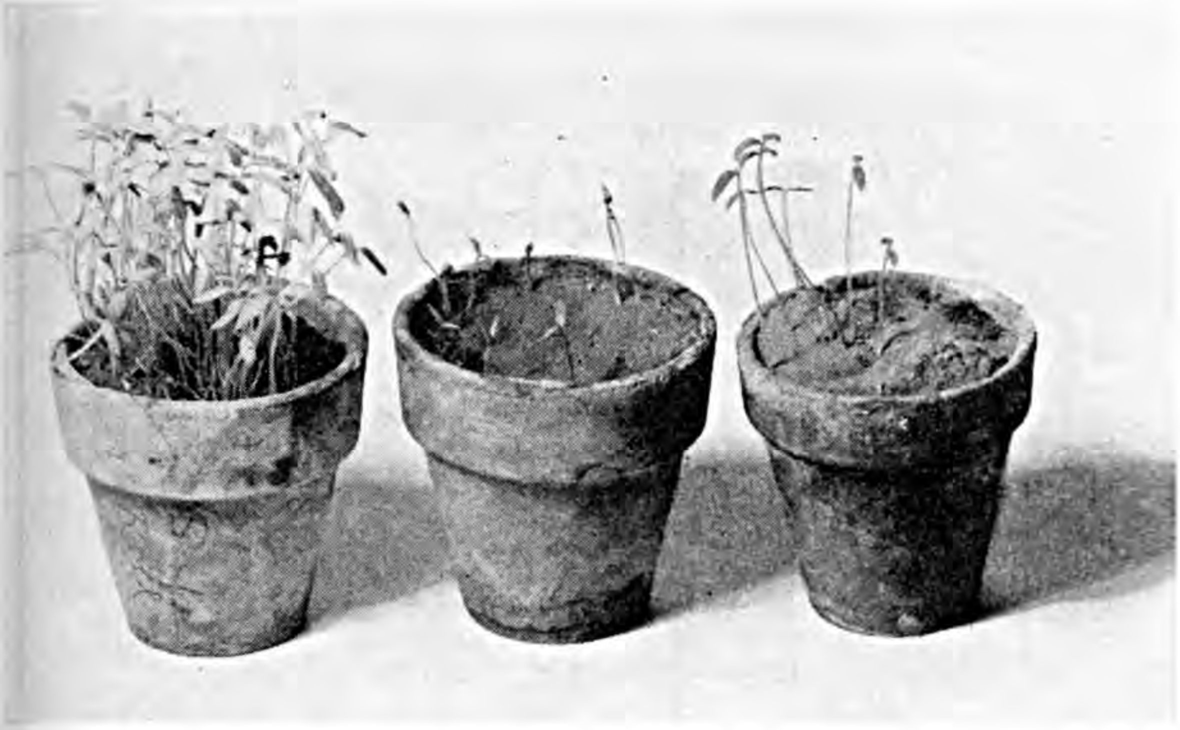

Fig. 5. Showing the effect of reclamation which removes salinity without improving structure. Pot on left shows growth when salinity and structure have both been improved. Two pots on right contain soil in which salt was removed without improvement in structure.

claimed by merely incorporating gypsum in the soil. The soil must be leached after applying the gypsum in order to remove the products of the reaction between sodium carbonate and calcium sulphate and to bring about a replacement of adsorbed sodium.

In some instances nitric and sulphuric acids have been used as alkali soil correctives because they will neutralize excess alkalinity and dissolve the insoluble calcium in the soil.

Sulphur offers the greatest competition to gypsum in the group of alkali soil correctives. It oxidizes readily in the soil to sulphuric acid. This provides for neutralization of excess alkalinity and, due to the reaction between this sulphuric acid and calcium carbonate, it supplies soluble calcium in the form of calcium bicarbonate and calcium sulphate for the replacement of adsorbed sodium. One part sulphur is equivalent to five parts gypsum in reclamation. It acts more slowly than gypsum because it must be oxidized by soil microflora before it is of any value.

Another excellent soil corrective is organic matter. Semi-arid soils are sadly deficient in organic matter, so that animal and green manures not only are good correctives but also benefit the soils in many other ways. By means of the carbonic acid liberated during the breakdown, soluble calcium as calcium bicarbonate is supplied. Secondly, organic matter improves the soil structure, for the decomposition products are excellent binding agents. The ultimate success of any program designed to improve the soil structure depends upon the permanence with which the dispersed clay particles are aggregated into crumbs — that is, water-stable crumbs. Organic decomposition products accomplish this most effectively.

The ideal soil corrective is a mixture of gypsum, sulphur, and manure. The gypsum will supply immediately soluble calcium, the sulphur will serve as a continuing source of soluble calcium, and the manure will tend to bind the soil particles into permanent crumbs.

Control Measures

In the husbandry of alkali soils, an ounce of prevention is truly worth a

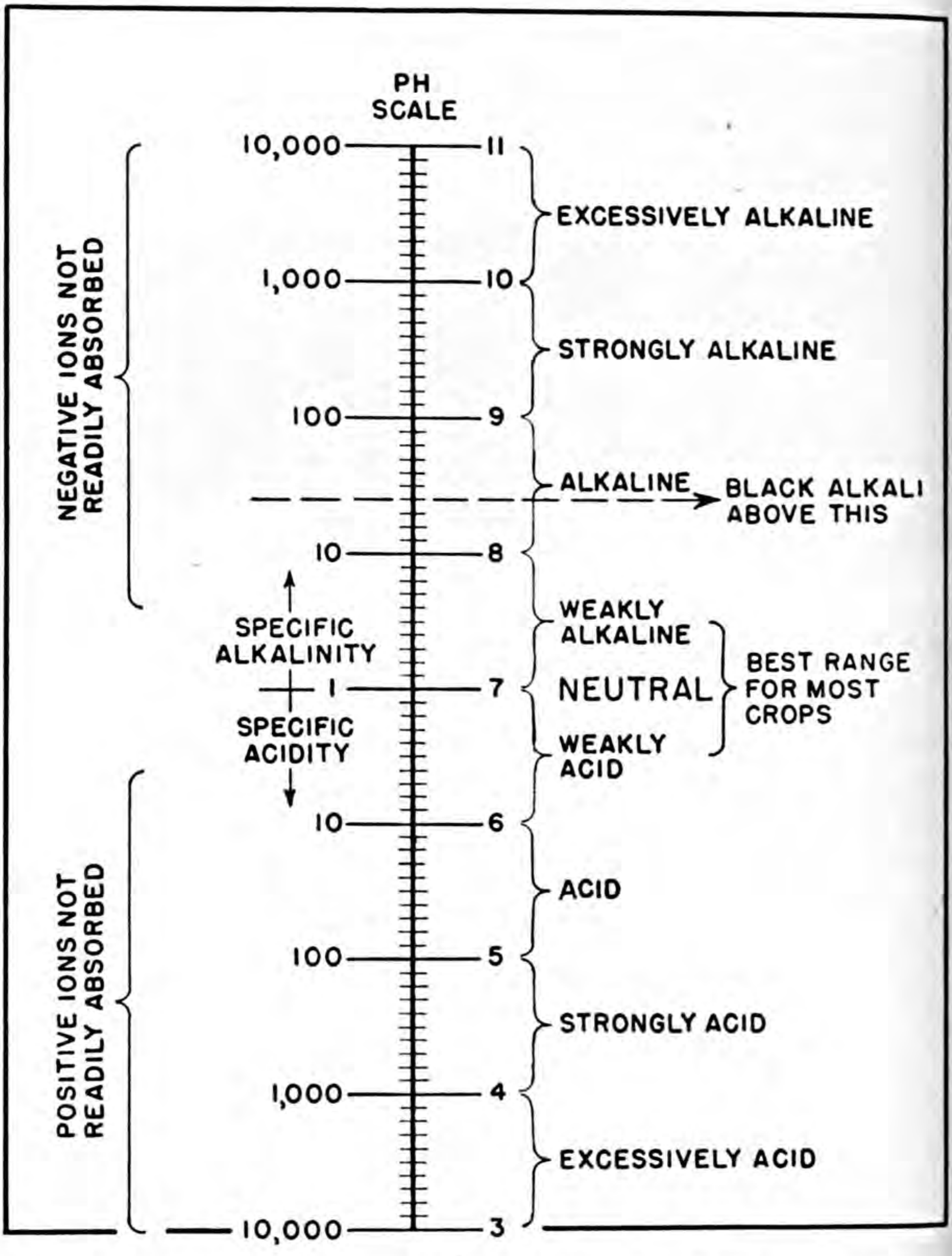

Fig. 6. Relation between pH, alkalinity, acidity, plant growth, specific alkalinity, and specific acidity.

pound of cure. The irrigation farmer in the Southwest will always have the problem of alkalinity and salinity facing him. Obviously the philosophy of prevention is the one to adopt, for control measures are more efficiently and economically operative than reclamation measures.

Of first consideration in control is the quality of the water. Agriculture is probably the only large industry in which hard water is not only desirable but essential. By hard water I mean one in which the calcium salts are in excess of the sodium salts. When a water of this type is not available, the farmer should resort to applications of gypsum to the irrigation water or make light annual applications of gypsum or sulphur to the soil. This will tend to keep the soil solution well supplied with soluble calcium. This policy is further advisable because a large part of the soluble calcium in irrigation water and the soil solution is precipitated in the soil as calcium carbonate and an appreciable amount used as food by the crop. On the other hand, sodium is not considered as a plant food and practically all that enters the soil remains there in solution. Under the most ideal conditions, therefore, the sodium:calcium ratio in the soil will increase.

Other control measures involve certain phases of the irrigation program; namely, number of irrigations, interval between irrigations, and quantity of water used. Substantially more water must be applied to cropped land than the total lost by evaporation and by transpiration through the crop; otherwise there will be an accumulation of salt in the soil. This may vary from 5 to 30 per cent depending on the soil types and the salinity of the water, and obviously this excess of water should be used to flush the soil and not spread thinly over a series of irrigations.

Soil research has made many valuable contributions toward solving the problems of semi-arid saline and alkaline soils. Our knowledge and understanding of the fundamental chemical and physical reactions between the soluble salts and soil minerals have advanced to the point where reliable advice can be given to farmers. There are wide variations in the soil even on single farms and, therefore, reclamation and control depend to some extent on the ability of the farmer to coordinate the results of research with his own experience.

Fertility is a term used with reference to the supply of plant food in the soil and its availability. When deficiencies exist, commercial fertilizers or other soil amendments may be used to maintain or rebuild it. Productivity is the capacity of the soil to produce. A fertile soil can be non-productive if such growth-limiting factors as salinity, alkalinity, and poor soil structure prevent a crop from utilizing this fertility. Since these growth-limiting factors may often function without any outward evidence of crop distress, it behooves the irrigation farmer to adopt a philosophy of prevention. When a crop shows an outward manifestation of distress, it is then evidence that the time has come for a costly reclamation program.

Motor Meanderings

(*From page* 5)

made on night roads. As I drove along peering past the headlights in snow or rain and listening hard for any signs of engine trouble, my gratitude went to the skill and pains which trained workmen had put into this small single item in a vast assembly line. To be master of a smoothly running mechanism that withstood cold and bad roads and the shocks of indifferent driving, and brought one safely back up the familiar lane toward the cozy lights of home—that was indeed a miracle. We who were not born in the midst of motor marvels and instantly responsive levers have a keener and a deeper appreciation of the wonders that have come to us, but I am afraid that too few of us are good stewards of such rich experiences.

For we now travel at our own will as fast and often faster to distant destinations than many of the overland trains we used to meet with great expectations at the country depot. The road which skirted the rural home where I was raised no longer presents a gently rising, winding hill, lined with locust trees and elderberry bushes. The deep dust of summer no longer fluffs up between the stubby toes of trudging urchins on that somnolent stretch of lane, where one riding in a buggy might hear the bees droning in the clover and spy a robin's nest in a lilac bough, or shout a brief message to a friend standing by a pasture gate.

Our rapidly moving era has no time for that meandering mood. The highway is a straight avenue of blazing concrete in noonday sun, no bushes are on its graded borders, barefoot boys don't dare to take a chance, and the small noises of nature are completely blotted out by the swish and roar and hum of onward motion. But at least you can stop and exchange ideas with more friends in an hour than it was possible for you to visit in the dawdling days of yore. It does have its real and vital compensations, all "poetry and romance" aside.

Take the two eventful trips we took through Canada—the first time by transcontinental train de luxe, with special stop-overs at famous recreation spots, and the next time by leisurely (?) motoring. On that second excursion with the family along, there were many and varied opportunities to get the feel of things, to know the wherewithal and the personalities of towns and people.

WITHOUT a convenient equipage at our private disposal, where would we have known Francois, the genial waiter at the village inn west of Quebec, who gabbled with our daughters and smiled at their high-school French? Could we have halted at the roadside to admire the quaint ovens and the gaudy hooked rugs, examined the thatched roofs and looked at the frequent fences in the realm of ancient "metes and bounds?" Without our own conveyance, excitement over crossing a bumpy, unfinished bridge east of Montreal, and whimsical delight over the ox carts of the Island of Orleans would have never been ours.

AND, moreover, in similar New England rambles by family bus one season later, how could my wife and daughters have had the dear and unforgotten chance to sniffle a little in the cottage where the Alcott sisters lived and wrote the classic so precious to most feminine hearts? How could we have paused at Concord and Lexington along the trail of the Minutemen and storied Paul Revere, with its tradition kept as well burnished and as shining as the silver he created? Without easy egress, would we have gazed upward from the lake along the towering cliff to discern the granite features of the sachem's gloomy face, as introduced to us by Hawthorne? Or could we have watched the Portuguese fishermen wind their nets in that famous harbor from whence so many have "gone down to the sea in ships?"

Could we have learned first hand that New York State is not all pavements and night shows and gluttony and glitter, and that there lie many peaceful meadows, winding streams, and forest reaches in the trek from Elmira to the Hudson?

And then, closer home and dearer still, the possession of a family vehicle of fairly wide range gave us the opportunity to go to accepted and invited places where wild flowers grow, there to take upon permission a few good specimens to transplant in our own rocky nook at home—where some of the hepaticas, violets, and trilliums still bloom for other eyes.

Of course, there have been vandals, interlopers, and trespassers following the wake of the motor age; people who translated their escape from dingy streets and cramped quarters into reckless disregard for privacy and the decent rights of mankind. Others have made once restful glens and bowers of beauty into a vast litter of despoliation and abandon and robbed the countryside of precious plants. Fortunately, however, they sometimes tackled poison oak and ivy and retribution came home to the right roost.

LOOKING back over the motoring hours of other days, I find that the rides where I had companionship to and fro were nicer ones than the many miles over which I traveled alone. None of my folks were backseat directors, and I was never annoyed in this way by somebody breathing on my neck at every curve. Not even my mother-in-law, believe it or not! They just leaned back and scanned the scenery or gossipped about the relatives we had visited.

I always followed the rule of taking on only riders who were known to me, running no hazards with strangers or pick-ups. How fast the mileage flowed past when I had a congenial co-rider who could argue with me vehemently about all manner of current perplexities. We have solved the problems of cooperation, farm credit, parity prices, production incentives, foreign exports, state and federal relations, and the more intimate ones of mortgages and neighbors and furnaces.

The only drawback to this conversational travel was that we used up so much gas by ourselves and under the hood that we sometimes ran out of both kinds. Then we had to mix walking with talking.

I look back at the isolated travelogues with little real enthusiasm. No doubt I have spent more than an average of 20 hours each week humped over the steering wheel all alone. Meandering is then monotony. In summer the concrete pavement ahead shimmers in the sunlight, you glimpse washing waves of water over the crest in a sort of mirage, the click of the tires and the hum of the motor put you into a drowse, and sometimes in the worst of such fits you just pull up at the shady roadside and take a brief snooze.

Certain roads often traveled day and night finally lose their original charm and local luster. One such numbered highway I followed four times each month for ten years became a burden to me because of traveling it so much alone. I do not care to see it again.

My road work was done for a farm journal. I was not among the fraternity of space-peddlers, who probably had more fretful reveries en route than I did, whose duty was space-filling. It always seemed to me that they supported the paper by their efforts, while maybe I helped to make it saleable in the first place. Ordinarily they dictated the total amount of pages each issue carried, more or less, while I simply laid by a good collection of personality and production yarns to fit any linage which remained.

Being a little on the shy side, I did not possess the daring and ego that is such a mainstay of urban reporters. I hated to intrude on strange farmers, uncorking personal questions and maybe taking a few pot shots at them with a graflex. I have drifted around a whole section of land sometimes working up the right line of approach. Yet usually after the ordeal was over and my notes and films were safely stowed away, I drove out of the farmstead with the back seat full of fruit or vegetables or eggs or other plunder—almost like your traditional country parson taking his toll in kind.

THEREUPON my day-dreaming while driving began. Often it would revolve around the mental picture of just how this "story" should be presented, what slant was the best for a "lead," how certain titles and legends would look, and the effect of the feature on the general situation.

My travels were generally of two kinds—attending formal gatherings and conventions, which usually meant a direct route with no pauses; and cruising, like a taxi, searching the countryside for nice buildings, new mechanical methods in use, or likely looking livestock or chickens. This cruising seems now like an aimless sort of excuse for making a living. It sounds like a tramp's life. Maybe it was, for too few of the articles resulting from those rambles have ever been preserved—unless in private scrapbooks I know not of.

In a personal sense, I never had the dog sent after me. However, owing to some adverse political slants which appeared in some of the columns of our sheet unrelated to my field hegiras, a farmer on one occasion refused to let me alight in his barnyard on my harmless and utterly non-partisan mission. "No dumb writer for that gol-blasted paper is goin' to give me a write-up," was his diplomatic comment.

THIS turn of the tide and sundry objections to our support of support prices and our boosting of benefit payments sometimes delayed my contacts and disrupted the free flow of my pristine style. As long as I stuck religiously to the accepted standards of rural journalese jargon and played up rugged individualism, prideful progress in production this year over that, good bulls and helpful families, overcoming weather and bugs, outguessing the neighbors, and kindred safe-and-sane features—well, my old car was welcome to free gas at the farmer's own tank and a blessing in farewell.

So after many moons of this meandering and lonely riding one comes to the conclusion that at least the work was clean, that the time might have been more wasted otherwise, and that a lame back and a stiff left foot are mementos soon forgotten from tedious travels. In these peregrinations I may not always have toted home the bacon, but I am satisfied because I never sold anyone a gold brick.

A Few Whinnies

AS A CHEMIST SEES HER

Analysis of the creature known as woman as seen through the eyes of the chemist:

Symbol: Wo

Accepted Atomic Weight: 120.

Physical Properties: Boils at nothing and freezes at any minute. Melts when properly treated. Very bitter if not well used.

Occurrence: Found wherever man exists.

Chemical Properties: Possesses great affinity for gold, silver, platinum, and precious stones. Violent reaction if left alone. Able to absorb great amount of food matter. Turns green when placed beside a better looking specimen.

Uses: Highly ornamental, useful as a tonic in acceleration of low spirits and an equalizer in the distribution of wealth. Is probably the most effective income-reducing agent known.

CAUTION: Highly explosive in inexperienced hands.

—E. J. Kraska.

Very often it is the mink in the closet that keeps the wolf at the door.

BIG MOMENT

The lowly cub reporter who was assigned to cover the class plays of the high school came in for his share of literary fame when the following appeared in his write-up: "The auditorium was filled with expectant mothers, eagerly awaiting the appearance of their offspring."

Penny (nine years old)—"Mother, that horrid Jones boy called me a tomboy."

Mother (noting her torn dress and tear-streaked face, and remembering the Jones boy was twice her size)—"And what did you do?"

Little Girl—"I made him take it back. I kicked him in the shins and tripped him and sat on his chest and pounded his head against the ground until he yelled: 'You're a perfect lady!' "

STOPPED COLD

A Des Moines home-owner, wearing his oldest clothes, was mowing his lawn when a woman in a ritzy car stopped and asked him: "What do you get for mowing lawns?"

"The lady who lives here lets me live with her," replied the home-owner, and the lady in the car, without comment, drove away.

An Ex-GI who was plenty "pitched off" from being ordered around in the Army was filling out an income-tax blank; he came to the part marked "Do not write in this space." Incensed at this limitation on his personal liberty, he penciled in the forbidden space:

"I will write where I damn please."

"Am dat you, Liza?"

"Yessuh."

"Am you' gwine to marry me?"

"Sho ah is—who is dis talkin'?"

Good Luck
FOR FISHERMEN

THE PLANT SPEAKS

A new four-reel series of 16 mm., sound, color films which may be booked independently or in any combination. They may be used to best advantage when shown at least one day apart and in the following sequence:

THE PLANT SPEAKS THRU DEFICIENCY SYMPTOMS pictures soil depletion, erosion, and deficiency symptoms on plants. (Running time 25 min. on 800-ft. reel.)

THE PLANT SPEAKS, SOIL TESTS TELL US WHY depicts taking soil samples on the farm and the interpretation of soil tests. (Running time 10 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU TISSUE TESTS shows the value of tissue testing and the procedure for testing plant tissues in the field. (Running time 14 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU LEAF ANALYSIS evaluates leaves in plant growth and leaf analysis in determining fertilizer needs. (Running time 18 min. on 800-ft. reel.)

We shall be pleased to loan these films to agricultural colleges, experiment stations, county agents, vocational teachers, responsible farm organizations, and members of the fertilizer trade.

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Machine Placement of Fertilizer (West)
Ladino Clover Pastures (West)
Potash from Soil to Plant (West)
Potash Deficiency in Grapes and Prunes (West)
New Soils from Old (Midwest)
Potash Production in America (All)
Save That Soil (All)
Borax From Desert to Farm (All)

IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of time of loan.

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August-September 1947 10 Cents

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VOLUME XXXI NO. 8

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Facing Life . . .

For Better or Worse

Jeff McDermid

YES, I *do* forget that nuptial anniversary sometimes, but had I been unfortunate in the choice of a life partner I probably would scan the calendar for its approach like a condemned prisoner waiting for his doom. Anyhow, what's such a date when every morning brings another satisfactory day of married companionship?

One who has been thus united through thick and thin with a courageous person of sound mind and sympathetic understanding usually gets a special "lift" out of that part of the wedding ceremony where the young folks join hands and plight their troth "for better or for worse, for richer or for poorer, through sickness and through health, 'til God doth us part." At least I have wanted to blow my nose when the parson got to that part, thinking of all the things it could mean.

To us particularly there have passed about three decades of experiencing life's ups and downs together. On the whole it has been for better, for normal health and comfort, and also for "richer"—in other ways than goods and money at least. The fleeting sick spells, some of them somewhat serious, have only served as the seasoning to make the dish more palatable. It is through them that one learns to sense the value of the simple blessings so often taken for granted and never put on the credit side of the family budget.

Meanwhile we have two photographs laid by to remind us how each of us looked back there in the somewhat distant interval of our first closely associated teamwork. The young woman looks dainty, demure, and hopeful in her own make of bridal gown, with the glint of confidence in her expression which later years have not always justified. But she has it still, despite my shortcomings.

I even remember the day she posed for it. It was a fortnight after our honeymoon and she tried very hard to arrange the veil and the folds of the gown just as they looked when we stood up together, but she had to be content with a bunch of artificial flowers that the photo property man provided. She turned thumbs down on my idea of sitting in with her for the picture, as she had seen too many corny specimens in old albums, with the groom standing up like Napoleon at the battle of Waterloo, with one hand coyly resting on the slim shoulder of his affianced. Even when I pointed out that it was the handle-bar moustaches of former victims that really spoiled the view, and which I was unable to muster, she still refused.

I glance at that picture every morning as I go in to shave. Then I wonder what she ever saw in a guy with thin, grayish hair, sagging jowls, fine-cut wrinkles induced more by laughter than by strain, and an anterior bulge at the waist line which reflects much good work done by her in the kitchen. So far I haven't had the courage to ask her.

TIME HAS treated her well because she has always had so much of it to give to others. On second thought, I am not sure but that that statement might not stand along with the acceptable quotes from the Saints as a proper tribute to place upon the spot where she finally rests—at some, I trust, far distant date.

For when we walk out together in these mellow seasons of our lives I find her step as brisk, her form as wholesome, and her face as fresh and cheering as on the day we dodged the rice and wore our wedding togs so proudly.

I've never been much of a poetry fan, but one little thing from Tennyson's Idylls of the Kings seems to sum up all successful marriage partnerships. The lines are: "In love, if love be *love,* if love be *ours,* faith and unfaith can ne'er be equal powers." To me it means that two folks who have mutual trust and live on the square are not bothered by triangles.

HOWEVER, WE must be tolerant. Neither of us has had any psychological irritations to frustrate us, and so perhaps we are not capable of testifying in the modern version of skepticism. All we know is that the vaccination "took," and that we escaped the dangers it was meant to forestall—and lived happily ever after, thus far at least.

This reminds me of a friend who in his sixth decade and after thirty-five years of wedded life cut loose and had himself a divorce. "Rather late in life, isn't it, after raising a small family," he said. "But she was not a good companion. She couldn't talk my language or reach the level of my reasoning. I stood it until the kids were gone and then I started fresh alone. In fact, I enjoy it, going where I please and seeking congenial conversation. I am bored no longer and she is probably happier too."

I have no answer, but perhaps if he had been less astute and less profound and a bit more folksy and ordinary-minded, like my frau and I, his heart might have given his brain a better deal. The best time to discover such things is before, not after, a wedding. Of course, the fly in the ointment there is that sometimes people change—alter their ego under pressure of domestic responsibility and put sense ahead of sentiment and self above everything else.

My fault, as She knows too well, lies in super-sentiment and a grave lack of aggressive go-getting, which to some other brands of feminine character would have been ample grounds for a rumpus. That I have escaped divorce is due to her forbearance rather than to much improvement in myself. It's a mighty good thing I realize this without being told, as it has given me the dash of humility one needs to compromise in tight connubial situations. To know and to accept a partner's limitations, and be thankful it isn't anything really "catching," is half the battle.

Respect on both sides is the rock on which a couple builds a real lasting partnership. I've learned that respect

is strengthened most in times of stress and in the intervals when either partner is obliged to manage the family affairs and household duties alone.

My journeys away from home have been more frequent and lasting than those of my wife, which is a common experience to many couples in these days of activities extended beyond the confines of the local community.

During all my long enforced absences the humdrum functions so vital to the pursuit of happiness and the attainment of security and health were carried on with regularity and dispatch. All pending bills were paid on time, insurance receipts were checked and honored, emergency repairs were attended to, the furnace was kept burning and all rooms warm, a small boy was hired to shovel snow outside, meals went forward on schedule, the kids were neatly clothed and prepared for school, and in summertime the garden and the lawn received such care as a busy household boss could ordain between other duties.

The only thing that seemed to languish a trifle in such periods of my absence was the social exchange. As a rule the neighborhood and lodge and church entertainments and the club dances were designed for man and wife, so that either one of us trying to represent the family alone presented a lone, lorn picture. School affairs like parent-teacher programs were an exception. Here either one of us might attend singly and not feel out of step.

Many a time in my absence the wife was utterly unable to accept a social dinner date with full certainty of meeting our promise. "If he gets home by Friday night, why yes,—but if he doesn't get in before six o'clock and have time enough to clean up, I'll let you know." To a hostess, any such half-hearted acceptance is worse than none. To a wife obliged to make such desperate dates, the experience is trying.

Yet when Yours Truly, the frequent traveler, was left alone to run the household, how vastly different were the results. Nobody ever phoned me for social dinner parties, of course, because most of the women friends of my wife kept tab on her whereabouts and knew when she was gone. No, it was not the invited affairs that bothered me—it was the meals I had to plan and supply right at home.

I SURMISED that if I set the alarm clock properly for a quick morning uprising all would be well. Naturally it did suffice to jerk me out of customary late morning slumber, but the fact that I was fully awake with my pants on was no guarantee that the rest of the day would prove a successful and orderly round of "wifely" duties.

Although careful directions had been dinned at me and even written on tablets left in conspicuous places, the ordinary routine chores of supervising children, pets, and plants, as well as keeping things dusted and clean, answering phone calls, paying bills and shooing away Fuller Brush men, replenishing the larder, attending the furnace and sorting the laundry stocks—these were terrifying tasks for a blundering husband.

I am aware that there are often exceptions. I know that men have told

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Fig. 1. The 13,000,000 tons of lime applied to Wisconsin's acid soil during the past 11 years have played a major role in the soil and crop improvement program. The acreage of alfalfa has reached the million mark. But there are still 6,500,000 acres of cropland in Wisconsin and another 3,500,000 acres of non-wooded permanent pasture that need lime, calling for a total of nearly 25,000,000 tons to complete the "once-over" job.

Whole-farm Demonstrations

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wisconsin

THE primary function of the agricultural experiment station, with its wide and almost limitless array of research projects in laboratory and field, is to discover, try out, and finally apply new ideas and theories in the field of farm science. It is a job of the extension specialist to take the practical and workable findings of research to the farmer and get him to put these new findings into practice. We teach, preach, write, and finally wind up by setting up actual demonstrations on farms in those counties where these new and approved practices are thought to be workable and practical. The widespread adoption by farmers of better soil and crop management practices is the ultimate goal of extension agronomists. And believe me this is a tremendous task, a never-ending challenge.

I have been at it for more than thirty years and in terms of accomplishments and the achievement of goals in Wisconsin, I think I can say our efforts have been fairly fruitful. I have seen the tonnage of fertilizers used in the State grow from some 3,000 tons back in the year 1916 to the present annual use of over 300,000 tons. I have seen the tonnage of lime increase from practically nothing to a yearly average of nearly 2,000,000 tons. In the wake of these hundreds of thousands of tons of lime and fertilizers, I have seen a great improvement in crop production. I have witnessed a doubling and trebling of our acreage of alfalfa. Clover has become a more dependable and abundant crop on Wisconsin farms. But I would not imply that the job is finished by any means. Wisconsin farmers are still way short of balancing their soil fertility budget; in fact, we are still cashing in on the native resources of our soils.

The fertilizer industry, too, has played an important part in this widespread interest and increased use of fertilizers. They have a product to sell and have spent thousands of dollars in educating farmers toward a more intelligent use of it.

In the spring of 1916 I was hired by Doctor H. J. Wheeler, manager of the Service Bureau of the American Agricultural Chemical Company, to undertake the job of carrying out a program of fertilizer experiments and demonstrations in Wisconsin. I was engaged in this type of educational and exploratory work in the states of Wisconsin, Minnesota, and Ohio for a period of six years, during which time I conducted hundreds of test plots and demonstrations and carried the results of findings and the story of fertilizers to thousands of farmers at meetings held during this period.

At the same time many other fertilizer companies were also doing missionary work in the Midwest. Armour, Swift, and Darling were active and great credit should be given to the work of the Soil Improvement Committee of the National Fertilizer Association, whose staff worked hand in hand with all of us in our early efforts. In more recent years, other educational agencies including the American Potash Institute, the American Cyanamid Company, and the Coke-Oven Ammonia Research Bureau have made substantial contributions not only as educational agencies in their direct appeal to farmers in behalf of a more intelligent and liberal use of fertilizers, but in their

Fig. 2. A "whole-farm" demonstration. Here is Christ Mayer of Junction City (Portage County), Wisconsin, who harvested the first crop of good clover in many years from this field. There are over 400 of these whole-farm demonstrations set up in a five-year cooperative project among TVA, the College of Agriculture, county agricultural agents, and farmers.

support of research fellowships set up at the various experiment stations over the country. The direct support by these agencies through the liberal contribution of fertilizers used in the thousands of test demonstrations carried out in Wisconsin has made possible a tremendous expansion of our test-demonstration program.

Federal Agencies

It has been my privilege to have had a part in this great program. For the past 25 years as a specialist in soils at the University of Wisconsin I have been preaching and teaching the principles of soil fertility maintenance and crop management. I have talked lime, lime, lime for alfalfa, for better and bigger crops of clover, corn, and grain. Our lime production program which tied in with the Federal action agencies, CWA, FERA, and WPA set up on a county- and state-wide basis and carried on for a period of some eight years in cooperation with county agents and their agricultural committees, resulted in a tremendous output of agricultural lime. In more recent years, the AAA (now known as the Production and Marketing Association) has contributed toward the cost of millions of tons of lime used by farmers in this and other states.

The Federal action agencies including the Soil Conservation Service, the Farm Security Administration, and the AAA have also played an important part in the sweeping changes which have taken place in the past few years in the thinking and attitude of Wisconsin farmers toward soil fertility maintenance and soil conservation through the use of commercial fertilizers. During the past 10 years we have carried out a number of large-scale educational drives and programs through our agricultural extension organization.

A state-wide program of soil testing was set up as a project in cooperation with the WPA several years ago. We established some 50 county soil-testing laboratories where thousands and thousands of soil samples were tested. The results of these tests placed in the hands of farmers had the effect of quickening and awakening their interest in fertilizers and lime, and provided an intelligent basis for their purchase and use.

I am convinced that thousands of field demonstrations with fertilizers carried out by county agents in cooperation with our soils extension service and supported by the Middle West Soil Improvement Committee and the American Potash Institute have been an important factor in influencing farmers. The farm machinery manufacturers have supported us in our demonstrational work by loaning us a large number of fertilizer-grain drills and other equipment for the application of fertilizers. During the past five years we have conducted hundreds of "plow-sole" fertilizer demonstrations in Wisconsin. The results of these demonstrations have been tabulated and summarized each year and reports have been placed in the hands of our educational leaders, fertilizer salesmen, and farmers. Stories have been written and published in the farm press in which the results of our demonstrations have been brought to the attention of a high percentage of the farmers in this State.

Whole-farm Demonstrations

Another agency which in the past seven years has played an important role in carrying the story of soil conservation, soil fertility maintenance, and crop improvement practices to Wisconsin farmers has been the Tennessee Valley Authority. "Whole-farm" demonstrations were set up in cooperation with TVA back in 1940.

This idea of whole-farm demonstration was suggested to the writer by the late Professor A. R. Whitson some 20 years ago. Professor Whitson felt that a number of farm-scale demonstrations should be carried on as a follow-up type of project in connection with our State Soils Laboratory Farm Examination Service.

When the Tennessee Valley Authority in 1936 asked us to submit plans in which rather extensive demonstrations

Fig. 3. Yields of corn were increased from 59.9 to 104.7 bushels per acre on the plot receiving 800 pounds of 8-8-8 on the plow-sole. Both plots received the conventional 125 pounds of 2-12-6 in the hill with attachment on the planter. This demonstration, conducted on the Harold Neis farm at Lancaster, Wisconsin, is one of the hundreds of such tests where the "plow-sole" method of fertilizer application has been tried out on Wisconsin farms in the past five years.

might be carried out with the various types of phosphate fertilizers which the Authority was manufacturing, the writer submitted a detailed plan for setting up a number of these so-called "whole-farm" demonstrations. In the proposal it was suggested that a program of soil and crop management be carried out over a period of five years on a selected number of farms where detailed examinations through the medium of the State Soils Laboratory had previously been made.

My proposal in 1936 to the Tennessee Valley Authority for the setting up of these whole-farm test demonstrations was turned down. However, projects of a similar character were inaugurated in the neighboring states of Iowa, Minnesota, and Missouri in the years of 1937 and 1938. During the winter of 1939 and 1940 the writer again worked out detailed plans for the setting up of a Wisconsin project of whole-farm demonstrations in cooperation with TVA and this time we modeled our procedure after the pattern followed by the states of Missouri and Iowa. Agreements between the Extension Service of the Wisconsin College of Agriculture and the Tennessee Valley Authority were drawn up and formally executed. Agreements between the Extension Service of the College of Agriculture, the county agricultural agents, the agricultural committees of respective counties, and individual farmer cooperators were drafted and signed by respective parties. Interdepartmental questions of administrative responsibility were settled and the program was finally launched. Some 45 farm cooperators were selected in three Wisconsin counties as a start in 1940.

The program was expanded in 1941 with nine additional counties coming into the project. At present, we are operating in 33 counties with a total of more than 400 farmers cooperating. An over-all state supervisor employed jointly by the Tennessee Valley Authority and the Extension Service of the College of Agriculture was appointed in 1941. For the past five years this man, Forrest Turner, has done a splendid job in the coordination and supervision of this work.

The value of these whole-farm test

demonstrations as a medium of extension education has been tremendous. The transformation that has taken place on many of the farms in the program has been recorded in almost unbelievable accomplishments. Crop production on many of these farms has been more than doubled. From timothy and quack grass to abundant crops of clover and alfalfa that fill haymows to capacity! Corn cribs and granaries filled to overflowing! New additions on the barns, remodeled and new farm homes! New furniture and household conveniences! And added income that is making possible opportunities for advanced education for the boys and girls in these farm homes!

All of these improvements and new opportunities came out of the same old farm, the same old fields. The same farmers and their families are working these farms. Lime and the liberal application of phosphate and potash fertilizer have literally worked miracles.

The Tennessee Valley Authority in its broad approach to the problems of soil conservation and the regeneration and rebuilding of the farms in this country has centered its great program around the well-established concept that the depletion of the available reserves of phosphorus in our soils was more responsible for crop failures and declining yields than any other single factor. We all recognize the tremendous toll which erosion has taken in a century and a half of careless farming. But by and large, the world over, the exhaustion of soil phosphorus is the number one basic cause of low yields and poor quality in our crops. True, soil acidity and the lack of available calcium and potassium have been partly responsible for the declining productiveness of our soils. In the wake of the combined lack of these major minerals and certain other minor trace elements, clover and other legumes ceased to flourish and in turn we were faced with a state of nitrogen starvation in our pastures and cultivated fields.

Available Potassium Supply Becoming Short

For years in Wisconsin prior to the setting up of our whole-farm demon-

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Fig. 4. This photo, taken back in 1917, shows one of several hundred test plots on potatoes. In these test plots some six or eight different fertilizer ratios and combinations of N-P-K were used. Invariably, the complete mixture with potash gave the largest yield. The 4-10-4 plot, left, yielded 354 bushels per acre as compared to the check plot which yielded only 216 bushels per acre. These plots were on the farm of R. H. Clark, Tomahawk, Wisconsin.

Fig. 1. J. W. Nelson, farmer in the Dugdemona Soil Conservation District near Ruston, La., says this improved hop, Persian, and white clover is worth $12 an acre to him in his dairying operation. In building the pasture, Nelson applied a ton of lime, 200 pounds of 20 per cent superphosphate, and 100 pounds of 50 per cent muriate of potash per acre.

Analyzing the Soils of Northwest Louisiana

By Lester L. Loftin

Soil Conservation Service, Shreveport, Louisiana

AT THE REQUEST of soil conservation district cooperators for information on the mineral deficiencies of their farms, in 1944 Soil Conservation Service technicians in Louisiana started taking soil samples and sending them to the State Experiment Station soils laboratory for analyses and fertilizer recommendations. So far, more than 600 samples have been taken in the four soil conservation districts of northwest Louisiana. These include samples of practically all the soils of both the basic land resource areas—Forested Coastal Plain and Red River Bottomland—that make up the four districts.

These analyses reveal that the amount of erosion the land has suffered, the crops that were grown, and the amount and kind of fertilizer that was used directly influence the amount of nutrients available in a soil for plants to use. They reveal also that most farmers living on hill land of the Forested Coastal Plain don't use enough fertilizer to meet the nutrient requirement of plants for proper growth. They show, in addition, that some farmers in the Red River Bottomland use fertilizers they don't need for crop production while others fail to use a necessary fertilizer.

The soils of the Forested Coastal Plain hills generally are deficient in phosphorus, potassium, and calcium. The average amount of available phosphorus and potassium is about half enough for proper plant growth. Where the available calcium—lime—is too low, as happened in many cases, plants can't gather enough of it from the soil to transmit it to animals. Bone structure suffers. The Forested Coastal Plain soils in this section are slightly to moderately acid. Many of these soils are in the acidity range that is most desired for general field crops.

The laboratory's average fertilizer recommendations for the hill soils of the Forested Coastal Plain with the fertilizer analysis are:

Cotton: 400 pounds of 4-8-8 fertilizer, side-dressed with 100 pounds of nitrate of soda or equivalent an acre.

Corn: 300 pounds of 4-8-8, side-dressed with 200 pounds of nitrate of soda or equivalent an acre.

Oats: 300 pounds of 4-8-8, top-dressed with 200 pounds of nitrate of soda or equivalent an acre.

Clover-grass pasture: None to 4,000 pounds of limestone, 400 to 500 pounds of 20 per cent superphosphate, 100 pounds of 50 per cent potash or equivalent an acre.

Lespedeza-grass pasture: None to 2,000 pounds of limestone, 400 to 500 pounds of 20 per cent superphosphate, 100 pounds of 50 per cent potash or equivalent an acre.

It is estimated that the annual plant-food requirement that should be met through the application of fertilizer in the State of Louisiana is 30,000 tons of nitrogen, 50,000 tons of phosphoric acid, and 40,000 tons of potash. But in the year ended August 31, 1945, only 17,200 tons of nitrogen, 11,000 tons of phosphoric acid, and 6,000 tons of potash were used. The need is for twice as much nitrogen, five times as much phosphoric acid, and seven times as much potash.

The Red River Bottomland soils, according to the analyses, run exceptionally high in available phosphorus and calcium; nevertheless, many river farmers use phosphate fertilizer and occasionally lime on their soils. The only river soils deficient in phosphorus are those that have been influenced by some stream coming into the river bottom from the Forested Coastal Plain area. The samples show that practically all the river soils are deficient in potash; however, very few farmers are using potash even though they are growing considerable alfalfa, a heavy user of that fertilizer. About the only samples showing sufficient potassium were taken on newly cleared land or from old house sites.

The average fertilizer recommendations for the river bottomland soils are:

Cotton: 75 pounds of 50 per cent muriate of potash, side-dressed with 200 pounds of nitrate of soda or equivalent an acre.

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Fig. 2. The Soils Laboratory at Louisiana State University took samples which proved this farm of Dan Logan's in the Upper West Red River Soil Conservation District close to Shreveport needed soil amendments. Mr. Logan, shown here in a field of hybrid corn, put out 300 pounds of 6-8-8 fertilizer per acre before planting the crop. Later he side-dressed with 400 pounds of nitrate of soda per acre. In spite of an exceedingly wet year in 1946, Logan harvested 60 bushels of corn per acre.

Minor Plant Nutrients[1]

By H. P. Cooper

Dean and Director, Clemson Agricultural College, Clemson, South Carolina

(Reprinted from Commercial Fertilizer, *January 1947)*

IT is now generally accepted that a large number of elements may be effective in the nutrition of plants. The nutrients are sometimes classed as major nutrients, including the three primary and the secondary, and minor nutrients, depending upon the significance of the various nutrients utilized by plants grown under different conditions.

In the manufacture of the fertilizers containing the three primary nutrients, nitrogen, phosphorus, and potassium, considerable quantities of the secondary relatively strong nutrient ions such as sodium, calcium, chlorine, and sulphur may be added as constituents of certain fertilizer materials. These secondary nutrients may play a very important role in the nutrition of some plants under certain conditions.

Relation of Relative Strength of Ions to the Intensity of Absorption of Certain Nutrients

In considering the major and minor plant nutrients, it may be desirable to note the relationship between the relative strength of ions and the selective absorption of the stronger ions by most plants. Since plants tend to absorb selectively nutrient ions according to relative strength rather than concentration, it is possible to predict the probable relative quantity of ions of different strengths which may be absorbed by many plants. Where comparable concentrations of nutrients are present in the medium, the expected average quantity of materials in a large number of plants would be in agreement with the relative strength of ions. Certain plants which tend to accumulate relatively large quantities of certain nutrients and the partial exclusion of some nutrients by some plants or tissues may be considered as an exception to this generalization. The arrangement of plant nutrient elements in order of relative strength of their ions from the strongest cation material to some of the stronger anion materials are included in Table 1.

Use of Energy Properties of Nutrient Ions in Soil Fertility and Nutrition Studies

The principal difference between inorganic and organic matter is the stored potential energy in the organic compounds. In order to secure a better understanding of the principles involved in plant nutrition, it is highly desirable that consideration be given to the energy properties of nutrient ions utilized by plants. The normal electrode potential, which is a measure of the intensity factor of energy of ions, is one of the most significant properties of nutrient ions to consider in studying the nutrition of plants and animals. The sign of the potential is opposite the pole sign.

Data in Table 1 represent averages for a large number of chemical analyses of different food-plants grown under varying conditions. This type of information may not be applicable to many specific situations, but it will serve to illustrate some of the most common nutrients utilized by many plants. It is noted that there is a close correlation between the relative strength of ions and the probable intensity of absorption and utilization of the various

[1] Technical Contribution No. 141, South Carolina Agricultural Experiment Station, Clemson, S. C.

nutrients by plants. It is generally accepted that there is little relation between the concentration of nutrient ions in the soil colloidal complexes and the absorption of the different ions. The relative strength of ions seems largely to determine the intensity of the absorption of most nutrient ions. There is less of the stronger sodium ion utilized by plants than the weaker calcium ion. This is probably due to the relatively low concentration of sodium ions in many of the soils in humid climates where the concentration of calcium is much higher than sodium. The relatively high content of iron in the plants in relation to strength of ions may be related to the relatively large quantity of iron in most soils. The technique followed in iron determinations may show more iron than is utilized as a nutrient. Much of the iron reported may be due to iron adhering to the surface of plant tissue, iron from mill used in grinding plant materials, or iron as impurities in chemicals used in making determinations. The major plant nutrients are expressed as per cent or parts per hundred; whereas, the minor nutrients are often expressed as parts per million. The three primary constituents of commercial fertilizer are nitrogen, phosphorus, and potassium. These three nutrient materials form some of the strongest ions utilized by plants. The secondary nutrients included in many of the mixed fertilizers are sodium, calcium, magnesium, and chlorine.

In mixed fertilizers the quantities of nitrogen, phosphorus, and potash are guaranteed, but there is usually no guarantee of the quantities of sodium, calcium, chlorine, or sulphur, which also form strong ions and may be absorbed in relatively large quantities, and may have a major role in the nutrition of plants under certain conditions.

The four latter materials may or may not constitute a significant proportion of the mixed fertilizer, depending upon

TABLE 1

THE ARRANGEMENT OF METALLIC NUTRIENT ELEMENTS IN ORDER OF ELECTRODE POTENTIALS OR THE ORDER OF THE RELATIVE STRENGTH OF THEIR IONS FROM THE STRONGER CATION MATERIAL TO THE STRONGER ANION MATERIALS.
THE MAJOR NUTRIENTS ARE EXPRESSED AS PER CENT OF DRY MATTER AND MINOR NUTRIENTS EXPRESSED AS PARTS PER MILLION.

Arrangement of Nutrients in Order of Strength of Ions		Average Chemical Composition of a Large Number of Plants
Materials	Normal Electrode Potentials in Volts	
Potassium*	+2.93	2.14 per cent or parts per hundred
Sodium[2]	+2.70	0.70 per cent or parts per hundred
Calcium[2]	+2.50	0.88 per cent or parts per hundred
Magnesium[2]	+1.55	0.31 per cent or parts per hundred
Manganese	+1.09	101 parts per million
Zinc	+0.76	41 parts per million
Iron	+0.43	251 parts per million
Copper	−0.40	11 parts per million
Boron		39 parts per million
Sulphur[2]		0.30 per cent or parts per hundred
Phosphorus*		0.34 per cent or parts per hundred
Chlorine[2]		0.70 per cent or parts per hundred
Nitrogen*		2.63 per cent or parts per hundred

*Primary fertilizer nutrients. [2] Secondary fertilizer nutrients.

the material from which the mixed fertilizer is made. Where such materials as mono- and dicalcium phosphate, ammonium sulphate, sodium nitrate, and muriate and sulphate of potash are used, sufficient quantities of these elements may be included in the fertilizer to supply the annual requirements of the crop being fertilized. However, where such concentrated materials as ammonium nitrate, ammonium phosphate, potassium phosphate, and urea are used in formulating high analysis grades of fertilizer, including 30 to 50 per cent or higher plant-food content, such nutrients as calcium, magnesium, sulphur, and chlorine may be deficient and become limiting factors in the production of crops. In many cases the calcium and magnesium requirements are being met by the application of limestone to the soil or through the inclusion of dolomitic limestone in the production of non-acid-forming fertilizers.

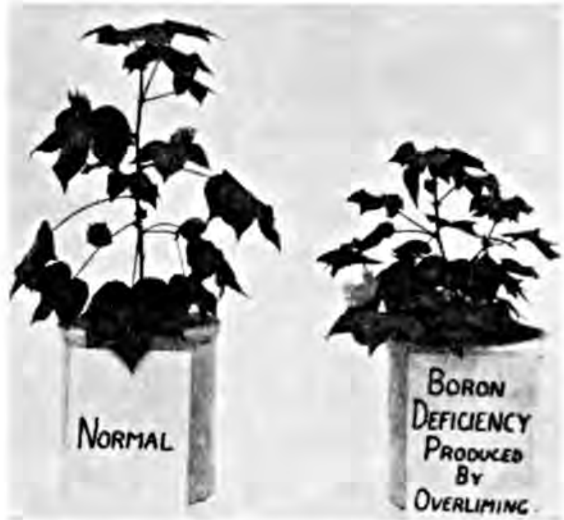

Fig. 1. The cotton plant on the left is normal, but the plant on the right shows boron deficiency. Note the low plant, short internodes, and profuse branching. Most of the fruit buds abort and few mature bolls are formed. (Grady sandy loam)

Soil Conditions Influencing Availability of Minor Plant Nutrients

The minor metallic nutrients such as manganese, zinc, iron, and copper and other minor non-metallic nutrients such as boron are not generally included in mixed fertilizers. Until recently little direct effort has been made to determine the conditions influencing the availability of minor nutrients in different soils. Alkali, over-limed, and strongly acid soils are likely to be deficient in certain minor plant nutrients. On many of the strongly acid, highly leached soils the minor plant nutrients are often the limiting factor determining the yield of crops. It is, therefore, becoming increasingly important that greater attention be given to the need for various minor nutrients on the different soils and to the quantity and form to apply under the varying soil conditions for certain crops.

On soils with a relatively high pH value or high in limestone there is often an accumulation of insoluble compounds of metallic elements forming relatively weak ions such as manganese and iron. The accumulation of such materials is related to the relatively low solubility of the carbonates, hydroxides, or oxides of these elements; whereas, there is a loss through leaching of soluble compounds on strongly acid soils with a relatively high content of sulphate, chloride, or nitrate ions. The solubility value of the different minor nutrients is included in Table 2. Any cultural treatment resulting in a large change in the pH value of a strongly acid, highly leached soil may significantly change the solubility and availability of most of the metallic minor nutrients.

The increased use of lime on our soils and the resulting higher crop yields requiring a larger supply of nutrients, and the direct effect of additions of limestone to the soil on decreasing the solubility and availability of the minor nutrients will call for a program to supply minor plant nutrients to our soil or directly to the plants as in sprays.

As the minor plant nutrients including such materials as boron, manganese, zinc, iron, cobalt, and copper may be deficient elements in the growth of certain crops under some conditions, it is desirable to consider the solubility of certain nutrient salts. Relatively large

TABLE 2

SOLUBILITY OF CERTAIN MINOR PLANT NUTRIENTS IN GRAMS OF ANHYDRIDE PER 100 GRAMS OF COLD WATER
TEMPERATURE AROUND 20 DEGREES CENTIGRADE OR AS INDICATED.

Ion	Carbonate CO_3	Hydroxide OH	Phosphate PO_4	Sulphate SO_4	Chloride Cl	Nitrate NO_3
Magnesium....Mg	0.0106	0.0009	0.0205	26.0°	35.3	42.33
Manganese....Mn	0.0065	0.0002	sl. s.	52.0	62.2	426.4°
Zinc...........Zn	0.001	0.00000026	i	86.5°	432.0	327.3^{40}
Iron...........Fe	0.0067	0.00067	i	15.65	64.4	83.5
Cobalt.........Co	i	0.00032	i	36.2	45.0^{7}	133.8°
Copper........Cu	i	i	i	14.3°	70.6°	137.8°

quantities of some of the minor plant nutrients such as boron, manganese, and iron may be toxic if excessive amounts are soluble in the soil. The solubility and the availability of these elements are determined largely by the soil reaction. Under most conditions nutrients reach an equilibrium and the soil complexes are favorable for the dominance of certain types of plants. Fertilizer and liming treatments may significantly modify the solubility and the availability of the various nutrients to certain plants.

Solubility of Minor Nutrient Compounds

Since the minor plant nutrient elements are most likely to be deficient in alkali, alkaline, over-limed, and strongly acid soils, it is desirable to consider the solubility of minor nutrient compounds. The lack of solubility and availability of the metallic minor nutrients in the presence of larger quantities of the stronger metallic ions in the soil solution may be the limiting factor in crop production on many soils. The deficiency of the total quantity of metallic minor nutrients in strongly acid soils is usually due to the solubility and leaching from the soil of the limited quantity of the minor nutrients which accumulate in strongly acid soils. The data in Table 2 showing the solubility values are very helpful in predicting the availability of the different metallic minor nutrients in the soils of various origin. The data on solubility values indicate the reason for relating the availability of metallic minor nutrients with the pH of the soil, applications of limestone, phosphorus, sulphate, chloride, and nitrate. The addition of limestone to the soils increases the carbonate and hydroxide content of the soil and may significantly decrease the solubility and availability of certain of the minor nutrients to plants. The addition of large amounts of phosphorus to the soil may markedly reduce the solubility and availability of such nutrients as zinc, iron, cobalt, or copper; whereas, the additions of large quantities of sulphate, chloride, or nitrate may markedly increase the solubility and availability of these nutrients.

These solubility values are very useful in predicting the soil conditions determining the desirability of adding minor nutrients in commercial fertilizers. The more general use of limestone on Southern soils has resulted in a critical deficiency of minor nutrients in many situations. The availability of the minor nutrient most widely affected by liming in this area is boron. There is a widespread deficiency of boron on soils heavily limed for the production of such legume crops as alfalfa. In addition to legume crops, the root and tuber crops such as beets, turnips, carrots, and potatoes may show a marked yield response to additions of boron.

The relatively low intensity of absorption and the relatively low mobility of the minor nutrients in tree plants suggest the necessity and desirability of applying some of the minor nutrients such as zinc, iron, and cobalt, which form insoluble compounds as hydroxides, carbonates, and phosphates in the soil, in spray solutions to foliage for best results. The very low solubility of zinc hydroxide suggests one of the reasons for the low availability of zinc in alkaline soils or soils with a relatively high pH value and a high concentration of hydroxyl ions.

Boron Deficiency

The boron content of soils varies from toxic quantities in arid regions to a marked deficiency as occurs in some of the heavily limed, highly leached soils in the Atlantic Coastal Plain region. The addition of large quantities of limestone to some of the strongly acid soils may result in a marked deficiency of boron.

The cotton plants in Figure 1 show a deficiency of boron induced by overliming. Boron deficiency in the cotton plant is characterized by short internodes and profuse branching of plants. Most of the fruit buds abort and few mature bolls are formed.

Fig. 2. The sweet potato vine on the bottom is normal while the one at the top is boron deficient. Note the short internodes, curled petioles, and distorted terminal bud on the vine showing boron deficiency.

Dr. C. J. Nusbaum at the Edisto branch of the South Carolina Experiment Station has studied the response of the sweet potato plant to addition of boron in different fertilizer combinations. The picture in Figure 2 shows the contrast between the normal plant and a plant showing boron deficiency. Vine shown at the top of the picture is from a boron-deficient plant, while that at the bottom is from a normal plant. Note the short internodes, curled petioles, and distorted terminal bud on plant showing boron deficiency.

A photograph showing the comparative yield of No. 1 sweet potatoes from three adjacent borax treated plots in a low lime, high potash series is shown in Figure 3. The highest yield was obtained from the application of 5 pounds of borax per acre. The yields of marketable potatoes for no borax, 5, 10, 20, and 30 pounds of borax per acre are 153, 235, 186, 159, and 133 bushels per acre respectively. The details concerning these experimental data are published in the Fifty-Seventh Annual Report of the South Carolina Experiment Station.

Solubility of Boron Compounds

The solubility values for the different boron compounds included in Table 3 suggest the probable effects of additions of lime on the solubility and availability of the boron in the soil. It has been observed that there is a definite quantitative relationship between the symptoms of boron toxicity and deficiency of such metallic cations as potassium and calcium in the nutrient complex. The potassium tetraborate is readily soluble in water and the presence of a large quantity of potassium in the soil will increase the solubility and availability of the boron in the soil. The presence of the available potassium would tend to increase the absorption and accumulation of boron in plant tissue. Therefore it is logical to expect that high potash fertilization may increase boron toxicity symptoms by lowering the resistance of plants to boron. This would be particularly true where there is in the soil a deficient supply of the relatively strong anions such as nitrate, chloride, or sulphate. Increasing the soluble calcium supply through liming practices may significantly depress the solubility of the boron in the soil through the formation of the relatively insoluble calcium borate. A small intake of calcium may lower the tolerance of the plant for boron, whereas an excessive intake of calcium may result in the plant having a high boron requirement.

Inclusion of Boron in Fertilizers

Since excessive quantities of soluble boron compounds may prove very toxic to certain plants, it is highly desirable to be extremely careful in including large quantities of boron in mixed fertilizers. The optimum quantity of boron for different crops may vary from the equivalent of 5 to 20 pounds of borax per acre depending upon the crop. It is not likely that the inclusion of 10 pounds of borax per ton of fertilizer would be an excessive amount for soils in humid regions where 1,000 pounds or less of fertilizer per acre are applied. Where the fertilizer application is a ton or more per acre, not more than 5 pounds of borax should be included in the fertilizer mixture for most crops. It is usually desirable to add as much as 20 pounds of borax per acre for alfalfa, particularly on soils which have been heavily limed.

Improved soil management practices and increased yields of crops very probably will make it necessary to include boron in the fertilizer for most crops. Many of our legume, root, and tuber crops such as beets, turnips, carrots, and potatoes often show a marked yield response to additions of boron to the fertilizer combination used for the different crops grown under various conditions.

Manganese

Manganese is generally recognized as one of the minor plant nutrients. It is usually widely distributed in minerals and soils and is often in association with iron, magnesium, and calcium. The acidity of the soil seems to be one of the most important factors in influencing the accumulation or the leaching of the manganese from the soil. The data in Table 1 show that manganese carbonate and hydroxide are relatively insoluble and a soil complex with a relatively high pH value will tend to accumulate insoluble manganese compounds. In the Southeastern states the chocolate, red, and brown soils often contain considerable quantities of manganese which may become soluble in toxic quantities if cultural and fertilizer practices significantly increase the acidity of such soils. On soils already acid with large quantities of sulphates, chlorides, or nitrates, soluble manganese compounds are formed as indicated by solubility values in Table 2 and may be leached from the soil in humid climates. The strongly acid gray sandy loam soils such as those found in the Coastal Plain are most likely to be deficient in available man-

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TABLE 3

Solubility in Grams of Anhydride per 100 Grams of Cold Water

Boric acid	H_3BO_3	= 5.15[21]
Potassium tetraborate	$K_2B_4O_7 \cdot 5H_2O$	= 26.70[30]
Sodium tetraborate (borax)	$NaB_4O_7 \cdot 10H_2O$	= 1.60[10]
Calcium metaborate	$Ca(BO_2)_2 \cdot 2H_2O$	= 0.31[30]

Fig. 1. With a push here and a shove there, this bulldozer operator rolls a huge boulder onto a giant, steel stoneboat.

Reshaping New England Farm Land

By A. B. Beaumont

Soil Conservation Service, Amherst, Massachusetts

UP New England way, Mother Earth is undergoing face-lifting operations which are not only improving her appearance but are making her more physically fit to meet the strong agricultural competition that is now upon us. Glacial boulders are being pushed around by the thousands, land hummocks leveled, and wet soils drained. While some woods and brush are being cleared from potentially good agricultural land, thousands of trees are being planted on non-agricultural sites. Farm ponds, also, are being constructed in a region naturally well supplied with lakes and ponds. Much of this activity in land improvement is being aided and fostered by soil conservation districts.

The trouble all along has been due to what happened to this landscape during periods of glaciation, some 25,000 to 50,000 years ago—only yesterday in geological time. That glaciation improved the soils of New England, it is generally agreed by pedologists, but every tiller of the soil of this section knows that the land surface was left in far from perfect condition. Farmers from the stone-free prairies of the Midwest are often surprised and dismayed by the numerous boulders of New England farm land. The story is told of a Midwestern farmer visiting this section for the first time. On asking a New England farmer where all the boulders came from, he was told that the glacier brought them. "Well, where is the glacier now?" "Gone back to get more boulders," was the reply. Maybe he was right.

Ten generations of New England farmers have removed many of the field stones. Most of these stones went into stone walls, partly because that was one way to get rid of them and partly because enclosures were needed. Most stone walls of this section antedate the invention of barbed wire by 100 to 200 years. The more numerous the stones, the more frequent were the walls, and the smaller the fields. Many fields or "lots" are two to five acres in area. Such small fields were all right for the period of the ox team and the hand scythe, but are an anachronism in this time of tractors, mowing machines, and pick-up hay balers.

In the old days, it was common practice for the farmer, his sons, and the hired man to "pitch in" after the harvests to "make" an acre or two of land and build a few rods of stone wall—a never-ending, back-breaking task. Nathaniel Shaler, famous geologist, estimated that by the last turn of the century as much labor had been expended in the building of stone walls in Massachusetts as had been devoted to building all the roads and all the buildings in the State. We have estimated from a measured sample that there are some 7,500 miles of interior stone walls in Massachusetts, at least two-thirds of which should be removed in the interest of modern farming methods, including the use of power field equipment and the establishment of soil conservation practices.

It is indeed a "far cry" from the simple equipment and low power used by New England farmers of several generations past to the high-powered, complicated, but effective machinery used today for land improvement. Farmers of bygone generations would stand in astonishment at the sight of modern mechanical behemoths now used. Then they had only crowbars, levers, hand shovels, perhaps a home-made capstan, and man-, horse-, or ox-power. Now they have bulldozers of different types, power shovels, draglines, improved stone-boats, and dynamite. I stood in amazement a while ago as I watched a skilled operator with a powerful bulldozer push a 10-ton boulder out of the soil and onto a large steel stone-boat and then hitch to the stone-boat and drag the boulder away.

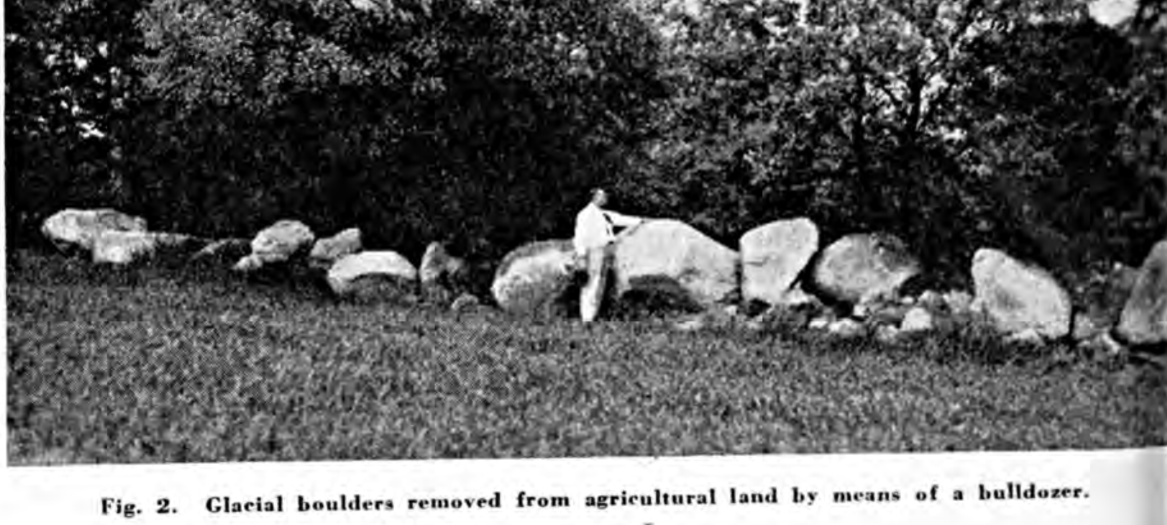

Fig. 2. Glacial boulders removed from agricultural land by means of a bulldozer.

Fig. 3. A dragline does the "dirty" work in large drainage ditch construction.

It is surprising, though, to see what large boulders were moved and placed in stone walls by farmers of earlier periods. But many stones left by former generations of farmers, because they had no means for moving them, are now being moved easily with modern mechanical giants. Some of the larger boulders, and also rock outcrop, are being broken with dynamite before removal. An old practice with respect to huge boulders was to dig holes close by the side of them and then pry them into the excavations. This was a dangerous practice, sometimes causing injury or death. A similar procedure is sometimes employed now, using a bulldozer or power shovel for digging the hole, and there is practically no danger connected with it.

Unfavorable topography is another New England handicap to modern stream-lined farming methods. While glaciation generally softened and smoothed a rough and jagged preglacial topography, there still remain hills and valleys, knolls and slopes, to which square and rectangular fields are no better fitted than is a square peg to a round hole. Small fields make a bad situation worse. Enlargements of fields by removing stone walls are making it possible to fit the fields to the land rather than attempting the impossible of fitting the land to the fields. It has taken New England farmers a long time to realize the importance of the former and the futility of the latter. Contour-planted rows and strips, sweeping in graceful curves across slopes and around hills, are now appearing on New England farm land, adding charm and beauty to a naturally attractive landscape.

In order that New England farmers may successfully compete with farmers on land more favored by nature, it is increasingly necessary that New England farm land be reshaped for the use of modern farm machinery. This is not a new idea,—farmers of this section have done it more or less since the days when they first began removing boulders. But in recent years the amount and the tempo of such work have been markedly stepped up. In a small way the work of glacial forces of thousands of years ago is being undone, and, oddly, the energy stored in the earth in an earlier geological age, in petroleum, is being largely used for the purpose. Powerful machinery actuated by the internal combustion engine is doing the job instead of the hand labor of generations past.

There is no standard procedure or method in the modern disposal of stones. Each farm is an individual case. Disposal is easy and inexpensive when there is a ravine or swamp nearby, into which the stones may be pushed or hauled on truck or stone-boat. Sometimes, as in the case of a stone wall, a deep trench may be dug with power shovel or bulldozer and the stones buried and covered with at least two feet of soil. Some stones are used to build foundations for farm roads or highways. Sometimes they are simply pushed to the side of a field with no particular consideration for future developments. Such disposal is often unsightly and may later cause trouble. There should be a well-conceived plan for each case of stone removal. Technicians of the Soil Conservation Service assisting district supervisors are rapidly accumulating a body of knowledge of the best methods and procedures in this type of land improvement.

Farmers are spending up to $150 per acre for stone removal. It is hard to justify some current stone removal on economic grounds, but that was also true in the past. However, in the past practically all the work was done by farm help at odd times, and there was little or no cash outlay. Even with a large cash outlay many farmers justify investing more in the improvement of their own land than comparable improved land at a distance from their farms could be bought for, on the basis that they already have a certain overhead in buildings and equipment and that the nearby land helps make a more efficient operating unit. But some farmers, particularly wealthy industrialists to whom farming is a sideline, are investing more money in land improvement than appears justifiable from an economic standpoint.

According to records taken by C. R. Creek of the Massachusetts Experiment Station, it cost $45 to $135 per acre to remove boulders from a rough pasture with a bulldozer, as a first step in land improvement. An additional $10 per acre were spent in picking up smaller stones in preparation for seeding. Scattered stones were pushed off hay, corn and vegetable land at costs ranging from $20 to $85 per acre. All this work was done with privately contracted equipment. In Vermont, where equipment is operated by soil conservation districts, costs of similar work have been reported somewhat lower than those above.

Mr. Creek has reported costs of stone wall removal at 85 cents to $1.10 per linear yard, where a trench was dug with a gas shovel and stones were pushed into it with a bulldozer. Somewhat lower costs have been reported in Rhode Island when the stones of a wall were pushed onto a giant steel stone boat and hauled to a nearby swampy area for disposal. The steel stone-boat in this case was designed by technicians of the Soil Conservation Service and can carry a load of 10 to 15 tons of stone. It can be used for transporting large field boulders as well as the smaller stones of walls. Stone walls are also removed by loading them into trucks with a power shovel and then

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Fig. 4. Terraced and contoured tobacco in the Connecticut Valley.

Fig. 1. A common sight in Aroostook County potato fields at time of blossoming. A favorable combination of weather, soil, and adequate fertilization results in luxuriant growth of vines and high yields of tubers.

Fertilizing Potatoes Economically in Aroostook County, Maine

By G. L. Terman and Arthur Hawkins[1]

Agricultural Experiment Station, University of Maine, Orono, Maine

MAINE currently produces more potatoes than any other state in the United States. Of the total output in Maine, Aroostook County produces about 85 per cent. In addition to high total production, the average acre yield of potatoes for Aroostook County is higher than that for any state. The reasons for this high acre yield and high total production include a combination of favorable conditions for growing potatoes, such as cool temperatures, sufficient precipitation for good crops in most years, suitable soils, the use of good seed, and adequate fertilization. During the war period prices have been favorable and most potato farmers have been "pouring on" the fertilizer. It is their opinion that, since fertilizer costs make up only a small portion of the total production costs, there is no point in taking a chance that fertilizer will be the limiting factor in determining the yield per acre.

It was estimated from a study made in Aroostook County in 1940 and 1941 that the average fertilizer application for each crop of potatoes grown was approximately equal in plant-food con-

[1] Agronomist, Maine Agricultural Experiment Station, and Associate Soil Scientist, Division of Soils, Fertilizer, and Irrigation, U.S.D.A., respectively.

tent to 2,000 pounds of a 5-9-11 fertilizer per acre. This is, of course, a much higher rate than is normally applied for potatoes in most other areas, with the exception of certain states farther south along the Atlantic and Gulf Coasts.

The question of what effect the high rates of fertilizer application have had on the soil and the perhaps more practical question of whether the rates and analyses of fertilizer used are the most economical ones might be raised. During periods of high net returns this latter question might not be too important. With the prospect in the near future of the necessity of lowering production costs, however, the question assumes more important proportions.

Soil Fertility Survey of Potato Soils

In an attempt to obtain some of the answers, a coordinated attack was made upon the problem by the Maine Agricultural Experiment Station in cooperation with the Bureau of Plant Industry of the U. S. Department of Agriculture. This study was part of a regional study of potato soils [2] conducted by the various states along the Atlantic and Gulf Coasts and the Division of Soils, Fertilizers, and Irrigation of the Bureau. As an approach to the problem in Maine, a soil fertility survey of three potato-producing areas in Aroostook County was made in 1944. The areas surveyed were the central Aroostook area, Fort Kent in the northern part, and the Sherman area in the southern part of the County. At the time soil samples were taken, there was obtained from the farmer an estimate of the number of times his land had been cropped to potatoes during the past 10- or 20-year period and the amount of fertilizer that had been applied to the land in those periods. The amounts estimated were in fairly close agreement with the rates of application found in the study made in 1940 and 1941. The samples of soil taken were

[2] Proceedings of the Soil Science Society of America 10:240-256. 1945.

TABLE 1. ESTIMATED AVERAGE AMOUNT OF PLANT NUTRIENTS APPLIED IN FERTILIZERS PER ACRE FOR POTATOES IN AROOSTOOK COUNTY, THE AMOUNT REMOVED IN A 400-BUSHEL CROP OF TUBERS, AND THAT LEFT IN THE SOIL

Plant nutrient	Applied for the crop lbs.	Removed in tubers lbs.	Left in the soil	
			Lbs.	%
Nitrogen (N)	100	80	20	20
Phosphorus (P_2O_5)	185	20	165	89
Potassium (K_2O)	225	130	95	42
Calcium (CaO)	180	3	177	98
Magnesium (MgO)	36	10	26	72

analyzed for acidity, organic matter, readily soluble phosphorus, exchangeable potassium, and other exchangeable bases.

It was found from the survey that as a result of heavy fertilization of potatoes, there had been a very great residual accumulation of certain plant nutrients in the soil, notably phosphorus and potassium. The accumulation of these nutrients was directly related to the amounts applied in the fertilizer for each crop and the frequency of cropping to potatoes. That is, where erosion was not serious and the farmer had cropped his land frequently to potatoes—practically every year, in two years out of three, or one year in two—the content of residual plant food in the soil was much greater than where he had followed a system of cropping the land to potatoes once in three years or less frequently. Very little or no fertilizer is applied to other crops in the rotation in Aroostook County as compared to the amount applied for potatoes.

The accumulation of fertilizer residues may be explained by the difference in the amount of plant food applied in the fertilizer for potatoes and

Fig. 2. On soils high in residual phosphorus, good growth and high yields of potatoes can be produced with fertilizer containing no phosphorus. Plots fertilized with 2,000 pounds of 5-0-10 per acre in this field test in 1946 yielded 509 bushels per acre, while those fertilized with 2,000 pounds 5-6-10 yielded 575 bushels.

that removed in the tubers. The amount of plant food in the vines is not concerned, since they are left on the land and their content of plant food is largely returned to the soil. As shown in Table 1, only 11 per cent of the phosphorus applied in the fertilizer is removed by a 400-bushel crop of tubers, while 89 per cent is left in the soil. Similarly, 58 per cent of the potassium is removed in the tubers, while 42 per cent is left in the soil. With calcium and magnesium, too, only a small portion of these nutrients added in the fertilizers is removed by potatoes. Besides being added in the fertilizer, calcium and magnesium are also added to the soil in large amounts by liming with ground dolomitic limestone, the liming material most commonly used in Aroostook County.

The amounts of plant nutrients remaining in the soil are the result of several factors. In Table 1 only the amounts removed in the tubers are considered. Removal by other crops in the rotation, soil erosion, and leaching also reduce the portion of the total amount applied which remains in the soil. It is commonly known that relatively small amounts of phosphorus and potassium are leached from the soil in relation to the amounts applied, while relatively large amounts of calcium and magnesium are removed in this manner. This accounts in large part for the lack of any considerable build-up of calcium or magnesium in a well-drained soil under humid conditions.

Residual Plant-food Content of Aroostook Soils

Results from the fertility survey showed soils ranging from 25 to 609 pounds of readily soluble P_2O_5 per acre (expressed as pounds per 2,000,000 pounds of soil, as determined by the Truog method), with about 39 per cent of the samples falling in the range of 101 to 200 pounds, 16 per cent below this amount, 42 per cent in the range of 201 to 450 pounds, and only 3 per cent above 450 pounds. The average content of readily soluble P_2O_5 in uncleared soils of Aroostook County is about 35 pounds per acre. As to the exchangeable (available) potassium content, the soils ranged from 38 to

1,036 pounds K_2O per acre (2,000,000 pounds of soil) with only a few samples falling below 100 pounds. Compare this range with an average content of 70 pounds exchangeable K_2O per acre in virgin soils. From these comparisons it may be seen that practically all of the soils that have been cropped to potatoes, with a few exceptions, are more fertile with respect to content of phosphorus and potassium than are similar soils which have never been cropped.

In following up the findings of the fertility survey, well-replicated fertilizer experiments were located in 1945 and 1946 on soils considered to be low, medium, and high in their content of residual P_2O_5 and K_2O for growing potatoes. Many fertilizer experiments had been conducted prior to 1945, but little attempt had been made to relate the fertility level of the soil to the response of potatoes to fertilization with P_2O_5 and K_2O. For readily soluble phosphorus, the arbitrary divisions made were: low, less than 250 pounds P_2O_5 per acre; medium, 250 to 450 pounds; and high, more than 450 pounds. For exchangeable potassium, the divisions made were: low, less than 300 pounds K_2O per acre; medium, 300 to 500 pounds; and high, more than 500 pounds. All fertilizer mixtures were applied in side-bands with a two-row potato planter with fertilizer attachments specially constructed to insure uniform application. Rows were spaced 34 to 36 inches apart and seed pieces planted nine inches apart in the row.

TABLE 2. RELATIVE RESPONSE OF POTATOES IN 1945 TO P_2O_5 ON SOILS HAVING DIFFERENT LEVELS OF RESIDUAL P_2O_5.

Fertilizer treatment Pounds per acre of $N-P_2O_5-K_2O$	Relative[1] response to fertilization		
	Soils low in P_2O_5 (Av. 4 tests)	Soils medium in P_2O_5 (Av. 4 tests)	Soils high in P_2O_5 (Av. 3 tests)
100– 0–200...	....	....	94
100– 40–200...	96	91	97
100– 80–200...	98	96	100
100–120–200...	97	97	98
100–160–200...	100	100	100
100–200–200...	100	....	....

[1] Average yields for 2,000 pounds of 5-8-10 fertilizer taken as 100 are: low soils—383, medium soils—328, and high soils—342 bushels per acre. These differences are due to differences other than soil fertility, such as location, weather, variety, etc.

TABLE 3. RELATIVE RESPONSE OF POTATOES IN 1945 TO K_2O ON SOILS HAVING DIFFERENT LEVELS OF RESIDUAL K_2O.

Fertilizer treatment Pounds per acre of $N-P_2O_5-K_2O$	Relative[1] response to fertilization		
	Soils low in K_2O (Av. 2 tests)	Soils medium in K_2O (Av. 3 tests)	Soils high in K_2O (Av. 6 tests)
100–160–100...	96	97	100
100–160–150...	98	99	101
100–160–200...	100	100	100
100–160–250...	98	98	99
100–160–300...	98	100	99

[1] Average yields for 2,000 pounds of 5-8-10 fertilizer as 100 are: low soils—400, medium soils—363, and high soils—308 bushels per acre. These differences are due to differences other than soil fertility, such as location, weather, variety, etc.

Results from Fertilizer Experiments in 1945

In 1945, eleven rate tests of P_2O_5 were completed, as well as eleven of K_2O. In this year two of the tests were located on soils considered to be low in readily soluble P_2O_5, six on soils rated as medium, and three on soils high in P_2O_5. In Table 2 is given the average relative response of potatoes to fertilization with P_2O_5, based on the above grouping. The rather low response to applied P_2O_5 on soils of all levels of available P_2O_5 may be noted. The lack of any appreciable response to P_2O_5 in one of the two tests on soils

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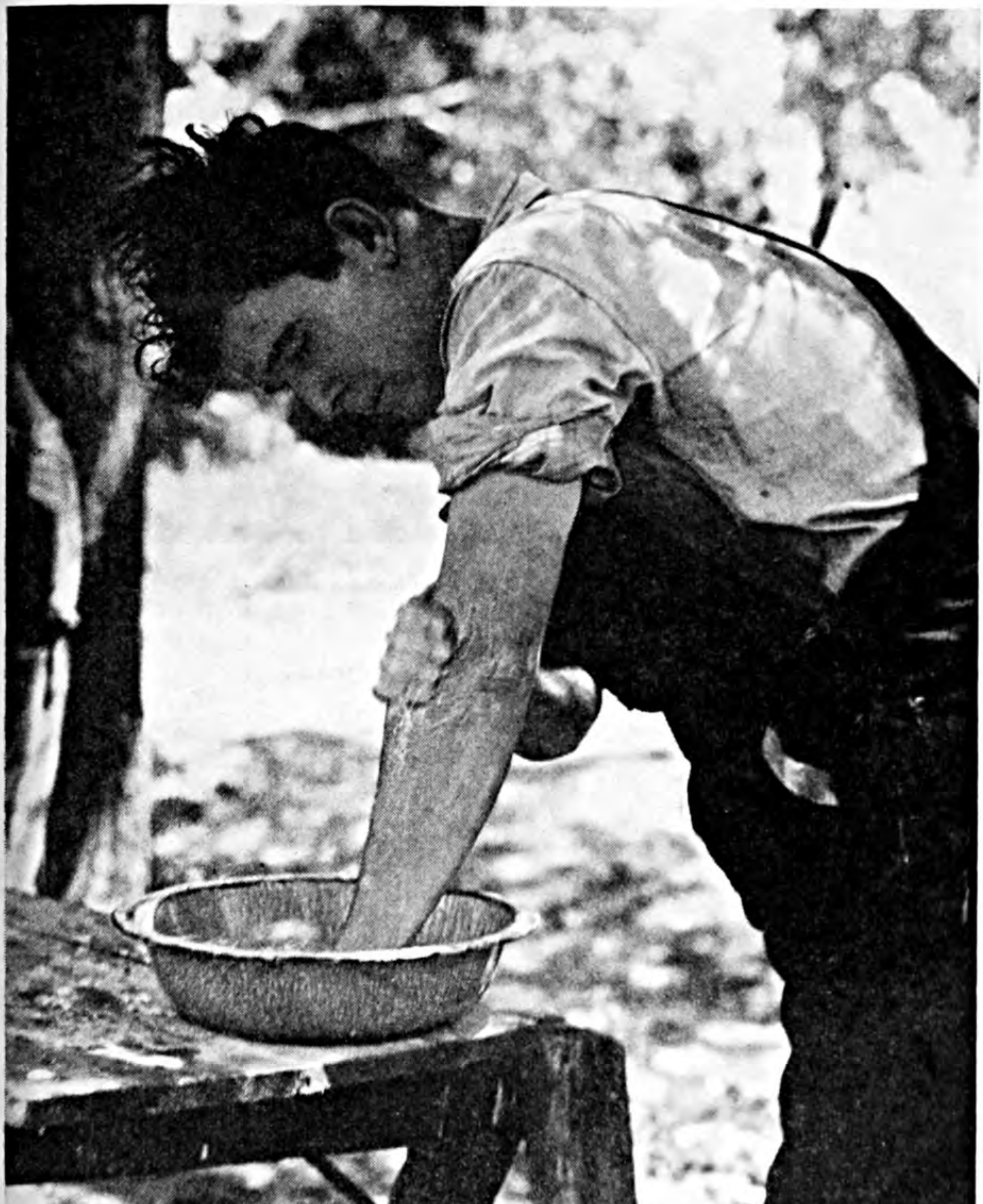
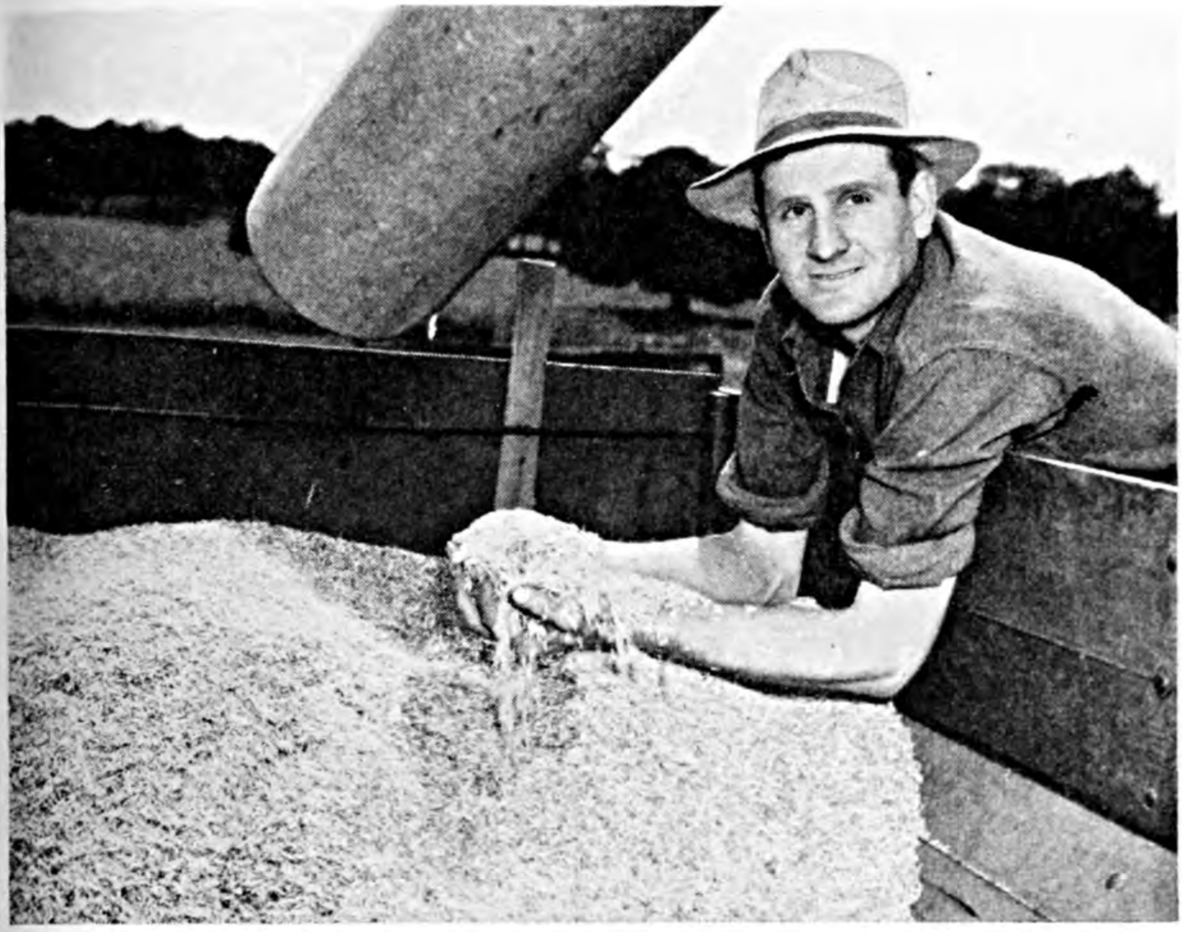
PICTORIAL



WASHING UP!

Above: **At work again after the mid-day siesta.**

Below: **Shadows on a by-way in the Midwest.**



Above: A good thresh is quantity plus quality.

Below: Bumper crop left wheat on the ground.

Hoosier farmers believe in seeing how the other fellows do it. After a picnic dinner at Frankfort, Indiana (above), this Farm Management Tour made a stop at the nearby farm of George Rothenberger (below).

The Editors Talk

Limiting Factors

In our striving for higher yields and greater efficiency of production, new problems which in the past have been given little consideration are being met. It usually has been thought that such factors as sunlight, carbon dioxide, and oxygen were practically limitless so far as crop-producing needs were concerned and should such not be the case, there was nothing that could be done about it. With the recent development of improved varieties of crops, heavy fertilization, and thick crop stand or population in order to gain the maximum production per unit of land, it looks as though these "limitless" factors may become limiting.

Investigations now under way cause one to wonder if sunlight can be a limiting factor when corn or other crops are thickly planted. A way around this has been suggested by interplanting crops of different heights so as to allow light to reach more of the plants and also to permit more circulation of air. Work in several states in the Midwest and South is underway based on the idea that heavy populations of corn on one acre and soybeans on another acre may not give as good results as interplanting the two on two acres. These investigations look very promising although conclusions cannot yet be made.

Other work underway involves means for increasing soil aeration. Lysimeters which formerly were used to measure leaching and water movement are now being used also to study air movement in the soil, and what might be called a forced draft is being employed to force air through the soil in lysimeters to see what effect this added aeration will have on crop growth. This study is interesting in its implications especially in view of the recognition of a soil compaction, resulting over large areas of the humid zone from decreasing organic content of the soil and the use of heavy implements, and limiting root growth of most plants.

This recognition is leading to a new interest in the use of the deep-rooted legumes having the ability to penetrate these compact layers. New tillage implements also are being devised to cope with the problem. The question of oxygen in the root zones of plants as well as that of carbon dioxide as a limiting factor in plant growth which have been touched on only lightly in this country in the past are receiving much more attention as a result of such lines of investigation.

New ways of getting fertilizers into the soil are being undertaken with great potentialities of influence upon fertilizer practices. The use of the direct application of nitrogen solutions to soils opens up a number of lines for investigation. The low cost of such nitrogen applied in the fields may necessitate an exploration of economic factors and result in some of our ideas as to the proper amounts of fertilizer to use and even farming systems being radically changed. The possibilities of overcoming nitrogen deficiencies during the course of a single crop season might influence considerably the possibilities of increasing yields or at least of preventing the lowering of production due to nitrogen deficiencies during the season. Other fertilizers also may be applied in solution and this combined with the use of portable irrigation may greatly reduce the gamble on the weather always being made by the growers.

Greater recognition of the role of minor elements is having its effect on fertilizer practices. In some areas the so-called minor or secondary elements have now become so widely needed that their use is as common as that of the so-called major elements. Present indications lead one to believe that such a trend will continue and probably spread to most of our agricultural soils. Often being asked is the question as to whether some of the so-called rare elements may not be factors in crop production. Commonly neglected in the past because of lack of sufficient refinement in our research tools, their role in plant nutrition may be brought to light in further research.

Some of our scientists are talking about 300 bushels of corn per acre and seemingly fantastic production of other crops. While yields of this range may not be immediately possible, who can say they will not eventuate when one looks back over the strides that have been made in recent years in meeting our agricultural production goals? When shooting at such yields, however, it is almost certain that many of the factors in plant growth that have been regarded in the past as non-limiting will have to be given due consideration in the future.

Back to School

Although remarkable progress in rural education has been achieved, particularly in the consolidation of schools and club activities, there is still much food for thought in a statement once made by the late J. McKeen Cattell, far-famed educator and supporter of the advancement of science. In an article published in the Popular Science Monthly for January 1909, he wrote:

> "Mankind will last only so long as children are born and cared for; and no plausible substitute for the family has been proposed . . . The school by its nature weakens the family, for it takes the children away from home and gives them interests not centered in the home . . . We need most of all to make life in the country attractive and fine . . . The country school is at present no such place. Its general tendency is not to prepare children for usefulness and happiness in country life, but rather to make them inefficient and uncomfortable there and to send those who are more clever and ambitious away to the city. And the school shares with the city the bad preeminence of being one of the principal causes now working to break up the family . . . Can one not fancy a school in the country, the house a model of simple beauty . . . surrounded by gardens, orchards, and barns? In this house the children would gather . . . for some two hours a day. The master and mistress and their older children . . . would teach the tricks of reading, writing, and reckoning to those who lacked them, and all would be encouraged to go as far as they cared along the paths of letters and science. Two further hours might be spent in working about the place, in the shop, in the garden, or with the animals, sewing, cooking or cleaning, learning to do efficiently and economically the things that must be done . . . Children would always be the chief concern in a home and in a school such as this. There would be no pathological, no economic, no psychological conditions at work for their extermination."

We are hearing much about the systems of Progressive Education in our urban schools. Was Dr. Cattell thinking of one for our rural schools? It was on his great foresight that he gained much of his renown.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	.....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	
1922	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	
1923	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	
1924	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	
1925	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	
1926	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	
1927	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	
1928	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	
1929	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	
1930	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	
1931	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	
1932	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	
1933	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	
1934	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	
1935	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	
1936	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	
1937	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	
1938	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	
1939	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	
1940	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	
1941	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	
1942	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	
1943	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	
1944	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	
1945	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	
1946									
August	33.55	48.6	143.0	280.0	180.0	178.0	15.10	59.10	
September	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	
October	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	
November	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	
December	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	
1947									
January	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	
February	30.56	31.9	131.0	228.0	123.0	199.0	17.50	88.20	
March	31.89	33.6	139.0	235.0	150.0	244.0	17.40	88.00	
April	32.26	30.1	147.0	233.0	163.0	240.0	17.20	88.00	
May	33.50	44.6	153.0	233.0	159.0	239.0	16.80	83.70	
June	34.07	46.0	156.0	249.0	185.0	218.0	16.00	79.60	
July	35.88	48.5	169.0	251.0	201.0	214.0	15.10	79.00	

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
1922	185	228	95	114	116	109	98	135	....
1923	231	190	133	137	129	105	110	183	....
1924	185	190	98	170	166	141	107	147	143
1925	158	168	245	188	109	163	108	140	143
1926	101	179	189	134	116	138	112	98	139
1927	163	207	146	124	132	135	87	154	127
1928	145	200	76	134	131	113	95	152	154
1929	135	183	189	133	124	117	92	137	137
1930	77	128	131	123	93	76	93	98	129
1931	46	82	66	83	50	44	73	40	115
1932	52	105	55	62	50	43	52	46	102
1933	82	130	118	79	81	84	68	57	91
1934	100	213	64	91	127	96	111	146	95
1935	90	184	85	80	102	94	63	135	119
1936	100	236	164	106	163	116	94	148	104
1937	68	204	76	93	81	109	74	87	110
1938	69	196	80	83	76	64	57	97	88
1939	73	154	100	85	88	78	67	94	91
1940	80	160	78	97	96	77	64	96	111
1941	137	264	116	107	117	107	81	211	129
1942	153	369	168	136	143	124	91	202	163
1943	160	405	188	232	174	154	125	231	245
1944	167	420	214	219	170	160	138	234	212
1945	181	435	199	228	178	169	127	230	224
1946									
August	287	486	205	319	280	201	127	262	162
September	285	488	184	255	269	202	130	256	154
October	304	530	175	238	266	213	136	293	151
November	236	438	176	228	198	214	145	399	207
December	242	435	181	239	190	217	149	406	166
1947									
January	240	390	185	351	188	216	147	401	238
February	246	319	188	260	192	225	147	391	275
March	257	336	199	268	234	276	147	390	299
April	260	301	211	265	254	271	145	390	295
May	270	446	220	265	248	270	142	371	286
June	275	460	224	284	288	247	135	353	215
July	289	485	242	286	313	242	127	350	189

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
August	2.22	1.46	16.88	8.14	6.07	12.14
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
February	2.41	1.46	10.01	11.06	12.14	10.17
March	2.41	1.46	11.98	11.06	12.50	10.50
April	2.41	1.51	11.72	10.79	12.75	11.39
May	2.41	1.51	10.55	9.98	12.75	8.80
June	2.41	1.51	10.94	9.98	12.75	8.26
July	2.41	1.59	12.56	9.98	12.75	8.66

Index Numbers (1910-14 = 100)

1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
August	83	51	482	231	180	345
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293
February	90	51	286	313	360	289
March	90	51	342	313	371	298
April	90	53	335	306	378	324
May	90	53	301	283	378	250
June	90	53	313	283	378	234
July	90	56	359	283	378	246

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910-14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.9	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
August	.700	2.60	6.60	.471	.729	22.88	.176
September	.700	2.60	6.60	.471	.729	22.88	.176
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January	.700	2.60	6.60	.535	.797	26.00	.200
February	.720	2.60	6.60	.535	.799	26.00	.200
March	.740	2.75	6.60	.535	.797	26.00	.200
April	.740	2.97	6.60	.535	.797	26.00	.200
May	.740	2.97	6.60	.535	.797	26.00	.200
June	.752	2.97	6.60	.330	.589	12.76	.176
July	.760	2.97	6.60	.353	.629	13.63	.188

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1920	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
August	131	72	135	66	76	95	80
September	131	72	135	66	76	95	80
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83
1947							
January	131	72	135	75	84	108	83
February	134	72	135	75	84	108	83
March	138	76	135	75	84	108	83
April	138	82	135	75	84	108	83
May	138	82	135	75	84	108	83
June	140	82	135	60	62	53	80
July	142	82	135	64	66	56	82

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
August	249	214	187	116	67	293	131	70
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	206	126	69	359	131	78
February	262	234	209	124	70	329	134	78
March	280	240	216	128	70	354	138	78
April	276	243	215	129	71	354	138	78
May	272	242	215	127	71	339	138	78
June	271	244	215	125	71	343	140	63
July	276	244	219	128	72	359	142	67

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Since June 1941, manure salts are quoted F.O.B. mines exclusively.

**** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizing Materials, 1946," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., Spec. Publ. 220.

"Commercial Fertilizer Sales as Reported to Date for Quarter Ended March 31, 1947," Bu. of Chem., Dept. of Agr., Sacramento, Calif., FM-142, May 26, 1947.

"Agricultural Mineral Sales as Reported to Date for Quarter Ended March 31, 1947," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., FM-143, May 26, 1947.

"Grades of Mixed Fertilizers in California," Bu. of Chem., Dept. of Agr., Sacramento 14, Calif., FM-147, June 2, 1947.

"Handbook of Commercial Fertilizers and Soil Amendments," Ext. Serv., Colorado A & M, Fort Collins, Colo., Bul. 393-A, April 1947, R. S. Whitney and R. H. Tucker.

"Fertilizer Studies with the Red McClure and Bliss Triumph Varieties of Potatoes in the San Luis Valley," Agr. Exp. Sta., Colorado A & M, Fort Collins, Colo., Tech. Bul. 35, April 1947, J. G. McLean, W. C. Sparks, and A. M. Binkley.

"Tonnage of Different Grades of Fertilizers Sold in Delaware, 1946," Agr. Exp. Sta., Dover, Delaware, C. E. Phillips.

"Results of Fertilizer Tests with Corn in Georgia During 1946," Agr. Exp. Sta., Experiment, Ga., Press Bul. 585, March 28, 1947, L. C. Olson and O. L. Brooks.

"Report of Analysis of Commercial Fertilizers," Dept. of Agr. and Immigration, Baton Rouge, La., 1945-1946.

"Commercial Fertilizers, 1946," Agr. Exp. Sta., Orono, Maine, Official Inspections 201, Oct. 1946, E. R. Tobey.

"Tung Fertilization," Agr. Exp. Sta., Miss. State College, State College, Miss., Inf. Sheet 379, Nov. 1946, W. W. Kilby.

"Boron Deficiency of Cabbage," Agr. Exp. Sta., Miss. State College, State College, Miss., Inf. Sheet 382, Dec. 1946, J. A. Campbell.

"New Developments in Fertilizing Corn," Agr. Exp. Sta., Miss. State College, State College, Miss., Inf. Sheet 386, Feb. 1947, H. V. Jordan.

"Commercial Fertilizer Report for 1946," Agr. Exp. Sta., Montana State College, Bozeman, Montana, Bul. 441, Jan. 1947, A. H. Kruse and P. C. Gaines.

"The Response of Clover and Total Forage to Top-Dressing Fertilizers," Agr. Exp. Sta., Univ. of N. H., Durham, N. H., Sta. Cir. 74, May 1947, F. S. Prince, P. T. Blood, and G. P. Percival.

"Commercial Fertilizer Law and Regulations," State Dept. of Agr., Charleston, W. Va., Bul. (n.s.) 54, June 8, 1947.

"Commercial Fertilizers—1946," State Dept. of Agr., Madison, Wis., Bul. 271, May 1946, W. B. Griem.

"Commercial Fertilizers—1947," State Dept. of Agr., Madison, Wis., Bul. 279, Jan. 1947, W. B. Griem.

"Role of Potash in Growth and Nutrition of Maryland Tobacco," U. S. D. A., Washington, D. C., Tech. Bul. 933, April 1947, J. D. Bowling and D. E. Brown.

Soils

"Soil Properties Contributing to Citrus Chlorosis as Revealed by Seedling Tests," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Tech. Bul. 112, Sept. 1946, W. T. McGeorge.

"Physical Land Conditions on the Queen Creek Soil Conservation District, Arizona," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Tech. Bul. 113, Dec. 1946, E. C. Nielson, W. G. Harper, and H. V. Smith.

"Soil Survey of Durham County," Dominion Dept. of Agr., Guelph, Ontario, Canada, Rpt. No. 9, Dec. 1946, L. R. Webber, F. F. Morwick, and N. R. Richards.

"Soil Reaction (pH), Some Critical Factors in Its Determination, Control and Significance," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 400, Aug. 1944, G. M. Volk and C. E. Bell.

"How Productive are the Soils of Central Illinois?" Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 522, March 1947, R. T. Odell.

"Supplement to Kankakee County Soil Map and Report (No. 13)," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., March 1947, Herman Wascher, E. P. Whiteside, and R. S. Smith.

"Cass County Soils," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Soil Rpt. 71, March 1947, G. D. Smith, F. F. Riecken, and R. S. Smith.

"Soil Fertility and Conservation, A Minnesota Program," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Bul. 254, March 1947, P. M. Burson, C. O. Rost, and E. R. Duncan.

"Conservation and Land Use Investigations," Agr. Exp. Sta., Okla. A. & M., Stillwater, Okla., Sta., Bul. B-309, May 1947.

"Improving Garden Soil Fertility," Ext. Serv., Okla. A. & M., Stillwater, Okla., Cir. 448, E. L. Whitehead.

"Sheet Erosion on Two Vermont Soil Types," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt., Bul. 538, May 1947, J. B. Kelly and A. R. Midgley.

"Third Report of the Vermont State Soil Conservation Committee—July 1, 1944-June 30, 1946," State Soil Conservation Committee, Burlington, Vt.

"Methods of Soil Analysis for Soil-Fertility Investigations," U.S.D.A., Washington, D. C., Cir. 757, April 1947, Michael Peech, L. T. Alexander, L. A. Dean, and J. Fielding Reed.

"When Drought Returns to the Great Plains," U.S.D.A., Washington, D. C., Farmers' Bul. 1982, March 1947, Tom Dale.

"Black Alkali Reclamation," U.S.D.A., Soil Conservation Serv., Region 6, Reg. Bul. 101, Soil Series 8, Jan. 1947, C. H. Diebold and J. A. Downs.

"Use of Sulfur on Dispersed Soils," U.S.D.A., Washington, D. C., Reg. Bul. 102, Soil Series 9, Dec. 1946, C. H. Diebold and Glenn Niner.

Crops

"More Corn per Acre and How to Grow It," Ext. Serv., Ala. Polytechnic Inst., Auburn, Ala., Cir. 272, Jan. 1947, J. C. Lowery and D. R. Harbor.

"Annual Lespedeza in Alabama," Ext. Serv., Ala. Polytechnic Inst., Auburn, Ala., Cir. 319, Jan. 1946, J. C. Lowery and D. R. Harbor.

"Grow Lespedeza Sericea," Ext. Serv., Ala. Polytechnic Inst., Auburn, Ala., Cir. 320, Jan. 1946, J. C. Lowery and D. R. Harbor.

"Our Goal, A Bale or More per Acre," Ext. Serv., Ala. Polytechnic Inst., Auburn, Ala., Cir. 324, rev. Jan. 1947, J. T. Belue and J. C. Lowery.

"How to Manage Your Fish Pond," Ext. Serv., Ala. Polytechnic Inst., Auburn, Ala., Cir. 325, rev. Feb. 1947, A. M. Pearson.

"The Experiment Station Reports," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 464, Dec. 1946.

"Hints for the Gardener," Ext. Serv., Univ. of Ark., Fayetteville, Ark., Leaf. 50, rev. 1946.

"1946 Arkansas Corn Yield Tests," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Series No. 6, Feb. 1947, D. B. Shank and B. D. McCollum.

"Twenty-Seventh Annual Report, Period Ending December 31, 1946," State Dept. of Agr., Sacramento, Calif., Vol. XXXV, No. 4.

"Production of Easter Lily Bulbs," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif., Cir. 132, Feb. 1947, H. M. Butterfield.

"Raspberry and Blackberry Culture," Hort. Exp. Sta., Ontario Dept. of Agr., Toronto, Ontario, Can., Bul. 355, rev. March 1947, W. J. Strong.

"NPK, Put It Back," 59th A. R., Agr. Exp. Sta., Colorado A. & M., Fort Collins, Colo.

"Small Fruits in the Home Garden," Ext. Serv., Colorado A. & M., Fort Collins, Colo., Cir. 143-A, Nov. 1946.

"Adapted Vegetable Varieties for Colorado," Ext. Serv., Colorado A. & M., Fort Collins, Colo., Cir. 146-A, March 1947.

"Colorado Lawns, Planting and Maintenance," Ext. Serv., Colorado A. & M., Fort Collins, Colo., Bul. 392-A, Jan. 1947.

"Tobacco Substation at Windsor, Report for 1946," Agr. Exp. Sta., New Haven, Conn., Bul. 504, Feb. 1947, P. J. Anderson, T. R. Swanback, and A. B. Pack.

"1946 Report, Florida Agricultural Extension Service," Gainesville, Fla.

"Peanut Curing Studies," Ga. Exp. Sta., Experiment, Ga., Bul. 255, June 1947, W. K. Bailey, T. A. Pickett, and J. G. Futral.

"Annual Report, 1945," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Bul. 530, April 1946.

"Strawberry Culture," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Cir. 335, Feb. 1947, G. H. Firor.

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Reshaping New England Farm Land

(*From page* 22)

hauling them away. This method is particularly applicable in cases where the stones must be removed distances greater than one-quarter of a mile. Shattering of large boulders with dynamite or by heat facilitates their removal by trucks.

Woodland and pastures are being cleared of trees and brush with bulldozers. Uncut large trees are more easily removed than are their stumps, because of the leverage effect gained by the trunk and top. Removal of roots after the trees are cut is a costly job and often as expensive as removal of the trees. Woodland is being cleared at costs varying from $50 to $150 per acre, and pastures with brush and small trees at $20 to $50 per acre. The bulldozer has been found especially adapted to the removal of filler apple trees, which have been removed at 21 to 32 cents per tree.

Land drainage is a high priority problem in New England. Much long-needed work in this field is now being undertaken in this area. There are the small simple jobs on individual farms and the more complicated large community projects involving a number of farms. Soil conservation districts are facilitating drainage work in a big way. Technicians of the Soil Conservation Service are doing the necessary preliminary engineering, and district supervisors are providing either district-owned excavating equipment or the service of private contractors for doing the job. Many of the smaller ditches are being blasted with dynamite. Drainage ditches are being blasted in Massachusetts at a cost to the farmer of 10 cents per linear foot. An advantage of blasting is that no spoil bank is left. For the larger main ditches required in a group drainage project, a dragline or power shovel is the most practical means of excavating. Costs of dragline excavations for drainage in Vermont have been reported from 7 cents to 15 cents per cubic yard.

The construction of farm ponds is still another way in which New England farm land is being reshaped. Although nature endowed this section with thousands of lakes and ponds, there is need for many thousand more small ponds. They are needed for stock water, fire fighting, fish supply, and recreation. A pond for each farm is the goal of one leading insurer of farm buildings. Ponds are constructed with bulldozers and draglines for the most part, but some jobs may be done by blasting. Cost of ponds may vary from $35 to $1,000 or more, depending on size, soil, and terrain.

A confidential note for tourists: The face of New England is not being changed so much or in such way as to rob it of its charm. Changes are occurring slowly but surely, and it is the belief of some landscape artists that the curves and contours incidental to conservation farms will enhance the beauty of the justly famous New England landscape.

Analyzing the Soils of Northwest Louisiana

(*From page* 12)

Corn: 50 pounds of 50 per cent muriate of potash, side-dressed with 300 to 400 pounds of nitrate of soda or equivalent an acre.

Oats: 50 pounds of 50 per cent muriate of potash, top-dressed with 300 to 400 pounds of nitrate of soda or equivalent an acre.

Alfalfa: 100 pounds of 50 per cent muriate of potash an acre.

Clover-grass pasture: 50 pounds of 50 per cent muriate of potash an acre.

The laboratory doesn't test for available nitrogen. Nitrogen compounds are unstable in the soil and the available nitrogen will vary greatly at different times of the year. The potential supply of nitrogen in the soils of this area is generally less than .03 per cent, which is an exceedingly short supply. All the soils of this area respond to the application of nitrogen.

If crops are to yield their maximum, the soils' mineral shortages will have to be corrected. The most exact method of determining these deficiencies is by soil analyses. Since most farms have many soils, and since each field has been handled differently in the past, a number of soil samples have to be taken on a farm before a proper over-all fer-

Fig. 3. This shows the effect of continuous row crops. Nothing was returned to the soil. Erosion resulted plus social and economic damage. The family had to move away. It is to avoid conditions like these that Soil Conservation technicians and Louisiana State Soils Laboratory men are working to get the proper fertilizers put in the soils.

tilization program can be carried out. Even if all the necessary elements are made available to plants in a soil, a good crop is not assured. Cultivation methods, plant diseases, insects, noxious weeds, the weather, soil tilth, and other factors have to be reckoned with.

Many farmers of northwestern Louisiana are realizing that their margin of profit in crop production actually depends on the proper use of fertilizers. They are beginning to profit from the services rendered by the State soils laboratory. Soil conservation district cooperators who follow the State soils laboratory fertilizer recommendations, along with their other soil conservation district practices, have obtained outstanding results in quality and quantity of crops produced.

They report pastures that will sustain a cow to one and one-half acres; originally it took seven acres of that land to feed a cow. Oat yields are up to 60 bushels an acre; 30 bushels is considered a good yield on the same soil. Corn yields reach 60 bushels an acre; the State average is 17 bushels.

The soil is the foundation of agriculture. Better crops, better livestock, and the assurance of a nutritious diet to human beings will result with proper fertilization, an integral part of the soil conservation program.

Fertilizing Potatoes . . . Aroostook County, Maine

(*From page* 26)

low in P_2O_5 caused the average response of this group to be quite low. The zero P_2O_5 treatment was omitted on most of the soils having a low or medium P_2O_5 content, so that response to the first increment of P_2O_5 (40 pounds) was not measured. The highest amount of P_2O_5 was likewise omitted on most of the soils medium to high in P_2O_5. No yield increase was obtained from applications of P_2O_5 greater than 160 pounds per acre at any location. On soils high in readily soluble P_2O_5, maximum response was obtained with 80 pounds P_2O_5 per acre.

Of the eleven rate tests of K_2O completed, two were located on soils low in exchangeable K_2O, three on soils rated as medium, and six having a high content of K_2O. As shown in Table 3, there was little response in yield of potatoes to applied K_2O, even on the soils low in this plant food. In no case was there a significant response to any rate tested, although a zero K_2O treatment was not included in these experiments. Lack of adequate moisture for potatoes in August may have been a factor in the low response to potash fertilization at all fertility levels.

Results from Fertilizer Experiments in 1946

In 1946, nine rate tests of P_2O_5 were completed. Of these, seven were on soils low in content of residual P_2O_5 and two on soils rated high in P_2O_5. None of those completed were on soils having a medium content of P_2O_5. As shown in Table 4, response of potatoes to P_2O_5 was marked on soils having a low readily soluble P_2O_5 content. Average increases in yields for the seven tests were obtained for all rates of P_2O_5 included in the comparisons. Much less response to P_2O_5 was obtained on the soils high in P_2O_5, no response being obtained to rates above 120 pounds of P_2O_5 per acre.

Of the eight rate tests of K_2O completed, three were on soils low in residual K_2O, three on medium, and two on soils high in K_2O. Table 5 gives the relative response of potatoes to K_2O on the different groups of soils. As may be noted in the table, there was little or no response to K_2O above 120 pounds per acre for any of the fertility levels. Significant decreases in yield resulted in some of the tests from higher rates of potash fertilization. Another effect of excessive rates of application of K_2O in 1946 was noted on the starch content of the tubers, as measured by determination of specific gravity. As an average of four field tests, application of 300 pounds K_2O per acre decreased the starch content of tubers about two per cent, as compared to tubers from the zero potash treatments. Since the tubers receiving no potash contained approximately 14 per cent starch, an appreciable reduction in quality resulted from the heavy application of potash. Eating quality, content of dry matter, and mealiness are fairly closely related to the starch content.

Discussion of Results

Results obtained from fertilizer experiments in 1945 and 1946 indicate that considerably more phosphorus and potash fertilizer is commonly applied in Aroostook County for potatoes than is necessary for efficient production. Similar results were obtained in less extensive experiments conducted in 1943 and 1944. The lack of response to potash in the experiments was most noticeable. Out of the total of 28 potash rate tests conducted during the four-year period on soils of widely varying contents of exchangeable K_2O, potatoes showed a response to applications of more than 100 to 120 pounds of K_2O per acre in only eleven tests. In these tests increases in yield from applications up to 180 to 200 pounds K_2O per acre were obtained in seven tests. In only one test in 28 was there a response to more than 200 pounds K_2O per acre. Most of the soils on which increases in yield from rates of above 120 pounds K_2O per acre were obtained were low in exchangeable K_2O. In several of the tests, however, especially in 1945, some of the cases of lack of response may be attributed to lack of moisture in August. This does not explain lack of response in some tests in 1946, since in this year high yields of potatoes were obtained with adequate fertilization in all experiments where the stand was adequate.

From the estimates in Table 1, indicating that about 89 per cent of the normal application of P_2O_5 for potatoes is left in the soil, it might be supposed that more phosphorus is also being applied than is needed for the crop. Results of the experiments, however, indicated responses in many cases up to 160 or 200 pounds of P_2O_5 per acre. Since even a large crop utilizes only a small portion of these amounts, this response, especially on some soils high in residual P_2O_5, is not clear. An explanation of the response to heavy applications of P_2O_5 may perhaps be associated with the need of the potato plant, with its limited root development, for a relatively large supply of readily soluble phosphorus early in its growth period. Another cause may be the effect of phosphorus in reducing the harmful effects on the plant of soluble aluminum, manganese, or other toxic factors in the rather acid soil in which potatoes are commonly grown.

Much of the tonnage of fertilizer used on potatoes in Maine has been in grades having high ratios of potash such as 1-2-3, 2-3-4, 2-3-5, or 2-4-5. Equivalent grades or approximate ones

TABLE 4. RELATIVE RESPONSE OF KATAHDIN POTATOES IN 1946 TO P_2O_5 ON SOILS HAVING DIFFERENT LEVELS OF RESIDUAL P_2O_5.

Fertilizer treatment Pounds per acre of $N-P_2O_5-K_2O$	Relative[1] response to fertilization: Soils low in P_2O_5 (Av. 7 tests)	Relative[1] response to fertilization: Soils high in P_2O_5 (Av. 2 tests)
100– 0–200	68	96
100– 40–200	88	100
100– 80–200	95	103
100–120–200	98	105
100–160–200	100	100
100–200–200	104	103

[1] Average yields taken for 2,000 pounds of 5-8-10 fertilizer as 100 are: low soils—473, and high soils—485 bushels per acre. This difference is due not only to difference in soil fertility but also to location, weather, etc.

TABLE 5. RELATIVE RESPONSE OF KATAHDIN POTATOES IN 1946 TO K_2O ON SOILS HAVING DIFFERENT LEVELS OF RESIDUAL K_2O.

Fertilizer treatment Pounds per acre of $N-P_2O_5-K_2O$	Relative[1] response to fertilization		
	Soils low in K_2O (Av. 3 tests)	Soils medium in K_2O (Av. 3 tests)	Soils high in K_2O (Av. 2 tests)
100–160– 0 . .	87	94	90
100–160– 60 . . .	96	99	95
100–160–120 . . .	97	102	99
100–160–180 . . .	100	100	100
100–160–240 . . .	100	99	99
100–160–300 . . .	97	99	102

[1]Average yields taken for 2,000 pounds of 5-8-9 fertilizer as 100 are: low soils—515, medium soils—475, and high soils—498 bushels per acre. These differences are due to difference in location, weather, etc.

are 5-7-10, 5-8-12, 6-9-15, 8-12-16, 8-12-20, or 8-16-20. The 1-2-2 ratio such as in the 5-10-10, 8-16-16, or 5-8-7 grades, having equal or approximately equal amounts of P_2O_5 and K_2O, have been or still are popular. During the war period when prices have been favorable, applications of 2,500 pounds of 5-7-10 per acre, 2,000 pounds of 6-9-15, 1,500 pounds of 8-12-16, 8-12-20, or 8-16-20, or even 2,000 pounds of 8-16-16 have been common with many farmers. In terms of pounds of plant food per acre the equivalent amounts range as high as 160 pounds of N, 320 pounds of P_2O_5, and 320 pounds of K_2O per acre. Some farmers apply even larger amounts than these.

In the rate tests of P_2O_5 and K_2O it was found that 160 to 200 pounds of P_2O_5 and K_2O were adequate on practically all of the soils on which experiments were conducted. In order to supply these amounts of P_2O_5 and K_2O from the fertilizer grades commonly used, from 80 to 100 pounds of N or less would be applied in the fertilizer. Other experiments have shown that 100 to 120 pounds of N per acre usually give a maximum return. To give a more nearly correct proportion of plant food in the fertilizer for potatoes in Aroostook County, then, it appears that a 2-3-3 ratio would be more satisfactory on most soils than any now mixed for the potato farmer. An application of 1,500 pounds of 8-12-12 or 2,000 pounds of 6-9-9 would supply 120 pounds of N and 180 pounds each of P_2O_5 and K_2O per acre. These amounts of P_2O_5 and K_2O are in line with the results from fertilizer experiments. This amount of fertilizer would supply somewhat more N and K_2O and much more P_2O_5 than is normally removed by moderate to high yields of tubers. A larger amount of potash than 180 to 200 pounds per acre may increase yields of potatoes on soils quite low in potassium. However, potato soils in Aroostook County which are low in potassium are almost invariably also low in phosphorus. On these soils a 1-2-2 fertilizer ratio such as in the 8-16-16 grade, when applied at a rate to furnish 120 pounds of nitrogen, should give best results. Where an application of less than 120 pounds of nitrogen is desired, such as following a legume crop or where potatoes are harvested early for seed, the 1-2-2 ratio should also be used.

On soils quite high in both residual phosphorus and potassium, it appears that a 1-1-1 fertilizer ratio would be most efficient. An application of 1,200 pounds of 10-10-10 would supply 120 pounds each of N, P_2O_5, and K_2O. At this rate of application, K_2O would be removed from the soil in larger amount than is added in the fertilizers. In periods of low net returns, however, the farmer might well consider the utilization of some of the residual fertility being accumulated in most potato soils in Maine.

There are certain cases in which a 2-3-4 fertilizer ratio may be more desirable than those containing less potash. One case is where a crop such as peas, which usually removes about 75 to 100 pounds of K_2O per acre, is grown in the rotation. Application of additional potash for the pea crop should prove desirable to prevent depletion of potassium in the soil to a low level. Another possibility for applying less P_2O_5 than K_2O for potatoes is that of applying the phosphate in a more efficient manner than any method now commonly used. There is considerable experimental evidence that applying the phosphate in a band with or near the seed piece is a more efficient method than applying it in side bands and much more efficient than applying it broadcast. Experiments are now under way to obtain more information on this point. There is also experimental evidence that certain potato varieties need less phosphorus than others. For example, the Green Mountain variety has been found to respond much less to phosphorus than do Katahdins and certain other varieties.

Although many farmers believe that they are obtaining increased yields of potatoes from excessive applications of P_2O_5 and K_2O, carefully conducted experiments have not substantiated this belief. It is more likely that where such increases are being obtained most of them are due to the larger amount of nitrogen in the fertilizer. Much of the phosphoric acid and potash now being used inefficiently as excessive applications for potatoes might well be used to grow better pasture, hay, and other feed crops. Much of the pasture and hay land of the Northeast is in a very low state of fertility, a condition which is certainly an important factor contributing to the high cost of production of livestock products in this region.

Minor Plant Nutrients

(*From page* 18)

ganese, particularly the soils which contain a large quantity of nitrates such as organic soils. Heavy applications of agricultural lime may significantly decrease the solubility and availability of the manganese in certain soils. Under most conditions an application of the equivalent of 25 to 50 pounds of manganese sulphate or other soluble manganese salts will supply the annual requirements for manganese for most crops. The most convenient method of adding soluble manganese is through mixed fertilizer or an application of basic slag which contains a considerable quantity of available manganese.

Zinc as a Nutrient

Since zinc is present in small quantities in most soils and is one of the relatively weak nutrient ions, it is difficult to predict the conditions determining the availability of sufficient zinc for optimum growth of different crops grown under various soil conditions. The solubility value for certain zinc compounds suggests some of the major factors which affect the available zinc supply at different pH values. The solubility values for zinc carbonate and hydroxide indicate that soil with a high pH value usually would have a low availability of zinc. Since the solubility of zinc hydroxide is very low, it is not difficult to understand why it is often impossible to secure a response from adding zinc to soils with a relatively high hydroxide content. The very high solubility of zinc nitrate shows why the quantity of nitrogen supply in the soil may affect the solubility of the zinc in the soil. The presence of nitrates in the soil solution would significantly increase the solubility and availability of the zinc in the soil. The presence of chloride or sulphate ions in the soil solution would have an effect similar to nitrate on the solubility and availability of zinc in the soil.

The addition of zinc to soils with a relatively low pH value or a relatively high content of nitrate, chloride, or sulphate ions may result in an increase in solubility and an adequate supply of available zinc for many crops. The addition of nitrates, chlorides, or sulphates in fertilizers may result in the depletion of the native supply of zinc in the soil through leaching. The relatively low mobility of zinc in the soil and the low intensity of the absorption of the weak zinc ions by most plants suggest the response of certain plants, particularly the tree crops, to applications of zinc to foliage in spray solutions.

Iron

The relatively large quantity and the widespread distribution result in an adequate total supply of iron in most soils. The low solubility of iron hydroxide shown in Table 1 and the relatively low intensity of absorption of the weak iron ion by most plants, particularly in the presence of the stronger cations such as potassium and calcium, suggest some of the reasons for a deficiency of iron under certain soil conditions. Excessive quantities of lime and a marked increase in the hydroxide content of the soil solution will significantly decrease the solubility and availability of iron in many soils, particularly those low in organic matter and nitrogen. The incorporation of organic matter and the addition of nitrogen will usually increase the availability of iron by the formation of iron nitrate or other soluble iron compounds.

Copper

Copper is considered one of the minor plant nutrients. The average copper content of a wide variety of plants, as shown in Table 1, is very low, only 11 parts per million of the dry matter of plants. The very small amount required by most plants probably accounts for the fact that early experimental cultures failed to show that copper is an essential element for plant growth.

Soils high in organic matter, particularly newly cultivated peat soils, are most likely to have a deficiency of copper. Copper deficiency is most likely to occur on mineral soils formed under acid conditions where the relatively large quantity of strong anions such as sulphates, nitrates, and chlorides results in the solubility and the leaching of copper from the soil. Peat soil relatively high in calcium is most likely to show a deficiency of copper, as the high calcium content of the soil would favor the formation and accumulation of nitrates in the soil. The data in Table 2 show that copper nitrate is highly soluble, which would result in much of the available copper in the soil being lost through leaching. Under some conditions the copper in the bordeaux sprays was sufficient to supply the copper requirements of certain tree crops on certain soils. Where a relatively low amount of copper is found, it may be desirable to apply copper sulphate to the soil. Soils with a relatively high pH value will fix relatively large quantities of copper; whereas, on acid soils much of the copper added to the soil may remain soluble and be toxic to certain plants.

Applications of Minor Metallic Nutrients

Where the pH value and the concentration of the hydroxyl ions are not too high in the soil, it is usually satisfactory to apply soluble salts of the minor nutrients. An annual application of 25 to 50 pounds per acre of sulphate, chloride, or nitrate of manganese, zinc, iron, or copper will usually supply the nutrient requirements of most plants. On alkaline soils or soils which have received a heavy application of lime, the intensity of absorption of the weaker ions may be very low, which makes it difficult for the plants to secure enough of these nutrients for optimum growth. Under such conditions the application

Fig. 3. Yields of No. 1 sweet potatoes from applications of boron. Left, none; center, five pounds; and right, ten pounds of borax per acre. The yields per acre of marketable potatoes for none, five, and ten pounds of borax per acre were 153, 235, and 186 bushels per acre, respectively.

of these nutrients as a spray to the foliage may be the most effective means of supplying these nutrients to some plants. It has been determined that driving zinc nails into certain trees supplies the zinc necessary for their growth.

Use of Basic Slag on Acid Soils

Under most acid soil conditions the use of 1,000 to 2,000 pounds per acre of Birmingham basic slag and an application of 5 to 20 pounds of borax per acre will supply the minor nutrients needed by most crops. Under certain conditions it may be desirable to add 25 to 50 pounds of copper sulphate per acre. Where two or more minor nutrients are deficient, an application of basic slag is often the most economical and satisfactory way of supplying most minor nutrients. Heavy applications of basic slag are not satisfactory on soil when it is undesirable to significantly change the soil reaction.

Summary

1. It is now generally accepted that a large number of elements may be effective in the nutrition of plants. The nutrients are sometimes classified as major nutrients including the three primary and the secondary, and minor nutrients, depending upon the significance of the various nutrients utilized by plants grown under different conditions.

2. The major nutrients in plants are commonly expressed as per cent or parts per hundred; whereas, the minor nutrients are often expressed as parts per million rather than as per cent of material.

3. Since there is a definite quantitative relation between the intensity of absorption of nutrients and the relative strength of ions, the relatively weak minor nutrient ions do not constitute a large proportion of the mineral nutrient requirements of plants.

4. The energy properties of nutrient ions largely determine the intensity of absorption of different ions by most plants.

5. In mixed fertilizers the quantities of nitrogen, phosphorus, and potash are guaranteed. With the exception of bright leaf tobacco fertilizer, there is

usually no guarantee of the quantity of sodium, calcium, chlorine, or sulphur, which also form relatively strong ions, may be absorbed in relatively large quantities, and may have a major role in the nutrition of plants under certain conditions.

6. The mixed fertilizers may or may not contain significant quantities of the secondary elements depending upon the types of materials used in making mixed fertilizers.

7. The minor plant nutrients such as manganese, zinc, iron, and copper, which form relatively weak ions, are usually not utilized in large quantities by most plants.

8. Alkali, over-limed, and strongly acid soils are most likely to be deficient in minor nutrients.

9. Soils with a relatively high pH value, or low soil acidity, are most likely to be deficient in available minor nutrients, due to the formation of relatively insoluble carbonates and hydroxides of these minor nutrients in the soil.

10. The addition or the presence of a relatively large quantity of phosphorus in the soil may decrease the solubility and availability of the minor nutrients by forming relatively insoluble phosphate compounds.

11. On soil with a low pH value, or high soil acidity, there may be adequate or toxic amounts of the minor nutrients soluble and available to plants. The presence in relatively large quantities of the strong anions such as sulphate, chloride, and nitrate ions increases the solubility and availability of the minor nutrients in the soil.

12. When minor nutrients are applied to soils in combination with fertilizers, it is usually desirable to utilize the soluble compounds such as sulphate, chloride, and nitrate.

13. Boron is very probably more deficient than most of the other minor nutrients, in the Southeastern states.

14. Heavily limed soils are most likely to be deficient in boron.

15. Such crops as alfalfa, beets, turnips, carrots, potatoes, and cotton often show marked yield responses to an application of boron.

16. Since excessive quantities of soluble boron may prove very toxic to certain plants, it is highly desirable to be extremely careful in the inclusion of large quantities of boron in mixed fertilizer. The optimum quantity of boron for different crops may vary from the equivalent of 5 to 20 pounds of borax per acre.

17. Due to the increased use of limestone on Southern soils and the resultant widespread boron deficiency in many of the soils, it is highly desirable to include boron in fertilizer for most of our crops. It is not likely that the inclusion of 10 pounds of borax per ton of fertilizer would be an excessive amount for most of the soils in humid regions where 1,000 pounds or less fertilizer per acre are applied. Where the fertilizer application is a ton or more per acre, not more than 5 pounds of borax per ton should be included in the fertilizer mixture for most crops.

18. Due to the widespread deficiency of boron on many of the limed soils and the low cost of adding the borax, it is strongly recommended that prophylactic quantities of boron be added to all mixed fertilizers to be used in this region.

19. Where such nutrients as manganese, zinc, iron, or copper are deficient, the addition of 25 to 50 pounds per acre of the soluble compounds such as sulphate, chloride, or nitrate of these materials in advance of planting will often supply adequate quantities on acid soils.

20. On soils with a high pH value and a high hydroxyl ion content, the solubility and availability of the minor nutrients may be very low. The low intensity of absorption and the low mobility of these ions in the sap of the plant may make it necessary to apply these nutrients as a spray to the foliage, particularly to certain tree crops where it is necessary for the nutrients to diffuse through the plant sap to the leaves of the trees.

Whole-farm Demonstrations

(*From page* 10)

strations the hundreds and thousands of demonstrations and experiments carried out had shown positive evidence of a great need for potash. On many soils highly profitable responses to treatment with potash fertilizers were shown. In fact, on certain soil types the low level of available potassium appears now to be even more responsible for legume failures and poor yields of grain and corn than the low level of available phosphorus. Fully 75 per cent of our Wisconsin soils need a combination of both phosphate and potash fertilizers in order to make possible maximum yields of legumes and other crops.

Through our livestock and dairy systems of farming we have lost thousands of tons of potash in the wasteful and careless system of handling stable manures. There are soil type areas representing millions of acres in Wisconsin where apparently the supply of available potassium was short even in the virgin state.

In our program of whole-farm test demonstrations we started out with a full recognition of the importance of potash. We wanted to make sure at the outset that fields being seeded to legumes received the proper balance of plant-food nutrients the first year. The need for potash, phosphate, and lime was first established by soil tests.

In our test demonstrations we always leave a no treatment strip across the entire length of the field. Adjacent to this check plot we have made a practice of putting in a strip with phosphate only, and in some cases potash only. In this way, we have proven to the farmer the need for both potash and phosphate and the almost universal need for both.

What do the cooperators have to say about the transformations they see on their farms? Well, you can imagine what anyone would say when the yields of grain are increased by 50 per cent and the yields of hay the year following are doubled.

Here is a typical story of one of these transformations. Frank De Chant bought a run-down, badly neglected farm of 160 acres in Glendale Township, Monroe County, Wisconsin, in 1941. The sale price to him was $7,500. The purchase of this farm was financed through the Farm Security Administration under the tenant purchase plan. Neighbors told him he would fail; every farmer, they told him, for many years previous who had tried to make a living off this place had failed. But Mr. De Chant, by good fortune, started out as a TVA cooperator. Lime and fertilizer were applied that first year according to soil tests. On most fields which were seeded to alfalfa he applied the equivalent of 500 pounds of 0-20-20 per acre. Yields of grain were increased a good 50 per cent and seedings of clover made a luxuriant growth in the stubble that fall. The year following he filled his haymows to overflowing with protein-rich legume hay.

Mr. De Chant has paid for this farm within a period of six years. But that's not all, for during these past six years he has purchased more than $10,000 worth of farm machinery and other new equipment, bought a new car, put over $1,000 into improvements on his barn and home, and they are all paid for. His yields have been more than doubled every year (by comparison with check plots) and not only more feed but better quality feed has been produced. This past year he had so much hay that his two barns would not hold it and so he sold a considerable tonnage of baled hay direct from the field to his neighbors.

This may be an exceptional case but there are literally hundreds of TVA cooperators who will tell you similar stories. When you boil their stories down to the one underlying factor most responsible for their success, these farmers will tell you that liberal treatment with fertilizers and lime did it. A farmer must feed these good crops to good cows and in turn follow a program of crop management and soil erosion control.

But the opportunity for increased income and better living through the more generous and liberal use of lime and fertilizers is just now unfolding itself to Wisconsin farmers. The 300,000 tons of fertilizer used on Wisconsin farms in 1946 should be doubled if we are to break even on a soil fertility balance sheet for the State as a whole. Farm prices for the past five years have been a big factor in this greatly expanded use of fertilizers, but it is true also that our Wisconsin farmers have learned by their own experience that it pays to fertilize.

Education through our system of agricultural extension, through the medium of the teaching and training of the boys in our high schools by the Smith-Hughes teachers of vocational agriculture, the help—direct and indirect—rendered by the allied educational bureaus supported by the fertilizer industry, the impetus given to soil conservation practices by our Federal action agencies, and the greatly expanded program of whole-farm test demonstrations supported by the Tennessee Valley Authority—all of these have played a part in this re-awakening of the farmer and the general public in matters pertaining to practices of soil-building and conservation.

This period in our nation's history may go down as the great soil conservation era. Soil science has come into its own. Teacher, preacher, doctor, writer, banker, industrialist, business man, and even the layman seem to have caught the surge of this great movement. "Notre sol est notre patrie. Protéger l'un est servir l'autre," and as the French people say: "Our soil is our country, to save the one is to save the other." We have made a good start in the direction of better land use, soil conservation, and fertility maintenance in Wisconsin. Extension education in soils directed by college specialists and carried out by county agents and Smith-Hughes teachers, all of us working together with the Federal action agencies of the USDA, TVA, and the educational bureaus set up by the fertilizer industry, can do a good job.

For Better or Worse

(*From page* 5)

me (early in their marital career) that they love the clinging-vine-and-the-sturdy-oak type of union; that the face and form of the wife is worth more than her managerial skill, and all that kind of tripe. While there is nothing to prevent a smart pin-up girl from being a bang-up wife, I always advise them with the goodness of an uncle to beware of looks when picking cooks.

No, I have never regretted the fact that my good frau is independent and resourceful. She can outthink me and outmaneuver me with zest and great ability when the proper time arrives. At other less important occasions she defers to my wisdom and my experience and good judgment, thereby making me feel right smart and proud over a minor victory.

In some romantic fiction and books on social history, the householders and parents of the past century are made to appear paragons of steadfast virtue and of unremitting and unselfish toil.

Some agencies have done this with a purpose. Even our own parents sometimes pointed back to other years of sacrifice and renunciation, devotion to stern duty, and small and fleeting pleasures.

It would seem as though they stood, as it were, on the dividing line between the era of self-control and good family deportment and the loose and easy-going epoch of our modern domestic life. They were "the last of the Mohicans" prior to the advent of the jangle and jumble of irresponsible marriages and woeful neglect of parental responsibility.

YET in my own way of thinking about it, there are more pressures, more distractions, and more obstacles facing the pater and mater familias and their children since our country has attained "middle-aged" affluence with its high and complex standards, than the couples of the coonskin and calico period had to plague them.

Under a democracy like ours, now at the world's zenith of power and possession (outwardly anyhow), the glitter is hard on the mental eyesight, the hurry and worry is conducive to snap decisions and regrettable consequences, while the dwindling dollar of the lower-bracket boy makes it difficult for him to give his family the privileges which are advertised as part of the customary American pattern.

None of us who have slowly and painfully climbed along the steep incline in double harness would want to dump the load behind us or remove our sights so firmly fixed on the levels of living which seem to be attainable at the cost of a little more sweat and endurance.

To be sure, there are no lurking aborigines or wildcats ready to scalp us or rip us limb from limb, nor any wilderness in which to lose ourselves and our tearful progeny. Yet there are other no less troublesome and frustrating destroyers and annoyers of the soul's peace and solace ready to challenge pa and ma and their offspring today. Even without the atomic menace.

We must, of course, recognize that the family guardians of the past did not enjoy the regular advice and suggestions of the daily newspaper "lovelorn" writers or adjusters of mental quirks. Our grandparents had no chance to be psychoanalyzed, to be put wise to many primal needs of human nature, and to be warned against vagaries of behavior on the part of husband, wife, or mother-in-law. They had no frank books on biological aspirations and activities—only a back-hand and misunderstood reference to our relationship with the apes. Romantic novels were prim and prissy, all prunes and prisms, and very little harsh reality.

The Dads of former times made regular trips to the woodshed with recalcitrant urchins, but they did not go there to whisper to them all the sneaking facts of life. I presume Mothers did a trifle better job in that line than the Fathers did, strictly in confidence to the girls. Of this I cannot speak first-hand.

But today the parents find it hard to keep up with the youngsters in acquiring substantial knowledge of physical elements and the subversive social practices of the times. They get hep to things both through the old grapevine, undercover route, and the more up-to-date systems found in many magazines and library references. All of which makes the parental job of education less irksome but renders the job of supervision even more trying.

ONE of the duties of a married couple which is often wholly overlooked lies in the need for them to train themselves and their children to assume a share of community interest and responsibility. In the age in which we live, when taxes on real estate in some high assessment areas run to a dollar a day or better, plus interest and upkeep on the shelter alone, it is easy to neglect public affairs and neighborhood zeal so as to make ends meet at home.

There must be a happy medium somehow wherein the family can take part in events and programs and be co-operative beyond their borders and thereby gain confidence and bring the kids up in the right attitude toward others. Since the coming of modern equipment and facilities there is little excuse even for the remote rural family to be shy and aloof, bringing up their offspring in a suspicious and selfish way.

I confess that in our family it has been Ma who has taken the lead in this respect, seeing to it that the youngsters partook of many duties and privileges of citizenship and neighborhood and school relations. I have not been one of those carefree and convivial chaps who took keen delight in being a "joiner" and a back-slapping good-fellow. Often I have regretted my disinclination to wear goofy hats, march in long parades, and learn to sing the anthems of local or fraternal superiority. Hence it devolved upon the Better Half to coax us all into communal reunions and see that we did our share of the decorating, errand running, and program planning.

THEN when the Big War clouds gathered, all petty intimate family preferences had to yield to the larger and more portentous obligations that carried us far beyond the confines of our community, and projected us in one way or another into realms and regions which we had forgotten since our last examinations in geography. Maybe it happened just when we needed to be stirred and resurrected from provincial inertia into awareness of limitless horizons and the brotherhood of man. I was not so doubtful of the immediate results on our family attitudes during the war era itself as I have been since we began to "write the peace."

This present season of international adjustments finds Ma and me up a stump. Luckily, the kids have grown beyond our daily direction and are thinking for themselves more than ever. I say "luckily" because we are badly sidetracked, seeing no chance to get back on the main trunk line while the red and green semaphore signals are so badly mixed. We are beset with too many confusing voices and contradictory authorities.

FROM our own family experiences we know that up to a certain point a dose of sound appeasement and compromise keeps the household and its occupants satisfied and agreeable. Yet we haven't been able to succeed too well when we allowed some mean neighbor or selfish member of the family to pursue a narrow coarse unchecked and unbridled. But the real trouble is that we are obliged to sign away the future in a broad sense to a few officials and their opinions and judgment, and all a humble householder and taxpayer can do is to hope and pray that the leaders are endowed with sanity and balance. Like the late lamented Will Rogers (who kept us courageous and calm) most everything we know in the world today is what we read in the papers. I sometimes wonder if the papers sense this responsibility to so many quiet couples on the back streets.

You may think this is all getting a pretty "fur piece" outside the field of wedded life and marital duties. However, I am foolish enough to maintain that modern parents must assume some degree of interest in events which shape the lives of themselves, their kids, and the rest of the community. Our grandparents could run away from tight situations, and many of them did so—trekking westward to fresh fields far distant from the bothersome details besetting the older colonies. But there "ain't no place" to run to any more. We're stuck in our tracks. Moreover we are now citizens of Paris and Berlin and Prague—and some even aver, of Moscow. The whole blamed world has caught up with us. This is the price we pay for being so terrificly smart and amazingly versatile and scientific.

While we are trimming up the bandstand or the schoolhouse at our community festivals we must be thinking in big terms of the hungry bellies of babies abroad and what would be the lasting effect of feeding some of them or letting the whole tribe starve, for all we care. No such posers throttled us when we were young. We strutted our stuff on our own stage and shut the rest of mankind outside.

One might assume that in this present dilemma the returned veteran on the next street to ours might allay our fears and unravel our twisted skeins of thought on world affairs. We thought so a few months ago, trusting to the power of personal observation and judgment by one of our neighbors to set us aright. But Ma and I haven't been able to pick up many crumbs of comfort or get wiser to what ails the universe by peppering him with questions. Even my son-in-law who partook of certain dangers and discomforts abroad speaks, when he speaks at all, in the blue language of tough skepticism. So we just sit it out and wonder if that new grandchild will live in a better or a bitter world—and why in tarnation we couldn't have done something more effectively to guarantee reasonable hope for all such unfolding personalities.

IN conclusion, then, I still adhere to my thesis that the married folks of the present day really take on a carload of burdens and duties when they clasp hands and go in for "better or for worse." Pioneer hardships of former times have a counterpart today, and believe me, I take off my bonnet to any couple who weathers the storm and keeps the old home craft right side up.

And more especially to those who do so under sorrow and sickness, loss of employment, or disability. When they start handing out more medals let's distribute a few to the householders who kept those home fires burning and the rent paid while heroes and statesmen "wrote the peace."

MISUNDERSTOOD

Several men were traveling by train. Presently one produced a large fruit cake, which he devoured greedily.

Time passed. Suddenly he began groaning and doubling himself up and straightening out again. When this had gone on for some time, a friend asked him:

" 'Smatter, Jim?"

"That cake I ate," groaned the sufferer. "It had nuts, and I think the missus forgot to shell them."

"Lor!" said his friend. "And can you crack 'em just by bending?"

"Have you noticed how untidy Old Maid Jones' house has become lately?" asked the first gossip.

"Yes," replied the second, "ever since the minister said, 'Man sprang from dust,' she quit sweeping under her bed."

SHE WAS A BELIEVER

A negro spinster of uncertain years decided at long last to join the Baptist Church. As the deacons plunged her into the river the first time, she gasped, "I believe." The second time she chattered, "I believe." A third time, gulping for air, she sputtered, "I believe." One of the elders interposed: "You believe what, sister?" She eyed him savagely: "I believe you stinkers are trying to drown me."

A Washington diplomat was entertaining a French official. The official had difficulty with the King's English. He expressed his thanks for the kindness of his host, but added apologetically:

"I'm so sorry to cockroach on your time."

"Oh," answered his host, "think nothing of it. But you don't mean cockroach, monsieur; it is encroach, you mean."

"Oh, is it? I see—a difference in gender."

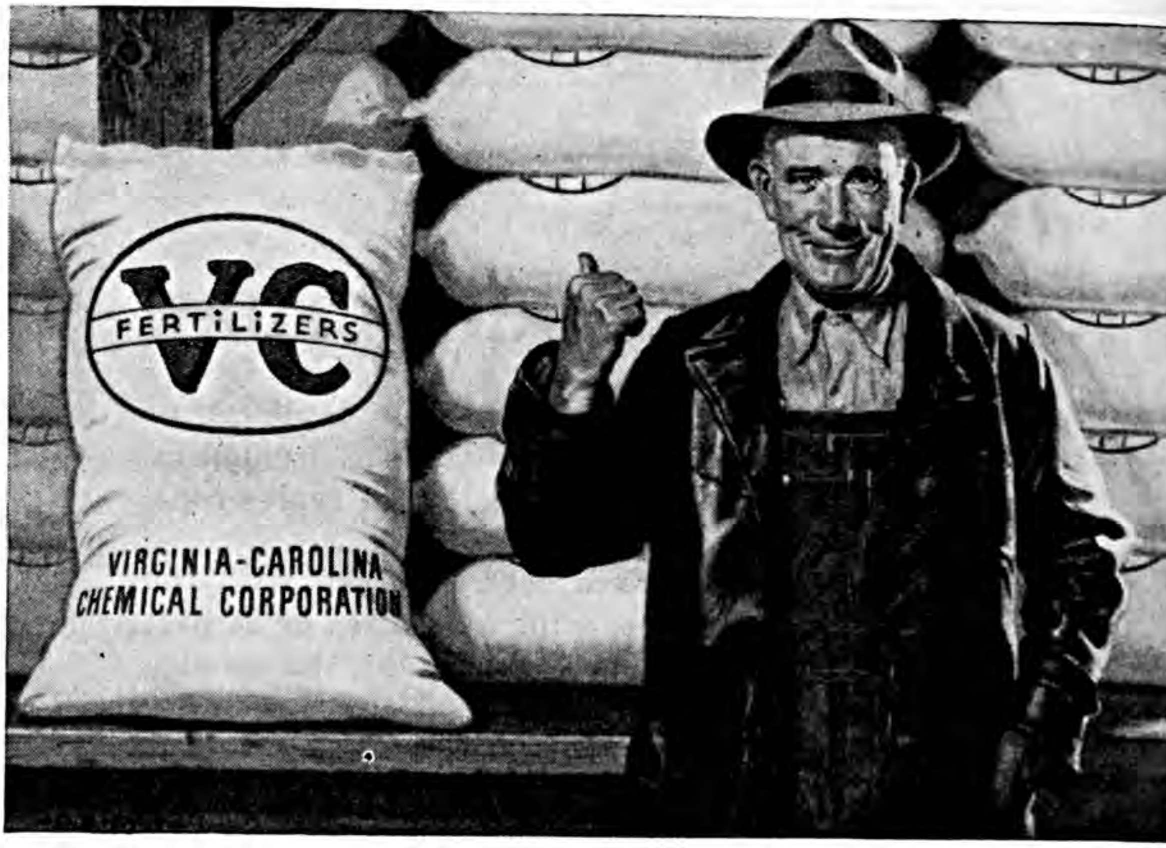
A recession is a period in which you tighten up your belt. In a depression you have no belt to tighten up—and when you have no pants to hold up, it's a panic.

"Be careful of a live wire when you're in the bath tub."

"Oh, I am. I always lock the door."

A neighbor, passing the cabin of a mountaineer, had the bad fortune to run over and kill the mountaineer's favorite dog. He went into the house and told the man's wife what had happened and how sorry he was. The owner of the dog was out in the fields, and the motorist decided he had better go out and tell him of the accident, too.

"Better break it to him easy like," said the wife. "First tell him it was one of the kids."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The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

VOLUME XXXI NO. 10

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The American Potash Institute, Inc.

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EVERY EAR COUNTS THIS YEAR

Better Crops with PLANT FOOD

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VOL. XXXI WASHINGTON, D. C., October 1947 No. 10

Recollections . . . . .

About Pa

Jeff McDermid

IN SPITE of all the famous books and plays that have been written about Fathers and the relatives who lived with them in those far-off simple times, it strikes me that almost any fellow with a fair memory and a liking for reminiscences could whittle away with zeal on a picture of his own Dad—possibly long since departed this life. By and large and taking into consideration their influence on the period in which they lived, most of those good old Dads of ours registered almost nothing tangible or lasting in a public way. Yet it has always sort of impressed me that it is the multiple effect of all these humble and obscure Dads working along quietly and unobtrusively and without renown that really makes this one of the best of all nations in the world.

You see, they leave behind them a strong private tradition, if not a public acclaim, which, like all the nameless creeks that bring more waters to a great river, serves to deepen and widen the flow of national integrity. For the sum total of a country's character rests upon the communities and families that sustain it.

I suppose also that a majority of us had country-born-and-bred fellows for our progenitors. Not that this makes a whit of real difference in their uphill battles or their degree of responsibility from the Dads who never left the pavements—but it sort of unites a lot of us in a common "pasture" as it were from where we can look over the fences in the same general direction and note the same scenery while discussing our honored Sires.

I do not draw upon my own case because it is remarkable or because it has any brilliant periods or startling memoirs to submit. In fact, I have no line of writing by my Father to show anybody or any masterpiece of his making to exhibit with pride.

He was just "Pa," very deficient in book learning and scholastic knowledge, somewhat awkward in his etiquette at times, and constantly short of the wherewithal to do the things that he saw some other Dads perform for their offspring.

MOST OF THE big successful books I have read about Fathers are set in a realm of riches compared to my own; and those Fathers were usually more or less successful professional or business men with a background of varied experiences and important outside activities. I haven't yet found a book that spoke honestly about some very ordinary Father, who found himself at times just a few jumps ahead of his creditor and no personal skills or influential friends to lean upon when the going got tough. That a guy really had a Father who went through the wringer and always had to pinch and ponder the future financial outlays, and yet who came out of his trials and bothers without losing his decency or his kindness, dignity or self-respect is perhaps something to brag about.

I've seen the time long ago in my early teens when I would have been sorry to admit that we were hard up; and that I was almost ashamed to have my Father come into the classroom to give an old soldier's Memorial Day talk —after the custom of my home town. I guess many kids go through that foolish shrinking spell when their parents are none too well dressed or modern, and more than ever so when some peculiar physical trait is observable.

I confess it made me sink my head and blush when the afternoon program in school included a short speech on patriotism and war experiences which the old soldiers took turns in giving, because quite often my Father was assigned to do the honors himself. He had no blemish on his war record or personal integrity, but he came out of the fever and ague marshes of the South with traces of malaria which left him nervous and ill at ease on public occasions. He had a perpetual case of stage fright and his voice trembled and his legs shook. Yet he took the call to public duty unflinchingly and muddled through his talk somehow, usually winding up with a poem he had made up himself about some boys around the campfire on the evening before a battle. The other kids in school took it much better than I did, and clapped loudly when he finished, and made no wisecracks at me afterwards either. But I was relieved when the program ended and Father beat a hasty retreat to help fix up the floral bouquets for the graveyard exercises.

Personally I think he would have done much better had I not been in the audience. He was probably trying hard not to shame me. The next day during the big parade down Main street behind Luder's German cornet band I seldom felt anything but a rush of glory and warmth, as I beheld Pa and old Man Blowers trudging at the head of the Grand Army Post No. 14; the one serving as officer of the day—who commanded the "boys" to "fall in,"—and the other holding aloft the Stars and Stripes nicely balanced by a pole set in the socket of a leather belt. Behind the "veterans" came the soon-to-be veterans, members of the Gifford Guards, in light blue uniforms and flat-fronted kepis on their heads—later discarded for the broad felt hats and khaki in the Spanish-American war.

THIS WAS as close to national immortality as my Father and his old comrades ever got. I presume a faint reminder of it may still exist on succeeding Memorial Days when the iron flag-holders mounted on their graves bear faded, rain-washed bunting placed there by a patriotic generation who never knew them, and the mournful winds from the river carry hints of another spring seedtime which they shall never see. They do not lie in Arlington or under marble emblems, but perhaps those grass-grown rural cemeteries prove just as comfortable as a bivouac for nameless private soldiers awaiting the morning and the reveille.

My Father was born in Bennington, Vermont, in 1841, in a family of seven children, his father a blacksmith on the village green. There was a flag pole on that greensward, for Dad told me about the cheering done by a few Democrats in Vermont at the victory of President Polk and how some wag shinned up the liberty pole to hang a cow "poke" atop it in simulation of the winner's name.

He had few memories of the Green Mountain State itself, although the traditions and legends and lore of the era and the region came easily from his lips, like the rhymes from the McGuffy readers, Ethan Allen and Ticonderoga, the duel between Henry Clay and John Randolph of Roanoke, old English hunting songs with their echo, "temer-ren-ten-ten," home-made game boards for Nine Men Morris, and nursery jingles like "Richard and Pritchard were two pretty men who got out of bed when the clock struck ten." These and anecdotes of the family coming west via Erie Canal, and the elder son who left with the drovers for the long overland journey to the gold rush at Sutter's Mill, were often recited on winter nights from his old armchair by the kitchen window.

Dad's mother was a Putnam, some distant kin of General Israel's. She had a twin sister who married and went west to settle in Wisconsin three years prior to the exodus of my Father's tribe to follow the same uncharted pathway. The correspondence between the twins led all other reasons for the migration, the rest of it being laid to restless itching for new places and a diminished income from the Bennington smithy amid its rugged and stubborn farm land. My Father was about seven years old when he went on that great adventure, probably giving no lingering backward glance at the Green Mountains—which by the way, he never saw again.

Anyhow, the reunion of the twins and their families took place at last in a little hamlet east of the Badger capital, from whence the pioneers went the next spring to locate in a scrub oak clearing among the sand hills—fertility being of less moment then than wood and fresh water. Some of their best neighbors were Winnebago Indians, with whose boys my Father ranged the fields and forests in his teens, with nary a hint of race prejudice or ancient grudges.

Something that was always deeply appreciated and long remembered by the western migrators was the invoking of original native humor and the ability to defend one's self against a bully. I find this trace in the tales of my Father too. One had to be lighthearted and strong to endure, I guess. If they had had what we have to enjoy perhaps their ideals would have been slightly different. But far from me ever belittling them, I honor their reliance upon themselves for happiness and security, such as it was.

IN THIS VEIN, I recall that my Father's chief delight was in memories of his uncle, the husband of the

(*Turn to page* 49)

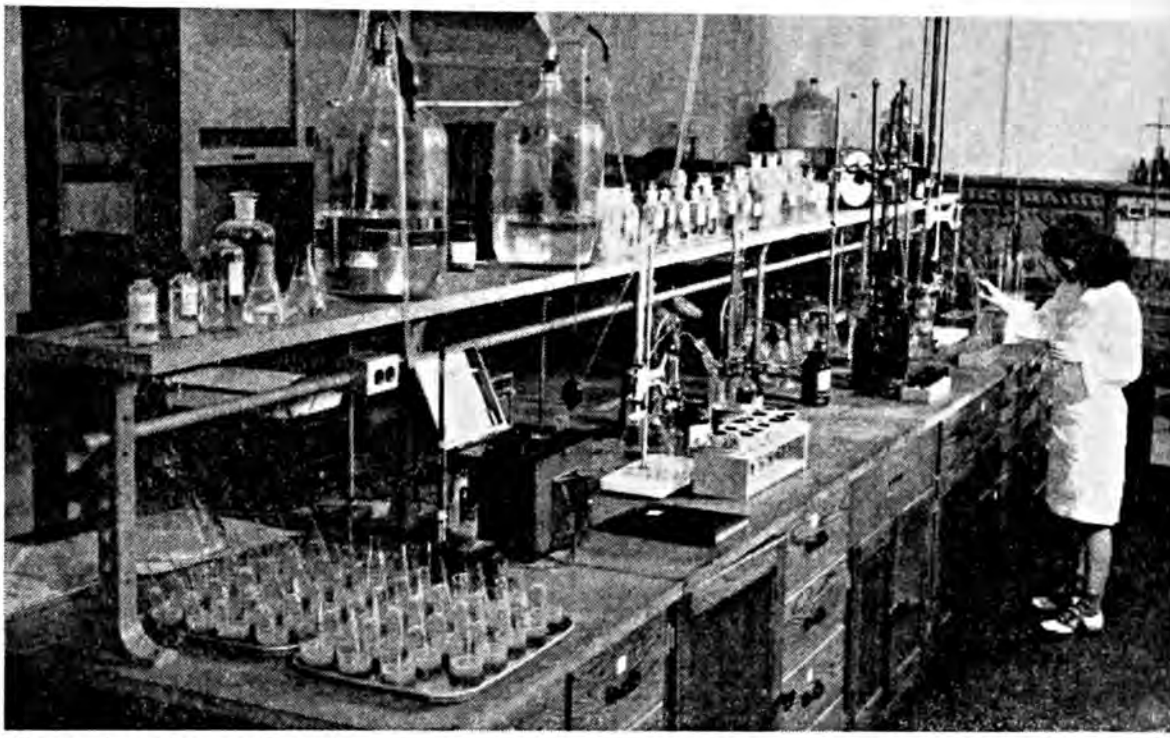

Fig. 1. A modern, well-equipped rapid soil and plant test laboratory. For running soil tests only, the laboratory may be much simpler. The G.L.F.-Seabrook Farms Raw Products Research Division Laboratory, a portion of which is shown here, provides information for the fertilization and liming of 25,000 acres of South Jersey farms.

Let's Replace Guessing With Soil Testing

By Benjamin Wolf

Soil Chemist, Seabrook Farms Company, Bridgeton, New Jersey

EVERY FARMER needs to know whether each field on his farm has sufficient quantities of available nitrogen, phosphorus, potassium, calcium, magnesium, and trace elements to meet the needs of the particular crop he is growing. It is also as important to know whether soil conditions, such as acidity and organic matter, are sufficiently favorable to permit the ready movement of these nutrients from the soil into the plant. Much of this information can be supplied quickly and easily by obtaining a rapid soil test.

Rapid soil test results can give a wealth of information to the farmer. They can tell him whether each field has the proper "sweetness" or acidity for crops to be grown. Since crops vary as to their requirements from this standpoint, it is absolutely important that each field be adjusted to give maximum crop yields. If too acid, soil test results will tell the amounts and kind of lime needed to sweeten the soil. If too sweet, they will provide information concerning amounts of sulfur necessary to make it more acid. These tests will also provide information about the approximate amounts and kinds of fertilizer necessary for production of good crops. They can give much information as to whether organic matter supplies are being maintained at satisfactory levels, and can well point out toxic conditions such as are produced by excess fertilizer or presence of alkali salts or salting from sea water. In other words, knowledge of the basic requirements for feeding maximum crops of high quality can be brought into a farmer's hands in a short time by these methods.

Necessity of Tests

Such information is necessary if we are to meet the soil requirements of the particular crop that is grown. Many factors other than soil conditions enter into producing a bumper crop. However, there is no possibility of such crops unless soil conditions are optimum or nearly so. It, therefore, is a necessity to adjust the lime and fertilizer applications, and other soil additions as well, to meet the exacting requirements of good crops. Properly correlated soil test results offer the best possible means of calculating the amounts and kinds of materials needed, since they provide knowledge as to what is lacking in the soil. As can be seen readily, they are starting points for making up soil deficits.

The amounts of fertilizers, lime, and other amendments that are called for are based on actual crop response at certain levels of soil nutrients as measured by rapid soil tests. Knowing the change from one level to another by different applications of materials on certain soils also helps in the interpretation of the tests. Such preliminary knowledge is necessary for properly using rapid soil test data but is of no direct concern to the farmer. Once such data are obtained, they can be used indefinitely in an area to advise farmers as to the approximate amounts and kinds of materials he needs to add to the soil. The farmer receives the results in terms of pounds per acre of a particular kind of lime, fertilizer, or other ingredient and he need only follow the recommendations given.

If a farmer does not have these results, he must guess every time anything is added to the soil. He may be a good guesser; but since the odds are all against him, more often he is not. The depleted, ruined lands of America are mute testimony of the fact that past generations were very poor guessers. The present generation of farmers is still largely guilty of guessing. We have learned to mine nutrients out of a soil faster than any people in the history of the earth. General intensification and the lack of animal manures have added problems of fertility unknown to our forebears. While today we have more knowledge as to how soil impoverishment may be eliminated, we will fail dismally unless we proceed to use this knowledge to the fullest extent.

Many so-called progressive farmers often are as guilty of guessing wrong as their less educated neighbors. Knowing the agricultural value of lime, a "progressive" farmer in the area used large amounts of lime annually. A recent analysis of the soil, however, showed that the applications had not been used judiciously. There were fields having a pH of 7.5, or slightly alkaline, while some fields had a pH of 5.0, or strongly acid. In growing spinach, which in this area does best at pH of approximately 6.0-6.5, that growing on the higher pH was chlorotic and unsalable, and the fields having pH of 5.0 hardly had a stand.

Results of Tests

Guessing in this case was expensive. It usually is. It would have cost the farmer in question no additional amount for lime if all fields were limed to a satisfactory level. The amounts of money his crop would have returned in one year by being grown at proper acidity levels would have amply paid for obtaining soil test results for years.

Results of rapid soil tests also offer a means of saving money in the cost of fertilizers. For years Seabrook Farms Company has applied 1,000 to 2,000 pounds of a 4-12-8 fertilizer per acre for growing vegetable crops. At first there was a need for such applications because when land was taken over for vegetable production much of it was low in nutrients, particularly phosphorus. Such applications, year after year and sometimes two and three times per year for several crops, have built up supplies of phosphoric acid in the soil. Need for extra nitrogen to give a better balanced condition has been met by extra additions of cyanamid and side-dressings of soluble nitrogen. More recently experiments based on rapid soil tests have shown that extra nitrogen but much less phosphoric acid will give better crops. This year an 8-8-8 or 10-10-10 fertilizer in amounts supplying about 30 additional pounds of nitrogen but 100 pounds less phosphoric acid per acre was used on many fields. This change, besides offering better crops of better quality, will provide considerable savings on Seabrook Farms' 1947 fertilizer bill.

Not all fertilizer savings based on soil tests are as large. Seabrook Farms could make large savings only because large amounts of phosphoric acid have been used for years on about 18,000 acres. The savings of actual fertilizer for small operators may be small but a total of them in any area is impressive. For in any community, there will be a number of farmers using either wrong amounts or kinds of fertilizer or both. For example, there are fields requiring large amounts of nitrogen, others may require large amounts of phosphoric acid, and still others may need high potash. Certain fields may require large amounts of two of these nutrients but not of the third. It may well be that large amounts of nitrogen are called for, but instead of supplying the need, excess money is spent for other elements needed only in small amounts. Often mixed fertilizers are being used when single ingredients are called for. Unless a test is made, there is no way of knowing the special conditions or needs of each soil.

Applying the same kind of fertilizer and perhaps at the same amounts to each field, as often is done, results in considerable waste of fertilizer. If it were only the price of the fertilizer that is being wasted, the situation would not be too serious. However, when the wrong amounts or kinds are being used, crop yields are markedly affected. Supplying certain elements in excess while failing to supply others in sufficiency causes unbalance with poor yields or poor quality or both.

In terms of crop, the savings even for farms of small acreage are most impressive. The results from a soil test may mean a good crop or no crop.

TABLE 1. NUMBER OF RAPID SOIL TESTS REQUIRED TO DO A COMPLETE JOB OF SOIL TESTING FOR VARIOUS CROPS IN NEW JERSEY

Crop	Acres	Acres per sample	Sampled	Number of samples
Vegetables	136,000	5	annually	27,200
White potatoes	50,000	10	annually	5,000
Sweet potatoes	14,000	5	annually	2,800
Hay	227,000	10	once in 3 yrs	7,560
Fruits	37,000	5	annually	7,400
Grains (other than cereals)	72,000	10	annually	7,200
Cereals	230,000	10	annually	23,000
Pasture (plowable)	200,000	10	once in 3 yrs	6,660
Total	966,000			86,820

The soil tests in such cases may suggest additional fertilizer or lime. Payment of such increases will be in form of greater yields, prevention of crop failures, and production of good quality produce. To a livestock producer, good quality will be very helpful in increased stock production, more milk, less breeding troubles, better weight gains, etc. If produce is sold directly, good quality may be responsible for a profit when a loss would otherwise be expected. In this postwar world with its keen-competition-for-purchases appeal, this is apt to be especially true.

Testing Is Insurance

In a sense, results of soil tests are a form of insurance—insurance that there will be no large waste of fertilizer or lime applied and insurance of producing good crops. Such insurance is well worthwhile. To illustrate this point, we might consider the cost of soil testing in the State of New Jersey. From Table 1, about 90,000 samples would have to be analyzed each year to give complete soil test results on the 966,000 cropped acres. The cost of such analyses would run between \$100,000 to \$150,000. This seems like an impressive figure until we stop to realize that in 1945 New Jersey farmers spent close to \$10,000,000 in purchasing some 245,000 tons of fertilizer and 186,000 tons of lime. Spending about \$125,000 for soil tests would represent a cost of 1¼ cents in order to wisely use each \$1.00 spent on fertilizer and lime. Viewed from a different angle, New Jersey farmers in 1945 produced approximately \$120,000,000 of farm crops. A cost of \$125,000 to insure a \$120,000,000 item is operating at a rate of a little over 0.1%. This is a much lower rate than these farmers paid to insure their dwellings, buildings, livestock, or machinery against loss by fire. Unlike fire insurance, money spent for crop insurance through rapid soil tests actually increases the value of article insured.

Considered from every angle, rapid soil tests are worthwhile and are urgently needed if we are to do an intelligent job of farming. How then can we get such results to every farmer or nearly every farmer in America?

Agencies for Testing

Most of the soil testing in this country today is done by state and federal agencies such as experiment stations or extension services. Such work is done free of charge or for only a nominal sum to cover cost of containers or postage. These organizations are not now equipped to handle the tremendous numbers of samples that are necessary to give each and every farmer soil test results. If all necessary samples were sent to these agencies, the service would completely bog down. Knowing this, there is a tendency on the part of agencies responsible for such testing to avoid advertising the work they are now doing just to prevent such a possibility. They could handle the load if sufficient funds were available. Sufficient funds also would help to make the soil testing results more accurate and useful by helping to supply information for proper interpretation of results. However, the \$125,000 worth for the State of New Jersey is a big "if" and would not be appropriated unless farmers within the State knowing its value would demand such a service.

Commercial organizations also have done considerable soil testing work. Such organizations as large farms, food processors, and fertilizer companies have been engaged actively in testing soils. There are many more organizations of these types that can well afford to do soil testing on their own. Payment for such tests is in the form of increased crop yields or better quality of crops or good will and prosperity of the patron.

Recently, the author has suggested how the fertilizer industry may well use soil tests in conjunction with bulk fertilizer spreading to completely revolutionize the fertilizer industry. Actual spreading of fertilizer would be done by the fertilizer company at rates and analyses suggested by rapid soil tests. Fertilizer mixed as needed would be spread immediately on farmers' fields. Elimination of storing mixed fertilizers, curing fertilizers, or of adding conditioner and elimination of bags and bagging would go a long way in paying for the added service of soil tests and fertilizer distribution. It remains to be seen to what extent the fertilizer industry will take advantage of the suggestion. If it does, this may be the most efficient way of handling the soil testing problem.

All of these methods (agency testing, commercial organization testing, or special fertilizer industry service) are not means of supplying rapid soil testing immediately to the many farmers who are now in need of it. To get this work started, it may be worthwhile for farmers' organizations to get together and do such testing on their own. In Illinois, a number of county laboratories for rapid soil testing have been established with the Farm Bureau underwriting the costs. These laboratories were set up by the Farm Adviser with help from the State University. Cost of setting up the laboratories has varied from $250 to $600. Farmers are charged at rate of 5 cents for each acidity determination, 10 cents for phosphorus determination, and 20 cents for potassium. Such charges are made to cover wages of the technician and the cost of testing materials. If samples are collected by the laboratory, a charge of 10 to 15 cents an acre is made for sampling service. In one county, a special service includes sampling, mapping of farm for lime, phosphate, and potash needs, and a visit by the Assistant Farm Adviser. The Farm Adviser discusses results of the tests and advises the farmer on lime and fertilizer applications as well as crop rotation. Charge for the complete service is at rate of 35 cents per acre.

The soil testing service by counties in Illinois is a most interesting innovation. It would be worthwhile for farmer groups everywhere to investigate these services. Other variations

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Fig. 2. A field of processing peas at bloom stage. Such fields of uniform, vigorous growth are possible only when all factors are at optimum. Use of rapid soil tests is an insurance that soil conditions for the crop are at optimum level.

From Broom Sedge To Beef Cattle

By Francis Murray

Associate Extension Editor, Purdue University, Lafayette, Indiana

YOU COULD TELL Paul Schaus, husky, middle-aged farmer of near Lamar in Spencer County, Indiana, to "go to grass" and he would hardly be offended. In fact he would very likely smile proudly and reply that he was already going to grass and plenty of it.

The story of Mr. Schaus and his triumphant conquest of erosion, low soil fertility, and a secure family income began a quarter century ago when he purchased a worn-out farm and simultaneously heard old-timers wonder out loud if he "was deliberately planning to starve to death."

A picture of that first 80 in the modest Schaus enterprise might have been described like this: The steep slopes were gashed viciously with gullies, the low ground was frequently flooded out, crops literally burned up in the hot dry summer days, a good corn crop averaged 35 bushels per acre, and legumes were too uncertain to speculate on. In addition, the buildings were in a similar state of collapse.

Fig. 1. Mr. Schaus uses barley for a winter cover crop because it yields good, makes good feed, and is hardy. He gets yields higher than his wheat yields would be. Here he is shown with a sample in one of his barley fields.

Paul had assembled all his formal education in the one-room school at the edge of the farm, but his thirst for new knowledge and his ability to observe and listen were boundless. Early in his struggle to improve productivity of his land, Paul went to the county seat and sought information at the office of the county agricultural agent. He studied crop rotations, new varieties, fertilizers, and drainage. He attended community crop schools and applied new management methods. Added to all these, he was a tireless worker who had good common sense.

Here is an example of Paul's determination to apply what he learned to his own impoverished land. He had been plagued by overflows caused by spring rains that rushed from a steep slope into a flat low area, invariably drowning out the crops. One day after a super "goose-drowner" he called county agent C. L. Dyer and suggested that he would like to try a series of diversion terraces on the hillside above the overflow land and asked the county agent to help lay them out.

That was 15 years ago. It was before field terracing was used in Indiana, particularly on southern hill farms. The terracing equipment included a two-horse breaking plow and a slip scoop. It was a slow, difficult job.

"Many a time during that first year," Paul recalls, "I would run to the hillside in the pouring rain and shovel earth frantically to patch low places where the water threatened to break out of the terraces. The first year of the new terraces the low land produced a good wheat crop, and it has been producing good crops ever since."

In the very community where more than a century ago Abraham Lincoln was splitting rails and hoeing corn, Schaus was pioneering in soil conservation. The initial terraces were only a few hundred feet long. More than a mile of them wind around the steep slopes on his farm now.

Eight years ago, Schaus, a cooperative responder to new and practical farming advice, was asked by Purdue University to permit his farm to be used for some soil fertility test demonstrations. Extension service officials had selected the Schaus farm because it was typical of the condition of hundreds of others in southwestern Indiana.

Subsequently, a specialist from the University and the county agent suggested a plan. It called for longer rotations, heavier and higher analysis fertilizer applications, liming, strip or contour cropping, and more attention paid to the permanent pasture program. Some of the fertilizer was TVA superphosphate obtained through the University extension service.

Each year, under the new plan, Schaus has been stepping up fertilizer applications, and adding to his liming and pasture program. As a result, grass and legume crops are growing abundantly on hillsides once covered with broom sedge, corn yields have passed the 100-bushel-per-acre mark, and pasture carrying capacity has jumped from 1,750 pasture days to 6,000 pasture days per year.

A shotgun mixture including clover, timothy, alfalfa, and brome became a standard crop until recently when Schaus seeded one field to ladino clover.

Schaus has turned his farm enterprise into a rather unique combination.

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Fig. 2. This field had been flooded by spring rains which poured from the hill at left. Diversion terraces shown were built with a walking plow and slip scoop nearly 15 years ago. Schaus saved the crop the first year and each year from then on. Contour plowing and strip cropping also are being employed in controlling erosion.

Field showing the second crop of alfalfa. Manure was used on the entire piece. On the left, 150 pounds of muriate of potash; on the right, none. Response is very clear.

The Potash Fertilization of Alfalfa in Connecticut

By R. I. Munsell

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THE oldest agronomic project still active at the Storrs Experiment Station is the response of alfalfa to soil treatments. Early in the history of the project, the importance of applying potash for alfalfa became apparent. In recent years, increasing difficulty has been experienced in maintaining alfalfa stands on Connecticut dairy farms for more than two or three years. In seeking a solution to this problem, rates and frequency of potash application were investigated in some detail.

Most of the tilled land in Connecticut has been cropped for 200 years or more. The soils were never very fertile. The present low reserve of relatively available potash may be due to past farming practices. As a result of poor storage and improper methods of application of farm manure, only a small part of the potash in animal voidings was returned to soil. And, even since commercial fertilizers have become available, relatively small amounts of potash have been used on alfalfa.

In seeding alfalfa, it has usually been recommended that sufficient minerals be applied to last through the average life of the stand. However, on a number of dairy farms, it was found that alfalfa seedings responded to additional potash,

TABLE 1.—K APPLICATIONS AND STANDS OF ALFALFA

K treatments		Stands at consecutive cuttings (%)					
No.	Time	1st	2nd	3rd	4th	5th	6th
1	August 1941	95	91	81	71	61	56
2	August 1941, 1943	96	83	73	66	61	64
3	August 1941, 1942, 1943	96	87	88	85	76	83
6	Every June and August	95	87	79	76	70	68
9	Every April, June, and August	96	94	90	81	76	78

even where manure was applied regularly. The high requirements of alfalfa for potash and the rapidity of potassium absorption when the supply in available form is large raised the question of the feasibility of adding enough potash at the time of seeding to last the crop through its probable life.

To obtain more information on this question, an experiment was started in August 1941. It was located on Charlton fine sandy loam soil on a field that had grown alfalfa since 1934. The pH of the soil was about 6.0 and the exchangeable bases totaled 6.5 milliequivalents per 100 grams of soil. The old stand of alfalfa had been plowed in May, and the land fallowed until August when Ontario Variegated alfalfa was seeded on all plots. The entire field received 47 per cent superphosphate at 300 pounds per acre. On this seeding, five different methods of applying potash were tested on quadruplicated plots, 52 x 11.5 feet. Each plot received the same total amount of potash during the three-year period 1941-44. The total application in each case was 360 pounds of K_2O per acre. The five treatments were:

(1) All of the potash disked in before seeding.
(2) Two-thirds of the potash disked in before seeding and one-third top-dressed in August 1943.
(3) One-third of the potash disked in before seeding and one-third top-dressed in August of 1942 and 1943.
(4) One-sixth of the potash disked in before seeding and one-sixth top-dressed in June and August of 1942 and 1943 and June of 1944.
(5) One-ninth of the potash disked in before seeding and one-ninth top-dressed in April, June, and August of 1942 and 1943 and April and June of 1944.

In 1942, 1943, and 1944, the alfalfa was cut twice per year following a 45- to 50-day growing period. Samples of pure alfalfa were selected immediately after cutting and these were analyzed for Ca, Mg, and K. The total yields of dry matter, including any volunteer

TABLE 2.—K APPLICATION AND CA IN ALFALFA

K treatments		Ca in consecutive cuttings M.E./100 grams dry matter					
No.	Time	1st	2nd	3rd	4th	5th	6th
1	August 1941	66	56	90	95	105	105
2	August 1941, 1943	73	66	101	103	99	104
3	August 1941, 1942, 1943	80	68	94	96	98	96
6	Every June and August	85	63	93	90	92	90
9	Every April, June, and August	82	66	97	93	97	100

TABLE 3.—K APPLICATION AND K IN ALFALFA

K treatments		K in consecutive cuttings M.E./100 grams dry matter					
No.	Time	1st	2nd	3rd	4th	5th	6th
1	August 1941	67	59	51	35	33	25
2	August 1941, 1943	54	51	33	29	37	27
3	August 1941, 1942, 1943	47	45	47	35	39	34
6	Every June and August	44	42	42	37	34	32
9	Every April, June, and August	47	45	35	38	36	37

grasses, were determined for each cutting. Any significant differences in total yields of the alfalfa as a result of fertilizer treatment were masked by the presence of volunteer grasses such as quack grass (Agropyron repens (L.) Beauv.).

The stands of alfalfa were estimated at least twice each season. The relationship between potash treatment and stands of alfalfa is brought out by table 1.

During the first harvest year, the stands were uniform for all K treatments. Under treatment No. 2, the stands decreased until the final third of the K was added in August 1943. At the end of three years, the poorest stand resulted from the first treatment where all of the K was applied at time of seeding. The best stand was maintained by treatment No. 3 where the K was added annually in equal amounts.

Chemical analysis showed that the rate and frequency of K treatment had considerable effect on the chemical composition of the alfalfa. In table 2 are given the Ca analyses for each cutting.

A single, heavy application of K before seeding depressed the Ca content of alfalfa markedly in the first and second cuttings and somewhat less so in the third and fourth cuttings. Except in the first cutting, applying two-thirds of the total K before seeding did not depress the amount of Ca in the alfalfa when compared with more frequent K treatments.

In table 3 will be found the K analyses of the six consecutive cuttings.

The effect of a single, heavy application of K before seeding was to give an increase in K content for the first three cuttings. Withholding one-third of the K until the end of the second year gave the lowest K content in the third and fourth cuttings. Dividing the K treatments into annual, semi-annual, and three times per year applications gave a more uniform content of both Ca and K for all six cuttings.

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TABLE 4.—K APPLICATIONS AND TOTALS OF CA, MG, AND K

K treatments		M.E./100 grams dry matter			
No.	Time	3rd	4th	5th	6th
1	August 1941	158	151	158	150
2	August 1941, 1943	153	155	155	148
3	August 1941, 1942 and 1943	159	152	155	148
6	Every June and August	154	148	144	141
9	Every April, June, and August	151	152	148	156

Fertilizer Placement for Corn On Sandy Soils of Minnesota

By J. M. MacGregor

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Fig. 1. Applying the fertilizer in the hill on the Sherburne County field.

FERTILITY experiments on the value of deep placement of commercial fertilizer by means of the "plow-under" method have been conducted by members of the Division of Soils, University of Minnesota, since 1942. Three years of investigation using commercial fertilizers at rates up to 1,000 pounds per acre on several finer textured soil types of the so-called "corn belt" in southwestern Minnesota demonstrated that in years of average precipitation the new placement method was probably not superior to fertilizing in the hill. Since investigators at the Indiana Station had secured excellent results with deep-fertilizer placement on the less fertile soils of that State, it was decided to initiate placement studies on the comparatively less productive sandy soils of Minnesota, of which there are some five million acres that might be utilized for agricultural purposes.

Four representative sandy land fields were selected in the spring of 1945, and several fertilizer combinations were applied at different rates on the "plow sole." Field corn was planted on two of these fields and navy beans on the two remaining. The amount and distribution of rainfall during the growing season of 1945 left little to be desired, and the response to fertilization, particularly to the application of nitrogen, was substantial. However, fertilizer applied to the corn in the hill also produced comparable increases in yield. Since the deep placement of fertilizer theoretically should encourage the development of roots more deeply in the soil than fertilizer placed more closely to the soil surface, the deep-placement method should have a decided advantage if drouth conditions should develop at any time during the growing season. The 1945 sandy land experiments demonstrated that the sandy lands were responsive to fertilization regardless of the method in which the fertilizer was applied.

Early in 1946, one field was selected as representative in each of the four counties of Anoka, Sherburne, Isanti, and Chisago. Six fertilizer treatments were applied on the plow sole in duplicate randomized plots 14 feet wide and 189 feet long. The corn was planted using a 42-inch x 42-inch spacing.

TABLE 1.—THE EFFECT OF FERTILIZER PLACEMENT FOR CORN ON HUBBARD LOAMY FINE SAND. ANOKA COUNTY, MINNESOTA, 1946

Applied plant nutrients, lbs./A			Increased yield over check plots (3.0 bu. and 0.55 tons fodder)			
			Ear corn in bu./A		Corn fodder in tons/A	
N	P_2O_5	K_2O	Hill-dropped	Plowed-under	Hill-dropped	Plowed-under
20	0	0	1.1	0.2	0.16	0.19
40	0	0	2.1	4.1	0.22	0.22
0	20	20	0.9	7.1	0.10	0.13
0	40	40	0.8	1.5	0.17	0.15
20	20	20	1.6	2.4	0.16	0.20
40	40	40	1.2	5.4	0.24	0.25
Average increase for fertilizer			1.3	3.5	0.18	0.19

The six fertilizer treatments were also applied in the hill in adjacent plots, and all treatments were later thinned to two stalks per hill. Yield samples were selected at random from the inner two rows of each plot at harvest time. Precipitation records were kept at each field during the entire growing season.

The soil types of the four experimental fields were not identical, but were typical of the area. Rainfall was abundant at all four locations until the end of June with the months of July and August being extremely dry for three of the fields. Early in September, the corn was further damaged by frost. Since rainfall deficiency varied at each location, the results of each field will be discussed individually.

1. *Anoka County Field—Hubbard Loamy Fine Sand.*

The rotation or sequence of crops

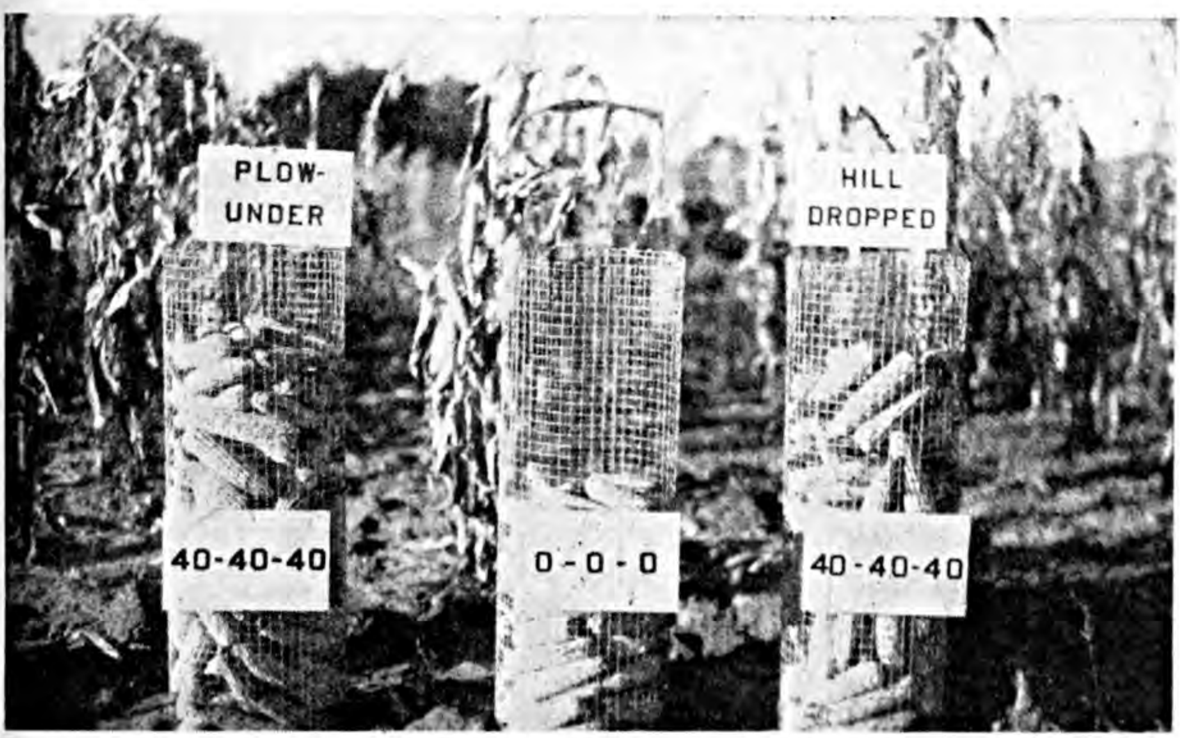

Fig. 2. Effect of fertilizer placement on yield of ear corn of the Sherburne County field.

TABLE 2.—THE EFFECT OF FERTILIZER PLACEMENT FOR CORN ON ZIMMERMAN LOAMY FINE SAND. SHERBURNE COUNTY, MINNESOTA, 1946

Applied plant nutrients, lbs./A			Increased yield over check plots (19.1 bu. and 0.87 tons fodder)			
			Ear corn in bu./A		Corn fodder in tons/A	
N	P_2O_5	K_2O	Hill-dropped	Plowed-under	Hill-dropped	Plowed-under
20	0	0	2.9	0.0	0.09	0.06
40	0	0	6.1	6.6	0.10	0.23
0	20	20	2.4	3.3	−0.02	0.08
0	40	40	5.6	2.7	0.19	0.11
20	20	20	6.8	7.8	0.09	0.16
40	40	40	6.9	7.0	0.10	0.19
Average increase			5.1	4.6	0.09	0.14

practiced was one of rye, corn, corn, corn. Rainfall for July and August totaled 1.37 inches, compared to an average normal of 6.61 inches for the two-month period. This deficiency severely affected the yield, but it was interesting to note that the corn with deep-placement fertilizer made much better growth than where fertilizer was applied in the hill. However, the extreme drouth and low water-holding capacity of the soil resulted in extremely low yields as shown in table 1.

2. *Sherburne County Field—Zimmerman Loamy Fine Sand.*

This field had been comparatively well managed with a clover, corn, rye, corn rotation being practiced.

The total rainfall for the July-August period was 1.73 inches compared with a normal period fall of 6.94 inches. No consistent growth differences due to fertilizer placement were noted during the growing season and figure 2 was taken at the time the corn was harvested. The yields of corn obtained are given in table 2.

3. *Isanti County Field—Zimmerman Loamy Fine Sand.*

All attempts to establish an alfalfa stand on this field had failed, probably

TABLE 3.—THE EFFECT OF FERTILIZER PLACEMENT FOR CORN ON THE MORE PRODUCTIVE PHASE OF ZIMMERMAN LOAMY FINE SAND. ISANTI COUNTY, MINNESOTA, 1946

Applied plant nutrients, lbs./A			Increased yields over check plots (29.4 bu. and 1.03 tons fodder)			
			Ear corn in bu./A		Corn fodder in tons/A	
N	P_2O_5	K_2O	Hill-dropped	Plowed-under	Hill-dropped	Plowed-under
20	0	0	6.6	1.4	0.30	0.12
40	0	0	9.8	4.5	0.49	0.26
0	20	20	0.9	−2.6	0.32	0.24
0	40	40	3.9	−2.1	0.30	0.11
20	20	20	13.1	1.8	0.56	0.19
40	40	40	18.3	9.9	0.87	0.51
Average increase			8.8	2.2	0.47	0.24

Fig. 3. Effect of deep placement of nitrogen on vegetative growth of corn in Isanti County.

due to a deficiency of lime. A rotation of potatoes, oats, corn, corn was being followed. Precipitation totaled 3.03 inches during July and August, which was approximately half the normal amount for this period. Although the soil type was the same as the previous field, occasional lenses of finer materials in the profile made it somewhat more retentive of water and the application of fertilizer showed more response as indicated in figure 3. The yields are given in table 3.

4. *Chisago County Field—Berrien Loamy Fine Sand.*

The water-holding capacity and general fertility of this soil were superior to the other three fields since the sand was underlain by a fine textured clayey subsoil at depths of three to four feet. Such soils often occur around the peri-

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TABLE 4.—THE EFFECT OF FERTILIZER PLACEMENT FOR CORN ON BERRIEN LOAMY FINE SAND. CHISAGO COUNTY, MINNESOTA, 1946

Applied plant nutrients, lbs./A			Increased yields over check plots (38.9 bu. and 1.37 tons fodder)			
			Ear corn in bu./A		Corn fodder in tons/A	
N	P_2O_5	K_2O	Hill-dropped	Plowed-under	Hill-dropped	Plowed-under
20	0	0	2.4	16.9	0.09	0.10
40	0	0	3.4	13.6	0.23	0.14
0	20	20	0.0	11.3	0.01	0.08
0	40	40	−2.4	6.4	0.01	−0.09
20	20	20	3.0	9.7	0.29	0.12
40	40	40	2.5	19.5	0.15	0.40
Average increase			1.5	12.9	0.13	0.13

Phosphorus: The Belle of the Soil

By George D. Scarseth

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CROPS do not use a large quantity of phosphorus, but what they do use is most important and the supply must be good. Crops use two to four times as much nitrogen and potash as phosphorus, but phosphorus is held so firmly by the soil that crops seldom get enough and farmers have had to spend annually about one hundred million dollars for this element as a fertilizer to add it in an available form to the soil. The phosphorus is chemically complex. It has many chemical handles with which to hang onto soil surfaces, and so does not move readily in the soil solution. I have compared phosphorus in the soil to a monkey in the jungle. One could not throw a monkey far through a thick jungle growth because arms, legs, and tail would soon catch a limb or vine to hang onto. Phosphorus likewise in the soil gets tangled up in many similar ways and tends to be hard to move and to be kept soluble and available.

Complex Behavior

To understand this complex chemical behavior, let us pretend that phosphorus is acting in a play as Miss Ortho Phosphate, highly attractive to Mr. Root Hair of the Plant Family. The stage is the soil and the scene of our first act is in a very acid room (soil at pH between 4.8 and 5.3). Along the walls of the room (colloidal surfaces) are numerous three-handed boys (trivalent, iron and aluminum oxides and hydrates) that have a great attraction for Miss Phosphate, who also has three hands. As long as these Iron and Aluminum boys have Miss Phosphate in this acid ballroom they can really strut their stuff and at once they are engaged and married. The marriage is made secure (insoluble) in the triple bonds of these hands. The knot is too secure (precipitates of insoluble iron and aluminum phosphates) for Mr. Root Hair to have much of a chance with his courting. He gets jilted and his poor mother, the Plant, starves because her son could not compete with this aggressive competition in such an unfavorable environment.

Addition of Lime

In the second scene, the room has been brightened up a bit with lime. There is just the faint trace of lime in the decorations (light liming to pH 5.3 to 6.0). But this change has proven allergic to the Iron and Aluminum boys for now they have lost a lot of their pep. They are, in fact, almost put out of commission (become insoluble) and the only time they can embrace Miss Phosphate is when she bumps occasionally into them as they sulk along the walls (absorption of phosphates by iron and aluminum in the clay particles). But once she touches the grabby hands of these sluggish, immobile Iron or Aluminum fellows she is really made a prisoner, held in a clumsy embrace (adsorption) but not nearly so snugly as when she was held by these same individuals when they danced about (soluble and mobile) in the first scene.

We notice in this second scene a big, dark, spongy fellow that in many physical respects resembles Mr. Clay Particle in which Iron and Aluminum are sandwiched. This dark chap answers to the name of Mr. Lignin Humate from the Family of Organic Matter. Strangely enough he tends to get into the hair of the Iron and Aluminum boys by getting in front of them to such an extent that these boys, who love Miss Phosphate so much, cannot touch her or hold her hands (protective colloid reaction). In fact, there is a rumor that this Humate fellow actually replaces Miss Phosphate at times by crowding her out of the embrace of these three armed bandits (anionic exchange). Mr. Root Hair enjoys having Mr. Humate around because he has discovered that Miss Phosphate is more free to give him some attention. In fact, in such situations Miss Phosphate is very likely to become annexed to the Plant Family.

The Happy Ending

The stage setting becomes a happy affair in scene three for here everything is sweetened up just right with lime (about pH 6.5). We find that the Iron and Aluminum boys are in jail (insoluble), and Miss Phosphate is keeping steady company with Calcium and Magnesium, the two sons of Old Man Dolomitic Lime. She is rather free to go to the Plant Family at any time, for whenever the door is open to the attractive boys, Calcium and Magnesium, they usually drag Miss Phosphate in, also (mono-calcium and mono-magnesium phosphates, slightly water-soluble).

It is interesting to note what happens if the stage becomes overdecorated with lime (overliming, pH above 7.0). Then Miss Phosphate and the Lime sons, especially with Mr. Calcium, go into such an embrace that they can hardly be moved (insoluble tri-calcium phosphate). Only a few of the relatives of the Plant Family as the Legumes are able to get them to move. The Legumes seem to have a better broom for sweeping them off their feet (root contact and action of excreted carbonic acid) than do their weaker relatives, the Grasses.

So, we come away from our play with the conclusion we liked the third scene best and that our hero, Mr. Root Hair, is further favored by having Mr. Humate around acting as the Jailer for the Iron and Aluminum boys and being otherwise generally helpful.

Method of Application

The behavior of phosphorus in the soil is extremely complex and this story is intended to illustrate only some of the chief characteristics. The practical advantages of correct liming, the addition of organic matter, and the use of legumes is implied. Phosphates do not move to any appreciable extent in the soil and are rapidly converted into unavailable forms when mixed thoroughly in the soil. For this reason they should be localized or placed with as little mixing with the soil as possible, as in bands. Top-dressing or high placement of phosphates for cultivated crops is not effective; on pastures where roots are near the surface top-dressing does satisfactorily. Of course, it needs to work in cooperation with the other nutrient elements because the plants will not respond well to additions of phosphates if one or more other nutrient elements are limiting.

If rock phosphate is used legumes must feed on it first for best results because this phosphate is in a naturally formed, insoluble tri-calcium phosphate that is available only through the action of carbonic acid to convert the phosphate to water-soluble mono-calcium phosphate, which can enter the plant. In superphosphates, the phosphate has been changed from the rock form to the water-soluble mono-calcium phosphate in the manufacturing process. Farmers can use both forms of phosphates in a

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Fig. 1. Urine spots in an alfalfa-brome grass field, May 15, 1945. (see Table)

Urine Spots Reveal Soil's Deficiencies

By D. R. Dodd

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THERE WERE many complaints in Ohio during the early spring of 1945 and 1946 about the slow and limited growth of grass pastures and hay fields. The dry season and close grazing of 1944 reduced the legume content in many fields. This reduced the amount of nitrogen that might be fixed by legumes. The cold weather of April in 1945 and 1946 prevented much nitrate formation and that formed doubtlessly was leached out of the soil to considerable degree by the excessive spring rains. However that may be, there were in the spring of 1945 and 1946 large responses to nitrogen fertilizer applications. The increased spring growth about urine spots of the fall of 1944 was also very pronounced. A good example of this fact was observed on a farm near Columbus on which some history and yield data were collected.

A seeding of alfalfa and brome grass was made in 1942. Along the fence a strip 20 feet wide was permitted to remain in Kentucky bluegrass. The field was used for hay and pasture in 1943 and pasture in 1944. Although the original stand of alfalfa was excellent, by the spring of 1945 it had declined until alfalfa made up only about 25

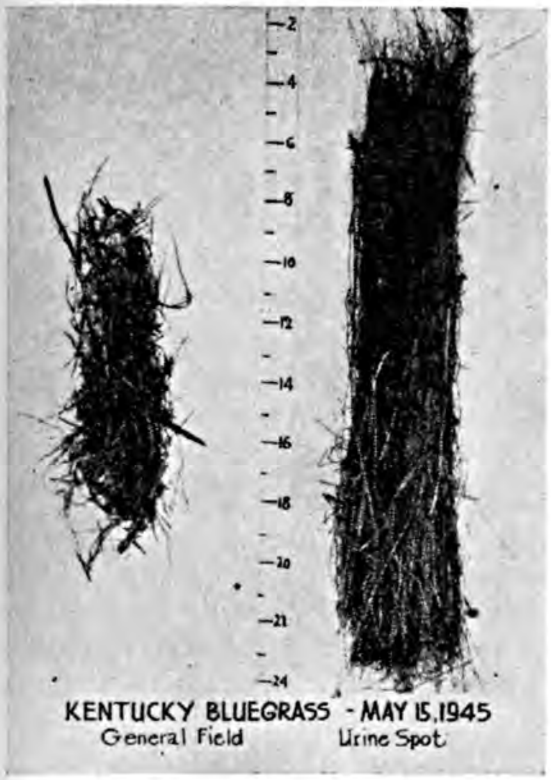

Fig. 2. The relative growth of Kentucky bluegrass on urine spots and adjoining areas. (see Table)

per cent of the alfalfa-brome grass vegetation. The field had been fertilized with 500 pounds of 0-12-12 when the alfalfa-brome was established. In the spring of 1944 it received about 10

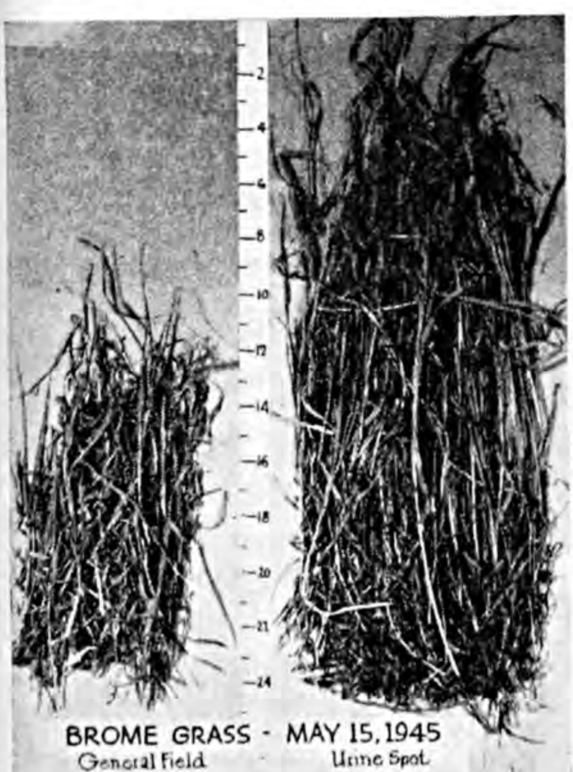

Fig. 3. The relative growth of alfalfa-brome grass on urine spots and adjoining areas. (see Table)

tons of manure and 500 pounds of 0-14-7 per acre.

In spite of the liberal manure treatment, urine spots of the previous year showed much ranker growth than the surrounding areas in the spring of 1944. On the Kentucky bluegrass strip the urine spots were especially prominent. In the spring of 1945, these urine spots were again very pronounced.

In order to get some idea of the difference in growth between the urine areas and the remainder of the field, comparable areas were harvested, the vegetation dried, and the acre yields calculated for the different areas. The results are given in the following Table.

YIELDS IN POUNDS PER ACRE, AIR-DRY BASIS OF DIFFERENT TYPES OF PASTURE ON MAY 15, 1945

Type of pasture	Pounds of air-dry herbage per acre
Old Kentucky bluegrass......	400
Urine spot in old Kentucky bluegrass..................	2,800
Brome grass with 25% alfalfa..	1,135
Urine spot in the brome-alfalfa.	3,405

The urine probably carried in solution about .8 per cent nitrogen, one per cent potash, and a trace of phosphate. All three nutrients were, of course, in a readily available form and probably contributed to the increased growth, but in consideration of the phosphate and potash otherwise applied, it would seem that probably nitrogen was the major factor contributing to this extra growth. This observation together with numerous others seems to indicate that low yields on grass pastures and hay fields frequently might be overcome by applications of appropriate fertilizers, particularly when the legume content is low. It is not presumed that the rate of application on

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Soil Fertility and Management Govern Cotton Profits

By H. B. Vanderford

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SUCCESSFUL farming is an enterprise that is governed largely by two important factors: the land, and the man or operator. The fact that variations occur in the productive capacity of soils throughout the country is well understood, but the limitations and agricultural possibilities of different soils are not always fully appreciated nor understood. A successful farmer or operator usually gets high efficiency from his land without exploiting the soil fertility at a detrimental rate, and in some cases over a period of time the fertility even may be increased.

Some soils by virtue of their fertility and physical properties have the capacity to produce high yields under very crude systems of management over a long period of time, while other soils require careful and extremely complex management practices in order to produce profitable yields. Good land can usually be used in many ways, whereas poor land generally has a limited number of profitable uses. Economic changes that force modifications in types of agriculture sometimes leave farmers in certain areas bewildered and finally bankrupt. In other areas, where the productivity of the soils permit a variety of uses, changes can be made in the pattern of farming without serious difficulties and hardships.

The Cotton Belt, sometimes referred to as the No. 1 problem area of the Nation, covers a wide range of climatic and soil conditions. The fertility levels of the soils vary from the lowest found anywhere in the whole United States to some that are relatively high. During the last 10 years Mississippi alone has produced, in addition to other crops, an average of approximately 1¾ million bales of cotton each year. This is more than any other state in the Cotton Belt produced except Texas. The yields per acre have naturally varied according to fertility levels of soils and management practices carried out on the farms. The average yield of all the acres planted to cotton in Mississippi during the last 10 years has been approximately 0.6

TABLE 1. COTTON PRODUCTION DATA ON FIVE FARMS WITH HIGH FERTILITY LEVELS

	500# bales per acre	Returns per acre	Cost per acre	Profit per acre	Labor returns per hour
	1.25	157.00	79.00	78.00	.780
	1.20	149.00	104.00	45.00	.820
	1.24	144.00	92.00	52.00	.450
	.90	107.00	47.00	60.00	.510
	1.10	137.00	67.00	70.00	.900
Average............	1.14	139.00	78.00	61.00	.682

bales per acre. This means, of course, that yields on the soils of high fertility have raised considerably the average yields of low-fertility soils under comparable management.

Many of the soils of Mississippi and other southern states are low in inherent fertility and have suffered a loss of plant nutrients from leaching, erosion, and other soil-depleting processes. This being true, they would be expected to respond favorably to applications of commercial fertilizers. The Mississippi Experiment Station has obtained results from fertilizer tests which show that applying commercial fertilizers to cotton is a profitable procedure; nevertheless, there are still many locations in the State where cotton is grown with little or no added commercial nutrients.

In order to ascertain the influence of soil fertility and management on the profit made by producing cotton, some farm management studies were made in 1944 by the Department of Agricultural Economics in cooperation with the Division of Soils of the Agronomy Department of the Mississippi Experiment Station. In this study an attempt was made to measure the actual weight that can be placed on soil resources along with the management factor in terms of farm income obtained from the production of "King Cotton."

Nature of Study

At the outset of the investigation a number of farms that were producing cotton as the principal cash crop were selected, and detailed soil surveys giving an inventory of the soils, slopes, and erosion conditions on each enterprise were made. By studying the soil maps and making visits to the farms, a number of these farms which were high in fertility, a number which were medium in fertility, and a number which were low in fertility were selected for further study. All of these farmers were probably above the average in managerial ability and were willing to cooperate in the study.

The farms that were classified as having a high fertility level were located in the Black Belt portion of the Coastal Plain section or adjacent to it. The low-fertility farms were located in areas where sandy Coastal Plain soils predominate and fertilization was a common practice. The actual expenses involved in the production of cotton were recorded by the farmer under the direction of the agricultural staff member for the year 1944.

Soil Fertility and Net Income

It must be remembered from the outset that productivity is not independent of management. These are two variables that are important in the operation of a farm and are designated by the agricultural economist as two factors of production. The inherent fertility governs the productive possibilities of each soil type, but the management determines what per cent of the capacity is attained. In this study the management factor was in every

TABLE 2. COTTON PRODUCTION DATA ON FIVE FARMS WITH MEDIUM FERTILITY LEVELS

	500# bales per acre	Returns per acre	Cost per acre	Profit per acre	Labor returns per hour
	.90	118.00	89.00	29.00	.460
	.57	73.00	43.00	29.00	.500
	1.12	137.00	101.00	37.00	.820
	1.13	142.00	101.00	41.00	.460
	.43	54.00	34.00	20.00	.540
Average...........	.93	117.50	83.50	31.20	.550

case above the average, as indicated by the interest in keeping farm records. Data showing the cost of producing cotton on the high-fertility farms are given in Table 1.

It is interesting to note that there was some variation in the yields per acre on these farms, but the average yield on the five farms was 1.14 bales per acre. The gross returns in terms of dollars per acre were rather high and might be misleading if the costs of making the returns were not considered. However, the actual costs were obtained and deducted from the cash returns giving the profit received from each acre of cotton grown on the various farms. The cost of producing an acre of cotton was in every case high, and much variation in this item was recorded by the operators. This can be appreciated when it is remembered that farm labor was receiving high wages in 1944 and all farmers did not work the same number of hours in the cotton field. One extra cultivation or hoeing on one farm would make the cost of producing an acre of cotton considerably higher than the cost on a nearby farm where the operator was able to get by without the extra cultivation. Picking was another expensive process and some of the farmers had to pay $3 per hundred to get the cotton harvested. The value representing the profit on some of the farms amounted to $70 and the average profit obtained on all these farms was $61 for every acre of cotton produced.

It might be well to point out that the acreage devoted to cotton on these five farms that year averaged approximately 24 acres per farm. This will give an indication of the farm income from cotton alone; and it is well above the total income on many farms. On these farms there was a wide margin between the cash returns and the actual cost, which is a situation that means more profit to the farmer and a higher farm income. The fertility level was sufficiently high on some of these farms so that more than a bale of cotton was produced without any commercial fertilizer.

The data obtained on the farms that were classified as having a low fertility level are given in Table 2. These farms were somewhat smaller than the farms classified as high in fertility. The acreage planted to cotton varied from 5.5 to 25 acres, making an average of 14.6 acres per farm. The yields on these farms were lower than on the farms high in fertility, but for this particular year they were up to the State average. In comparison with the farms high in fertility, it is significant to note that the average cash return per acre on low fertility farms was less than the production cost per acre on farms of high fertility. The margin between cash return and cost per acre in this case was narrow. The operators of these farms were obtaining a profit on the average of only $12 per acre, whereas the farmers on the good land were receiving five times as much.

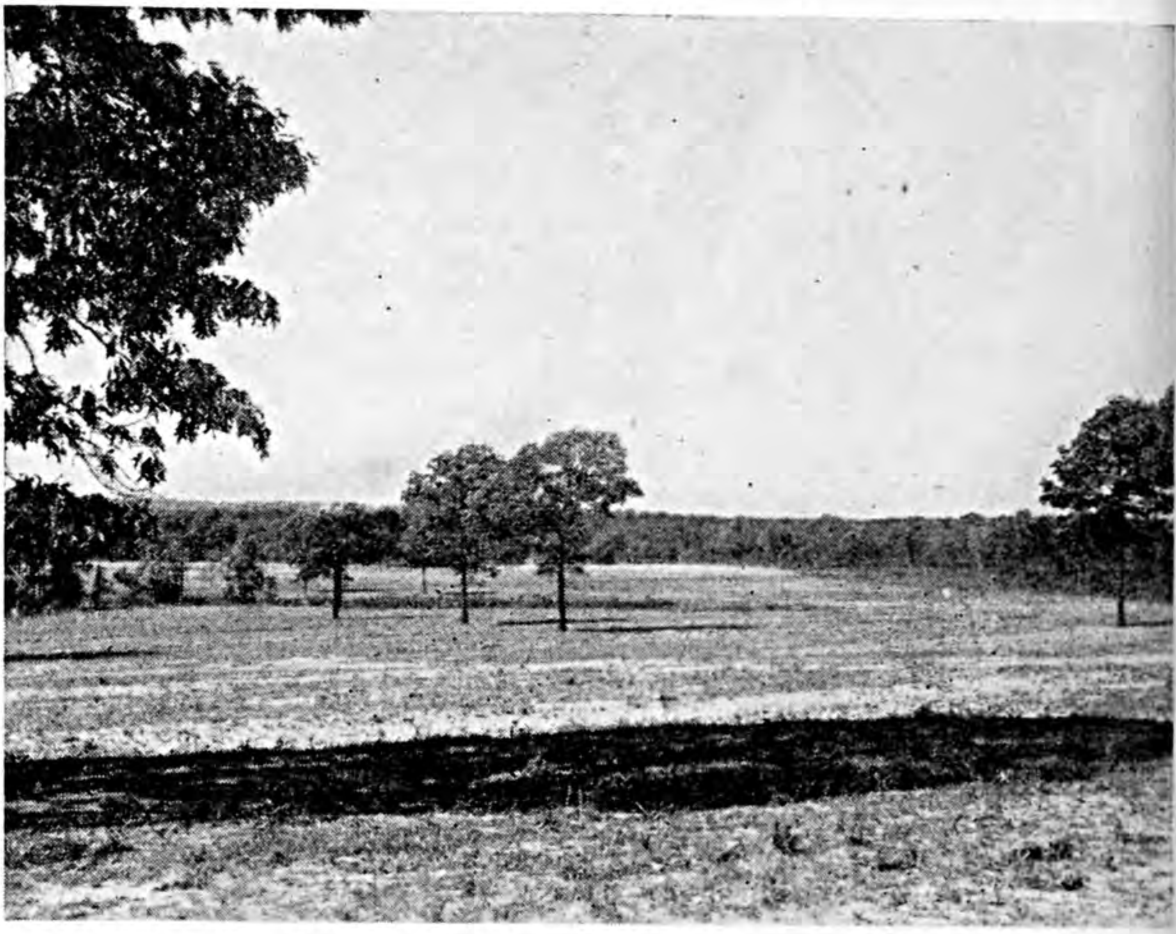
The farms classed as medium in fertility fit in between these two extremes insofar as profits were concerned. Data on these farms are shown in Table 3. It is interesting that the cost of production on the soils medium in fertility was highest of all. This was partly due to the cost of fertilizer added to the soils in an effort to overcome the deficiency in fertility. The average profit obtained on the six farms included in this study was $31.20 for each acre of cotton. The profit is more important to the farmer than the cost, and fertilizer used wisely usually pays high dividends in cotton production.

The results of this study, although of only one-year duration, indicate definitely that soil fertility is a basic factor in governing farm incomes and should be considered in all farm-management studies. Farming practices that have been successful on one farm may not be suitable for another farm in the same vicinity and may be still less suitable for a farm in another county

(*Turn to page* 47)

Above: **Fine homes with modern conveniences indicate soils high in fertility and good management.**

Below: **As the fertility declines and the topsoil is lost by erosion, the homes also deteriorate.**

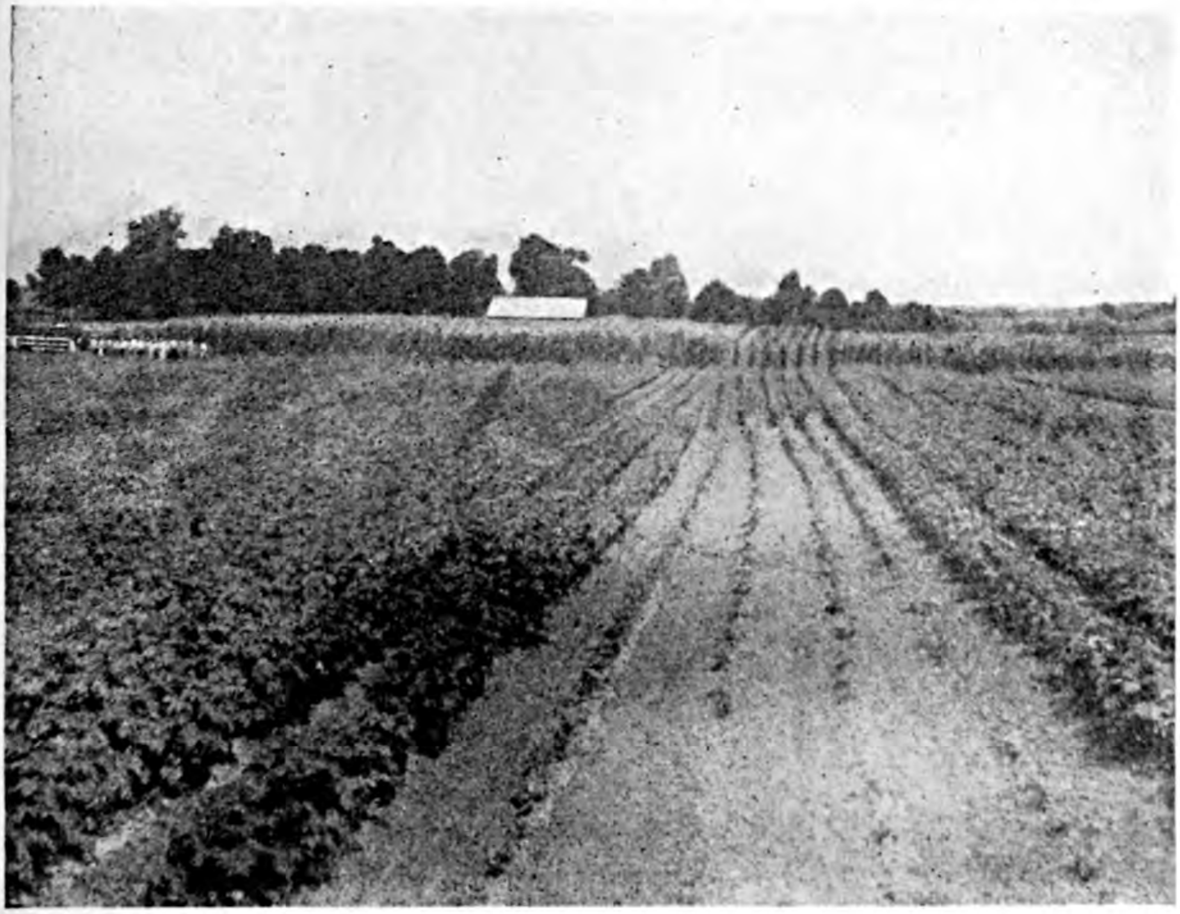


Above: **Idle land will provide some income for the farmer when prepared and managed as a pasture.**

Below: **White Dutch clover responds well to applications of lime, phosphorus, and potash.**

Above: **Poor, eroded, gullied land such as this is a liability to any farmer.**

Below: **The check plot shows the need for a complete fertilizer in this field of cotton.**



Every acre on the farm should produce a profitable crop. Here some rough, gullied land produces excellent kudzu which provides grazing during the summer months when the pastures need rest.

The Editors Talk

King Corn 1947

The eyes of the world have been turned on America's 1947 corn crop. Not only have the people in this country realized what a failure of the corn crop might mean in the way of food restrictions and higher prices, but the peoples in war-ravaged countries saw in such a catastrophe lessened possibilities for obtaining the wheat and other food products to stave off starvation this coming winter.

So great has been the interest in the matter that special corn reports—weekly surveys of progress in the Corn Belt as to stage of maturity and how much "soft" corn may result from killing frosts—are being made by the Crop Reporting Board. The first one appeared on September 19 based on September 12 data from the field. The reports are released on Friday of the week. The last one (as of October 3) stated that 87 per cent of the corn acreage in 12 Corn Belt states was largely safe from frost. Over the area as a whole the week ending September 19 was extremely favorable for corn maturity. It now is estimated that the total crop will be 2.6 billion bushels, which is about the average of the past 10 years, but only four-fifths of last year's record high.

Back of this lies another telling example of American achievement. Determined to produce a bumper crop this year, our farmers encountered an unusually cold and very wet spring, with serious floods in many areas delaying planting to critical dates. Every ingenuity had to be employed to get the corn into the ground, and much of it had to be replanted. This never could have been accomplished were it not for widespread mechanization, in the way of tractors and improved planting equipment, which has cut time and labor factors. Even so, many a tractor was run day and night.

Next came the use of hybrids, with much of the late planting being done with short season strains. The development of hybrid corn and its amazing effects upon increasing our corn yields are well known. Few are the acres now planted to open-pollinated strains.

Recent research on balanced fertilizers for corn and on corn population per acre was put to work. More acres were fertilized with greater amounts per acre. In order to utilize the additional fertilizer, heavier rates of planting were employed. This combination is resulting in significant increases in yields. Pest control was studied and practiced and the growing crop was carefully watched.

On August 1, when it became apparent that despite all of these efforts, early frosts might get as much as 200 million bushels of the crop, an intensive combined Federal, State, and private research program to develop portable corn-drying equipment for farm or community use was authorized as the first research project under the Research and Marketing Act. This emergency corn-drying project got under way without delay with four U. S. Department of Agriculture bureaus correlating their efforts and cooperating with experiment stations in the Corn Belt States. A few driers meeting specifications already have been purchased for demonstration purposes. With the most critical time for spoilage of soft corn in the winter or early spring, it is safe to say that this project will result in the use of enough driers to take care of a large percentage of the immature corn.

Corn is grown in every state of the Union. It is fortunate for the Nation that some of the states outside the Corn Belt have had better weather. The South is learning how to grow corn. Yields comparing well and even topping some of the yields in the Midwest are being obtained in North Carolina. It is estimated that this State will realize its highest average yield this year and that this average will surpass the highest average of the Corn Belt.

When the final corn picture for 1947 is drawn, it cannot help but prove a tribute to American agricultural science and the American farmers who are putting it into practice. And history may prove that at no other time has this combination done more for the benefit of all mankind.

Soil Fertility

What is it? According to G. B. Whiteside of the Dominion Experimental Station, Charlottetown, P. E. I., soil fertility is the capacity or quality of the soil necessary to supply plant nutrients in sufficient amounts and in the correct balance for the growth of plants when factors such as temperature, moisture conditions, and the physical condition of the soil are favorable. A good and inclusive definition, in our opinion!

He goes on to explain that soil fertility is not just a matter of the percentages of plant food constituents in the soil, but that it involves several other factors. Not only is it essential to have an adequate supply of plant nutrients in a form readily available for plant use, but to have them present in a proper relationship or balance, one to another. An excess of one nutrient element may result in restricted plant growth and lowered yields just as will an insufficiency of a plant-food constituent.

Soil reaction or the degree of acidity is also important in soil fertility. Where the soils are very acid, the availability of plant nutrients will be reduced. Soil reaction also influences the number and activity of soil organisms and may cause a reduction in the soil population resulting in the lowering of many soil activities.

To be fertile a soil must be in good tilth, permitting the free development of plant roots and allowing for the free movement of air and water while at the same time enabling the soil to retain enough water for plant growth. The tilth or physical condition of the soil will in large measure be determined by the amount of humus which is essential to a fertile soil. Humus will help to make plant nutrients available and help to conserve and maintain them in a proper balance, as well as being a source of nutrients.

Mr. Whiteside believes that soil fertility is not just a question of a supply of plant nutrients, but also of a proper soil environment. To maintain and build up a high state of soil fertility will require a well-balanced soil management program designed to supply organic materials and lime as well as mineral fertilizers, to include crop rotations, grassland management, and protection for bare plowed or cultivated land.

When people try to live by getting more out of the land and out of each other than they give back, the community sickens and may die. But it has been shown that when they take care of the land and each other, they are likely to find eventual security through this stewardship of their physical and human resources.—*Arthur Raper.*

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1922...........	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923...........	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924...........	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925...........	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926...........	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927...........	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928...........	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929...........	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930...........	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931...........	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932...........	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933...........	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934...........	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935...........	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936...........	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937...........	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941...........	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942...........	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943...........	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945...........	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
September...	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	....
October......	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November....	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December....	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	....
1947									
January......	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	....
February.....	30.56	31.9	131.0	228.0	123.0	199.0	17.50	88.20	....
March........	31.89	33.6	139.0	235.0	150.0	244.0	17.40	88.00	....
April.........	32.26	30.1	147.0	233.0	163.0	240.0	17.20	88.00	....
May..........	33.50	44.6	153.0	233.0	159.0	239.0	16.80	83.70	....
June.........	34.07	46.0	156.0	249.0	185.0	218.0	16.00	79.60	....
July..........	35.88	48.5	169.0	251.0	201.0	214.0	15.10	79.00	....
August......	33.15	38.1	161.0	270.0	219.0	210.0	15.30	75.50	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
1922...........	185	228	95	114	116	109	98	135	....
1923...........	231	190	133	137	129	105	110	183	....
1924...........	185	190	98	170	166	141	107	147	143
1925...........	158	168	245	188	109	163	108	140	143
1926...........	101	179	189	134	116	138	112	98	139
1927...........	163	207	146	124	132	135	87	154	127
1928...........	145	200	76	134	131	113	95	152	154
1929...........	135	183	189	133	124	117	92	137	137
1930...........	77	128	131	123	93	76	93	98	129
1931...........	46	82	66	83	50	44	73	40	115
1932...........	52	105	55	62	50	43	52	46	102
1933...........	82	130	118	79	81	84	68	57	91
1934...........	100	213	64	91	127	96	111	146	95
1935...........	90	184	85	80	102	94	63	135	119
1936...........	100	236	164	106	163	116	94	148	104
1937...........	68	204	76	93	81	109	74	87	110
1938...........	69	196	80	83	76	64	57	97	88
1939...........	73	154	100	85	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	107	117	107	81	211	129
1942...........	153	369	168	136	143	124	91	202	163
1943...........	160	405	188	232	174	154	125	231	245
1944...........	167	420	214	219	170	160	138	234	212
1945...........	181	435	199	228	178	169	127	230	224
1946									
September...	285	488	184	255	269	202	130	256	154
October......	304	530	175	238	266	213	136	293	151
November....	236	438	176	228	198	214	145	399	207
December....	242	435	181	239	190	217	149	406	166
1947									
January......	240	390	185	351	188	216	147	401	238
February.....	246	319	188	260	192	225	147	391	275
March........	257	336	199	268	234	276	147	390	299
April.........	260	301	211	265	254	271	145	390	295
May..........	270	446	220	265	248	270	142	371	286
June.........	275	460	224	284	288	247	135	353	215
July..........	289	485	242	286	313	242	127	350	189
August......	267	381	231	308	341	238	129	335	211

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
February	2.41	1.46	10.01	11.06	12.14	10.17
March	2.41	1.46	11.98	11.06	12.50	10.50
April	2.41	1.51	11.72	10.79	12.75	11.39
May	2.41	1.51	10.55	9.98	12.75	8.80
June	2.41	1.51	10.94	9.98	12.75	8.26
July	2.41	1.59	12.56	9.98	12.75	8.66
August	2.53	1.60	13.01	9.98	12.75	8.73

Index Numbers (1910-14 = 100)

1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293
February	90	51	286	313	360	289
March	90	51	342	313	371	298
April	90	53	335	306	378	324
May	90	53	301	283	378	250
June	90	53	313	283	378	234
July	90	56	359	283	378	246
August	94	56	372	283	378	248

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.9	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
September	.700	2.60	6.60	.471	.729	22.88	.176
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January	.700	2.60	6.60	.535	.797	26.00	.200
February	.720	2.60	6.60	.535	.799	26.00	.200
March	.740	2.75	6.60	.535	.797	26.00	.200
April	.740	2.97	6.60	.535	.797	26.00	.200
May	.740	2.97	6.60	.535	.797	26.00	.200
June	.752	2.97	6.60	.330	.589	12.76	.176
July	.760	2.97	6.60	.353	.629	13.63	.188
August	.760	3.08	6.60	.353	.629	13.63	.188

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1920	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
September	131	72	135	66	76	95	80
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83
1947							
January	131	72	135	75	84	108	83
February	134	72	135	75	84	108	83
March	138	76	135	75	84	108	83
April	138	82	135	75	84	108	83
May	138	82	135	75	84	108	83
June	140	82	135	60	62	53	80
July	142	82	135	64	66	56	82
August	142	85	135	64	66	56	82

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	206	126	69	359	131	78
February	262	234	209	124	70	329	134	78
March	280	240	216	128	70	354	138	78
April	276	243	215	129	71	354	138	78
May	272	242	215	127	71	339	138	78
June	271	244	215	125	71	343	140	63
July	276	244	219	128	72	359	142	67
August	276	249	223	130	75	364	142	67

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Since June 1941, manure salts are quoted F.O.B. mines exclusively.

**** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

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Soil Management Practices in the Orchard

¶ Considerations that should be kept in mind in managing an orchard are covered by T. A. Merrill in "Soil Management Practices in the Orchard," Michigan Agricultural Experiment Station Circular 199. First consideration, of course, must be given to the question of whether the particular location is suited at all to growing of fruit trees. In this respect, drainage and condition of the sub-soil have to be given careful consideration. Different fruits and even different varieties vary somewhat in their tolerance of poorly drained or of excessively drained locations. Owing to the fact that air-drainage is desired as a partial protection against frost injury, orchard soils are frequently subject to erosion, and too frequently in the past the danger of serious soil loss due to this has been neglected.

The author points out the advantage of contour cultivation and lays great stress on using an adapted cover on the orchard soil. Several different types of cover are discussed, with sods consisting of grass or mixtures of grass and legumes apparently being most favored. It is admitted that there are differences of opinion concerning the desirability of permanent grass sods especially for peaches, cherries, and plums, but the author feels that this can be handled successfully if the proper fertilization program is followed.

In establishing the cover crop, a fertilization adapted to the plant and the soil should be made so as quickly to establish a good cover. In many cases, 250 to 400 pounds of 0-20-20 per acre seem to be well adapted. If a permanent grass sod is maintained, high nitrogen fertilization must be provided. Some growers prefer an alternate middle method whereby alternate middles are sown to a cover to last one to three or four years, while the other middles are being cultivated. At the end of the period, the plantings are then reversed, so that over a period of years the entire orchard is covered half the time. The good features of mulching and trash cultivation also are discussed.

The author draws a distinction between fertilizing the cover crop and fertilizing the tree. The cover crop in general can be fertilized the same as if the crop were not being grown in an orchard. Trees admittedly have nutrient requirements similar to other plants, but the author calls attention to the fact that the trees occupy the land for a period of years and their roots are able to forage through a large volume of soil, so that their feeding power and fertilizer requirements may be somewhat different from those of the cover crop. On some soils, minerals such as potash, boron, magnesium, calcium, sulphur, phosphorus, and others are needed, and should be supplied if the soil does not furnish sufficient quantities. But in general, he feels that nitrogen should be the principal fertilizer for trees, while the minerals should be considered mainly in connection with the cover crop. Fertilization, of course, will not compensate for improper management from the viewpoint of disease and insect control, and best results from the orchard can be obtained only if all these factors are properly considered.

A Twelve-Month Grazing Program for the Rice Area of Louisiana

¶ A combination of rice-growing and cattle-raising is practiced in parts of Louisiana. The land is allowed to lie idle between rice crops, and cattle are grazed on the volunteer growth of grasses and weeds. Production records of the cattle as well as yields of rice have been unsatisfactory under this system, and the Louisiana Experiment Station undertook investigations on methods of improving the productivity of the land for both forage crops and rice. This work is reported by R. K. Walker and M. B. Sturgis in Louisiana Agricultural Experiment Station Bulletin 407, "A Twelve-Month Grazing Program for the Rice Area of Louisiana."

Pasture experiments were established at five different locations. While the treatments varied slightly, in general one area was left untreated, another area was seeded with a mixture of grasses and legumes, a third area was seeded and treated with 400 pounds of a complete fertilizer per acre at planting time (4-12-8, 3-12-12) and top-dressed after a year or two with 200 pounds of 0-12-12 per acre. A fourth plot would receive limestone in accordance with acidity of the soil in addition to the seeding and fertilizer. The plots were grazed and the animals weighed at 30-day intervals.

The results of the treatments are measured in terms of beef production per acre. The untreated plots and those just seeded in most cases produced very little beef, sometimes as low as seven pounds per acre and in all but four cases less than 100 pounds per acre. The combination of fertilizer and lime along with seeding usually produced over 200 pounds of beef per acre and in many cases around 300 pounds. The good treatment would spread the grazing season on a higher level over a longer period of the year. A combination of lespedeza and oats would furnish forage during the winter. The lespedeza was cut for hay, the oats pastured through the winter and then harvested for grain. It was found that the grazing value of oats as a pasture was 92 pounds of beef per acre during the winter period. In addition 25 bushels of oats were harvested.

Not only did the pasture treatment program improve the beef production, but, at two locations where this work was carried on, it also increased the yield of rice sown on the pastures after they were plowed up. Part of the rice was treated with 200 pounds of 4-12-8 at planting time, while part was left unfertilized. In one case the unfertilized rice growing on the area which had not been treated for pasture produced six barrels per acre, while on the pasture area which had been given the best treatment the yield was over 17 barrels per acre. This yield was further increased to 19.2 barrels per acre by fertilizing the rice at planting time. There was less increase in yield of rice due to fertilization at planting time when the rice was planted on the well-treated pasture than when it was planted on the untreated pasture. Rather similar results were obtained at another location. The work in this Bulletin shows rice growers how to increase not only the yield of rice but also the production of beef.

Phosphorus: The Belle of the Soil

(*From page* 21)

farming system that contains legumes. The phosphates used in the starter fertilizers for corn and grains should be the immediately soluble forms as super or triple superphosphates. The kind of phosphate to use with respect to the content of phosphate depends chiefly upon the net costs when applied to the ground. In areas far removed from the raw materials the higher analysis becomes the more economical.

Let's Replace Guessing with Soil Testing

(*From page* 10)

may be tried and actual testing may be done more efficiently on a regional basis. No matter what variation is used, joint farmer action with costs apportioned to farmers taking advantage of the service seems to be a quick, efficient way of getting rapid soil tests to large groups of farmers.

The best possible solution for getting soil test results to all farmers may well be a combination of methods suggested. What may work well for one state or area may be inadequate for another. Such considerations will be worked out in time and to the best advantage of the majority. The important thing at present is to realize the necessity of soil tests and start immediately in bringing such tests to all farmers.

In bringing such tests to farmers, it is important that reliable methods be used and they be correlated properly with crop response for the region in which they are going to be used. We now have methods accurate enough to do the job, if they are used intelligently. Such methods are simple and easy enough to be performed by persons of average intelligence, but supervision is needed. The correlations with crop response if not already established in a region need to be determined. This part of the work has to be done by skilled technicians. In many areas considerable correlation has already been made. Where lacking, such correlations can readily be obtained if some money and effort are put to the job.

We are on the threshold of a great era of scientifically applied agriculture. Proper use of rapid soil tests can supply necessary information for the intelligent use of lime, fertilizers, and other amendments, thereby increasing the efficiency of every farmer and so his prosperity. The extent to which we put rapid soil tests to work will in a large measure determine whether we will obtain full value of lime and fertilizers used and the maximum yield and quality crop possible. Until farmers can take into consideration the soil needs for producing a maximum crop of high quality, they must work in the dark, guessing at the amounts needed, wasting ingredients added, and reducing their returns.

From Broom Sedge to Beef Cattle

(*From page* 12)

He feeds his crops to a herd of beef cattle he raises and to a flock of 700 Leghorn pullets. He has found it not only a good paying combination but a source of steady income. In recent years, he has been selling some of his hay and grain, "to get it out of the way of this year's crop." He is no

Fig. 3. These fat, healthy beef cattle on the Paul Schaus farm are thriving on a field of ladino clover growing on the once nearly worthless hillside. Broom sedge has been replaced by the pasture crop through proper fertilization and erosion control.

speculator. He has no desire to go into farming in a big way. For example, he could pasture over 100 feeder cattle this year on his grassland instead of his herd of 40, but he would rather be sure there will be more than enough pasture and feed. Likewise, Schaus could buy much more land to add to his 160-acre farm, but he assures you he would rather be a good farmer than a big operator.

"Besides," Schaus explains, "with my farm set-up, I have time to do some of the things my neighbors ask me to do." A check-up shows they ask him plenty. He is township farm bureau chairman, AAA chairman, chairman of the Spencer county co-op, and chairman of board of trustees at St. Peter's church at Lamar. In addition he is trouble shooter for the Lamar telephone cooperative. He volunteers that service just to make sure the community enterprise will always function.

Potash Fertilization of Alfalfa in Connecticut

(*From page* 15)

Mg analyses are not available for the first two cuttings, so table 4 shows the total milliequivalents of Ca, K, and Mg for the last four cuttings only.

A study of these figures shows that the totals of the three elements varied very little regardless of when the K was applied. This conclusion agrees with the studies published by New Jersey and Indiana showing that the cation content of alfalfa tended to be constant. The alfalfa samples were not analyzed for Na in the Storrs experiment. However, analyses made by the New Jersey Station indicated that the Na content of alfalfa was usually less than one milliequivalent per 100 grams of dry matter.

In the spring of 1945, soil samples were taken by one-inch layers to a depth of six inches from various plots in the field used for this experiment. These samples have been analyzed for available potash by the method of Volk and Truog. The results of some of these analyses are shown in table 5.

The amount of soluble potash in the top layers of soil from the plots receiving all the K application before seeding is higher than would be expected because an extra treatment of 200 pounds of 60 per cent KCl was applied in August 1944, at the end of the three-year experimental period. Under all treatments, the concentration of available potash decreased with increasing soil depth. Annual applications of 200 pounds of 60 per cent KCl have maintained the most uniform concentration of soluble potash throughout the plow layer. Frequent small applications of

TABLE 5.—READILY AVAILABLE SOIL POTASH AS EFFECTED BY POTASH FERTILIZATION

K treatment		Soluble potash by inch layers (Pounds per acre)					
		0–1″	1–2″	2–3″	3–4″	4–5″	5–6″
600 lbs.	60% KCl before seeding	436	294	167	94	72	70
200 lbs.	Annually	397	252	153	109	98	108
67 lbs.	Every April, June, August	633	343	190	87	67	70
10 tons	Manure every August	421	230	131	96	93	83

potash have maintained a relatively high level of soluble potash in the first and second inches compared with the lower layers. By way of comparison, Volk and Truog have set 200 pounds per acre of available potash in the plow layer as the minimum amount required for most crops.

The results of this experiment as well as data from other stations tend to show that "luxury consumption" of alfalfa occurs when the supply of available potash in the soil is plentiful. This results in a change in the balance of minerals absorbed by the plant. To maintain stands and yields of pure alfalfa, it seems advisable to apply potash in more frequent and smaller amounts. On the basis of our present knowledge, an application of 200 pounds of 60 per cent KCl annually would be recommended for alfalfa.

Urine Spots Reveal Soil's Deficiencies

(*From page* 23)

the urine spots is indicative of a desirable rate.

The present general practice of applying 200 to 300 pounds of a complete fertilizer in connection with the seeding of a grain crop in which a new meadow is being established and expecting this to meet the requirements of the next two or three years certainly does not seem adequate. Whether or not extra fertilizer can be profitably used, what its composition should be, and where, how, and when it should be applied are questions needing further study. Plants, like farm animals, cannot grow without adequate nutrients. Our pasture and hay crops, because of their feed value and effect on soil productivity, are probably our most valuable general farm crops, but for them we make the poorest provision of the nutrients they require.

Fertilizer Placement . . . on Sandy Soils of Minnesota

(*From page* 19)

meter of more sandy areas. The field also had been well managed and had been in alfalfa for two years preceding the 1946 corn crop. The July-August rainfall totaled 5.10 inches with the normal average for this period being 6.63 inches. Lack of moisture and available plant foods did not limit plant growth on this soil as severely as on the three other fields. The application of fertilizer in the hill was carried out one week after planting, being applied as soon as the plants emerged. This irregularity from the usual procedure of fertilizing at planting time was caused by the operator being unable to mark rows without planting. Table 4 presents the yields obtained.

It is evident that the deep placement of fertilizer may have been superior to the hill-dropping method on this field. It is impossible to establish whether this yield difference was brought about by the fertilizer placement or was due to the delay in applying the hill-dropped fertilizer.

The investigators considered the possibility of fertilizer placement affecting the concentrations of nitrate, phosphate, and potash in the growing tissues of the corn plants. Extensive field tests of the growing tissue at three periods in the later stages of development showed that fertilizer placement had little or no significant effect on the concentrations of these nutrients.

TABLE 5.—SUMMARY OF THE EFFECT OF FERTILIZER PLACEMENT ON INCREASING CORN YIELDS GROWN ON FOUR SANDY MINNESOTA FIELDS. 1946.

County	Soil type	Soil texture	Total rainfall July–August		Average yield of six fertilizer treatments with four replicates			
					Ear corn, bu./A		Fodder, tons/A	
			Inches	% of Normal	Hill-dropped	Plowed-under	Hill-dropped	Plowed-under
Anoka	Hubbard	Loamy fine sand	1.37	21	2.6	8.3	0.73	0.74
Sherburne	Zimmerman	Loamy fine sand	1.73	25	25.0	23.6	0.96	1.01
Isanti	Zimmerman	Loamy fine sand	3.03	46	38.5	31.2	1.50	1.33
Chisago	Berrien	Loamy fine sand	5.10	77	42.2	49.9	1.50	1.55
Grand Average (96 plots)					27.1	28.2	1.17	1.16

A summary of fertilizer placement effects on the yield of corn under variable moisture conditions is given in table 5.

The use of the "plow-under" method for the deep placement of commercial fertilizer is theoretically ideal, especially in growing seasons experiencing a rainfall deficiency or a poor precipitation distribution. The study of fertilizer placement on the sandy soils of Minnesota during the growing season of 1946 was an excellent opportunity to study the effect of deep-fertilizer placement on soils of relatively low fertility and low water-holding capacity. It is obvious that the effect of fertilizer placement will vary, depending upon soil and weather conditions. It is also apparent that deep placement of commercial fertilizer is not invariably superior to the hill-dropping method commonly practiced by the farmers of this State.

Soil Fertility . . . Cotton Profits

(*From page* 26)

or state. No attempt is made to discount the value of management or to show that the picture portrayed by these farms of low fertility could not be changed under different management. This is a separate factor of production and will be considered later.

Soil Management Is Important

In order to show the effect of excellent management on the profit obtained from an acre of cotton, some attention was given to three farms on which the operators were practicing excellent systems of management. Data collected on these farms for the same year are shown in Table 4, along with a comparison with the average gross returns, cost per acre, and profit per acre for 32 farms used in the study. The operators of these farms were doing an excellent job of management and the crops were all arranged and planned according to soil conditions. Large amounts of commercial fertilizers were used on all three farms and proved to be good investments. The cost figures involved in producing an acre of cotton on these farms were all high. However, the high yields obtained under this type of management were sufficient to pay high production costs and still leave a good margin of profit. These farmers had done an excellent job of farm planning and the different soils were planted to crops well adapted to them. The ideal of "treating every acre according to its needs" was approached on these farms.

The soils comprising these three farms were all sandy Coastal Plain soils and were normally low to medium in fertility levels. Soils like Ruston, Savannah, Cahaba, Prentiss, Iuka, and Manatchie sandy loams made up the greater part of all three farms. There were also some areas of poorly drained soils such as Myatt and Bibb on these farms. In every case, these poorly drained soils were being utilized for pastures, and corn and feed crops were grown on the bottom soils, and the cotton was grown on the upland or better drained terrace soils.

The operators of these farms had planted the crops according to soil conditions, which is the paramount factor in good farm management. By adjusting the crops to the soils, fertilization paid high dividends. It can be seen from Table 4 that the average cost to produce an acre of cotton on these three farms was approximately $100. However, this money proved to be a good investment in terms of high yields per acre and total income. By spending $129 per acre, one of these farmers made $213, or a profit of $83 from each acre planted to cotton that year. This is more profit than was realized by the farmers on the fertile land, but if the farmers on the fertile land had been practicing crop adaptation and fertilization equivalent to these three operators, their total farm incomes and profits would surely have been much greater. When the crops are planted according to desirable soil conditions, fertilizer responses are at a maximum, and the profits are, of course, greater.

An effort had been made on these farms to utilize to a good advantage all the land on the farm as well as the portion planted to cotton. There are many farms on which the operators are doing an excellent job of management on a portion of the land, but at the same time are neglecting sadly a greater part of the farm. In some cases 80 out of 100 acres will be producing very little and receiving no attention from the owner or operator. The taxes paid by the farmers on their land are usually the same on every acre regardless of the use made of it. Therefore every acre of land on the farm should be devoted to some profitable crop. In some cases the best adapted crop may be cotton; in others, pastures; in others, timber; and in others, fish. No land, where there is sufficient moisture, is worthless. Land is only worthless in terms of some uses. Whenever proper land use is practiced, every acre pays its pro rata share of the farm income and no part of the farm is a burden or liability to another part.

As stated before, farming is a business involving two principal factors: the man or operator, and the land or physical resources. Excellent management

TABLE 3. COTTON PRODUCTION DATA ON SIX FARMS WITH LOW FERTILITY LEVELS

	500# bales per acre	Returns per acre	Cost per acre	Profit per acre	Labor returns per hour
	.48	63.00	57.00	6.00	.590
	.70	87.00	68.00	19.00	.470
	.67	85.00	69.00	16.00	.640
	.80	102.00	83.00	19.00	.590
	.60	74.00	65.00	9.00	.470
	.40	52.00	48.00	4.00	.330
Average.	.60	77.00	65.00	12.00	.515

TABLE 4. THE EFFECT OF GOOD MANAGEMENT ON COTTON PRODUCTION

	500# bales per acre	Gross returns per acre	Cost per acre	Profit per acre	Labor returns per hour
	1.51	181.00	99.00	82.00	.940
	1.70	213.00	129.00	83.00	.920
	1.10	135.00	69.00	66.00	.940
Average.	1.43	176.00	99.00	77.00	.933
Average of 32 farms in study.	. . . .	121.58	82.68	38.90	. . . .

will always get more efficiency out of the land than poor management, but the possibilities of the operator are limited by the productive capacity of the soil. The data obtained from this study also indicate that soils having low fertility levels might better be used for the production of some crop other than cotton. Some other type of farming would probably be more suitable and provide employment over a greater part of the year. With a profit of only $12.00 per acre, it would require more acres of cotton than the average farm family could manage to enjoy a comfortable living. More acreage is usually necessary in order to change from a cotton economy to another system of farming. This brings forth a land problem that is often difficult to solve, but in areas where the fertility level of the soils is low, it may be easier to solve this problem than to try to make a decent living by clinging to the tradition of growing cotton continuously.

About Pa

(*From page* 5)

other Twin. It seems that he was dubbed a "clown," meaning one who could play practical jokes and perform odd and humorous things. And as for the man of muscle, he often related how the storekeeper in his adopted village was the terror of rascals and rowdies, because he was able to haul off like lightning and strike a "hundred-pound blow." Possibly Abe Lincoln was not the only efficient merchant in the Midwest of that era. (If Dad's folks had used motor cars instead of oxen, they might have gone visiting in the Illinois Sangamon country inside of four or five hours.)

The sand country where they settled furnished little or no incentive or chance for good farming, even as meager as the skills were then. This is the reason no doubt that my Father was never a first-rate farmer, but one who liked to live in the open and grow a few necessary crops, just enough for his family and the livestock with naught to sell toward a bank account. It was not indolence or carelessness which plagued those unlucky squatters whose choice of claims was based on timber and wells. Funds to better their lot or find a nicer location were not forthcoming in the tight times of the Fifties in that far-off land of barter and trade.

Except for the Civil War adventure and the subsequent elevation of my Father to be post commander or adjutant or officer of the day or something, his life was pretty ordinary. He worked at what his hands could turn up, having no trade or skilled craftsmanship. No thankful government bestowed sustenance or scholarships upon him with which to make up for lost time. In fact by dint of lots of maneuvering and much oath-taking and physical examinations, as well as fees to special Washington pleaders, he like many other veterans of the time finally received as much as twelve dollars a month pension. And plenty of citizens hated to see him cash that voucher four times a year and begrudged it to him. But of course $144 annually was some money in the Nineties when you never ate out, saw a movie, or bet on the ponies. It worked all right when your kids were trained never to ask for money and to be tickled pink over a foaming glass of root beer as a Saturday treat. All the same, it meant that you didn't have much left in your marble bag when all the other fellows were playing for "keeps."

AFTER discharge from the Army there seemed little to do on the one-horse farm up in the hills, so Father went into the next best opportunity—the lumber woods. This was in the heyday of the big cuts, the huge river-borne rafts, the cook shack, and the long drives. I guess Dad put in good licks at all of it, as well as hauling supplies. He made several excursions with rafts down the Mississippi, past towns he knew as a soldier. He must have worked for Mike Fink and Paul Bunyan, although I never heard any of those legends from Father, strange to say. But he cooked and ate so many flapjacks and baked beans during his logging days that we seldom had those tidbits on our table while I was growing up.

Somehow he got hold of a picture taken at a shingle mill where he was employed, the only graphic evidence of his years of toil. Its yellow hazy surface shows a long shed-like building with a tall smoke stack, and a crew of a dozen men perched on the roof. Dad said he was the fourth man from the west edge, but one must take his word for it.

WE of humble, unpretentious parentage retain much of certain family incidents to refresh us whenever the murk of material hazards threatens our peace of mind. Each of us has these obscure, unsung examples of fortitude which discount all the fumblings and failures.

Among these simple things I treasure most, to be explicit, is the strange relationship I bear in spirit to a white pine tree. This tall, majestic pine stands watch over a quiet country graveyard in a southern Minnesota county. For nearly sixty-five years this tree has seen the drought and the deluge, the clouds and the sunshine, the hopes and the fears of rural folk whose loved ones come to rest beneath its resinous boughs. Its relationship to me lies in the saga of its seedling, planted by my Father in that spring which followed a wintertime of woe.

He had come to Minnesota with his frail wife and three small children, hiring out as a tenant laborer after futile years trying to "catch up" after the Civil War and lumber camp experiences. The proverbial church mouse was a cheese-surfeited fatty compared with him. Like Mark Tapley, however, he usually found occasion to be "jolly" when other folks would normally be glum; and he made the most of meager comforts amid his round of rough and rigorous toil.

His optimism met a test indeed that winter of the Seventies. His summer's wages hardly sufficed to buy the family's food, albeit the fuel could be hewn from slashings round about. In January his wife's dry cough grew worse, and the fatal ending hung like a specter at her bedside. An epidemic of diphtheria seized the pioneer community, and Father nursed the two elder children to safety, after one consultation with an overworked practitioner.

Alone amid the greasy utensils in a

man's culinary sphere, milking one cow and keeping the homestead fires alive, he was hardly prepared to welcome the Angel of Death in proper fashion—yet she came and bore away the youngest child, a boy of four, who had been defeated by thin living and the current malady.

THUS I am confident that as each one of us passes the half century an old stiff rocking-chair, with one of his wife's faded patchwork quilts wrapped in folds over himself and the choking baby. I remember his repeating the incident to me in after years, after his second marriage in our own home. He told me how strong he felt in faith and hope because tiny "Elmo" reached up his hands and touched the tips of unseen wings in that cold and cheerless room.

Nobody came to the funeral. You see, it was pretty cold weather in Minnesota that year, and the rough, new roads were not plowed out as quickly as they are today after every storm. Besides, Father never had much time or money for churchly contributions in the local parish. He was just a drifting stranger doing day-work anyhow. Few there were who even knew him on the streets.

So Father found a little pine packing case somewhere, and he took his pick and shovel over to the adjacent cemetery and carefully located a spot in the no man's land of the Potter's Field, where he laboriously dug the little grave. I guess for this once anyhow he didn't feel very jolly, but he remembered a few verses from the New Testament and so after he had lowered the small box into the narrow frosted hole, he bent down a minute in the deep snow for a private doxology. After he had thrown back the frozen clods and marked the spot with a shingle, Father resolved to erect a more suitable living memorial to his boy in the coming springtime.

And again in the spring when he found time to transplant the seedling pine, his labors were also unattended and unobserved save for stray squirrels and songbirds. His wife had meanwhile passed away and her body had been taken to another burial ground by her relatives.

On that May morning Father probably had more time and inclination for a private ceremony and some reverent reveries all his own, at least more than he had when my half-brother was buried. At any rate, he set the tree a few feet beyond the unmarked mound and kept it well watered from that spring through the summer, hoping against hope that when he moved away in the fall the roots of the seedling pine would sustain it as a lasting landmark, so that the stubborn land so unkind to little ones of low degree might grow a giant pine to outlive generations yet to come and be a mark of one man's courage amid much harrowing care.

It really did. And this is why I am a little proud of being somewhat related to a calm and glorious pine—as much a part of my family life and tradition as any blood relation whom I claim and love. It reaches a step nearer immortality than any of us hope to come, for that tree is known quite well throughout that happy countryside and is therefore safe from vandals because of its pride and beauty of form and its sanctified location.

THUS I am confident that as each one of us passes the half century mark and knows that the first half is always the hardest, it will not be so difficult to be serene and patient toward that which remains to be done. We have been heirs to many errors, but likewise we are the reapers of a golden harvest of memory in which the noble and the just and humble predominate. Whether or not that which is left for us to do has a "punch" in it, we may be sure that we shall get some "kick" out of it after all.

I guess there are just about two classes of folks when it comes to family memories and histories. One group is always delving into annals and pedigrees, not being quite satisfied in having an immediate humble origin but always hoping that somewhere in the tomes of past years they will stumble upon something genteel and polished. The other tribe is like me—fairly satisfied that I did not inherit a harelip or color-blindness, or have moronic tendencies from too many inbred strains. Actually, I can't tell you what year my great-grandfather immigrated to America or how many Injuns he killed. I lack a single picture of any ancestor back of my own Father and wouldn't recognize one if somebody dragged it out of an album somewhere up in New England. Thus plenty of glory has perished, and maybe a heap of shenanigans too. I may have deprived my progeny of a lot of distinction, but they can start in fresh and make some for themselves.

FOR after all is said and done, we have to remember that we are or have been Fathers and Mothers also. Some of this next generation some day will find a little time on their hands between office hours and conventions to think back to simpler years when you and I ran the family show. They won't bother any too much about musty archives or what Grandfather did before they were born, but they will retain a fairly clear mental picture of the ups and downs of Life with Father.

If our health stays good, it's up to us to show them that we are not entirely forgetful or forgotten, and that we can still laugh at life a little, exert some interest outside of our own bellyaches, and behave with decorum and tolerance in an age which has somehow grown wider and deeper than the one wherein we took root.

No, a lot of us aren't going to find a spot in history books or monuments to perpetuate us, but our only hope is to live so as to achieve fair treatment a few years hence when the kids have time to "think about Pa."

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

- Tomatoes (General)
- Asparagus (General)
- Vine Crops (General)
- Sweet Potatoes (General)
- Better Corn (Midwest) and (Northeast)
- The Cow and Her Pasture (General)

Reprints

- N-9 Problems of Feeding Cigarleaf Tobacco
- F-3-40 When Fertilizing, Consider Plant-food Content of Crops
- S-5-40 What Is the Matter with Your Soil?
- II-12-42 Wartime Contribution of the American Potash Industry
- J-2-43 Maintaining Fertility When Growing Peanuts
- Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
- FF-8-43 Potash for Citrus Crops in California
- A-1-44 What's in That Fertilizer Bag?
- H-2-44 Efficient Fertilizers for Potato Farms
- AA-8-44 Florida Knows How to Fertilize Citrus
- QQ-12-44 Leaf Analysis—A Guide to Better Crops
- P-3-45 Balanced Fertility in the Orchard
- Z-5-45 Alfalfa—the Aristocrat
- DD-5-45 A Case of Combined Potassium and Boron Deficiencies in Grapes
- GG-6-45 Know Your Soil
- LL-8-45 Fertilizing for Better Soybeans in North Carolina
- OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
- PP-10-45 More Vegetables for Less Money
- QQ-10-45 A Little Boron Boosts Sweet Potato Yields
- TT-10-45 Kudzu Responds to Potash
- YY-11-45 Potash—In War and Peace
- ZZ-11-45 First Things First in Soil Fertility
- CCC-12-45 Poor Soils—Poor People
- B-1-46 Potash Increases Tomato Yield and Quality
- H-2-46 Plow-sole Placed Plant Food for Better Crop Production
- J-2-46 Correcting Potash Deficiency in Growing Corn
- N-3-46 Sweet Potatoes Are Proving New Gold for the South
- S-4-46 Plow-under Fertilizer Ups Corn Yields
- T-4-46 Potash Losses on the Dairy Farm
- W-4-46 Muck Soils Produce Quality Sweet Corn for Canning
- Y-5-46 Learn Hunger Signs of Crops
- AA-5-46 Efficient Fertilizers Needed for Profit in Cotton
- BB-5-46 The Soil Is Our Heritage
- HH-6-46 Mistakes Versus Essentials of Pond Management for Fish
- II-6-46 Pastures in Mississippi Produce Profits
- LL-8-46 Trends in the Use of Major Plant Foods
- NN-10-46 Soil Testing—A Practical Aid to the Grower & Industry
- OO-10-46 Soil Aeration Affects Fertilizer Needs
- VV-11-46 Using Potash in Soil Conservation
- WW-11-46 Soil Requirements for Red Clover
- XX-12-46 Farm Mechanization in Relation to Cotton Quality and Marketing
- YY-12-46 How Guernsey Calves Helped Solve a Feed & Crop Fertilization Problem
- ZZ-12-46 Alfalfa—A Crop to Utilize the South's Resources
- BBB-12-46 Fertilizing & Cropping Systems for Flue-Cured Tobacco
- A-1-47 Fertilizing Vegetables by Applying Fertilizer to Preceding Cover Crop
- B-1-47 The Use of Dipicrylamine in Tissue Testing for Potash
- C-1-47 Potash Meets Its Responsibilities
- D-1-47 Good Pastures Conserve and Pay
- G-2-47 Research Points the Way for Higher Corn Yields in North Carolina
- H-2-47 Large Grasses for Pasture
- I-2-47 Fertilizers and Human Health
- J-2-47 Yields Tell the Story
- K-2-47 Potash Pays for Peas at Chehalis, Washington
- L-3-47 Sugar Beets Require Adequate Soil Aeration
- M-3-47 The Role of Major Elements in Plant Nutrition
- N-3-47 Efficient Management for Abundant Pastures
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- R-4-47 The Effects of Fertilizers on the Blackland Soils of Texas
- S-4-47 Rice Nutrition in Relation to Stem Rot of Rice
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- HH-6-47 Determining New and Better Fertilizer Ratios

THE AMERICAN POTASH INSTITUTE

1155 16TH STREET, N. W. WASHINGTON 6, D. C.

The wind was blowing very violently on a street corner and a young lady's dress was blown up around her neck. When a man standing near began to laugh, she irately said, "I see you are no gentleman."

"No, and I see you are not either," was the reply.

An insurance man met a friend and said, "Your wife needs an insurance policy to protect her fur coats and clothes."

"No," said the friend, "She has a new idea. I found out about it last night when I got home. She has a man in the closet watching them."

A woman in slacks: So round, so firm, so fully packed!

All men are born free and equal, but most of them get married.

Little Willie had just returned from his first day at Sunday School where his teacher had been a middle-aged woman.

Mother: "How did you like Sunday School, Willie?"

Willie: "Oh, it was all right."

Mother: "What didn't you like about it, dear?"

Willie: "Well, the teacher talked all the time about Jesus. How wonderful he was and how good. I guess she's his grandmother."

It was a warm day, and a dull case concerning the rights of river commissioners was being argued.

Counsel made speeches of interminable length, and the judge fell into a doze.

"But, we must have water here, your honor," thundered the defending lawyer in such stentorian tones that the judge came to.

"All right," he mumbled hastily, "but only a very little in mine!"

When Junior asked his parents about life they told him they had planted a seed and he grew from it. That night Junior put a watermelon seed under the rug. The next morning he lifted up the rug and there was a big cockroach.

Junior addressed the cockroach sternly: "You're very lucky. If you weren't my son, I'd squash you."

One arm makes dangerous driving and darn poor hugging.

"What about this 'ere universal disarmament, Bill?"

"Why, it's summat like me and my old woman. When there's a bit of a shindy brewin' the one wot proposes peace is the one wot ain't got 'old of the poker!"

Then there's the one about the guy who shipped a pair of rabbits from coast to coast by air express. The crate arrived with two rabbits. That's fast transportation!

THE PLANT SPEAKS

A new four-reel series of 16 mm., sound, color films which may be booked independently or in any combination. They may be used to best advantage when shown at least one day apart and in the following sequence:

THE PLANT SPEAKS THRU DEFICIENCY SYMPTOMS pictures soil depletion, erosion, and deficiency symptoms on plants. (Running time 25 min. on 800-ft. reel.)

THE PLANT SPEAKS, SOIL TESTS TELL US WHY depicts taking soil samples on the farm and the interpretation of soil tests. (Running time 10 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU TISSUE TESTS shows the value of tissue testing and the procedure for testing plant tissues in the field. (Running time 14 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU LEAF ANALYSIS evaluates leaves in plant growth and leaf analysis in determining fertilizer needs. (Running time 18 min. on 800-ft. reel.)

We shall be pleased to loan these films to agricultural colleges, experiment stations, county agents, vocational teachers, responsible farm organizations, and members of the fertilizer trade.

OTHER 16MM. COLOR FILMS AVAILABLE FOR TERRITORIES INDICATED

Potash in Southern Agriculture (South)
In the Clover (Northeast)
Bringing Citrus Quality to Market (West)
Machine Placement of Fertilizer (West)
Ladino Clover Pastures (West)
Potash from Soil to Plant (West)
Potash Deficiency in Grapes and Prunes (West)
New Soils from Old (Midwest)
Potash Production in America (All)
Save That Soil (All)
Borax From Desert to Farm (All)

IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of time of loan.

American Potash Institute
1155 Sixteenth Street
Washington 6, D. C.

Better Crops with PLANT FOOD

November 1947 10 Cents

The Pocket Book of Agriculture

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

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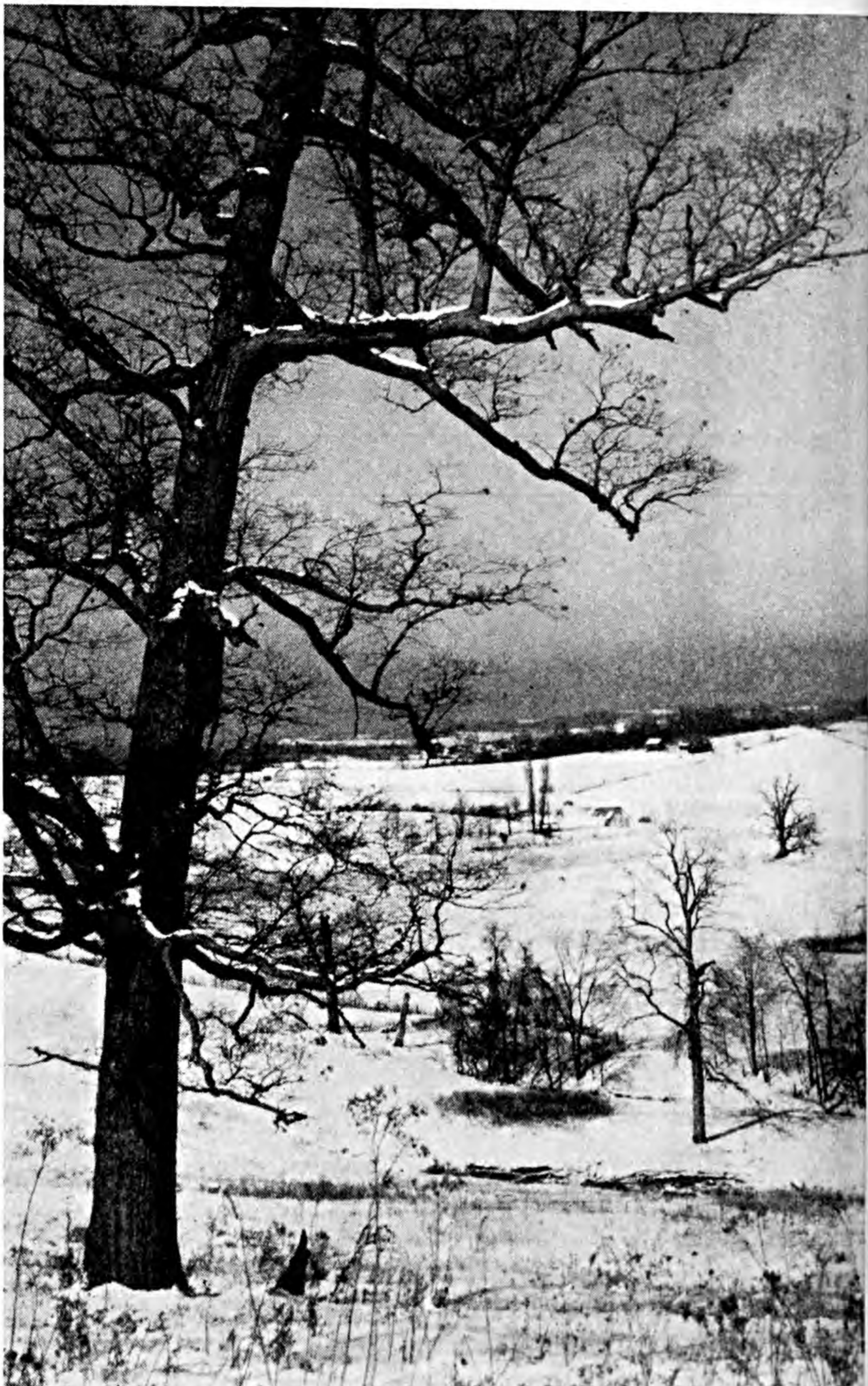

THE FIRST SNOWFALL

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VOL. XXXI WASHINGTON, D. C., November 1947 No. 11

Confronting the . . .

Food Furore

Jeff McDermid

BEING ON THE FOOD "firing line" surely gives one a big appetite. You don't have to pitch manure or grain bundles to get it either.

There are at least two spots where public inquiry is focused respecting food supplies and prices in a constant and perplexing way, about which a few rambling observations may not be inadequate. The two red-hot information dispensing agencies that have borne the brunt of the avalanche of daily queries are the Office of Information's press and radio services in U. S. Department of Agriculture at Washington, D. C., and the respective regional field branches devoted day and night to the same round of endless conversation.

Right here some smart alec might flip the remark that what we need is less conversation and more conservation in food tonnages, but such a chap lacks information, not to say intelligence. If you stifled conversation, dear readers, you would hamstring the mainspring of facts and figures upon which so many rely to keep the w. k. campaign raging. How else do you presume the columnists and commentators get their low-downs on the high-ups? Or the morning daily its startling revelations to accompany the eggs on Tuesday and the bacon on Thursday?

Unfortunately, the word "information" sometimes gives the wrong clue when it is printed on an office door. It doesn't signify that behind its glazed surface there sits a wiseacre or a whole school of sages who can save you from investing in a world almanac or spending an hour in a Carnegie library. It's hard enough to satisfy requirements if the blank spaces to fill in are restricted to farms and farming, feeds and feeding, eats and eating. But sad to say, that's never the way it works in an "Information" office. You are just as apt to have to reply to an ink spot remover query as to a question on removal of the spud surplus.

Many times while occupying an intensive place in a strategic center of the web of crosscurrents flowing around food affairs, yours truly has used other men's research as an anchor to windward. If someone had not lugged brief cases around and bent wearily over dry accounts and bills of lading for weeks on end, plenty of reporters, editorial writers, and radio commentators would have been shy of ammunition, or would have had to improvise more than customary.

Ordinarily it is an all-year-round open season for hunting for statistical researchers in Washington and elsewhere. Gunning for their goats is a national pastime when malefactors in other fields with more ulterior motives are not in sight. I hold no special brief for statisticians or their brief cases as such, ask no favors for them which are undeserved—but it does seem as though many of us might recognize at this juncture, when hot figures on food are so popular, that these studies have some current usefulness.

For example, in the heat of the h. c. of l. furore and the morbid curiosity about food of all kinds, including the contents of the garbage can and the rat's nest, we relied a lot on certain happy references we had in stock. These included a study on marketing margins in meats and another in grain products; an estimate of meat bills paid by consumers for several years in relation to net income; and a valuable piece giving details about waste and loss in food merchandising.

ON THE SIDE related to production, the feed saving drive found the country well fortified by years of basic data on rations and substitute cereals for corn and wheat—in fact, so well are we endowed with data that we believe the livestock world is better supplied with nutrition tables and formulas than human beings are.

If the Federal offices and files do not have material to support fundamental and funny queries, the State experiment stations often can unearth them. No matter how incongruous the query or how vapid the suggestion, the one who answers the phone or dictates the return letter must give it as much sober thought as though the life of the U.N. hung in the balance. The job of the public information desk in reality is to clear these things to inquiring reporters or curious cranks. The drawback to it is the physical lack of drawers and filing cabinets to keep your assorted answers in, as well as a shortage of manpower (and womanpower) to handle the load.

DURING THE WAR YEARS, farm journals were mainly the mediums which reported the 30 per cent or more increase in food production by a decreased farm working force equipped with machinery and fertilizers. Hardly any space was devoted to that in the daily newspapers, where more exciting and sensational war news was the rule.

About the only echoes of rural progress which newspapers retailed in 1941-44 related to the boost in farm incomes and those horrid arrangements which the hay-shakers had with Uncle Sam to loot the family lunch budget. It was not until folks had settled down into a race for comforts and luxuries after V-J Day that the readers of newspapers began to get anxious about the effect of price decontrol and cash competition upon the scope and variety of their victuals, and the price tags thereon.

Only a few stopped to inquire what effect the price incentive measures in agriculture had had on maintaining full gravy bowls during the lend-lease era, when outbound foods to armed forces and our allies accomplished what our mutual friend, Claude Wickard, called "winning the war and making the peace." They had "et up" all the provisions of yesterday and were hungry for more—the cheaper the better.

At this strategic point, I reach into the handy grab-bag and insert a digit clincher, like we use with stray newspaper men:

"In 1935 official figures show that disposable income per capita for the country was only $435. That year consumers spent $1,863,000,000 for beef, and steers grading choice and prime at Chicago made up 14 per cent of the total sold for slaughter.

"In 1945 disposable income was rated at $1,073 per capita. Consumers spent $3,026,000,000 for beef. Choice and prime steers sold at Chicago amounted to 36 per cent of the total there."

Mounting grocery bills and cuts of meat that were costly enough for jewelry window displays aroused the populace. Reactions toward most agricultural information quarters came immediately. You almost ruined your eyesight delving down long columns of published tables trying to locate the farmer's share of the retail customer's price and why.

Let us be Thankful

PRIOR TO THIS dizzy period, the nation embarked on its first campaign to get food, mostly grain, to starving Europe and Asia. We then possessed some vestiges of wartime controls on tap, so the wheels began grinding pronto and the officials started serving dark blue bread to reporters in Washington as a foretaste of what was to come. This was the signal for us to rap on the doors of the scientific bureau bakers and millers within our bailiwick. Reporters wanted all the dope there was, and then some, on the saving from a higher rate of wheat extraction and its effect on everything from milk toast to expectant mothers.

Similarly, and even more subsequently, Information toilers were besieged for data on distilling and brewing (which were then under curbs) to ascertain to what extent the cocktail hours of official circles might suffer sudden spiritual dilution or how much more one might expect to fork over for cereals in liquid form. The writing fraternity is usually presumed to have recourse to such stimulating beverages to a greater extent than, shall we say, the ministry. Hence they had a rather urgent and personal zest for following this line for a fill-in.

Every side current that swept the stream of activity during the postwar grain export period has called forth countless queries. Boxcar shortages, reports of wheat piled outdoors, stevedore strikes at the docks, black-market rumors, speeches in Congress and on the radio pro and con, and behavior of the future markets all have been turned wrong side out in a feverish search for stories.

Utilization of the cereals exported at ports of destination, method of distribution abroad, whether grain growers in Europe were selling their stocks or hoarding them for barter, and what some rabble-rousers were quoted as advising in a "fur off" land—all came tumbling back to land on our desks for possible official comment.

But the greatest crush of visits, phone calls, wires, and letters began to arrive last midsummer, when the Crop Reporting Board and its field associate corps assembled the estimates which presaged a much curtailed corn crop. This ushered in the biggest correspondence and publicity educational course

(*Turn to page* 51)

How Different Plant Nutrients Influence Plant Growth

By Lester L. Loftin

Shreveport, Louisiana

OF THE 92 elements of which the earth is composed, plants require for proper growth considerable amounts of only 10 major elements and minute amounts of a number of other elements. These elements are carbon, hydrogen, oxygen, and nitrogen, which come directly or indirectly from the air and water; and phosphorus, potassium, calcium, sulphur, magnesium, and iron, which come directly from the soil. Copper, zinc, boron, manganese, and perhaps others which come directly from the soil are required only in minute amounts but are important from the standpoint of plant growth or of the well-being of the animals that consume the plants.

Of the elements mentioned, nitrogen, phosphorus, and potassium are the most likely to become critically deficient and may be classified as fertilizer elements in the commercial sense.

Fig. 1. Left, complete fertilizer; center, starved for nitrogen; right, starved for potash.

Nitrogen

Of the three elements, nitrogen, phosphorus, and potassium, that are usually applied in commercial fertilizers, nitrogen seems to have the quickest and most pronounced effect. It tends primarily to encourage aboveground vegetative growth and to impart to the leaves a deep green color. With cereals it increases the plumpness of the grains and their percentage of protein. With all plants nitrogen is a regulator in that it governs to a certain extent the utilization of potash, phosphoric acid, and other constituents. It also tends to produce succulence, a quality particularly desirable in certain crops such as lettuce and radishes.

Plants receiving insufficient nitrogen are stunted in growth and have a restricted and fibrous root system; the leaves turn yellow or yellowish-green and on some plants tend to drop off. The addition of a small amount of available nitrogen will, other conditions being favorable, cause a remarkable change, indicative of the activity of the element within the plant. Of the three common fertilizer constituents, nitrogen is the only one which, added in excess, will ordinarily result in harmful effects on the crop. Very dark green, soft, and sappy leaves are an indication of an oversupply of nitrogen. The possible and important detrimental effects of an excess of this element are as follows:

1—It may delay maturation by encouraging excessive vegetative growth which remains green beyond the normal period of ripening.

2—It may lower quality. The shipping qualities of certain fruits and vegetables are greatly impaired by this condition.

3—It may weaken the straw and cause lodging in grain. This is due to an extreme lengthening of the internodes, and as the heads fill the stems are no longer able to support the increased weight.

4—It may decrease resistance to disease. This is probably due to a change in the physiological conditions within the plant, and also to a thinning of the cell wall, allowing a more ready infection.

Many crops such as the grasses, lettuce, radishes, and the like depend on plenty of nitrogen for their best and most normal development. In fact, standard quality is not attained unless large amounts of nitrogen are available. With such crops, therefore, the detrimental effects that have been mentioned are not to be expected unless excessively large amounts of nitrogen are present. Nitrogenous fertilizers may be used freely with these crops. As a rule, one can be guided by the cost of the materials in relation to the value of the crops.

Phosphorus

No form of life could exist without phosphorus. Cell division and the formation of fat cannot go on to a sufficient extent without it. Starch may be produced when it is deficient, but does not readily change to sugar. Seeds do not form without its presence. Flowering and fruiting depend markedly on phosphorus. Phosphorus especially hastens the maturation of the crop and in this respect counteracts the effect of excessive nitrogen.

Phosphorus, also, encourages root development, particularly of the lateral and fibrous rootlets. The ratio of grain to straw, as well as the total yield, is increased in cereals by phosphorus. Phosphorus also strengthens the straw,

Fig. 2. Left to right: Starved for potash; starved for phosphorus; starved for nitrogen; a normal ear which was grown with a complete fertilizer.

thus decreasing the tendency to lodge. A lack of phosphorus results in a restricted root system and a bronzing or purpling of the leaves.

The palatability of vegetables is influenced to a great extent by phosphorus. Phosphorus is also known to increase the resistance of some plants to disease, due possibly to its effect in aiding a more normal cell development. Phosphorus tends to alleviate the detrimental effect of overliming, perhaps by restoring the phosphate nutrition that seems to be upset by the absorption of too much calcium.

Potassium

The presence of plenty of available potash in the soil has much to do with the general tone and vigor of the plant. By increasing resistance to certain diseases and encouraging the root system, potash tends to counteract the ill effects of too much nitrogen. In delaying maturity it also works against the undue ripening influence of phosphoric acid. In a general way, it exerts a balancing effect on both nitrogen and phosphorus.

Potassium is essential for starch formation and is necessary in the development of chlorophyll. It is important to cereals in grain formation, giving plump heavy kernels. It also seems especially valuable to leguminous crops of all kinds. Abundant available potassium is absolutely necessary for tuber development and consequently this element is almost always present in fertilizers used for potatoes. It may be present in large quantities in the soil and yet exert no harmful effect on crops.

A lack of potassium markedly impairs the capacity of a plant to assimilate carbon dioxide. The leaves die at the edges and appear blotchy in color and they do not contain their normal amounts of sugar and starch. The addition of available potash to the soil rectifies this condition by encouraging photosynthesis, the use of nitrate nitrogen in protein synthesis, the intake of water, and root development. The influence on starch production is especially noticeable with root crops, which markedly respond to potassium fertilization.

So far as is now known, potassium does not build into the structure of any of the plant's parts. A plant will hold its potassium salts from being washed or leached out as long as it is living but as soon as the plant is killed by cutting, the potassium, no longer held, will be washed out readily—as, for example, by rain on dried hay or cornstalks. Some potassium salts will also move from the plant back into the soil as the plant matures. Not much is known about the function of potassium in plants. More is known about what happens to a plant when this element is deficient.

In considering the respective effects on plant growth exerted by the three principal fertilizer elements, it is noticed that they tend to check, balance, and support one another.

Calcium

The carbon dioxide in the soil solution makes it a potent solvent for cal-

Fig. 3. Potash deficiency is indicated by white spots on alfalfa and clover. Later the edges of the leaves become dry and appear scorched.

Fig. 4. Chlorosis on potatoes due to lack of magnesium. The lower leaves of magnesium-deficient plants are brittle, which serves to distinguish them from leaves yellowing naturally through age.

cium compounds; thus calcium is leached out of the soil as calcium bicarbonate. The soil acidity is increased by this process. In plants, calcium is built into the walls of the cells to form a protective "sieve" for the nutrients to seep through in passing into the cells. It also acts as a cement between the walls of the cells to hold them together. As the cell processes go on to develop the complex substances in the plant, some organic acids are formed that would be harmful were it not for the neutralizing effect of calcium.

When calcium is added to the soil it is usually applied in the form of limestone. Lime is not, strictly speaking, a fertilizer but a soil amendment applied to correct acidity and improve other conditions of the soil; however, one of its functions is to supply calcium if the soil is deficient in this element.

Acid soils have many factors that are unfavorable for the proper growth of plants. The activity of many beneficial soil micro-organisms is greatly retarded by acids found in the soil. This condition affects the availability of nitrogen and other elements. Many species of the nitrogen-fixing micro-organisms are especially sensitive to acidity and can exist for only comparatively short periods in distinctly acid soils. High acidity may bring about toxic concentration of iron and aluminum salts. Certain fungus diseases develop to a harmful extent only in acid soils.

Lime applied to acid soils benefits them in many ways. It neutralizes acids in the soil and stimulates the proper decomposition of organic matter, improves the physical condition of heavy soils, supplies calcium, and promotes bacterial activity in the soil. It makes other elements available to growing plants and generally increases the efficiency of manures and fertilizers. Lime added to acid soils decreases the amount of toxic agents in the soil and in some cases reduces the susceptibility of plants to certain diseases.

Sulphur

Plants frequently contain more sulphur than phosphorus, calcium, or magnesium. Since sufficient amounts of sulphur are usually present in the soil we are not so well acquainted with it. Rain returns to the earth as much as 10 pounds or more of sulphur per acre annually. When phosphorus is applied in the form of superphosphate and acid-treated bone, sulphur is an accompanying element. In superphosphate, the sulphates commonly exceed the phosphates.

Plants that have insufficient sulphur show characteristic symptoms that may resemble those of nitrogen starvation. When sulphur is applied in any great amount, it is for reasons other than its direct nutritional effect. An example of this is the use of sulphur to increase soil acidity in the control of potato scab or in the growing of such acid-loving plants as Azaleas and Rhododendrons.

Magnesium

Magnesium is credited with being a

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The influence of various amounts of fertilizers on yield of sweet potatoes. Left to right—(1) 45 lbs. of nitrogen, 45 lbs. phosphoric acid, and 60 lbs. potash. (2) 60 lbs. of nitrogen, 90 lbs. phosphoric acid, and 120 lbs. potash. (3) 75 lbs. of nitrogen, 135 lbs. phosphoric acid, and 180 lbs. potash.

Fertilizer Practice For The Ranger Sweet Potato

By Jackson B. Hester

Campbell Soup Company, Riverton, New Jersey

OWING TO THE HIGH yielding quality, deep orange color, and pleasing taste of the Ranger variety of sweet potatoes, plus its adaptability for certain commercial uses, as well as the regular market, there has developed an interest in the most desirable fertilization practices. This variety was first developed by J. C. Miller and was introduced into New Jersey by D. R. Porter. During 1943 and 1944, in the hands of nine different growers under similar conditions, the Ranger produced 47 per cent more potatoes than the Yellow Jersey variety. Since the interest in the variety has increased, it has become necessary to learn as much as possible about its fertilizer requirements.

Growers' Fertilization Practices and Yields

A survey of a number of growers' fertilization practices reveals that different quantities and methods of fertilization have been used. The summary of this survey is shown in Table 1. The amount of fertilizer that gave the largest yield was 45 pounds of nitrogen, 135 pounds of phosphoric acid, and 180 pounds of potash. The method of fertilization obviously was important and the use of part of this fertilizer before planting and the remainder by side-dressing seemed to give the best yield. This is largely due to the sandy nature of the soil. A number of good farming practices are necessary to get the maximum advantage of the fertilizer used and these data reveal that some growers used the necessary amount of fertilizer, but did not produce the crop, due to some other limiting factor. In this connection, some experimental results obtained in 1946 are interesting.

Experimental Findings

A fertilizer experiment was laid out on a Sassafras sand near Cinnaminson, New Jersey, for the purpose of obtaining information about the amount of fertilizer and method of application. The soil is typical of those used in New Jersey for sweet potato production. The organic matter content is approximately one per cent, the pH value 5.0, and the available nutrient low, with the exception of phosphorus. The phosphorus content of most of these soils has been built up to a rather high level during the past years, although most of it is tied up by the soluble aluminum and iron that occurs in the soil at such low pH values.

Before the sweet potatoes were transplanted to the field, 500 pounds of a 3-9-12 fertilizer mixture per acre were broadcast on the land. This mixture contained five pounds of borax to the ton. The fertilizer was disked into the soil and the plants set with five pounds of 8-24-8 starter mixture per 50 gallons of water. The remaining fertilizer treatments were (1) none, (2) one and two side-dressings of 500 pounds each of 3-9-12 on one series of plots, and (3) one and two side-dressings of 250 pounds of muriate of potash on another series. Following the heavy rains in early June, approximately 100 pounds of ammonium nitrate per acre to supply additional nitrogen were broadcast on the whole area. The maximum yield was obtained with 75 pounds of nitrogen, 135 pounds of phosphoric acid, and 180 pounds of potash.

It is observed that four of the grower's yields were superior to this. They used the same amount of phosphorus and potash, but less nitrogen. Magnesium deficiency developed in the experimental plots after the heavy rainfall in June, and an attempt was made to correct it by spreading 200 pounds of magnesium sulfate per acre down the rows on July 22. While no further symptoms developed, the original breakdown in the leaves was not corrected. This undoubtedly cut the yields somewhat. More magnesium deficiency developed on the plots receiving 360 pounds of potash than on those receiving the lower amounts of potash. Table

TABLE 1

GROWERS' FERTILIZATION PRACTICES AND YIELDS FOR THE RANGER SWEET POTATO

Grower	Fertilizer Used Pounds per Acre			Method of Application	Total Yield Lbs./A.
	N	P_2O_5	K_2O		
A	45	135	180	Row and side-dressed	21,550
B*	45	135	180	2/3 plowed down, 1/3 side-dressed	20,085
C	55	140	170	Row and side-dressed	18,370
D	30	120	180	Broadcast and side-dressed	17,700
E	30	90	120	Two side-dressings	15,490
F	60	180	240	Broadcast	13,550
G	70	140	140	Row and side-dressed	13,020
H	42	126	168	Row and side-dressed	12,950
I	48	144	192	Broadcast and side-dressed	11,800
J	30	90	120	Row	10,030
K	45	135	180	Row and side-dressed	8,130
L	60	180	240	1/2 plowed down, 1/2 side-dressed	8,000
M	60	180	120	Row and side-dressed	6,490
N	42	126	168	Broadcast	6,050
O	60	180	240	Broadcast	2,960
P	9	27	36	Row	2,420

* 5 or 6 tons of chicken manure.

2 and Figure 1 give the yields from these treatments. Because of the magnesium deficiency and the influence of potash fertilization upon it, a series of experiments in 1947 were planned.

TABLE 2

EXPERIMENTAL FERTILIZATION PROGRAM

Relative Order	Fertilizer Used Pounds per acre			Total Yield Lbs./A.
	N	P_2O_5	K_2O	
1..........	75	135	180	17,342
2..........	45	45	210	15,783
3..........	60	90	120	14,728
4..........	45	45	360	14,112
5..........	45	45	60	11,625

Six replications. Differences highly significant. Credit is given G. E. Smith and P. P. Nixon for assistance in obtaining these records.

Magnesium Deficiency

Magnesium deficiency symptoms on the Ranger sweet potato are different from those on the other varieties grown in New Jersey. For example, where the interveinal yellowing develops on the other varieties in New Jersey, the Ranger variety shows a purplish red color similar to the cotton plant. Furthermore, this purpling is transferred to the root, making the potato objectionable looking when cut. Since many of the commercial fields showed magnesium deficiency, it is believed that magnesium nutrition is important. In other words, the soil should be well supplied with magnesium or some should be used in the fertilizer because most sweet potato soils are not limed as a regular practice.

In 1947 a Sassafras (Toghwogh, Indian name) sandy loam which had a poor soil test for magnesium and on which sweet corn growing in 1946 showed magnesium deficiency was selected for the investigation. Seven different fertilizer mixtures were made, namely (1) 3-9-6 (N-P-K), (2) 3-9-12, (3) 3-9-18, (4 and 5) 3-9-12 with 2% and 4% MgO from magnesium sulfate, and (6 and 7) 3-9-12 with 2% and 4% MgO from dolomitic limestone. Amounts of calcium limestone equivalent in neutralizing value to the dolomitic limestone were added to the mixtures that did not have magnesium sulfate. Five pounds of borax per ton were added to each mixture. The potash was derived from 60% muriate of potash, the phosphate from 20% superphosphate, and the nitrogen from sulfate of ammonia and cyanamid. The fertilizer was added at the rate of 1,600 pounds per acre, 800 pounds in the row previous to planting and 800 pounds by late side-dressing. The plots were 1/80 acre in size with the two center rows (3 ft. x 18 in.) being harvested. All plots were replicated five times and subjected to statistical analyses.

The data given in Table 3 show that there was no significant difference in the yields of 6, 12, and 18 per cent potash in the mixtures where magnesium was left out; whereas, increased yields were obtained with the addition of magnesium to the fertilizer mixture. The addition of 4% MgO from dolomitic limestone gave a highly significant increase in yield at the one per cent level. The potatoes produced on the plots having magnesium added were free of the purple color in the potato and were smoother in appearance where the deficiency was corrected.

Because of the widespread magnesium deficiency in the sweet potatoes grown on Coastal Plain soils and for better utilization of the potash added, it is recommended that sweet potato fertilizers carry available magnesium. Some growers are using less potash in their mixtures because of the severe magnesium deficiency. This is not a solution to the problem, for the growers are sacrificing yield and quality.

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Fig. 1. Contented cows on good pasture help insure profit from dairying.

Are You Pasture Conscious?

By S. D. Gray

Washington, D. C.

SUCCESSFUL FEEDING of livestock, whether beef or dairy, depends to a large extent upon the relative availability of suitable pastures. Barn feeding is always expensive. Under average conditions it costs from three to four times as much per day to feed a mature animal in the barn or feed-lot as on pasture. Where pasture is the principal asset as in the range country and where grain or other concentrates are limited in supply as in the Northeastern States, the practices employed will, or should be, based on maximum use of pasture.

Through the tragic sequence of ignorance and mismanagement our farm economy at various times has suffered, due to overproduction of certain farm crops. Crop farmers instinctively dislike any talk of balanced production. For years they have been urged by Federal and State agricultural authorities, as well as the fertilizer industry, to reduce the acreage of these crops and to give more attention to pastures. Despite these efforts, little real progress was made until the great agricultural depression of the early "Thirties." Federal subsidies under the Soil Conservation and Agricultural Adjustment Acts provided an incentive, and national emphasis on balanced production gave to pastures the prominence they deserved.

Pasture improvement programs today are making remarkable progress in many states. Vast numbers of farmers who early recognized the logic of wider use of pasture at the expense of cultivated crops, and got on the "band wagon," have a deep appreciation of its importance for prevention of soil erosion as well as the inevitable benefits of diversification—balanced production, better utilization of land and labor, better livestock feed, and increased net returns from farming operations.

Livestock farming, one of the most important and profitable types of farming in the Northeastern States, has been greatly influenced by pastures. Valuable as they have been as a chief source of feed, their full importance as an agricultural resource has never been fully developed. Their economic utilization is still the most important problem in the stabilization of the post-war agricultural program in this region.

While pastures have contributed greatly to the success of livestock farming by supplying a cheap and highly nutritious feed, it must be remembered that this in far too many instances has been largely at the expense of the fertility of the soil. Continuous removal of the mineral plant-food elements, lime, phosphorus, magnesium, and potash, in livestock products sold off the farm, without replacement through fertilization, has reduced yields and increased cost for barn feeding to a point which seriously threatens economic production on many farms. Fertilization of good pasture to keep it good, or of below average pasture to restore it to a satisfactory level of production, is not only a wise investment but a realistic challenge to every business-minded livestock farmer.

In planning for pastures on the average livestock farm a number of things must be considered. The principal object, of course, is to provide feed in quantity as well as quality for the animals to be fed. There is also the consideration of the threat to civilization from soil erosion and the need of a protective covering of pasture herbage to heal the scars of wind and water and to hold the surface soil and fertility that remain. In these major objectives, simple fundamentals are involved. In the words of Dr. W. A. Albrecht of Missouri they are summed up in this concise statement: "Sick soils will not produce healthy plants; sick plants will not nourish healthy animals; and sick animals will not yield a satisfactory income."

Mining soils of their fertility too frequently has resulted from farming operations. Again quoting Albrecht,

Fig. 2. Young steers make good use of fertilized pasture.

Fig. 3. This Skowhegan, Maine, pasture received 600 lbs. of 5-8-7 fertilizer and returned a net profit of $36 per acre.

"It has brought us face to face with the simple fact that our plant factories are not running as efficiently for feed production as they once did when our soils contained more of their virgin fertility. Our farm meat and milk factories consequently also are operating on less efficient levels. Notwithstanding our knowledge of better nutrition and ability through diagnosis of animal ailments to determine the causes, the solution in the final analysis must come from supplying the animals more nearly normal nutrition by way of normal feeds grown on fertile soils."

In the economy of Nature, one of the highly important tasks assigned to plants is that of collecting mineral elements from the soil and processing them for the use of animals. The final product, therefore, is good or bad in proportion to the abundance or lack of the essential minerals supplied by the soil. Under range conditions, animals roaming freely have considerable capacity for balancing their own rations. Confined to a specific field or farm, however, where their feed may be deficient in certain minerals, abnormalities in growth and reproduction are likely to result.

When chemical analyses of soils or herbage are related to specific animal abnormalities, they invariably designate the seat of the trouble as the low level in the soil of the nutrients essential for plants and required in larger amounts by animals. Mineral deficiencies in plants and in the diet of animals that feed on them are most likely to occur in the marginal soils of humid regions, where the virgin fertility has been exhausted or where the system of farming has not permitted the economic use of lime and the ordinary mineral fertilizers. Such soils are widely distributed in the older agricultural sections of the Northeastern States.

The carrying capacity of many pasture lands is ridiculously low. A study of the statistics on this subject reveals that on the arid and semi-arid ranges from 25 to 100 acres of land are required to support one full-grown cow or steer. In the humid regions where moisture is not a factor and where the soil fertility is still such as to support a fair growth of herbage, about five acres are required to support one animal unit. An examination of records on carrying capacity of pastures in important European countries shows that the number of acres required to carry one animal unit ranges from .91 in Belgium to 2.65 in Great Britain and Ireland. Corresponding figures from Germany, Denmark, and the Netherlands are 1.24, 1.46, and 1.60 respectively.

Pastures in the humid regions of the United States have gone through several distinct stages of impoverishment, each followed by lower production of forage of inferior quality. Depletion of the supply of lime and phosphorus is usually the first stage encountered and is reflected in a less vigorous growth of the grasses and legumes. This is followed by the exhaustion of potash, disappearance of legumes, and the appearance of inferior species of grasses, weeds, moss, and finally brush. In the first stages of soil fertility exhaustion, the use of phosphorus alone or with lime is likely to be sufficient to bring back the clover and through its growth help maintain the nitrogen supply. Most of the permanent pastures in the humid areas probably passed the first stage of fertility exhaustion more than a generation ago. They are now, therefore, about equally deficient with respect to potash, organic matter, and nitrogen.

Results of fertilizer experiments on pastures have been, on the whole, impressive and clear cut. Quite generally they have emphasized the importance of liberal fertilization. While authorities are agreed that phosphoric acid is almost universally deficient and consequently the basis of any successful treatment, repeated tests have shown that it is not always a sufficient treatment. Evidence is accumulating from experimental work in widely separated areas showing that potash is frequently as necessary as phosphoric acid, particularly in areas where emphasis is placed on the need for legumes in the pasture. These data also have stressed the relationships of lime to efficient utilization of phosphorus and potash. While the recommendations of the different experiment stations vary with respect to the fertilization of pastures, they are, generally speaking, in very close agreement on the matter of major objectives and practical management practices.

Pastures are recognized as being the best and cheapest source of protein feed. In the young, tender stage pasture grasses contain more protein than alfalfa hay and about twice as much as mixed clover hay. Cost of this protein is about one-third as much as in purchased feed. It is quite clear from the experimental work officially reported that both the yield of dry matter and the protein are greatly increased by proper fertilization.

Fig. 4. Fertilized pasture insures both early and late grazing and reduces cost for manger feeding.

Apart from bulk, the feeding value of pastures varies in different areas. It has been shown in recent investigations, reported by Dr. J. B. Orr of Aberdeen in his book "Minerals in Pastures," that one of the most important factors in determining the feeding value is the amount of calcium, phosphorus, sodium, potassium, and chlorine present in the herbage. Some pastures may be so poor in one or the other of these elements as to be the cause of disease among

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At the Tip of the Shoot And the Point of the Root[1]

By George D. Scarseth

American Farm Research Association, Lafayette, Indiana

YOUR PROGRAM COMMITTEE has reflected the wideness of your interest and their own adventuresome spirit in extending to me an invitation to address you. I am not an apple authority and have never been called a horticulturist, but have been branded variously as a soil scientist, agronomist, chemist, plant physiologist, banana specialist, photographer, and fisherman.

Well then, since we have unfurled our banners in their true light there can be no misunderstanding. I will rely on your own common sense and understanding of the practical angles of your apple-producing business to select and modify what I say in such a way as might best suit your individual particular case.

About three weeks ago I had the pleasure of attending an apple field day, or should I say orchard day, with the Horticultural Society of a neighboring state. At this session I heard a great deal about insects, pests, rots, dusts, and sprays, and absolutely nothing that dealt with such fascinating, and I think, important aspects as light, temperature, sugar production, foliage, woody growth, fertilizers, cultivation, moisture, root growth, and last but not least, what it takes for a tree to make a big crop of apples.

If I knew the answer to all the 64-dollar questions that relate to "what it takes to make an apple tree produce big efficient crops," I would be in the fruit business and sitting in the audience with you listening to Doctor Tukey and these other specialists giving me bits of facts for me to work out the profitable answers myself. Since I am only another specialist, I will limit myself to some of my own special facts and conclusions.

A Tree Has Work to Do

Let us consider an apple tree that has reached fruit-bearing age. In the spring of the year the tree must put out a whole crop of new leaves and blossoms. All the material to make this new growth must come from within the whole plant system—that is, the stuff to make this first new growth must be in the plant at the end of the winter. The sugars, amino acids (proteins), and mineral nutrients to make this material must be in the plant before the awakening period in the spring. We cannot assume that these growth materials come from an early spring treatment of the soils, such as from an early nitrogen application. We know that the sugars for the carbohydrates and woody parts of the new growth were made in the leaves the previous season. So it is most vital that the fall leaf crop was adequate to make enough sugar for the fruit crop as well as to store a goodly supply in the tree roots.

With a rich winter store of sugars to make carbohydrates and cellulose that are needed for new leaves, and a good supply of nitrates to make amino acids and proteins for the cells, plus the mineral nutrients that are needed, the tree is compelled to push out a big leaf growth as soon as the air warms up in the spring.

The new crop of fruit will be greatly affected by this leaf crop, because the

[1] Address before the International Apple Association, Detroit, Michigan, August 11, 1947.

leaves are the "work benches" in this apple factory.

We want this tree factory to work in making apples, and not be just busy making a lot of new woody growth. Of course, we could starve the tree so much that it could not make the necessary new growth that is needed. On the other hand, we could so overfeed or wrongly feed the tree that it has no other course to follow than to make just more growth and new foliage all summer long when it should be making apples and stuffing them with sugar. Let us consider this ticklish angle further.

When to Apply Nitrogen

Suppose a tree goes through the winter with its system rather starved for sugars and nitrates. When the spring warmth comes the pressure from the internal stuff will not be great and we can expect a poor development of leaves.

Now, suppose we give the tree a heavy spring nitrate fertilization with a soluble nitrate fertilizer and observe what happens. We see that such a tree responds rapidly in that the leaves turn deep dark green. A lot of new growth develops. Long, woody growth results, even a lot of water sprouts may develop. On this new growth new leaves are formed—the tree looks good to the eye. Is it making a lot of fruit? You know the answer is "no." This new growth of wood and leaves draws so heavily upon the sugars the older leaves are making that there seems to be none for the fruit. It is almost as if the tree felt that things were so rosy with plenty of food that "why worry about protecting myself by reproducing my kind with seed (new fruit)."

If there were a lot of organic matter in the soil or even a high nitrogen-containing mulch on the ground, we know that the tree would not get much of the available nitrates early in the spring. None of the organic nitrogen in vegetable matter or humus becomes available in the soil in the spring until the soil becomes warm. It does become available with warm weather and is then dynamically supplied, a little at a time, all the growing season. This is one of the great virtues of getting nitrogen to plants through humus—it is never too big a shot at one time with none present at other times.

So what is the conclusion from this type of reasoning? It adds up to an argument for applying the nitrogen fertilizers in the fall so that the tree roots can be absorbing them all winter out of the ground. How early or late in the fall? Late enough not to start a lot of new growth and early enough for ammonia nitrogen as in ammonium nitrate to be nitrified to nitrates. This process takes a few days of warm weather.

After such a bold statement without support of experimental evidence except scientific deductions, I should grab my bags and rush from town—never to mislead an apple producer again. I personally am a worshipper of fundamental facts. The fundamental facts are usually colorless by themselves, and the scientists that grub them out are usually the greatest underpaid and unappreciated servants in our past or modern times, but I have followed the procedure of fitting facts together to arrive at a practical answer so many times with profit to myself and employer that it is far better than merely guessing. The proof is needed but since the show goes on daily, the deductions made on fundamental facts are better than taking no action, because there might be no experimental proof. This tribute to fundamental facts and the unsung scientists that produce them is appropriate, because they are more valuable than the experiments to prove their practicability. On this of course, I could draw argument, but we digress from our story.

Let's Not Forget What a Mulch Does

The only place we could find fishworms during the hot, dry period of

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Fig. 1. Agricultural workers of Northeast Mississippi studying oats and rye grass for hog grazing on the J. C. Hardin farm November 1, 1946, in Pontotoc County. Cost of labor, machinery, fertilizers, minerals, and seeds was $47.45 per acre. Grazing at five cents per head per day totalled $490.50.

Fall and Winter Grazing In Mississippi

By Q. S. Vail

County Agent, Pontotoc, Mississippi

IN APRIL of 1946, after making the spring tour at State College, Mississippi and Noxubee County, as arranged by the State College Extension Service, Experiment Station, and Noxubee County Agent, and after discussing with the Pontotoc County Assistant Agent the need and best way of getting more fall and winter grazing in Pontotoc County, we decided to carry a group of Pontotoc County farmers, businessmen, and agricultural workers to Noxubee County for a short tour of several grazing projects.

Due to the limited number that could be handled in Noxubee for lunch, and in order to get a selection of farmers and interested businessmen who would do something about the grazing after they got back home, we limited the number to be invited. In order to get the influence and help of other agencies, the Assistant Agent and I personally visited each County agency, including two banks, dairy plant, Soil Conservation Service, Farm Home Administration, and Agricultural Adjustment Agency. We sold them on the tour and let them select their 10 men, and our office selected another 10. We wrote the five vocational teachers asking them to invite about 10 farmers.

Fig. 2. Improved dallis grass and white clover pasture. Fertilizer used was one ton basic slag and 200 lbs. muriate of potash.

Forty-seven showed up out of approximately 60 invited, and we hit the rain and mud to see grazing crops of oats, crimson clover, wild winter peas, dallis grass, white Dutch clover, and combinations being grazed by beef and dairy cattle.

Approximately 35 of this number listed their names with me later, after they had studied over the program, as wanting to start grazing projects on their farms. All were given cartons to collect soil samples from selected plots and samples were forwarded to State College Experiment Station Soils Laboratory for 15 of the cooperators. The necessary lime and phosphate or basic slag and potash were given on each analysis.

W. R. Thompson, Extension Pasture Specialist, talked to this 35 in a called meeting in May and stressed plans, minerals, preparation, and management. Seed and fertilizer dealers were informed as to materials needed and assistance was given them in securing these materials. Farm visits were made during July and August to assist the cooperators in planning. Farm visits were made again in September with W. R. Thompson to all 30 who carried on through with their planning. Seeding began August 31 and continued into October.

Recommendations of following soil analysis tests, applying minerals before breaking, applying 32 pounds nitrogen at time of seeding, seeding 3 bushels of oats, 20 pounds crimson clover, 20 pounds rye grass, 40 pounds wild winter peas, 5 pounds white Dutch clover, 15 pounds dallis grass, 25 pounds lespedeza, and 30 pounds sudan were made. Oats, rye grass, and crimson clover in combination were recommended as mixture to give most fall and winter grazing per acre, with oats and crimson clover next, oats and wild winter peas third, and rye grass and crimson clover or rye grass and wild winter peas last. Oats and wild winter peas were recommended drilled or cut in, rye grass seeded on top and harrowed in, and crimson clover seeded on top and cultipacked, if possible. Grazing was recommended to begin with oats when 8 to 10 inches high and control grazing until well established. Minerals and nitrates were scarce materials and were used as obtained.

The average cost ran about $25 an acre where recommended seeding and soil analysis reports were carried out and was divided as follows:

		PMA
3 bu. oats @ $2.00	$6.00	
20# crimson clover @ 22¢.	4.40	2.40
20# rye grass @ 11¢	2.20	
1,000# basic slag @ $15 per ton	7.50	3.50
or		
500# of 20% phosphate @ $24 and	(6.00	
2½ tons lime @ $4.37 delivered & spread	10.93)	
100# potash	2.50	1.50
Labor and machinery	10.00	
	$32.60	$7.40
Less PMA payment of approximately	7.40	
Total Cost	$25.20	

An agricultural workers' tour was agreed on for November 1, 1946 by J. E. Stanley, District Extension Agent, and W. R. Thompson, Extension Pasture Specialist, who also assisted a committee of Pontotoc County agricultural workers and several other district and State men in selecting 10 farms for the tour. One hundred fifteen attended and voted unanimously to return in the spring to see the same plots after they had gone through the winter. Eight community tours and one round-up county tour were held during the first part of November, with a total of 267 attending. Information sheets giving details of minerals, preparation, and seeding of each plot were given to each attending these tours.

Farm visits to all 30 farms were made in February of 1947 with W. R. Thompson, and suggestions offered on seeding lespedeza, top-dressing, and when to quit grazing plots on which seeds and small grains were to be saved. One night meeting was held, with Thompson leading the discussion and showing colored slides of grazing and pasture plots.

Farm visits were made during the first part of April of this year to the 10 farms toured the preceding November 1 in preparation for the April 11 agricultural workers' tour. Due to heavy rains over the district, only 60 showed up. Two stops had to be eliminated on account of roads. The county farmers' tour was set for May 9, with seven of these farms visited and 350 attending. Fifteen counties were

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Fig. 3. W. P. Giuhan, Pontotoc County, shown with registered Duroc Jersey hogs grazing oats, crimson clover, and rye grass. Acreage was increased from 17 acres in 1946 to 75 acres this year.

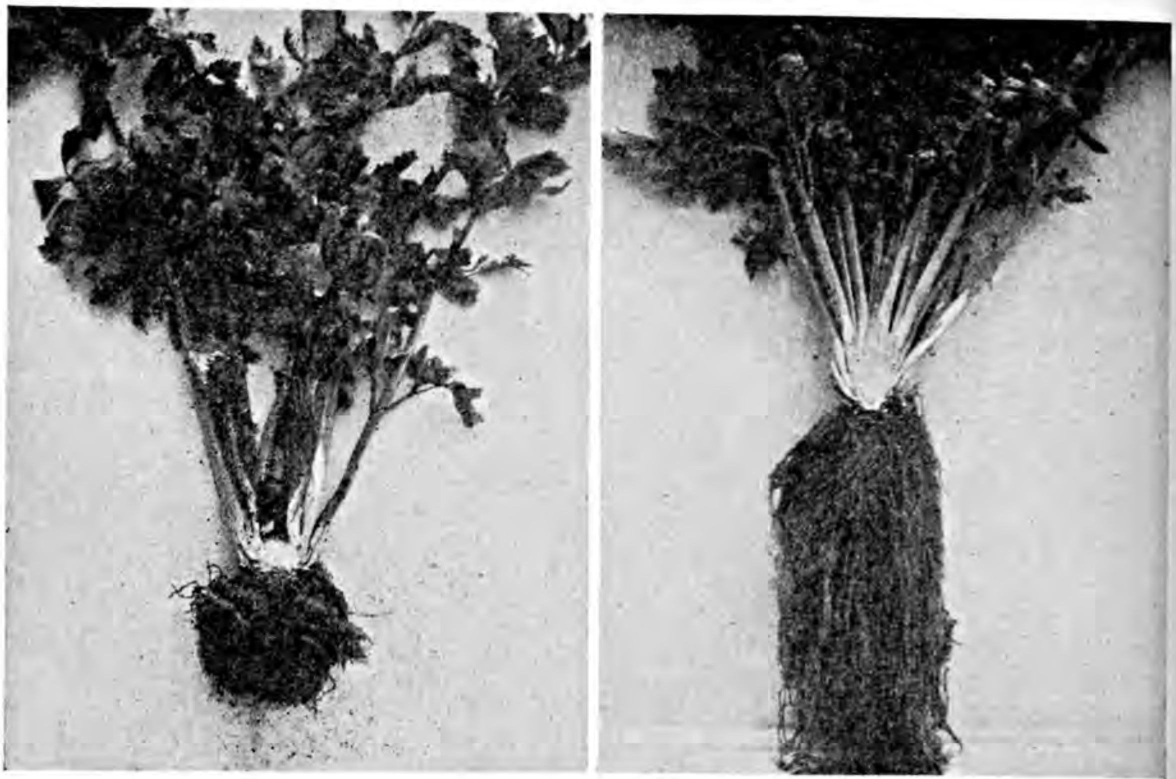

Fig. 1. These celery plants were well developed and equally vigorous when they were transplanted into the same kind of high boron-fixing soil. Without boron (left) the new growth or heart died and turned black. The roots were stubby, brown, and knotty. With boron (right) the heart was clear white and roots were vigorous.

Boron For Vermont Farms

By Kathleen B. Webb

Extension Service, Burlington, Vermont

IN World War I, boron in fertilizers proved to be a villain. Today, however, scientists are proving this villain is really a hero—if properly used. In recent years no single plant nutrient has received as much attention as boron. At least thirty-one states in the United States and six provinces in Canada have reported boron deficiencies in more than forty different crops. Although boron is a minor element in that only small quantities are needed, it is "major" in its essential role in normal plant nutrition.

In a report just published as Vermont Agricultural Experiment Station Bulletin 539, "Boron for Vermont Soils and Crops," agronomists A. R. Midgley and D. E. Dunklee describe their experiments with boron. The object of their work was to study the boron-deficiency symptoms of plants and to learn how boron should be used on Vermont soils. Their work was financed in part by a grant made by the American Potash Institute.

Chemical studies made on thirty-nine different soil types showed that only 22, or 56 per cent, had sufficient boron for most Vermont crops. However, even on these soils, extra boron is needed for high boron-requiring plants like alfalfa, many garden crops, and apple trees, Midgley and Dunklee point out in their report.

To study the boron deficiency symptoms they grew various crops in a special soil that contained no boron but was well supplied with the other plant nutrients. They obtained truckload lots of a highly leached A horizon of a podsol soil. After liming this soil, a generous amount of a complete fertilizer, together with magnesium and manganese, was added so that a lack of these would not limit plant growth. This soil was used with and without borax in greenhouse pots as well as in large metal tanks outside.

By placing plants at different stages of growth in this boron-deficient soil, a great variety of symptoms was produced on each plant. Midgley and Dunklee explain that this is because boron, unlike many other nutrients, cannot be reused by plants. A continual supply seems necessary for normal growth because, without adequate boron, growing points are usually affected first. "Dieback" or death of terminal buds and stems in the case of apple trees, "yellow top" of alfalfa in which the new growth turns yellow, and heart rot of celery where the growing tips die and are later invaded by organisms—all these symptoms were produced when the plants were starved for boron.

Fig. 3. When this one-year-old carrot root was transplanted into a very boron-deficient soil, there was typical dieback of the growing points and the nodes swelled.

Fig. 2. Cracks and external cork formed on these apples when drought or insufficient water early in the year shut off the supply of boron. They are known as drought spots.

When plants were given a new supply of boron after the growing points had died from boron starvation, additional shoots appeared, causing a multiple branching or witches' broom effect. With some plants a rosette appeared, due to an excessive number of leaves with shortened internodes. Defective flowers and a stripping of seed heads resulted in poor fruit or seed formation. Cankers appeared on stalks or stems of plants as well as on roots and storage organs. Splitting and cracking of fruit and stems seemed to be due to insufficient elasticity of cell membranes caused by lack of boron. Stalks, joints, and leaves swelled to abnormal size, ap-

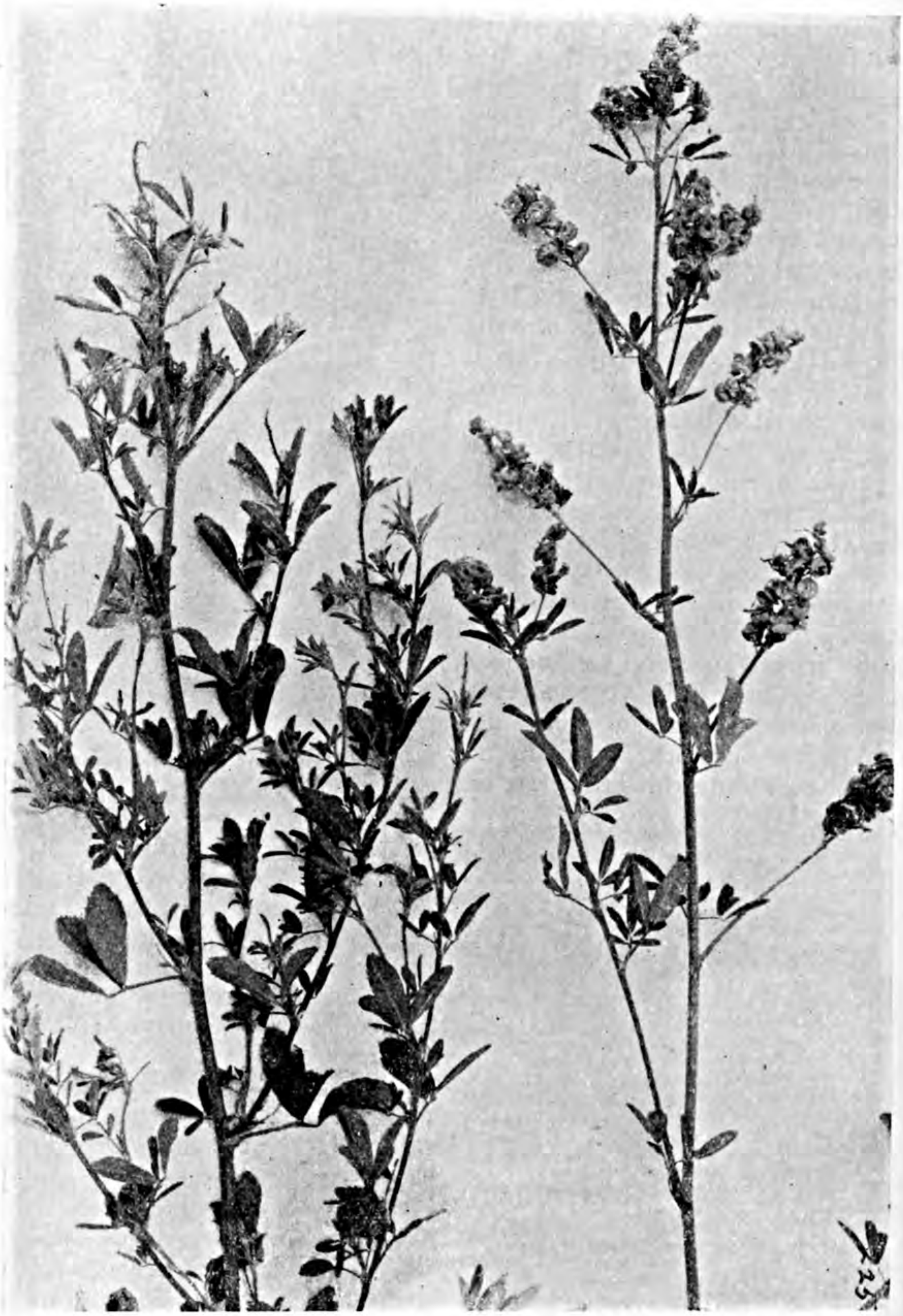

Fig. 4. Alfalfa plant without boron (left) lost all of its flowers and seed heads. Plant with commercial borax (right) produced a good crop of seed.

parently the result of an accumulation of carbohydrates that could not be properly moved through the plant without boron. Even roots produced knots or knobs and turned brown and died. Naturally these symptoms were not all obtained on all crop plants, but they occurred more or less on most plants that were starved for boron at different stages of growth, Midgley and Dunklee found.

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Some Things To Think About

By Firman E. Bear

Department of Soils, Rutgers University, New Brunswick, New Jersey

ON A VERY HOT DAY in July 1936, I drove across western Missouri on my way to Oklahoma to study the fertilizer-consuming possibilities of that State. The extremely dry weather that had prevailed generally over the United States for several years previously had reached its climax. Most of the grass and corn was dead or dying, and so also were the trees that were scattered about over the fields.

On reaching the main east-west highway we drew up to a filling station and got out of the car. It was only about 10:30 in the morning, yet the thermometer that was hanging in the shade of the building registered 114° F. Under such conditions, it did not seem worth while to go on to Oklahoma.

Coming back through Missouri the only green fields we saw were those that had been planted to soybeans or alfalfa, and they looked like oases in a vast desert. The total production of wheat and corn in the United States that year was estimated at 2.1 billion bushels. This is less than half the amount of these two grains that was produced each year during World War II.

If the 1934-36 dry-weather cycle had been delayed another 10 years, so that it would have occurred during the war, we and our allies would have found it extremely difficult, if not impossible, to have won the war. Fortunately, the weather was so favorable that we were able to harvest the largest tonnages of feed and food crops this country has ever known. The people of the United States ate more and better food during World War II than ever before. Meanwhile heavy demands were being made on our food reserves for shipment abroad, and these have been continued up to now. Grain carry-over was so short in 1946 that when the poor corn year of 1947 came along, even though it was an excellent year for wheat, a serious grain shortage developed.

The two horns of our present dilemma are: (a) the joint possibilities of another cycle of dry years and continued demand for very large amounts of food for Europe, and (b) the reverse situation of favorable weather and resulting high yields in the United States and sufficient agricultural recovery among the European nations so that they can meet most of their own food needs. Accordingly it becomes necessary to consider ways and means of dealing with the problem of possible agricultural overproduction if and when the worst of these two contingencies comes to pass.

During the past summer, 1947, I drove some 6,000 miles through the tobacco-cotton South, the cattle-wheat Southwest, the corn-hog Central States, and the grassland-dairy Northeast. One of the results of that trip was a highly favorable impression of the remarkable progress that has been made during recent years in the development of greatly improved techniques in farming. Another was a greater appreciation of the tremendous agricultural potentialities of this vast and highly progressive country in which we live.

Among the many observations of great interest to one who is concerned with better land use I have chosen a dozen items to call to your special attention:

1. The cotton area of the United States has dropped from 43 million acres, at the 1929 peak, to around 20 million acres, or less than half. Yet the total number of bales harvested has been reduced only about 20 per cent.

Some 23 million acres of cotton land have been released for other agricultural uses.

2. Kudzu, a long-vine legume, is now being widely used in the South as a soil-renovator and an erosion-stopper. It not only is taking over the waste land but it is climbing to the tops of the highest trees and it would cross the highways, except for the automobile wheels that cut off the ends of the vines.

3. The U. S. Forest Service is demonstrating on a 4½-million-acre scale in Louisiana that reforestation of non-agricultural land can be made a highly profitable enterprise. Newly planted trees, rightly cared for and protected against fire, are reaching the harvesting stage for pulpwood in seven years. An enormous cut-over area is being brought back from poverty to prosperity.

4. Contour-farming, with supporting terraces, is now being employed on a tremendous scale in the Cotton Belt to save both soil and water. This is making it possible to do away with one-man-one-mule farming and to use modern machinery on an ever-enlarging scale.

5. Texas cattlemen are now building large storage ponds to save the water from the heavy but too infrequent rains. These not only meet the needs of livestock but, in some cases, provide water for irrigation as well.

6. Prominent industrialists of Dallas, Texas, have financed the purchase of a large tract of nearby black prairie land for a Texas State Research Institute and have provided for its liberal support. One of the primary aims of this agency is to develop improved methods for the 9-million-acre Blackland Belt in that State. These men propose to erase the handwriting of erosion that, until it is stopped, will continue to spell ruin to this exceptionally fine agricultural area.

7. Combine-sorghums are growing rapidly in favor in Texas, Oklahoma, and Kansas. When the 40 per cent improvement in yield that is fully expected from the hybridization of these grain sorghums has been effected, greatly enlarged production of this highly important dry-land grain crop is certain to occur.

8. One-way disc plows, with 26 discs each that cut a 15-foot swath, are now being used, singly and in gangs, with a high degree of speed and efficiency for preparing land for seeding in the Wheat Belt. This implement mixes the straw with the surface soil where it aids greatly in absorbing the rainfall and stopping wind and water erosion.

9. Farmer-cooperative elevators, holding as much as six million bushels each, are being built in ever-increasing numbers to house the tremendous wheat crops of Oklahoma and Kansas. These modern elevators have suction fans that operate, while the grain is being unloaded, to collect the dust. At one such set of elevators 30 carloads of dust, containing 12 per cent protein, were saved and sold for use in mixed feeds.

10. One-man balers are now in operation both in the wheat and hay fields from way west of the Mississippi River clear to the Atlantic Coast. These do a lot of work with very little labor but a high degree of efficiency.

11. The concept of 100-bushel-per-acre yields has spread through the Corn Belt. Corn growers are sold on hybrid seed and thicker stands and they are beginning to pour on lime and fertilizer.

12. Irrigation is being rapidly expanded not only in the arid areas of the United States but in the high-rainfall areas as well. Extra water is being applied on an ever-enlarging scale to vegetables and potatoes in the humid areas, and some of it is spilling over onto haylands and pastures.

These are only a few of the many developments in agricultural practice that are having highly important effects on our farm economy. These improved techniques are taking a great deal of the gamble out of the production and sale of crops and livestock. But they are only the beginning of a rapidly expanding program that is being designed to tie the soil down, improve its productivity, and stabilize the agriculture in this country.

It must be pointed out, however, that a gigantic task still remains to be done. For example, it was necessary to make a wide detour to avoid the flooded areas of central Missouri. As soon as public approval can be obtained, the red rivers of the Cotton Belt, the gray-brown rivers of the Wheat Belt, and the gray-black rivers of the Corn Belt must be made to run clear. Vast plans have been conceived to soak in the rain where it falls and to hold the excess water upstream until it no longer constitutes a menace to the people and to the land farther down the watershed. A typical example is found in the trash-farming program that is being applied to over one million acres of Nebraska corn land. The farmers in that area are discarding the mold-board plow. And that is a mere beginning to the many changes that must and will be put into effect out in the open country where the floods have their origin.

To the man who thinks in terms of soils and the fertility problems related

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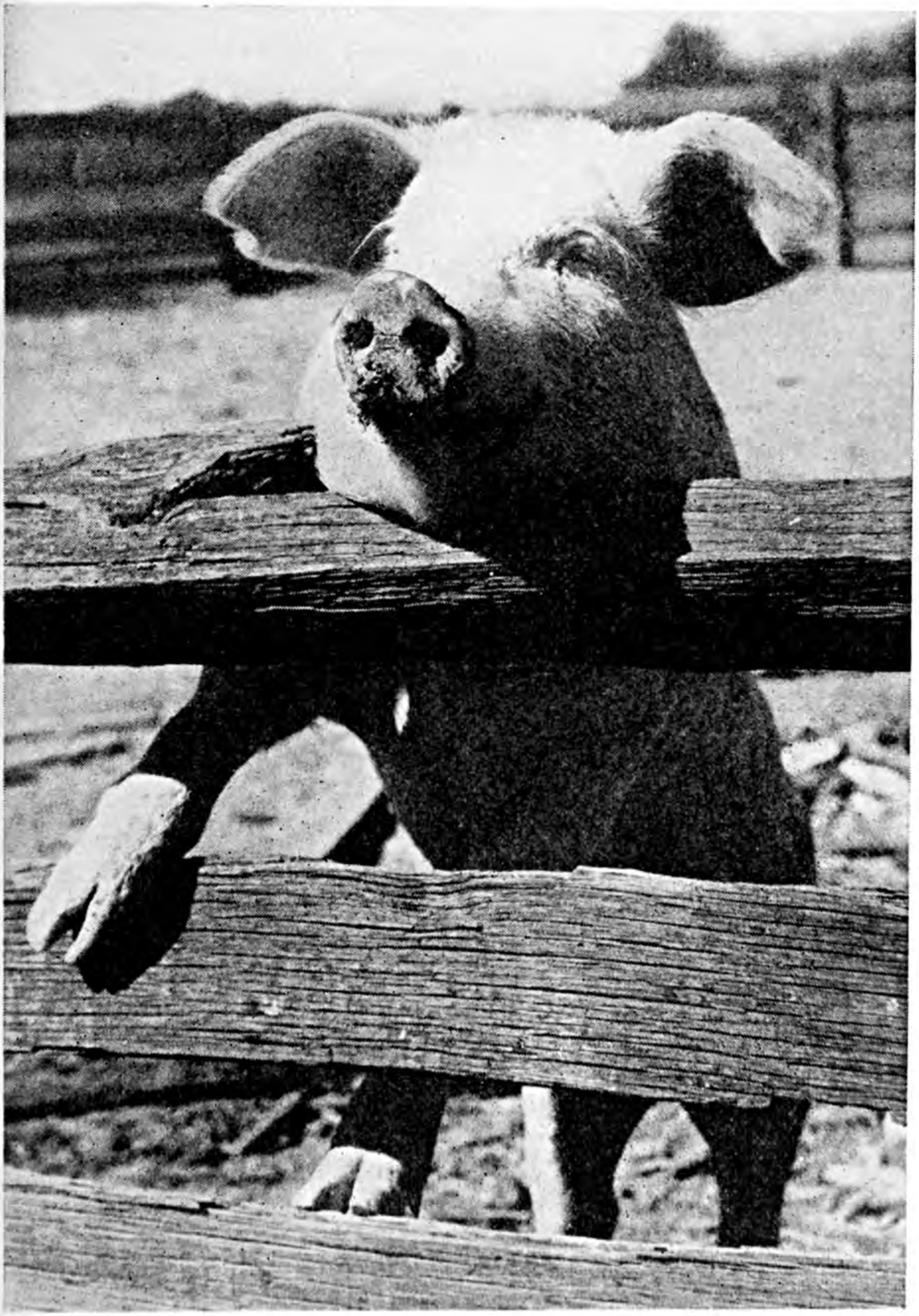
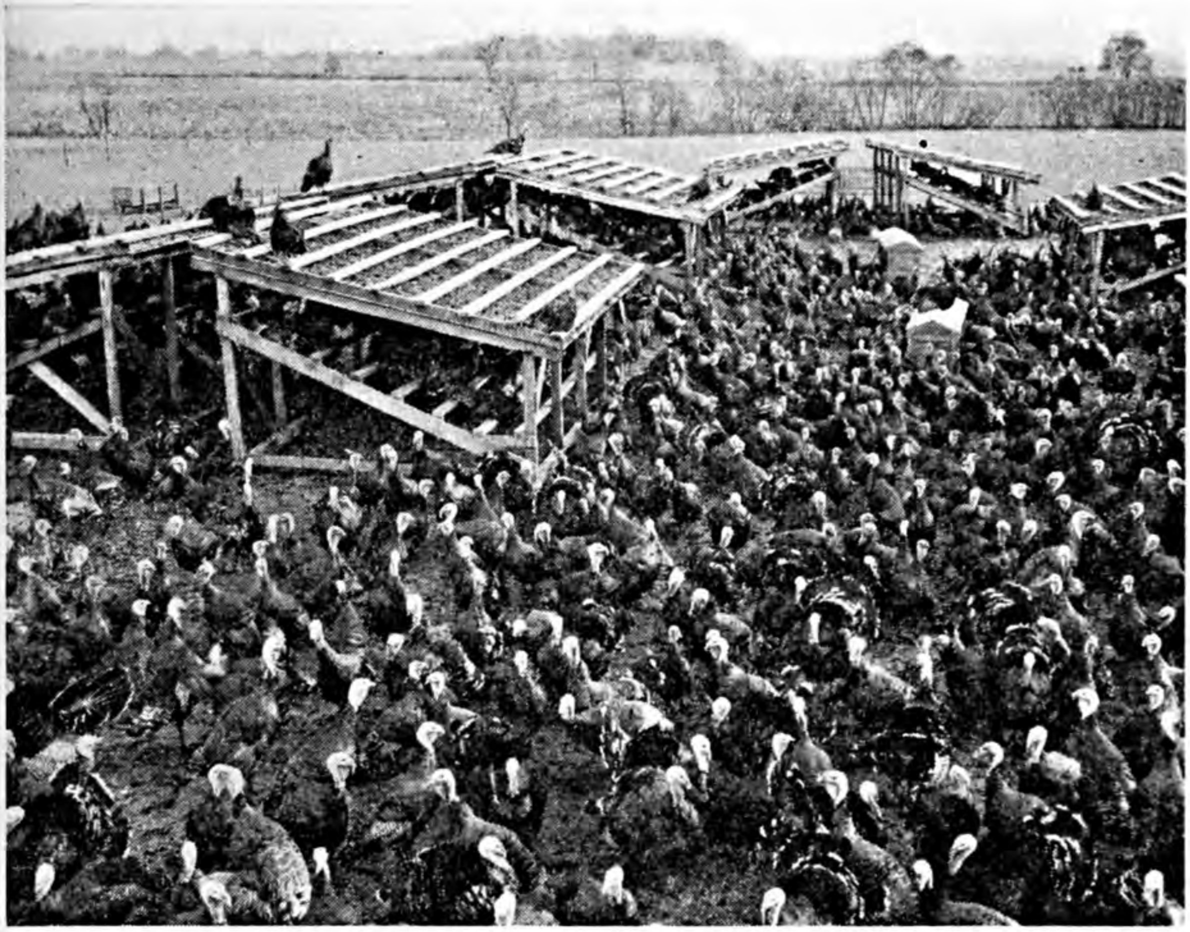
PICTORIAL

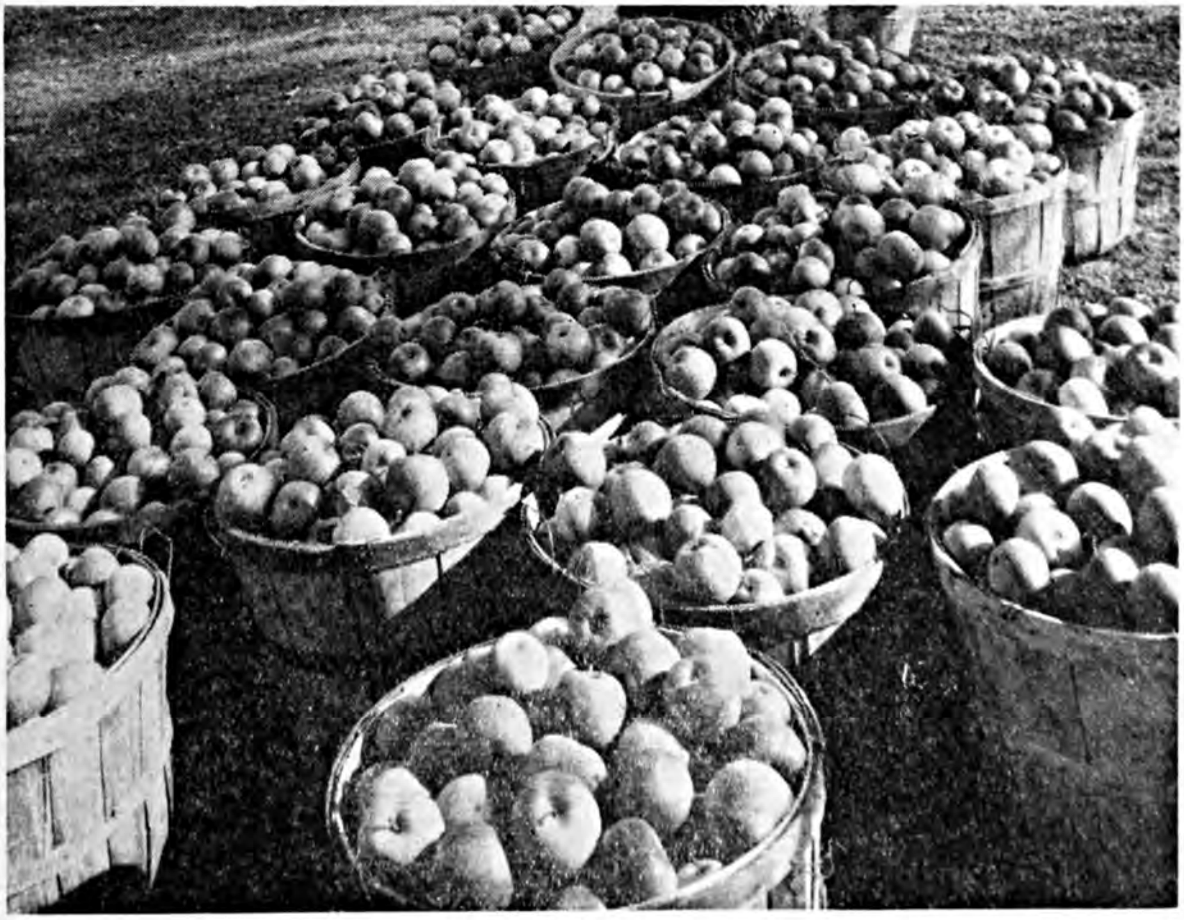


ALWAYS HUNGRY!

Some of our American Bounty

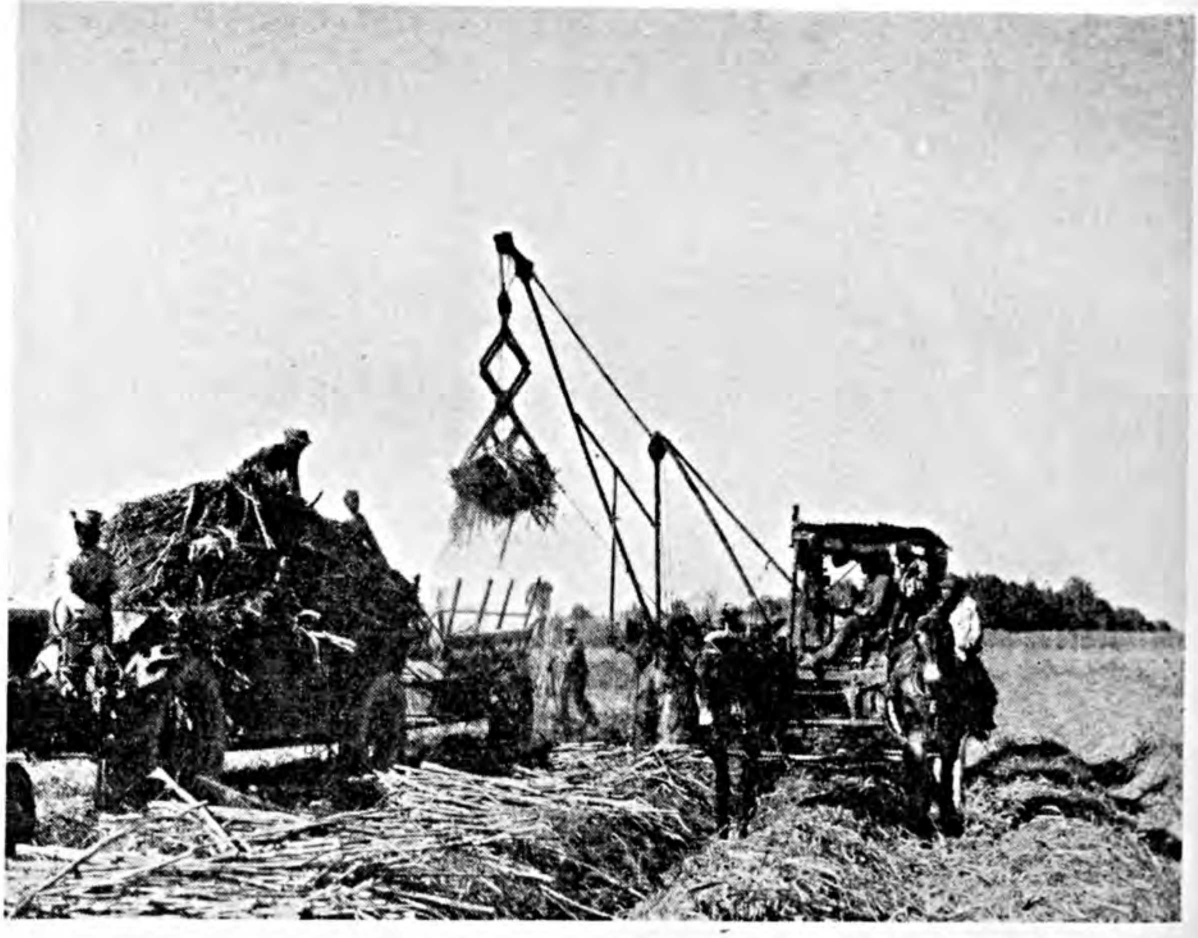


For Which to Give Thanks



Above: **The worry over this year's corn crop is ended.**

Below: **Sugar cane on its way to the Nation's sweet-tooth.**



The Editors Talk

Our Nation's Land Resources

One travels the "open spaces" and, viewing the broad expanses of cropland, range, and forest, is impressed with the Nation's land resources. One reads the astronomical figures of our crop production and livestock population and congratulates himself on living in a land of plenty. Yet few of us, except that they be of a particularly statistical mind, have any conception of the comparatively small percentage of our land area that keeps us alive.

We have Claude C. Haren of the Bureau of Agricultural Economics, U. S. Department of Agriculture, to thank for a comprehensive breakdown of the major uses of land in the United States in 1945. With text and graph published in the October 1947 issue of *The Agricultural Situation* he has presented some thought-provoking information.

"Less than one-fifth of the Nation's land area provides, directly as foodstuffs or fibers or indirectly as feed and forage for livestock, most of the agricultural products which go to meet our needs," he says. "The 350 million acres, more or less, from which crops have been harvested in recent years represent 2½ acres per capita. The 200 or more crops grown include all of the major crops except certain tropical and subtropical commodities. About two-thirds of the acreage of crops harvested and an even larger part of the tonnage go to provide feed for livestock. One-fifth of the acreage is utilized for growing wheat, rice, and similar crops, staples in the diet of a large proportion of the population of the world. About one-tenth of an acre per capita is used to produce fruits and vegetables. The fiber, oil-producing, and other crops account for the remaining one-tenth of the acreage of harvested crops."

To what uses is the rest of our land area put? Crop, pasture, grazing, and forest uses add up to slightly over 1,700 million acres, or 90 per cent of the land area of the country, according to Mr. Haren. Of the remaining 10 per cent, 3.7 per cent is occupied by cities, parks, roads, railroads, etc., and 2.3 per cent by farmsteads, roads, lanes and farm wasteland. The remaining 4 per cent or 78 million acres of desert, rock outcrop, tidal marshlands, and coastal beaches, is of slight agricultural value, although these areas have some usefulness for wildlife protection and as recreational sites.

For years we have been hearing that the limitations to our agricultural frontiers have been reached. Still the output of farms and ranches each year since 1940 has averaged a fifth above 1931, the pre-drought peak, and over a third above 1920. Farmers since 1941 have been growing record amounts of most crop and livestock products without much increase in their acreage of crop, pasture, and grazing land.

Altogether, more than half of our land area is used or available for pasture for farm and range livestock. These areas now provide at low cost about a third of the feed and forage requirements of these animals. "Changes in consumers' food habits during the past three decades have increased the value of this pasture resource," Mr. Haren says, "but pasture improvement, despite gains through reseeding, use of fertilizers, and application of soils and moisture stabilizing measures in recent years, remains an important but largely undeveloped field."

There is much more of interest in this analyst's report. He discusses forest-producing land which has dwindled to 56 per cent of the originally forested area. The significant thought of his whole discussion lies in his concluding sentence on forests: "Future dependence, as upon crops and pastures but over long-time growth interval, must be placed upon present and prospective increments." In other words, it is up to us to take care of and constantly improve what we now have.

The Soil Bank Account

A man's bank account is of vital interest to himself and to those with whom he does business. The regularly issued statements of his deposits, withdrawals, and balance receive his prompt attention. He wants to see what he has accumulated, what he has had to take out, and what is left on which he can base his future operations. Why, then, do so many farmers neglect to check into the fertility of their soils—a bank account as truly as any which they may carry at a commercial bank? From this fertility must come their chief income. On it, their successful operations depend.

This is an excellent time of the year for a farmer to get a statement from his soil bank account. Crops have been harvested and livestock is moving to market. The fertility withdrawals have been made. What did they produce and what is the balance left? The year's accomplishments are being summed up and plans for next year are beginning to take shape. There is time to look into these things and to consider the plant-food requirements of the crops to be planted next spring. In other words, this is an excellent time of the year for a farmer to have his soils tested.

There are other reasons than those given above for this statement. The experiment stations and soil-testing laboratories which make the tests are less "swamped" with soil samples than during the spring and can be more prompt in getting their reports back to the farmer. This will give him more time for making his inventory and future plans and will permit him to get his order for fertilizer in early—an important factor in assuring him that he will have it when he wants to apply it. Spring is the farm's busiest season and anything done ahead is time gained.

A great many farmers are taking advantage of these opportunities. However, they are open to and should be realized by a vast number who still are indifferent to them. Anything the advisory forces can do to encourage more operators to have their soils tested is an accomplishment toward the bettering of American agriculture.

We are founded as a nation of farmers and in spite of the great growth of our industrial life, it still remains true that our whole system rests upon the farm; that the welfare of the whole community depends upon the welfare of the farmer; the strengthening of country life is the strengthening of the Nation.—*Theodore Roosevelt.*

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1922..........	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923..........	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924..........	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925..........	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926..........	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927..........	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928..........	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929..........	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930..........	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931..........	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932..........	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933..........	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934..........	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935..........	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936..........	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937..........	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938..........	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939..........	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940..........	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941..........	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942..........	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943..........	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944..........	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945..........	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
October......	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November....	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December....	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	....
1947									
January......	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	....
February.....	30.56	31.9	131.0	228.0	123.0	199.0	17.50	88.20	....
March........	31.89	33.6	139.0	235.0	150.0	244.0	17.40	88.00	....
April........	32.26	30.1	147.0	233.0	163.0	240.0	17.20	88.00	....
May..........	33.50	44.6	153.0	233.0	159.0	239.0	16.80	83.70	....
June.........	34.07	46.0	156.0	249.0	185.0	218.0	16.00	79.60	....
July.........	35.88	48.5	169.0	251.0	201.0	214.0	15.10	79.00	....
August.......	33.15	38.1	161.0	270.0	219.0	210.0	15.30	75.50	....
September....	31.21	40.7	149.0	240.0	240.0	243.0	16.10	75.60	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
1922..........	185	228	95	114	116	109	98	135	....
1923..........	231	190	133	137	129	105	110	183	....
1924..........	185	190	98	170	166	141	107	147	143
1925..........	158	168	245	188	109	163	108	140	143
1926..........	101	179	189	134	116	138	112	98	139
1927..........	163	207	146	124	132	135	87	154	127
1928..........	145	200	76	134	131	113	95	152	154
1929..........	135	183	189	133	124	117	92	137	137
1930..........	77	128	131	123	93	76	93	98	129
1931..........	46	82	66	83	50	44	73	40	115
1932..........	52	105	55	62	50	43	52	46	102
1933..........	82	130	118	79	81	84	68	57	91
1934..........	100	213	64	91	127	96	111	146	95
1935..........	90	184	85	80	102	94	63	135	119
1936..........	100	236	164	106	163	116	94	148	104
1937..........	68	204	76	93	81	109	74	87	110
1938..........	69	196	80	83	76	64	57	97	88
1939..........	73	154	100	85	88	78	67	94	91
1940..........	80	160	78	97	96	77	64	96	111
1941..........	137	264	116	107	117	107	81	211	129
1942..........	153	369	168	136	143	124	91	202	163
1943..........	160	405	188	232	174	154	125	231	245
1944..........	167	420	214	219	170	160	138	234	212
1945..........	181	435	199	228	178	169	127	230	224
1946									
October......	304	530	175	238	266	213	136	293	151
November....	236	438	176	228	198	214	145	399	207
December....	242	435	181	239	190	217	149	406	166
1947									
January......	240	390	185	351	188	216	147	401	238
February.....	246	319	188	260	192	225	147	391	275
March........	257	336	199	268	234	276	147	390	299
April........	260	301	211	265	254	271	145	390	295
May..........	270	446	220	265	248	270	142	371	286
June.........	275	460	224	284	288	247	135	353	215
July.........	289	485	242	286	313	242	127	350	189
August.......	267	381	231	308	341	238	129	335	211
September....	252	407	214	273	374	275	136	335	179

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
February	2.41	1.46	10.01	11.06	12.14	10.17
March	2.41	1.46	11.98	11.06	12.50	10.50
April	2.41	1.51	11.72	10.79	12.75	11.39
May	2.41	1.51	10.55	9.98	12.75	8.80
June	2.41	1.51	10.94	9.98	12.75	8.26
July	2.41	1.59	12.56	9.98	12.75	8.66
August	2.53	1.60	13.01	9.98	12.75	8.73
September	2.66	1.73	13.65	10.41	12.75	10.72

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish scrap	Tankage	High grade ground blood
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293
February	90	51	286	313	360	289
March	90	51	342	313	371	298
April	90	53	335	306	378	324
May	90	53	301	283	378	250
June	90	53	313	283	378	234
July	90	56	359	283	378	246
August	94	56	372	283	378	248
September	99	61	390	295	378	305

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.9	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367[1]
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January	.700	2.60	6.60	.535	.797	26.00	.200
February	.720	2.60	6.60	.535	.799	26.00	.200
March	.740	2.75	6.60	.535	.797	26.00	.200
April	.740	2.97	6.60	.535	.797	26.00	.200
May	.740	2.97	6.60	.535	.797	26.00	.200
June	.752	2.97	6.60	.330[1]	.589[1]	12.76[1]	.176
July	.760	2.97	6.60	.353	.629	13.63	.188
August	.760	3.08	6.60	.353	.629	13.63	.188
September	.760	3.42	6.60	.353	.629	13.63	.188

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1920	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83
1947							
January	131	72	135	75	84	108	83
February	134	72	135	75	84	108	83
March	138	76	135	75	84	108	83
April	138	82	135	75	84	108	83
May	138	82	135	75	84	108	83
June	140	82	135	60	62	53	80
July	142	82	135	64	66	56	82
August	142	85	135	64	66	56	82
September	142	95	135	64	66	56	82

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	206	126	69	359	131	78
February	262	234	209	124	70	329	134	78
March	280	240	216	128	70	354	138	78
April	276	243	215	129	71	354	138	78
May	272	242	215	127	71	339	138	78
June	271	244	215	125	71	343	140	63
July	276	244	219	128	72	359	142	67
August	276	249	223	130	75	364	142	67
September	286	252	230	133	79	372	142	67

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] **All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.**

** **The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Commercial Fertilizers Registrants to Date for the Fiscal Year Ending June 30, 1947," Bu. of Chem., State Dept. of Agr., Sacramento, Calif., FM-152, Sept. 22, 1947.

"Agricultural Minerals Registrants to Date for the Fiscal Year Ending June 30, 1947," Bu. of Chem., State Dept. of Agr., Sacramento, Calif., FM-153, Sept. 22, 1947.

"Commercial Fertilizers Report for 1946," Agr. Exp. Sta., New Haven, Conn., Bul. 502, Dec. 1946, H. J. Fisher.

"Fertilizer, Feed, Limes and Seed Report for Quarter Ending June 30, 1947," State Laboratory, Board of Agr., Dover, Delaware, Vol. 37, No. 2.

"Commercial Fertilizers Inspected and Analyzed in the State of Georgia, Year 1946," State Dept. of Agr., Atlanta, Ga., Serial No. 131, Jan. 1947.

"Fertilizers, Fertilizer Materials and Rock Phosphate Used in Illinois During 1946," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., July 1947, E. E. DeTurk.

"The Effect of Fertilizer Practice Including the Use of Minor Elements on Stem-end Browning, Net Necrosis, and Spread of Leaf-roll Virus in the Green Mountain Variety of Potato," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Bul. 447, Jan. 1947, A. Frank Ross, Joseph A. Chucka, and Arthur Hawkins.

"Results of Fertilizer Tests of Sugarcane in Mississippi During the Period 1941-1946," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 446, May 1947, I. E. Stokes and T. E. Ashley.

"Ammonia as a Source of Nitrogen," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 448, June 1947, W. B. Andrews, F. E. Edwards, and J. G. Hammons.

"County Fertilizer Data: Mixed Goods and Materials, July 1, 1946 through June 30, 1947," State Dept. of Agr., Jackson, Miss.

"Effect of Fertilizers and Lime on Yield, Protein Content, and Phosphoric Acid Content of Pasture Forage," Agr. Exp. Sta., Texas A. & M., College Station, Texas, P. R. 1039, Oct. 2, 1946, E. B. Reynolds and R. H. Wyche.

"Fertilizer Experiments with Tomatoes in Robertson County," Agr. Exp. Sta., Texas A. & M., College Station, Texas, P. R. 1080, May 24, 1947, Myron D. Bryant.

"Auto Rear-end Type Fertilizer Spreader," Agr. Ext. Serv., Texas A. & M., College Station, Texas, L-50, 1946.

"Boron for Vermont Soils and Crops," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt., Bul. 539, Aug. 1947, A. R. Midgley and D. E. Dunklee.

Soils

"Organic Matter in Florida Soils," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 433, July 1947, L. G. Thompson, Jr. and F. B. Smith.

"Plant Beds for Flue-Cured Tobacco," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 435, Aug. 1947, Fred Clark, G. M. Volk, and W. E. Stokes.

"Cultural Directions for Growing Mangos in Florida," Sub-Tropical Exp. Sta., Univ. of Fla., Homestead, Fla., Mimeo. Rpt. No. 10, June 1945 (rev. April 1947), Geo. D. Ruehle.

"How to Reseed Abandoned Land for Pasture and Range in Southern Idaho," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Cir. 112, Feb. 1947, R. H. Stark, J. L. Toevs, and A. L. Hafenrichter.

"Physical Land Conditions of the Fruit Breeding Farm at the New York State Experiment Station, Geneva, N. Y.," Agr. Exp. Sta., Cornell Univ., Geneva, N. Y., Tech. Bul. 279, Feb. 1947, Wilber Secor, Everett A. Carleton, and John Lamb.

"Removal of Alkali by Drainage and Leaching," Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo., Bul. No. 276, June 1946, T. J. Dunnewald.

"The Form of Selenium in Some Vegetation," Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo., Bul. No. 278, March 1947, O. A. Beath and H. F. Eppson.

Crops

"Grain Sorghum Production in Alabama," Agr. Exp. Sta., Ala. Polytechnic Institute, Auburn, Ala., P. R. Series No. 34, June 1947, D. G. Sturkie and T. H. Rogers.

"White Dutch Clover-Dallis Grass Pasture for the Gulf Coast Area of Alabama," Agr. Exp. Sta., Ala. Polytechnic Institute, Auburn, Ala., P. R. Series No. 36, Aug. 1947, Otto Brown and Harold F. Yates.

where most of the soil nitrogen is found. Undoubtedly the roots of trees and shrubs can feed on phosphorus and potash from the deep moist soil horizons, but they must feed out of the surface horizons for nitrogen. Therefore, it is important to keep that part of the soil moist throughout the entire growing season.

Mulches Help to Keep Soil Phosphate and Potash More Available

Excess drying of the soil tends to convert the nutrient elements, phosphorus and potassium, into crystalline unavailable forms. For this reason it is desirable that a soil should never become excessively dry. Available potash is held on the surface of the fine soil particles called colloids. These particles tend to be plate-like and expand when the soil is moist so that potash held between these plates can be obtained by the plant root. But excessive drying causes these plates to become "glued" together. When they are thus cemented they are very slow to separate again when the soil is wet. Therefore, it is better that they do not go through such a cementing process by excessive drying.

Mulches Increase Infiltration of Rain Water

Rain water should move into the soil rather than off the ground as so much of it does when the soil is hard and dense. Mulches prevent runoff and even though the mulch will hold a light shower from entering the soil there is still benefit from this high moisture content in the mulch in keeping the soil cool.

Mulches Improve Soil Tilth

The organic matter from mulches will furnish food for bacteria and fungi to live and multiply in the soil. Perhaps these micro-organisms give off healthy by-products, at any rate they help to granulate the soil to make it contain more pore space.

Mulches Can Do Damage

If a mulch is started, it should be maintained; otherwise it will encourage roots to become established near the surface. Then when the mulch has rotted away, the roots find themselves in the unprotected ground and trees and shrubs may suffer because of this.

Mulch Materials

The richer the mulch material is in important plant-food nutrient elements as nitrogen, phosphorus, and potassium, the greater will be the benefit from the mulch because of the nutrients thus supplied. Such mulches would be from legume crops or manures.

Sawdust mulches would help the water situation primarily. The high energy content of such materials may increase the need for nitrogen because much nitrogen is required to decompose all high energy materials as straw or sawdust that are high in cellulose but low in nitrogen content. Organic mulches like glass wool, gravel, or flagstones could only be beneficial as related to the moisture behavior and protection from erosion.

Mulches and Nitrogen Fertilizers

Theoretically a nitrate form of nitrogen should work better with organic mulches than the ammonium forms of nitrogen carriers. The nitrates are free to move into the soil, but ammonium nitrogen will not move deeply into a soil until converted through bacterial action to the nitrate form. Under high organic content mulches where the free oxygen supply is limited, it is doubtful if ammonium nitrogen forms will be changed over rapidly to the mobile nitrate forms.

Liming Orchard Soils

Liming orchard soils is risky business, especially on sandy soils, because such soils can be easily over-limed. The roots will have a hard time finding enough available iron, likely boron, and manganese wherever the soil pH is pH 7.0 or above.

"Quality of Cotton Produced in New Mexico 1940-1943," Agr. Exp. Sta., N. M. A. & M., State College, N. M., Bul. 330, June 1946, F. A. B. MacKeil and J. C. Overpeck.

"The Farmer, North Carolina, and the TVA," Agr. Ext. Serv., Univ. of N. C., Raleigh, N. C., Ext. Cir. No. 289, June 1946, W. B. Collins.

"The Price of Texas Farm and Ranch Lands, 1920-1945," Agr. Exp. Sta., Texas A. & M., College Station, Texas, Bul. No. 688, April 1947.

"Rural Non-Farm Family Living in Nine Vermont Towns," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt., Bul. 537, Aug. 1947, Robert M. Carter.

"Washington 4-H Clubs," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Ext. Bul. No. 363, April 1947.

"Marketing Margins and Costs for Grains, Grain Products, and Dry Edible Beans," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Tech. Bul. No. 934, Aug. 1947, Donald R. Stokes.

At the Tip of the Shoot and the Point of the Root

(*From page* 18)

the summer when I was a boy was between two buildings. For some reason the soil there was always moist—it felt nice and cool to our bare feet. The shade that kept the soil cooler than the surroundings was responsible for that moisture. This is a fact most of us overlook, and to better understand it can prove valuable.

Several years ago the late Professor A. R. Whitson of the Wisconsin Experiment Station told me how he was comparing the moisture content in the soil in a soybean plot with that in an uncropped plot. In August the soil moisture under the soybeans was actually higher than in the plot where no crops were growing. This did not seem reasonable, because we realize the soys were drawing heavily upon the soil water and were evaporating much of it into the air, whereas no plants were using water in the fallow plot. At that time we had no explanation for the difference.

In 1927 the answer came from a Russian named Lebedev who had spent his life studying soil moisture. He found that when the soil cooled during the night, moisture from the air would move into the soil in the early morning and forenoon hours after sun-up while the soil was cooler than the rapidly warmed air above the soil. In some tests he found that the amount of water thus entering the soil was equal to about ⅓ of the rainfall in Odessa where the tests were made.

Everyone is familiar with the wet ice-water pitcher and water glass, or knows how cold water pipes in the basement will become wet and even drip on a warm summer day. The soil under a board will be more moist than the adjacent soil. This is not due entirely to the board preventing evaporation, but is due in part to the shading effect of the board in keeping the soil underneath it a bit cooler than the surrounding atmosphere, thus permitting moisture from the air to move into the soil under the board and condense. It is difficult to maintain moisture in a hot soil but it is easy to keep a cool soil moist.

One of the great benefits derived from a mulch is that it keeps the soil cooler and thereby increases the moisture content in the soil; in fact it enriches the moisture content by actually drawing moisture into the soil from the air. There are data by Professors Gourley and Wander of Ohio State University which clearly indicate how a mulch will help the water situation. There are many other benefits derived from a good mulch.

Mulches Give the Roots a Chance to Feed on the Richer Topsoil

Plant roots cannot feed or grow in a dry soil. If a soil is not mulched, the topsoil will be dry during some weeks of every summer and thus plants are handicapped, which means a reduced growth and yield. It is in the topsoil

Fig. 6. With boron (right) Ladino clover grew well, but without it (left) it died in the seedling stage. Reseeding was not helpful as the deficient plants seemed to be more susceptible to damping-off.

need and have adopted the practice of applying one-half pound of borax for each medium-sized tree every other year. This is usually not enough unless it is applied in a band under the outer portion of the branches. When broadcast over the entire spread of the tree, the rate should be increased to at least one pound—about one pint.

When beet seed was planted on the boron-deficient soil, the plants often died in the seedling stage. Those that recovered, as well as healthy transplants placed in the same soil, produced typical beet canker and internal black spots. As beets have a high boron requirement, even a heavy application does not always guarantee against black spot and canker if a sufficient amount is not available to the plants.

With carrots Midgley and Dunklee experimentally obtained eight phases of boron deficiency; namely, yellows, bronzing of leaflets, dieback, multiple branching, death of seedlings, lack of flowers and seed, canker and splitting of exterior, and swelling of the nodes of second-year plants.

Grasses in general require very little boron, the agronomists found. They were able to produce sizable plants when seed was sown in the boron-lacking soil—in which other plants died in the seedling stage. With oats, however, a lack of boron may affect the formation of flowers and seed.

The best identification of boron-deficient Ladino clover was the bronzing of the leaflets, similar to the same symptom in alfalfa. Care must be exercised in using boron for Ladino clover, however, the agronomists caution, because new plants produce stolons that spread and root near the surface. Thus a heavy broadcast application on established stands may prove harmful—25 to 30 pounds per acre are recommended.

Experiments with potatoes and strawberries showed characteristic symptoms of boron deficiency when plants were grown in the special soil. Turnips were found to be good indicator plants of boron-deficiency. In fact, as they are widely grown in Vermont gardens, they are useful for this purpose.

All crops require boron for normal growth, but individual plant needs vary greatly. If the soil does not contain an adequate supply, some must be applied. A broadcast application of from 30 to 50 pounds per acre every three or four years will give most crops the needed insurance. However, when

Fig. 7. Relation between boron fixation and organic matter content of 38 soils.

Where a lot of sulphur sprays have been used over a period of years, the soil may be dangerously acid. Here it might actually even be deficient in calcium and magnesium. Light applications of dolomitic limestone (calcium and magnesium carrier) as if applying it for its plant-food content seems sensible.

Balanced Minerals

A well-fed tree needs all the minerals of life. Just because trees usually respond only to nitrogen fertilization does not mean that the other minerals are not needed. The needs vary too much with soil kind and past practices to dwell on here. A balance of nutrition is essential, and a sound procedure is to feed cover crops to use as mulches and then there will be a selection process by the organic matter producing crops to serve as a safety factor in feeding the trees.

As a layman apple watcher I think we still have a lot of opportunity to improve our tree performance from the root up and thus find ourselves lowering our cost of production.

Boron for Vermont Farms

(*From page* 24)

In making their recommendations for the use of boron, the agronomists warn that boron is not a cure-all. "It cannot replace other forms of plant nutrients; it merely supplements them. Nitrogen, phosphorus, potash, and lime are still the great quartette, but when boron is needed and properly used with them, decided benefits will result. Boron gives the greatest response on land well supplied with the other nutrients, because only a heavy and active plant growth requires much boron.

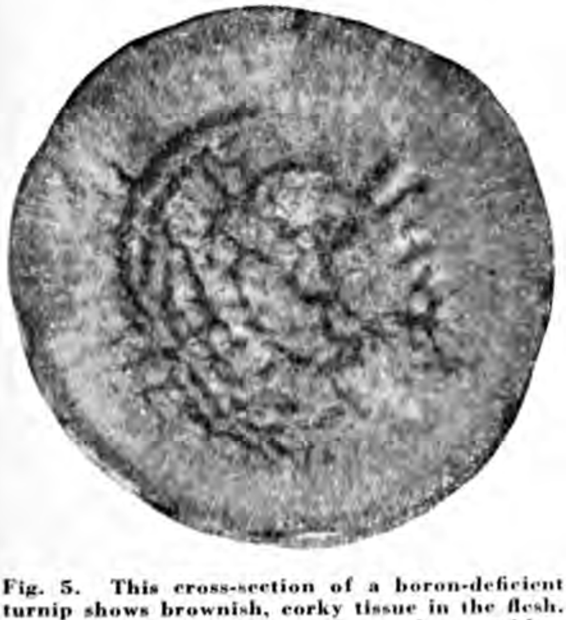


Fig. 5. This cross-section of a boron-deficient turnip shows brownish, corky tissue in the flesh. It is somewhat bitter and nearly worthless as food.

"Boron is like dynamite in that it is a very useful servant if used properly. It can be very helpful and beneficial, but used in excess it is harmful. Rates of boron tolerated by plants fall in a range much narrower than that for other fertilizers, and if a beneficial rate is doubled, injury may result," the authors warn.

Practically all the alfalfa stands in Vermont show signs of boron deficiency sometime during their life, Midgley and Dunklee state. They recommend broadcasting 40 to 50 pounds of borax on all Vermont soils before planting alfalfa. Borax greatly increases the life of the stand, improves yield, leafiness, and feeding value. Well-known boron-deficiency symptoms of alfalfa are: yellow top and terminal bronzing of the leaves, death of the terminal growing buds causing witches' broom, and lack of flowers and seed.

With apples the most outstanding symptom of a lack of boron is internal and external corky formation in the fruit. Apples showing internal cork have been obtained from practically every commercial orchard in Vermont, showing a widespread need for borax on apple trees. Most of Vermont's apple growers, however, are aware of the

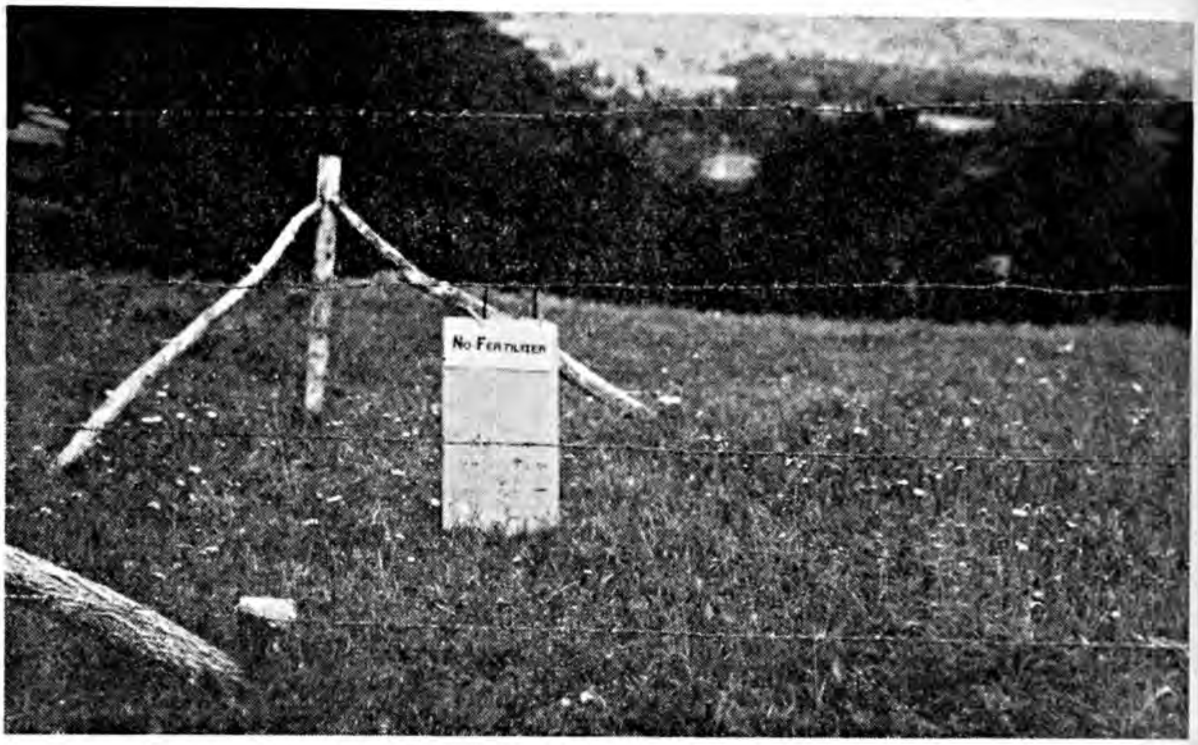


Fig. 5. A plot in a Pennsylvania pasture which received no fertilizer. Weight green grass—1,513 lbs. per acre.

It will be seen that there is a fairly close resemblance between the mineral content of good pasture and that of cow's milk. There is no natural foodstuff so well balanced in this respect as good pasture. The close correspondence of the mineral content of a good pasture to the mineral requirements of the animals is doubtless one of the most important factors in the high nutritive value of pasture for promoting growth and maintaining health of animals grazing thereon.

The mineral composition of different species of plants varies quite widely. The most outstanding difference is that between legumes and grasses. Legumes as a group tend to be richer than grasses in all of the minerals, especially in calcium. Grasses, however, are relatively richer in phosphorus than legumes. It is well known that the addition of clovers and other legumes to grasses increases the value of the grazing. This probably is due in some degree to the fact that the two together

COMPARISON OF MINERAL CONTENT OF GOOD PASTURE WITH OTHER FOODSTUFFS, WITH MILK AS THE STANDARD

(1,000 calories contain the following amounts in grams)

	Na_2O	CaO	P_2O_5	K_2O	Cl	N
Cow's Milk	0.81	2.38	3.43	3.21	1.4	8.32
Good Pasture	0.94	3.64	2.75	11.54	3.5	10.40
Maize	0.13	0.03	1.83	1.36	0.001	4.64
Wheat	0.13	0.14	2.75	1.59	0.2	5.60
Potatoes	0.49	0.28	1.60	5.56	0.3	3.36
Turnips	0.33	1.18	1.96	5.40	0.42	3.87
Decorticated Cotton Cake	0.24	1.22	11.26	8.05	0.11	26.32
Molasses	1.02	5.35	0.56	10.26	3.56	4.23

drilled, borax should not greatly exceed five pounds per acre. It is recommended by the authors that all fertilizers sold in Vermont carry some boron. Potato and perhaps garden fertilizer should not contain more than five pounds of borax per ton because the fertilizer is concentrated in rows. All other fertilizers should contain 10 pounds per ton because they are used at smaller rates.

Fertilizer Practice for the Ranger Sweet

(*From page* 12)

Summary

Observations of growers' practices and experimental work on the Ranger variety of sweet potatoes reveal, for average conditions, that 1,500 pounds of 3-9-12 fertilizer per acre are satisfactory. For good results 500 pounds of this mixture should be used before or at planting time, and the remainder as two side-dressings. This fertilizer should carry five pounds of borax per ton and from two to four per cent available magnesium oxide. If heavy rainfall occurs after the side-dressing, about 20 to 30 pounds of extra nitrogen as a late side-dressing should be used.

TABLE 3

THE INFLUENCE OF MAGNESIUM IN THE FERTILIZER UPON YIELD

Fertilizer Treatment	Magnesium Deficiency Observed	Yield Lbs./A.	% Increase over check
None	Moderate	11,200	....
(1) 3–9–6	Moderate	15,040	34
(2) 3–9–12	Severe	15,040	34
(3) 3–9–18	Severe	15,360	37
(4) 3–9–12 2% MgO*	Some	16,000	43
(5) 3–9–12 4% MgO*	Some	16,160	44
(6) 3–9–12 2% MgO**	Some	16,160	44
(7) 3–9–12 4% MgO**	None	20,000	79

* Derived from magnesium sulfate.
** Derived from dolomitic limestone.

Are You Pasture Conscious?

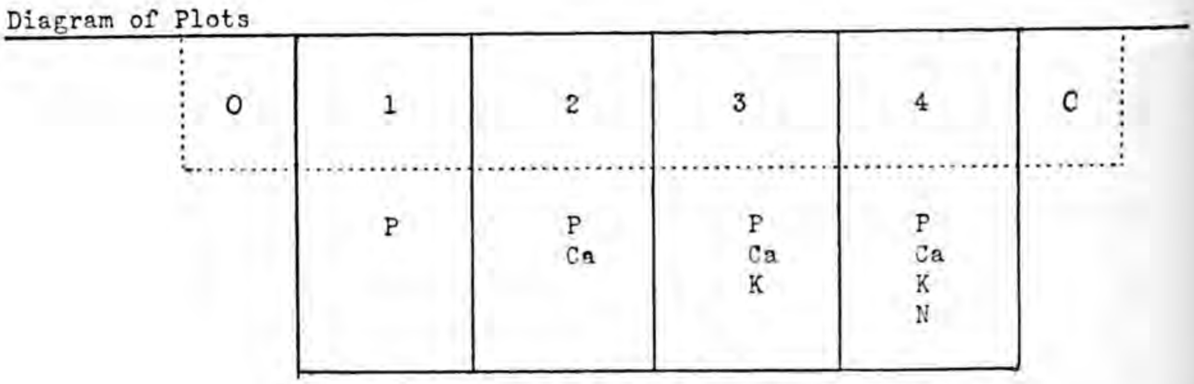
(*From page* 16)

grazing animals. Rickets in young animals and general unthriftiness and low producing capacity in mature animals are characteristics of mineral deficiencies most frequently observed. When considering the mineral content of a pasture in relation to its nutritive value, it is necessary to have some standard of the requirements of animals for the different minerals. In the present state of our knowledge, according to Orr, the amount of minerals found in milk affords the best available standard for growing and lactating farm animals. The following table compares the amounts of important minerals found in the quantities of cow's milk and good pasture which yield 1,000 calories.

In the Northeastern States Ladino clover, a giant type of white clover, is receiving a great deal of attention. It is a triple-purpose crop—valuable for hay, pasture, or silage. It is distinguished from ordinary white clover by having much larger leaflets and taller stems. Owing to its more erect growth, it is able to compete with tall-growing grasses and legumes. Although not so well adapted to closely grazed pasture sods as the smaller types of white clover, under favorable management and liberal mineral fertilization, Ladino is permanent and produces large yields of high quality feed.

Except on soils unsuited to the growing of pastures because of poor drainage, their shaly, sandy, or stony character, a system of fertilization that will supply an abundance of the necessary plant-food elements may be expected to increase the carrying capacity of pastures from 50 to as much as 100 per cent. There are many dairy and livestock farms in the Northeastern pasture region where pastures are so fertilized and managed as to provide the bulk of feed requirements of the herd from May 1 to October 15. On such farms milk or other livestock products are produced much more cheaply and with much less labor than on the average farm where only about 2½ months of grazing can be counted on. Stretching the pasture period from the low average of 2½ to possibly 5½ or 6 months by proper fertilization and management has been found to be easily possible.

If one is pasture conscious and desirous of better economic returns from his livestock enterprise, he owes it to his animals, to say nothing of his pocketbook, to waste no time in consulting with the pasture research and extension men of his State Agricultural Experiment Station. These men have the 'Know How' based on research.



A SIMPLE PLAN FOR PASTURE TOP-DRESSING TEST

Explanation: Four plots, each 2 x 8 rods 1/10 acre. Fertilizer and lime applied by hand, minerals in fall when possible and nitrogen in early spring following. All may be applied in early spring if necessary. Plant-food ratio N-P-K 1-2-2. Cattle to be fenced out of one end of plots and small areas of untreated land (0) each side (above dotted line) from the start and until growth response can be observed and recorded. Selection of Test Plots: In all cases test plots to be located on pasture land that is reasonably free from brush, well supplied with moisture, and not exhausted to the point where the desirable species of pasture plants have completely disappeared.

A little boy on return from Sunday School asked his mother if it was true that when people were born they came from dust, and when they die they return to dust. "Yes," replied mother. "Well, mummy," commented the youngster, "someone is either going or coming under my bed."

The doctor's waiting-room was very full. Every chair was taken and some patients were standing. There was a desultory conversation, but after a while a silence fell and the patients sat waiting. Finally, an old man stood up wearily and remarked: "Well, I guess I'll go home and die a natural death."

Fig. 6. A fertilized plot in same pasture as in picture opposite. Weight green grass—8,168 lbs. per acre.

in the proper proportions make a well-balanced diet. Data showing the preference of animals for fertilized pastures are numerous. Invariably a comparison of the chemical composition of samples from plots heavily grazed with those to which animals showed indifference reveals a significantly higher content of CaO, P_2O_5, Na_2O, K_2O, Cl, and N in the heavily grazed plots.

In a thought-provoking paper Dr. William Albrecht, University of Missouri, has pointed out that natural prairie grasses carry a high percentage of calcium and other cations including potassium. He further points out that leached soils may be so depleted of potassium as to interfere seriously with the production of proteinaceous plants. The theory advanced by Dr. Albrecht in respect to the importance of calcium and potassium in producing plants carrying a relatively high content of nitrogen, such as the grasses and clover, suggests very careful consideration of their importance in any pasture fertilization program.

White clover is sometimes styled the key to pasture improvement. By many authorities it is regarded as an excellent indicator of mineral deficiencies. When it fails, it is a reasonably sure sign that the supply of potash, phosphorus, and/or lime is deficient. The importance of mineral plant food in increasing yield and quality of herbage as well as for the health and productive capacity of animals gives a high degree of significance to this type of fertilization. A deficiency of minerals is usually associated with deficiency of protein and absence of properties such as leafiness and succulence on which the nutritive value of pastures depends so much.

The old axiom, "take care of the legumes and the grasses will take care of themselves," is being put into practice throughout the humid areas of the United States. The big problem in this connection is quite naturally that of supplying the necessary minerals, lime, phosphorus, and potash, before planting the legume. The second most important probably is that of selecting the legume best suited to the particular soil and climatic conditions. White clover, the premier legume for growth in association with grasses, does best under cool, moist growing conditions.

though crimson did well in all areas. Rye grass, crimson clover, and wild winter peas did not furnish much fall and early winter grazing due to late plantings and growth habits. Combinations are being tried with promising results on wild winter peas and Johnson grass, wild winter peas and kudzu, wild winter peas and sudan, rye grass and wild winter peas, crimson and white Dutch clover and lespedeza with controlled grazing. Combinations that will reseed themselves to furnish year-round grazing have a definite place in the program.

This program seems to be one that will grow fast in Pontotoc County and in Mississippi.

Some Things to Think About

(*From page* 26)

thereto, one of the most impressive happenings during World War II was the very great increase in the consumption of fertilizer and liming materials. Thus fertilizer sales jumped from 8 million to 16 million tons and those of liming materials from 16 to 29 million tons in less than a decade. If the yearly tonnages of these soil-building agents were placed in 30-ton freight cars they would make a continuous train extending three times the distance between New York and San Francisco. Such a phenomenal increase in the consumption of soil amendments, much of which was due to their expanded use in areas to the west of us, indicates that the newer land is now beginning to show serious strain from continued crop removal. The growing of higher-yielding hybrid corn, greatly increased acreages of soybeans, and year-after-year wheat crops has exhausted the soil of such a large part of its native fertility that yields can no longer be maintained at the desired levels without assistance.

The important point for the Eastern farmer to remember in this connection is that the agriculture of this region has been able to meet the competition of the fertile lands of the West while they were still fertile. In proportion as Western farmers find it necessary to increase their expenditures for soil conservation and soil amendments the competitive position of the Eastern farmer is improved. In other words, the farmers of this area should be able to withstand an agricultural depression much better than those of the corn- and wheat-growing areas to the west of us.

In proportion as surpluses develop and the agricultural situation deteriorates, more and more loose talk will be heard to the effect that the federal government should subsidize the manufacture of fertilizers so that all farmers can afford to use them in liberal amounts. If this were done on the scale suggested by its advocates, the net effect would be to substitute fertilizer for soil conservation. Much of the free fertilizer would merely float off the plowed land with the topsoil to be carried down to spread over and cover up the already rich soil in the valleys. If the federal government wants to subsidize agriculture, it should operate in conjunction with the Soil Conservation Service to the end that loss of topsoil and waste of water are stopped.

One of the most troublesome problems that confronts the farmers of the Northeastern States is the deterioration of the physical properties of cultivated land. The channels that were left behind by the roots of the original forest trees which once covered this area have been clogged with soil. The substitution of tractors for horses has made it possible to have a larger percentage of the land under the plow. The size, weight, and number of farming implements are being increased. Tractors and other heavy machinery are being run over the land too early in the

Fall and Winter Grazing in Mississippi

(*From page* 21)

represented in both tours, since some were rained out April 11.

Farm visits were made to all 30 demonstrations during the last of April and up to May 22, collecting data and making colored slides to be used in future educational pasture meetings.

A Year-round Pasture Calendar containing full details for year-round grazing has been developed to aid farmers in this program for the year 1947-48.

Summary, Observations, and Recommendations: All 30 cooperators decided to increase their acreages for 1947 planting. Plans were completed for year-round grazing for at least 20 of these cooperators. Seeding was done August 15 to September 1 of this year with some seeded in early August. All minerals were cut under before seeding, if available. Nitrate was cut under. Cultipacker was a must to preserve moisture, and stands of crimson clover seeded early. Oats, rye, grass, and crimson clover in combination furnished more grazing and produced a sod that was firmer in wet weather than any other combination. All livestock like well mineralized grazing. The Madison County Red Rust Proof and Nortex oats furnished more grazing and winter-killed probably less than upright growing oats.

Grazing and small grain programs fit well into the livestock and machinery farming. The farmers state that they have planned farther ahead in this program than ever before. A better conservation job has been accomplished with broadcast grazing crops on lands during heavy rainfall season. A better quality livestock with larger numbers used has resulted from the grazing. No mention of figures was made with the farmers regarding the general health of the livestock, but the veterinary bills and other losses were less than the average of neighbors who did not have fall and winter grazing, according to the local veterinarian.

This program has stimulated interest and is already responsible for several Grade-A dairy barns and beef herds. A better fencing and managing job is being accomplished in order to provide and control grazing and keep out neighbors' stock.

Due principally to this program, a larger per cent of PMA money was used in 1946-47 than the previous year, which meant more conservation practices completed. Farmers and businessmen have shown more interest and done more about this program than any program I have worked with since I have been in Pontotoc County. These farmers with this program are decreasing their cotton acreages voluntarily.

The cost figure averaged approximately $25 an acre, but in practically every case, the cost was grazed out by January 1. This cost included a 3- to 4-year supply of minerals which means that if the farmer saved his own seed, which he did in most cases, his only cost this fall was nitrate, breaking, and seeding.

The average of grazing days in 1946-47 was about 60. We hope to increase this to 120 days by planting a month earlier, increasing the grazing 4 to 5 times as much an acre by using 64 pounds nitrogen under grazing; seeding 4 bushels of the best grazing variety of oats to develop a sod that will stand more tramping; using a cultipacker in order to hold moisture, to get and hold a better stand of crimson clover, and pack the soil to prevent erosion; and by fencing to control grazing on various plots.

There seemed to be greater competition between small grains and legumes in the flatwoods and coastal plains areas than other areas, although different rates of minerals and nitrates influenced differences in other areas. Best results with crimson clover were obtained on Pontotoc Ridge soils, al-

Fig. 5. A spinach plant suffering from boron starvation. Note the numerous small, deformed leaves. The petioles were roughened, crooked, and twisted. These symptoms closely resemble the leaf symptoms on sugar beets.

soils of Florida by application of manganese.

Boron

A lack of sufficient boron is most likely to be associated with calcareous or heavily limed soils. When it is lacking, the plant is just as handicapped in performing its normal function as when it is starving for any one of the better recognized elements. A deficiency or excess of boron will produce characteristic symptoms in plants. In the past 15 years the effect of boron has been extensively studied. A number of heretofore puzzling diseases were found to respond to boron treatment. It has recently been shown that internal cork of apples, top rot of tobacco, cracked stem of celery, heart rot of sugar beets, and similar physiological diseases of plants are due to a deficiency of boron.

Copper

No upland soils that are low in organic matter have been found lacking in sufficient copper for plants. The need for copper is associated with soils of high organic content.

Zinc

Zinc has been found to be effective in treating some physiological diseases but not much is known about its action in plants

Fluorine

Fluorine has attracted considerable attention in recent years, not because of its influence on plant growth, but because of its value in the prevention of dental caries.

Iodine

It is known that when soils of an area lack iodine, the people living in that area do not receive enough in their locally grown food and, therefore, suffer a high incidence of goiter. A standard practice now is to add iodine to common table salt to furnish this element in the diet. Only in a few cases has the addition of iodine to the soil resulted in an increased crop yield.

There are many other elements found in plant tissue but there is controversy as to their actual value to the plant. From early days many soil investigators have centered their attention on nitrogen, phosphorus, and potassium and on methods of determining the so-called availability of these elements. Soil fertility is often defined in terms of these elements. However, the crop-producing power of soil involves far more than nitrogen, phosphorus, and potassium. The idea that these three elements are the only elements that are likely to be deficient has been thoroughly discredited.

It is evident that in the future more attention must be paid to soil deficiencies of all elements essential for normal development of plants and animals. The lack of accurate information on the content of secondary elements in the soil and plants and the effect of small quantities of these elements on animal and human health constitutes an important problem for further research.

spring and too soon after rains. As a result of all these, ponded areas and plow pans have developed, cutting down the capacity of the soil to absorb water, stopping the downward development of roots, and making crops more susceptible to drouth.

Now that crop surpluses are a possibility that cannot be ignored, it might be well to consider ways and means of taking some of the cropped land out of cultivation and renovating it. Greater effort should be put into the growing of deep-rooted hay and pasture legumes that send their taproots down deep into the subsoil to reopen it to the movement of air and water. Deep plowing, or the use of subsoiling devices, accompanied by the deep placement of lime, superphosphate, and potash, will aid in getting better stands of these legumes. Gypsum may be found to be of special value in this connection.

Thinking in terms of war and peace, bad and good weather, scarcity and surplus of food and feed, depression and prosperity, and disease and health, the best long-time move we can make is to encourage, by every means at our disposal, an increased consumption of meat, eggs, and milk, special emphasis being placed on the eggs and milk. Greater effort should be directed toward the development of grassland and forest agriculture. These offer tremendous possibilities in terms of more fertile soil, improved human health, better adjustment as between abundance and scarcity, and greater stability, not only for the agriculture of this country but for the whole economy of the Nation.

How Different Plant Nutrients Influence Plant Growth

(*From page* 9)

companion for phosphates; it combines with phosphates so that the latter can be moved to their proper places in the plant. We owe the beauty of a green world of vegetation to magnesium. It is the key element in the molecule of chlorophyll, the green pigment in plants that traps energy from the sun and makes plant life possible.

Plants develop a characteristic chlorosis when the magnesium supply is insufficient. One of the first deficiency diseases noticed was sand drown of tobacco. This is definitely a magnesium deficiency and generally occurs on the sandy coastal plain soils. Magnesium is usually added to the soil in the form of dolomitic limestone.

Iron

Plants need very little iron, yet it is a most essential element. It is directly connected with functioning of the chlorophyll. A lack of iron, therefore, will cause chlorosis in plants. In acid soils the iron is usually available to all plants, but in some neutral or alkaline soils it is so insoluble that some plants have difficulty in absorbing enough. In poorly drained soils iron may exist in a form that is toxic to plants, that is, when it is in the ferrous state. There are many cases of nutritional anemia among cattle and even among human beings directly traceable to soils deficient in iron. Plants grown on iron-deficient soils do not contain enough iron to support animals in health.

Manganese

In many soils and plants, manganese is a limiting element. A lack of manganese is usually associated with calcareous or overlimed soils. The recognition that manganese is an essential element for normal plant development has been confirmed by numerous investigators in the past few years. The gray speck of oats has been attributed to a shortage of this element in some soils. It has been found possible to cure the chlorosis of tomatoes and produce a normal growth on calcareous in the need to use an extension ladder to reach the grocery shelf.

I wish farmers didn't always seem to be on a sort of defensive and apologetic level. In hard times folks think farmers are grumblers and grouchers. At such periods their organizations are keyed defensively to the realities of low incomes on farms and social injustice. Then when we hit a better spell of higher rural wealth, we've got to explain, over and over, that farm income is not as tall as it looks after you subtract the expense "deducks." If an Information piece from a food agency fails to do this, it earns the audible chastisement from the farmers which it probably deserves.

Once again, with your indulgence, let's fumble into the fact bin and come forth with some alleged authoritative digits:

We begin by reminding everyone great and small that Mr. Farmer is also a Consumer. Too many reporters and editors in cities forget that. They think he picks all his food off the bushes and the bullocks probably.

Anyhow, we start with the fact that in late summer the farmer went to his food store and paid $1.95 for what cost him one dollar in the 1935-39 interval. Farmers buy a whale of a lot more stuff at the store to put into their pantries than your columnist tells you about. The above $1.95, remember, is just the same price the city man paid when *he* went buying meats and groceries.

NOW let's see what kind of a rubber dollar the farmer had to stretch in some other ways. He dug out his wallet and handed over $3.40 to his hired man for every dollar he paid him in 1935-39. Now on the same ratio we find the bloated income of the farmer tapped in a few other useful directions by the same old law of supply and demand that makes a nickel look like counterfeit money to urbanites.

For seed of a verified and quality kind he pays $2.40 to the old dollar; for building material, $2.20 to the dollar; for mixed feed, $2.65; and for somewhat less advanced items of cost, like machinery and fertilizer, he pays possibly around $1.36. But he's going to use more of the things he can get in ample supply, such as machinery and fertilizer, and if he didn't use them the consumer would think himself back in the starvation era again.

NOT all the background material for the support and explanation of current spot news in agriculture and food matters comes from the ones who are in the immediate breach, facing the daily volleys of high pressure queries. Tucked away in quiet office rooms in a cloistered, almost an academic fashion, are a few writers who have time to ponder. Some of them devote their lives to analyses of past and proposed economic trends and public policies. The lunch hour spent with these savants is quite refreshing, in that it proves to a hurry-up worldling that ponderous, uncontrollable, almost elemental, forces are at work constantly behind the fret and blather of every hectic day.

The other group of studious gentry is engaged in prying loose the secrets and processes within the network of scientific research bureaus—both State and National. They are popular interpreters of the jargon of the laboratory. They have their troubles no end, and also their victories and triumphs. We of the daily release department merely stamp the suitable release date on their productions, after such go through the tedious but necessary grill of "clearance." Some of them make front page position too, especially if they bear some news significance.

Now to some folks it would appear that a chap who spends so much of his waking hours hurling facts and figures broadcast to inquisitive newshawks is soon due for a couple of ulcers and a perpetual headache. On the contrary, many of us in the thick of the furore really take to it like a farmer takes to

Food Furore

(*From page* 5)

in cereal culture and utilization that the modern world has ever seen. It was a sweaty spell for the ones who guessed at the corn crop, and a turmoil for those who had to interpret its effect on domestic and foreign situations. We never had so many "situations" to shoot at in all our born days, nor as many fellows and gals with publicity machine-guns coming our way for powder and shot. Each crop report release day at 3 p. m. Eastern Standard Time saw mobs of the best magazine and big-town newspaper talent pushing and elbowing along the corridors of the Department to grab the hefty reports fresh from the figure foundry.

All that evening and part of next day the phones were jangling in jig-time. With maybe two or three perspiring purveyors of the Truth answering these calls and often relaying the worst questions to the adroit experts for solution, it was one joyous and entrancing bedlam. I suppose headline yarns and star radio vocalizers using much of this material served to spread the panic to far-off places.

Probably the real effect will not be as gruesome as some of the spread-eagle stories indicated. Reporters work in grooves and often find it hard to hit a proper balance. They take a cut phrase or a slogan for their cue, play up everything real and imaginary so it fits into the main theme, and work that until some fresh scent is met on the trail—when away they go like a pack after the new angle.

If the Information Desk dodges or parries or suggests some new approach, or tries to hint that we have had as bad situations and as poor corn crops as this one before and lived through it somehow, their comeback is that we may have had all this and Heaven too, but we did not have to share so much with foreigners.

Believe us, friends, Information people in a specialized agency like food must learn to be diplomats. On the one side we have the Bosses to protect and remain aware of lest the wrong inference be taken abroad. On the other and more pressing side, we are faced with a competitive press and radio, who expect and usually get a frank and fair analysis of what's commonly known as "background material." The trouble is, too much of the background gets into the foreground.

Moreover, your work as an Information person associated with farms and foods is not over when the last late release is phoned to the guy who had an assignment elsewhere than his customary "beat" with your agency. In any vast business circle such as this country has erected on the foundation of crops and livestock, you're bound to have a host of folks representing specialized and trade groups.

NEARLY a dozen requests arrive on an average routine day from members of the "laity," the ones not directly concerned with reporting for publication or radio. Maybe it's the meat packers wanting weekly figures on slaughter, or fats and oils exporters asking for latest allocations. Quite often some newcomer wants detailed reports on exports or imports, or some other data, which we do not handle. You shoo him away with kindly voice to pester some other government bureau.

The net, long-time result of all this surge of curiosity about farms and foods should provide a more general education to the masses relative to the hunger that is ours and the larder which is not replenished without much toil and some trouble. I wonder sometimes if this is really going to be the outcome. Or will there still remain some resentment, some feeling that farmers are grasping monopolists, that they rejoice

Father: "Didn't I hear the clock strike three when you got in last night?"

Daughter: "Yes, daddy. It was going to strike eleven but I stopped it so it wouldn't waken you."

* * *

"So," sobbed Nadya Oblomvivitch, "Ivan Skarenski is dead. Do you say he spoke my name as he lay dying?"

"Part of it," replied the friend, "part of it."

* * *

Serious young man—"Do you enjoy Kipling?"

Flapper—"I don't know—how do you kipple?"

* * *

WITHOUT A DOUBT

A clergyman, at a dinner, had listened to a talkative young man who had much to say on Darwin and his "Origin of the Species."

"I can't see," he argued, "what difference it would make to me if my grandfather was an ape."

"No," commented the clergyman, "I can't see that it would. But it must have made a great difference to your grandmother."

* * *

"All right back there?" called the conductor from the front of the car.

"Hold on!" came a feminine voice. "Wait till I get my clothes on."

The entire carful turned and craned their necks expectantly. A girl got on with a basket of laundry.

Cleo—"Dere goes dat slatternly Mandy Johnson wid her ten pickininnies. She sho' do look repugnant."

Mozelle—"Lan' sakes, agin?"

* * *

FAIR WARNING

Two of the girls were airing their troubles. "I'd like to get a divorce," said the first. "My husband and I just don't get along."

"Why don't you sue him for incompatibility?" asked the second, sympathetically.

"I would if I could catch him at it," replied the first.

* * *

"Have you said your prayers, Willie?"

"Yes, mom."

"Did you ask to be made a better boy?"

"Yes. And I also put in a good word for you and dad."

* * *

Right after the visitor left, Grandma, who had been seriously ill, seemed to take a decided turn for the better. When her daughter came into the room, the old lady asked, "What did you say was the name of that new minister?"

"That wasn't the new minister who called on you, Grandma. That was the doctor—the specialist we called from the city."

"You don't say," said Grandma, "Well, now that you mention it, I did think he was a mite too familiar for a minister."

harvests. If you don't carry all of it home with you or dream about it at night, if you balance your momental urgency with a dash of philosophy and see this whole thing as a process that began long before you were able to count and will keep on being an emergency long after you have been counted out, your nerves will stand the strain, even without fluid foods to sustain you.

Of course, not all the information agencies linked to food are found in the Government bureaus. The States also have their well-oiled offices to handle this with emphasis on localized aspects. Then there are a host of associations and food-handling outfits that use trained writers and observers to make contact with the public.

TAKING it broadly, I would much prefer to be a food information writer than one assigned to boost the virtues and the thrills of entertainment, athletics, cosmetics, soap, styles in clothing, or luxury lines. You'd get a lot of advantages in some ways that the food zealots seldom get. They might make you presents of the commodities you purvey in the event of some great successful outcome, whereas food informers never get a sack of spuds or a barrel of cider sent in compliments for their zeal. But aside from those rewards of a mundane sort, all the advantage seems to lie with the food informers.

It also lies with the ones who write copy for the agencies that serve farmers, because such facts quickly turn into net profit and eventually more tonnages of victuals. More production is wanted in the hungry world, and the best way to get it is to make it easier and more attractive for people to train for and engage in agriculture. That and the improvement of the farmer's public relations are of momentous significance, and will continue to be for the rest of the century—unless we decide to kill off the excess population rather than to give them a decent grubstake.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Better Corn (Midwest) and (Northeast)
The Cow and Her Pasture (General)

Reprints

N-9 Problems of Feeding Cigarleaf Tobacco
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What Is the Matter with Your Soil?
II-12-42 Wartime Contribution of the American Potash Industry
J-2-43 Maintaining Fertility When Growing Peanuts
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
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A-1-44 What's in That Fertilizer Bag?
H-2-44 Efficient Fertilizers for Potato Farms
AA-8-44 Florida Knows How to Fertilize Citrus
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—the Aristocrat
DD-5-45 A Case of Combined Potassium and Boron Deficiencies in Grapes
GG-6-45 Know Your Soil
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
TT-10-45 Kudzu Responds to Potash
ZZ-11-45 First Things First in Soil Fertility
CCC-12-45 Poor Soils—Poor People
B-1-46 Potash Increases Tomato Yield and Quality
H-2-46 Plow-sole Placed Plant Food for Better Crop Production
N-3-46 Sweet Potatoes Are Proving New Gold for the South
S-4-46 Plow-under Fertilizer Ups Corn Yields
T-4-46 Potash Losses on the Dairy Farm
W-4-46 Muck Soils Produce Quality Sweet Corn for Canning
Y-5-46 Learn Hunger Signs of Crops
AA-5-46 Efficient Fertilizers Needed for Profit in Cotton
BB-5-46 The Soil Is Our Heritage
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A-1-47 Fertilizing Vegetables by Applying Fertilizer to Preceding Cover Crop
B-1-47 The Use of Dipicrylamine in Tissue Testing for Potash
C-1-47 Potash Meets Its Responsibilities
D-1-47 Good Pastures Conserve and Pay
G-2-47 Research Points the Way for Higher Corn Yields in North Carolina
H-2-47 Large Grasses for Pasture
I-2-47 Fertilizers and Human Health
J-2-47 Yields Tell the Story
K-2-47 Potash Pays for Peas at Chehalis, Washington
L-3-47 Sugar Beets Require Adequate Soil Aeration
M-3-47 The Role of Major Elements in Plant Nutrition
N-3-47 Efficient Management for Abundant Pastures
O-3-47 Increased Quality of Products Is Answer to the Problem
P-3-47 Year-round Grazing
Q-4-47 Fertilizers for Sugar Beets
R-4-47 The Effects of Fertilizers on the Blackland Soils of Texas
S-4-47 Rice Nutrition in Relation to Stem Rot of Rice
T-4-47 Fertilizer Practices for Profitable Tobacco
V-4-47 Don't Feed Alfalfa at the "Second Table"
W-4-47 The Search for Nutrient Deficiencies in Farm Crops
X-5-47 Potato-growing Developments in New England
Y-5-47 Increasing Grain Production in Mississippi
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IT IS DIFFICULT TO SURPASS NATURE'S TRIMMING

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R. H. STINCHFIELD, *Editor*

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VOLUME XXXI NO. 12

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The American Potash Institute, Inc.

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United States Potash Company
Potash Company of America

green and growing like the needles of a pine amid the cheer, rather than to wither and fade like a leaf on a deciduous tree whose brief term of usefulness is past.

Probably the best way to achieve this self-hypnotism is to quit looking at the rising generations behind you with envy and gaze instead at folks existing in the ancient decades of life, whose behavior is either an inspiration or a warning. Looking at the feeble, who are apt to be forgetful and forgotten, one chooses to keep the mind and memory clear rather than to scan old scrapbooks for plaudits of ancient triumphs in an era that has ended.

Anyone who has taught, performed, or written for the people of his time must remain forever an observer, a student, and an interpreter. Happiest and most serene during his slightly downward journey on the train of time is he who can forget the bumps and jars of travel by searching familiar passing scenery for ambitious new improvements and flashes of the rainbow-colored dreams he noted there so eagerly of yore.

New faces and old incidents are not contradictory. Old plans and new ones have much in common. Old ways of saying kindly things will never change in spite of unfamiliar styles and modern marvels.

WITH THIS IDEA uppermost, I'd like to say again some of the things expressed before—taking just a rambling retrospect through idle thoughts of other Yuletides. Unlike Brother Webster with his dictionary, I've tried not to make them entirely disconnected reading.

Figments of fancy woven therein represent the best it is possible for me to conjure up, no matter how hard my efforts are or how anxious I am to outdo my own limited levels of expression. You say a thing one way, which is the best way it seems to you, and any further attempt to doll it up or punch it into better molds is taking pains in vain.

Age and changing custom and law and regulations have combined to sift out the original American spirit from some calendared occasions. But December's feast days stay the same. We can insult our souls and stultify every other holiday without much risk, but when one flaunts Santa, he's ready for the sanitarium.

I DO NOT KNOW who invented Christmas in the first place—maybe a sorrowful bunch of emaciated victims of Roman terrorism, or a few jolly priests in the Alpine valleys on the Austrian Tyrol; or perhaps rotund Saxon barons bringing in the boar's head for a round of reckless gormandizing. It makes little difference who plotted the idea, it survives and withstands every adverse current from Metternich to Mussolini and from the Huns to Hitler. No other date is so defiant of disaster.

After you have sat with your wife before the glowing hearth, surmounted by its holly fringe and row of hopeful hosiery, listening to carolers along some distant street, you are not so apt to blame the world for its sins as you are to thank it for its charity.

You recall that when we were very young the uplift of the holidays came to us largely because of delightful mystery and great personal expectations. Prior to my tenth year I had implicit faith in the jingling journeys of the snowy saint and did not allow mere physical improbabilities to shake my confidence. I may have wondered why Santa brought me the same kind of sugar cookies cut with the crinkly tins I saw my Mother use, or why some of his packages bore trade labels from Arthur & Johnson's when the North Pole factory was considered the source of all his benevolence. Even when at Sunday school gift night I caught our local blacksmith stuffing his muscular anatomy into a red suit trimmed with white braid and having facial trouble with adjustable whiskers—even then I rebelled against growing unbelief.

Better Crops with PLANT FOOD

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Best wishes are . . .

Yours for Yuletide

Jeff McDermid

FOR OVER TWENTY YEARS I've paid my respects to Christmas through these friendly columns, and paid my obligations to that hearty holiday in the usual family and community ways. Here we are again, ready to renew those pleasant relations. We've all come a long way since 1927, and many of us possess hair of a lighter hue (what there is of it) than we smoothed with those handy Christmas brush-and-comb sets that kids gave their Dads in holiday remembrance. In that precious interval of two decades we all have made new friends and lost some old ones; raised "Ned" and a few children; acquired good experience, a little leisure, a dash of conservatism to quell our egotism; and obtained some detachable teeth, those indispensable spectacles, and the early frostbite of rheumatism. Yet, no doubt the items we have gained meanwhile far outweigh the powers and privileges we have lost.

In those earlier essays it was customary to regard Christmas as a season pre-empted and claimed for infants and youth, so that the sharing of juvenile joys dictated most of those former sentiments. As one grows apace in years and finds weakness and frustration the common lot of elder observers, it seems a bit forced and artificial to indulge in the vivid and carefree Christmas outlook which comes so naturally to those of tender years, bright hopes, and boundless energy.

One wishes at such festive, soulful seasons to regain and re-live the pleasures of the times without regret and without reproach. To put it a bit more in metaphor, you long to be forever

Fig. 1. This field is typical of many in which poor aeration was induced by compacted soils, the result of working the soil while too wet last spring. Roots were severely rotted. Midwest, 1947.

Soil Aeration and Crop Response To Fertilizers—1947

By G. N. Hoffer

Lafayette, Indiana

CORN PLANTS on thousands of acres in the Midwest failed to respond to fertilizers this past summer—1947—because compacted soils prevented the roots of the plants from functioning efficiently. Many tons of fertilizers, applied either in small amounts in the hill or row, or in large quantities plowed under, were unused by the plants. Figure 1 shows the condition of the plants in many fertilized fields at the end of the growing season. The roots were severely rotted, the plants lodged, and poorly developed ears resulted.

The spring weather generally was cool and continued wet through the customary time for preparing the soil for corn. Growers became over anxious and worked their soils while too wet. Their usual operations of discing, plowing, planting, and cultivating compacted the wet soils. Many of the compacted zones were even deeper

Then came the time when we put on long pants and had socks too short for Santa, when our voices were changing, when we got into grammar school and the fifth ward gang and fed on Cooper, Henty, Cap Merrywether, and Robert Louis Stevenson. We knew all there was to know and much more that couldn't be repeated. We were proud of black eyes and grubby knuckles but ashamed of report cards or a poor catch "at first."

Ranging afield with air gun and fish pole, pockets bulging with artful barter,

chummy with freckled boys of no ancestry, and followed by yellow dogs of no pedigree—that was the age of independence and of nonchalance, a time when Christmas took a back seat for awhile. One could well be a little sorry for that kid, because he had so much faith in himself and the world of destiny and opportunity, and a lot of such stuff harder to swallow even than Santa Claus. He thought he was renouncing fairy tales. He wasn't hanging up "no socks no more." He was out to hang up a record!

In the next stage of life, the boy meets the girl of his choice. Thereupon old Christmas ideas crept back to warm his heart and tax his meager resources in trying to match the bewildering "for her" suggestions with his modest stipend.

Then the first Christmas eve spent with the first baby marks another epoch among those cherished moments. There was not always so very much left over to make merry with—but at least you were not knocking at somebody's overcrowded inn, and your credit with the milkman was good enough for a small but vital discount. Later on, as the tots became toddlers, you assumed the secret role of Santa yourself, just as your Father had done with much less to do with. Sometimes you slipped aside at the toy counter to count your change against furtive purchases, doubtful of their practical worth, but certain of their being cheerfully acknowledged and quickly smashed.

Those indeed, as you recall, were the days of rancid cigars, wrinkled neckties, no-go wrist watches, and cheap perfumery. But you passed it off by thinking that, after all, the beautiful gifts pictured in the de luxe magazines were not meant for a subordinate clerk with two babies, a hopeful wife, a yawning furnace, and a hefty mortgage. It was a time for slaying economic dragons with just a moment or two of Christmas mirth. So you took it in mighty measure, up there in the tiny flat or maybe on the rented farm. You forgot the dreams of fish-pole days and settled down in earnest to face the world as it came along, sure of the helpful handclasp of the finest little Mary since the Time of the Manger.

SO THEN it was we said: "Come, my friends, smuggle those mysterious bundles into the house through back door or cellar window; hide them in locked drawers or leave them awhile at the neighbor's until the hour arrives when the little tree shall be trimmed and the inquisitive children unwillingly shall be forced into bed. Tune on the radio to make Christmas carols loud enough to muffle the rattling of the paper parcels or the squeaking of toy dogs, while you are busy doing the honors awaited by expectant ones.

"Stoke the fire again, wind the clock, pat the lumpy stockings as they hang there in the ghostly firelight, count your limping bank balance once more, and then go heave yourself on the mattress. You won't need to set the alarm clock

(*Turn to page* 49)

materials to keep soil particles aggregated to a depth of from 6 to 18 inches, as shown in Fig. 2. In this respect the taprooted legumes have distinct advantages over the fibrous-rooted legumes in improving soil structure and tilth. Corn crops definitely respond to fertilizers better when the taprooted legumes precede them in the rotation.

The taproots shown in Fig. 2 were in a field at the C. M. Hobbs and Sons Nurseries, Bridgeport, Indiana. For years this company was attempting to use heavily fertilized soybeans, plowed under, to improve the soil tilth in their nursery fields. Soil profile samples revealed a tight soil immediately below the plow depth in these fields. During 1946 and 1947 sweet clover was planted and the improvement in the soil structure is shown in

Fig. 2. Soil samples and taproots of sweet clover plants, C. M. Hobbs and Sons Nursery, Bridgeport, Indiana. No. 1 shows compacted soil below plow depth—soybeans were plowed under. Nos. 2 and 3 show effects of one-year sweet clover growth plowed under. Note improved soil tilth in 2 and 3.

Fig. 2. Sample tube No. 1 is from a plot with soybeans plowed under. Note tight soil below plow depth. Numbers 2 and 3 show the effect of the sweet clover roots in improving the soil tilth after the first full year of growth. These taproots yield decomposition products with soil-aggregating properties when the plants are clipped and plowed under in the fall of the first season. If they are allowed to grow the second year the plants use up the energy materials stored in the taproots to produce the new growth. The old roots then become carbon carcasses of lesser value in improving the soil texture. Note the decayed roots of a second year plant in Fig. 2. Tissue tests on these roots reveal practically no mineral nutrients left in them.

Figure 3 shows the relative growths of eight-month-old alfalfa, red clover, and sweet clover seeded together in a pasture last spring. These plants were taken from about a square foot of Drummer soil on the farm of William Ross, Kentland, Indiana. At seeding time 500 lbs. of 0-10-20 per acre were applied. Observe the deeper penetration of the sweet clover roots when growing in competition with alfalfa and red clover. Various reports indicate that the soil aggregation and tilth improvement from the growth of one year of a good sweet clover crop are equal to that from two years of alfalfa.

The chief objection to sweet clover is the difficulty of getting a good stand due to the weevil which destroys the very young plants. C. V. Conder, Manager of the Triangle Farm Management Company, Inc., Sheldon, Illinois overcame this trouble by dusting five per cent DDT from an airplane over 400 acres of sweet clover just when the young plants were emerging this spring. He obtained excellent results and is planning additional acreages of this tilth-improving crop in 1948. Sweet clover and alfalfa are important crops in all of Conder's soil management programs.

Let us consider several typical cases

than the usual plow depths. The non-capillary pore spaces were reduced and this condition affected the drainage and aeration characteristics of the soils during the entire summer.

Field studies during the latter part of the summer revealed the startling fact that the crop rotations used to produce large volumes of cash crops during the war period, corn and soybeans mostly, had not maintained the necessary amounts of organic materials deep enough in these clay soils to prevent these difficulties.

High yields of corn under these climatic conditions were obtained invariably in those fields in which good stands of alfalfa or sweet clover in the rotation had kept the soils in good tilth. The purpose of this article is to feature the advantages of using deep-rooted legumes in Midwestern crop rotations to maintain the soil aeration conditions needed by healthy plants in order to use fertilizers efficiently and produce high yields. It is hoped that the field diagnoses of the different case histories briefly reported in this paper will stimulate more interest in these important soil-crop interrelationships.

Taprooted Legumes vs Corn Acreages

The need for more taprooted legumes to maintain better soil tilth is reflected in Table I which shows the relative number of acres of alfalfa and sweet clover in comparison to the acres of corn grown in each of the Midwestern States. The states are listed according to the widest ratios. The data are taken from the 1946 acreages in the U. S. Department of Agriculture Crops and Markets, January 1947 issue.

Interesting is the fact that the poorest corn fields due to the wet soil compactions were found in the states with the widest ratios.

Fibrous-rooted Legumes

The fibrous-rooted legumes—red clover, alsike, Ladino, soybeans, and others—along with grasses, such as brome, orchard, blue, and timothy, maintain good soil tilth when well fertilized. However, some cases of clover-grass pastures were found this summer with the soil compacted by grazing animals. Such pastures usually were in distress because of deficient fertility as well as sub-surface compactions. The fibrous-rooted legumes will supply organic matter when plowed under but this favors chiefly the topsoil. Yet in soils with compacted zones below the plow depth these fibrous-rooted legumes with their shallow roots limited mostly to the aerated topsoil may respond well to fertilizers. None thrive in soils that are wet for extended periods.

TABLE I. RATIO: ACREAGES OF ALFALFA AND SWEET CLOVER TO CORN—Midwestern States—1946

State	Ratio—Acreage Deep-rooted legumes to Corn
Illinois	1–16.1
Missouri	1–15.2
Iowa	1–14.2
Indiana	1–10.4
Kentucky	1– 8.5
Ohio	1– 8.1
Minnesota	1– 5.2
Wisconsin	1– 2.9
Michigan	1– 1.6

Taproots

The chief value of alfalfa and sweet clover is that they produce taproots, the growth of which is directed straight downward by gravity. This is the same influence in reverse that guides the upright parallel growth of all straight evergreen trees irrespective of the slope of the land. The taproots of the legumes have great penetrative powers when the plants are well supplied with plant nutrients, such as potash, phosphorus, calcium, and magnesium and will push deeply into compacted soils. There are many references in the literature on this subject. Our particular interest, however, resides in their ability to provide the organic

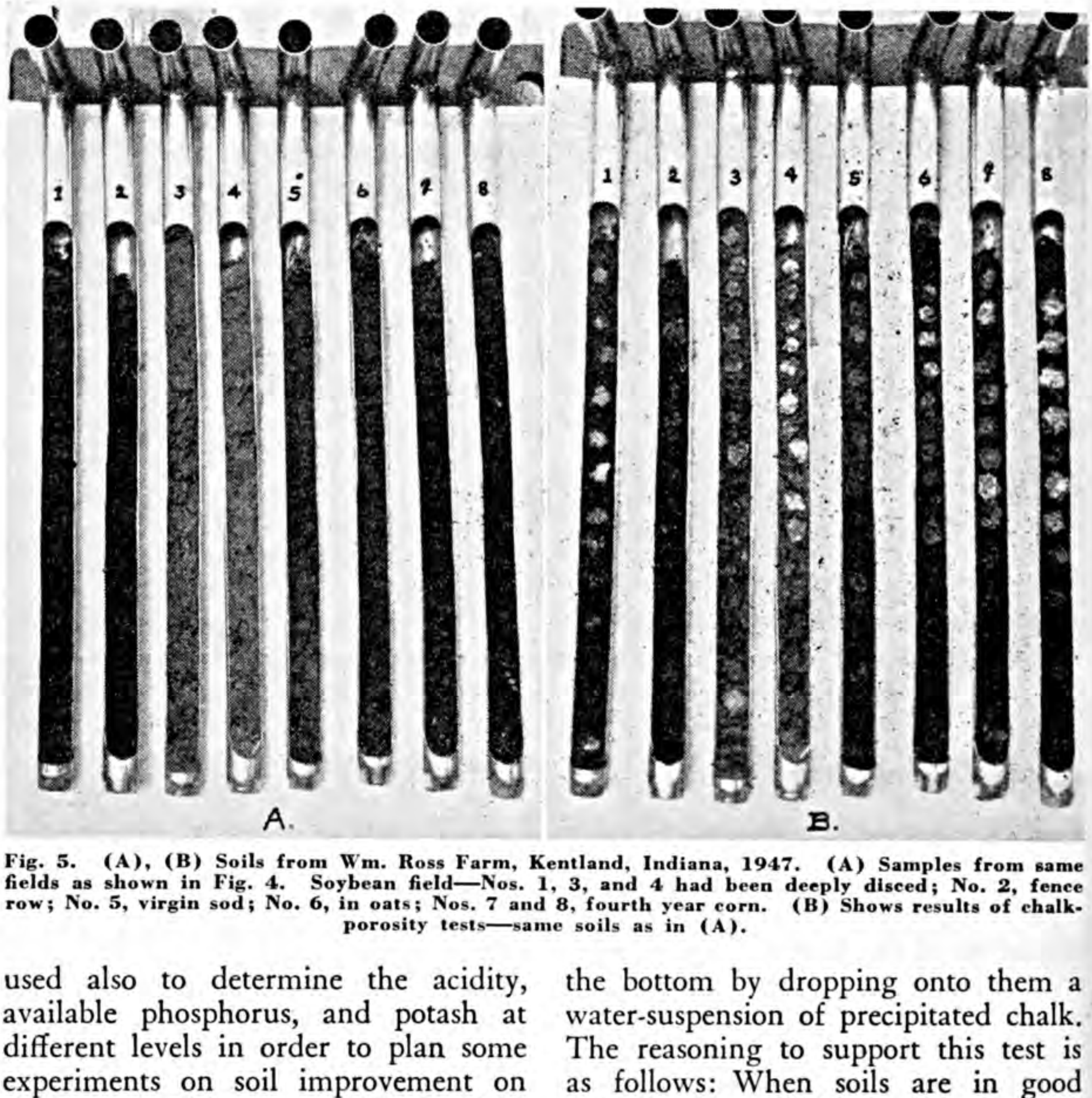

Fig. 5. (A), (B) Soils from Wm. Ross Farm, Kentland, Indiana, 1947. (A) Samples from same fields as shown in Fig. 4. Soybean field—Nos. 1, 3, and 4 had been deeply disced; No. 2, fence row; No. 5, virgin sod; No. 6, in oats; Nos. 7 and 8, fourth year corn. (B) Shows results of chalk-porosity tests—same soils as in (A).

used also to determine the acidity, available phosphorus, and potash at different levels in order to plan some experiments on soil improvement on this farm. This year, 1947, the field represented by soil samples 1, 3, and 4, was deeply disced, fertilized with 500 lbs. 0-10-20, and seeded to sweet clover, red clover, and alfalfa in early spring. Number 5 was seeded to oats. Field represented by Nos. 7 and 8 was disced deeply and planted to corn the fourth straight year.

Porosity — Chalk Tests

Figure 5-A shows samples of soil from the same fields in 1947 as shown in Fig. 4. These samples were taken September 15. Many interesting observations were made. Tests for soil compactions were made on the samples showing the white blotches—Fig. 5-B. The soils in the samples to the left (A) were tested for infiltration and porosity differences from the top to the bottom by dropping onto them a water-suspension of precipitated chalk. The reasoning to support this test is as follows: When soils are in good tilth, the non-capillary pore spaces will allow the small particles of precipitated chalk to enter the soil freely. When the soil is compacted, the soil pores will absorb the water but prevent the chalk particles from entering. A quick demonstration of zonal compactions is made by this test. (The test solution is prepared by adding two level teaspoonfuls of U.S.P. Precipitated Chalk to two ounces of distilled or rain water in a dropping bottle. Shake well each time before using and apply one, two, or three drops as needed to show the pore space differences.)

Now refer to Fig. 5-B and see what happened during the year in the fields tested. The compacted layers shown in Nos. 1, 3, and 4 in Fig. 4, were displaced by deep discing. Compare these with same numbered samples in Fig.

Fig. 3. Comparison of alfalfa, red clover, and sweet clover growths in same field after eight months. Wm. Ross Farm, Kentland, Indiana. 1947.

where soil compactions have affected adversely the growth of both fertilized corn and soybean crops.

Soil Conditions on Farm of Wm. Ross, Kentland, Indiana

In 1946, William Ross requested an inspection of his field of Lincoln soybeans that had been well fertilized but in September was not looking as well as expected. He had applied 400 lbs. of 3-12-12 to the beans at planting time to guarantee a good yield. Soil samples were taken in this field and it was found that the soybean plants were growing in a soil with about a 2-inch compaction just below the plow depth. Samples for comparative studies were taken also from a virgin sod, a fence row, and from a field in which corn was grown three consecutive years. Figure 4 shows these soil samples. Observe the compacted layers in Nos. 1, 3, and 4. These samples were from the field of Lincoln soybeans, while No. 2 was obtained in a close-by fence row. The compactions obviously were the result of poor soil management during a series of corn and soybean rotations in this field. The soil was a heavy clay loam—(Drummer, Parr, and Corwin soil types).

Sample 5 was from another soybean field on this farm—the first crop ever grown in this field. The sod was plowed in 1946 and the soil profile shows a slightly compacted zone just below the plowed-under organic matter. This compaction apparently is due to the plow-sole pressure which formed a thin tight layer of soil against which the finer silt and clay particles accumulated later by eluviation processes following the discing or plowing operations. Examples are shown in samples 1, 3, and 4.

Profiles 7 and 8 show the condition of the soil in a field where Mr. Ross had grown hybrid seed corn for three successive years. Number 7 was taken between the corn rows and shows the soil compacted to plow depth due to cultivation machinery. Number 8 shows a deeper compaction to 10 inches resulting from the weight of a detasseling machine operating 10 successive days during wet weather.

These samples shown in Fig. 4 were

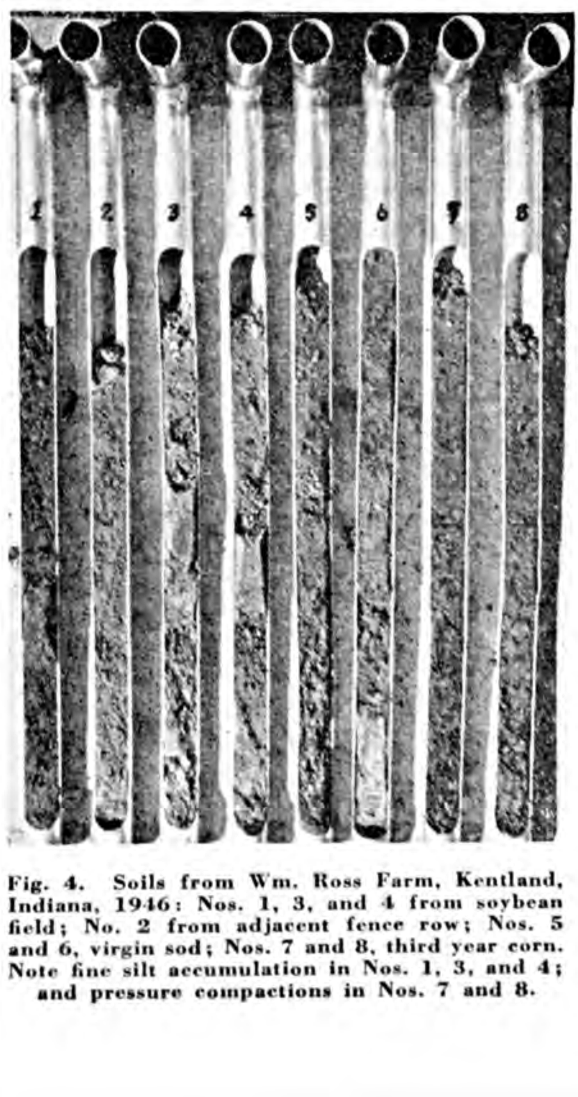

Fig. 4. Soils from Wm. Ross Farm, Kentland, Indiana, 1946: Nos. 1, 3, and 4 from soybean field; No. 2 from adjacent fence row; Nos. 5 and 6, virgin sod; Nos. 7 and 8, third year corn. Note fine silt accumulation in Nos. 1, 3, and 4; and pressure compactions in Nos. 7 and 8.

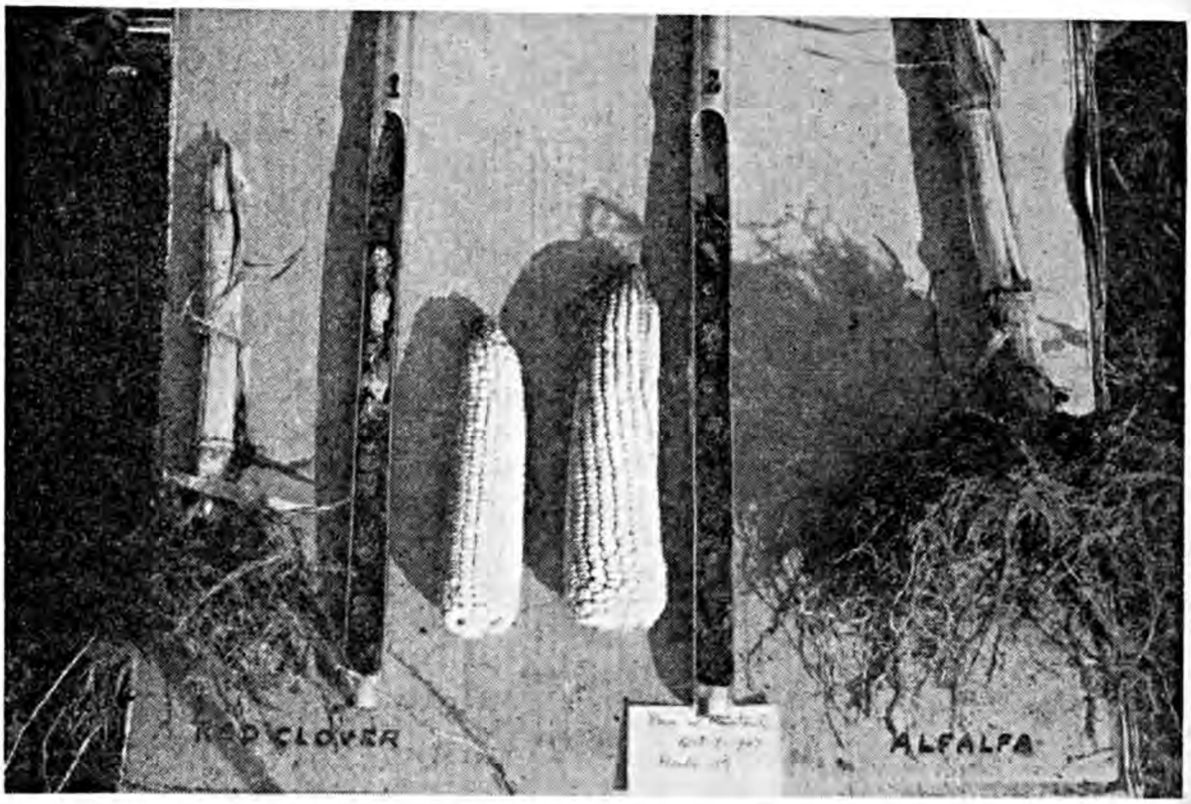

Fig. 7. Comparison of soils and corn plants from adjacent fields: No. 1 from field following red clover pasture; No. 2 from field following 3 years alfalfa. Note compacted soil to plow depth in No. 1 and good soil porosity in No. 2. The corn roots in No. 1 were rotted and many plants had lodged.

dressed with nitrogen fertilizers, the corn crops still showed nitrogen deficiency symptoms which were attributed to dry weather.

The soil profiles in Fig. 6 tell the story. The chalk-porosity tests were made on two samples: (1) and (2) from the pasture fields, and (3) and (4) from one of the corn fields. Note the compacted soil near the surface in (1); deeper in (2). Below these compactions the infiltration to the subsoil was good. Samples (3) and (4) were taken from the corn field; (3) in the row and (4) between the rows. The topsoil in (3) was pushed into the corn row while cultivating and served well for the brace roots of the plants to feed in. Below, the soil was tight and similar to that shown in (4). Mr. Wall is satisfied that the Ladino, brome, and some scattered alfalfa plants in his heavily pastured fields are not maintaining satisfactorily the tilth for corn plants, in spite of heavy amounts of fertilizers used. Plant tissue tests for phosphates and potash showed ample supplies of both in the pasture plants.

The profile studies indicated that opening the soil with straight discs was needed to correct the near-surface compactions in the pastures and that a deep-rooted legume should precede the corn crops on this farm, particularly in those fields where the porosity-chalk tests show an immediate need for the improved tilth below the plow depth. Mr. Wall admitted that his father had used sweet clover for this purpose years ago. This is just another case where the use of lime and fertilizers without the proper tilth-improving crops has not measured up to the requirements for maintaining good tilth for satisfactory corn production.

Corn Following Alfalfa and Red Clover

An interesting comparison between adjacent fields of corn was made while on a field trip with Dr. Fred Boyd,

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5-A. This field had been seeded to sweet clover, alfalfa, and red clover. In September the soil was still relatively tight below the plow depth as shown by the porosity-chalk tests, Fig. 5-B. Number 3 was in fair condition; No. 1 was fairly good to plow depth, but still showed a slight compaction at plow depth. After these legumes grow another season a series of samples again will be taken for further study. Number 2 sample from the fence row showed excellent tilth characteristics when tested. Observe that the chalk was absorbed at all levels.

Number 5 was from the virgin sod field samples as No. 6 in Fig. 4 in 1946. The tilth-porosity was excellent. Number 6 sample was from the No. 5, 1946 field. After two crops, soybeans in 1946 and oats in 1947, the soil is showing some compaction in the plow depth zone. The soil in this field will be watched closely to observe

Fig. 6. Soils from Otis Wall Farm, Advance, Indiana, 1947. Nos. 1 and 2 show compacted sub-surface soil in Ladino-brome grass pasture; Nos. 3 and 4, from corn field; No. 3, in corn row; No. 4, between corn rows.

whether or not the continued pulverization of the soil by the friction equipment—rubber tires, discs, plows, and cultivators—will form by eluviation processes compactions similar to those shown in Fig. 4, samples 1, 3, and 4. These dense soil zones consist of very fine silt and clay particles. Hardpans, plowsoles, and claypans affect the aeration, infiltration, topsoil saturation, and erosion control measures. Eventually the soil physicists may prescribe when, where, and how much fertilizer should be used for crops in these compaction-susceptible soils.

Refer again to Fig. 5-B, Samples No. 7 and 8. The corn plants in this field were growing under tight soil conditions similar to those in many areas in the Midwest this year. Note that the soil in this field was compacted by pressure to and below the plow depth. Weak and shallow root systems characterized the plants in this field. The future soil-management program for this field brings well-fertilized, deep-rooted legumes into the rotation in 1948. All of the fields on this farm will be studied during the next several rotations.

Ladino Pasture Problem

Ladino clover is proving to be an excellent crop, when fertilized, for pastures in Indiana, but when used in a rotation with corn its tilth-promoting ability is not too good. This is the case on the farms of Otis Wall, Advance, Indiana. Mr. Wall feeds thousands of lambs on his farms each year and has used Ladino, alfalfa, and brome in his pastures. These pastures are rotated with corn. The corn is always left standing and used for feed for other livestock during the winter.

The heavily fertilized Ladino clover crowds out the alfalfa in Mr. Wall's pastures, but with brome grass it should have kept the soil tilth in better condition. During the past summer tests were made on the soil in these pastures and corn fields. Although in rotation with this legume and side-are sold for highest prices on the New Orleans market.

In conjunction with the orchard grazing, most cattlemen also establish a permanent pasture consisting of Dallas grass for spring grazing and common lespedeza for fall grazing. By running a disk over them every three or four years, the pastures are brought to new life. Generous applications of basic slag or phosphate and lime together with potash are highly desirable.

In most cases, cattle are turned loose in winter on Singletary (also known as Caley or Wild winter) peas. This winter legume reseeds itself and makes an excellent cover crop. The drawback to grazing of Singletary peas is that the livestock must be removed from the orchard just as soon as the peas come into bloom to avoid the possibility of the stock being poisoned. Alyce clover, a sensational newcomer to the South's legume field, is used as a summer grazing and hay crop and also as an erosion preventive and soil builder.

Other Clovers and Legumes

Other winter clovers and legumes used in the tung orchards include White Dutch clover, vetch, and crimson clover. County Agent Sinclair recommends using White Dutch clover and/or crimson clover in pastures that are kept separate from Singletary peas and common vetch. In this way the two clovers reseed about the same time while the vetch and peas reseed about the same time, too. Neither interferes with the other in growth and grazing period.

Intermedia Crotalaria is used along with Alyce clover for summer grazing, the orchardists being careful to keep them in separate grazing plots. They usually prepare their seedbeds in May, breaking the land and disking in the minerals and fertilizers. The legumes are planted between May 15 and July 1, with June 1 as the preferred date. By August 1 these crops are ready to be grazed and are pastured until killing frosts occur. This is usually the third week in November down in Pearl River County. Just to be on the safe side, most orchardists remove the cattle in October and place them on the permanent pasture, giving the Alyce clover and Crotalaria a chance to reseed. In addition, this affords the vetch, peas, and White Dutch or crimson clover an opportunity to germinate and establish a stand during the absence of the cattle.

The Mississippi Extension Service has been conducting a 10-year demonstration on Pearl River County tung farms with the idea of developing a year-round grazing program. As a result, sleek herds of dairy and beef cattle may be found in almost every orchard in St. Tammany and Washington Parishes and Pearl River County. Marshall Ballard, Jr., of Lumberton, Mississippi, has found sheep grazing in tung orchards a very profitable enterprise. County Agent Sinclair says that his 167 dairy farmers in the county are learning that Alyce clover in tung orchards during the summer months is a good crop for conditioning cattle in the fall and thus getting them in good shape for winter.

The White Dutch and crimson clover should be planted between October 15 and November 15 on the Crotalaria stubble or sod. It germinates and is ready for grazing by January 15 to February 1—in some cases at a much earlier date. Singletary peas and vetch may be planted at the same time and will be ready to graze by December 1 through December, January, February, and March.

Additional Recommendations

To guard against any eventuality, County Agent Sinclair is recommending to orchardists that they plant about one-half acre of oats for each animal. That means 50 acres of oats for a 100-cow herd. The oats are planted in either August or September on well-prepared and fertilized ground and can be used for a catch crop to provide

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Pasturing Cattle in Tung Orchards

By Harold Severson

Evanston, Illinois

THE transformation of cutover pineland in Louisiana and Mississippi into great tung orchards covering hundreds and thousands of acres constitutes one of the South's great agricultural success stories. It was made possible by the discovery that tung trees could be grown profitably in the extreme lower part of the South on the right kind of soil—if given the right kind of attention.

The tung belt begins near Beaumont, Texas, and extends eastward along the Gulf Coast into northern Florida. It is approximately 100 miles wide. About half of America's tung fruit is grown in Pearl River County, Mississippi, with most of the production concentrated within a 100-mile radius of Bogalusa, a small city just across the line in Louisiana.

One of the biggest orchards is owned by C. W. Goodyear of Money Hill Plantation near Bogalusa and comprises about 6,000 acres. The Bogalusa Tung Corporation, a British concern, has about 7,000 acres. L. O. Crosby, Sr., located at Picayune, Mississippi, has around 5,000 acres of his own and supervises another 35,000 acres. Smaller orchards scale all the way from 1,000 acres down to an acre or two. Most of the little groves are found near Cairo, Georgia, where farmers often sell from $300 to $500 worth of nuts from their so-called fence-row plantings.

Now that the reckless promotional phase of the tung industry of the '30s, an era when speculators sold orchard sites at exorbitant prices, is only an unhappy memory, most of the orchards are owned by people willing to pay for upkeep of the groves. This includes pruning, fertilizing, and terracing. Cutover land is relatively cheap, but from $30 to $50 must be paid out for each acre in order to blast out and haul away stumps, terrace the slopes, and get the trees planted and fertilized.

Generally speaking, the right soil is one with a considerable amount of clay in it. The tung prefers slightly acid, rolling land that is easily drained. Hillsides, when properly terraced and fertilized, are quite satisfactory.

Use of Cover Crops

The cornerstone of success in the tung-growing business is use of cover crops. As a result, more and more orchardists are getting several crops from their orchards each year—tung nuts, beef, milk, and hay. The milk and beef are the result of planting good legumes between the trees for herds of dairy and beef cattle. The herds in many cases pay the cost of both cattle and tung production, according to County Agent J. M. Sinclair of Poplarville, Mississippi. That leaves the proceeds from the tung crop as a net profit.

One cattleman-orchardist who operates to good advantage in this manner is M. P. Clark of Pearl River County. His herd of purebred white-face cattle grazes 12 months of the year in his orchards, receiving no supplemental feeds except minerals. Yet the cattle

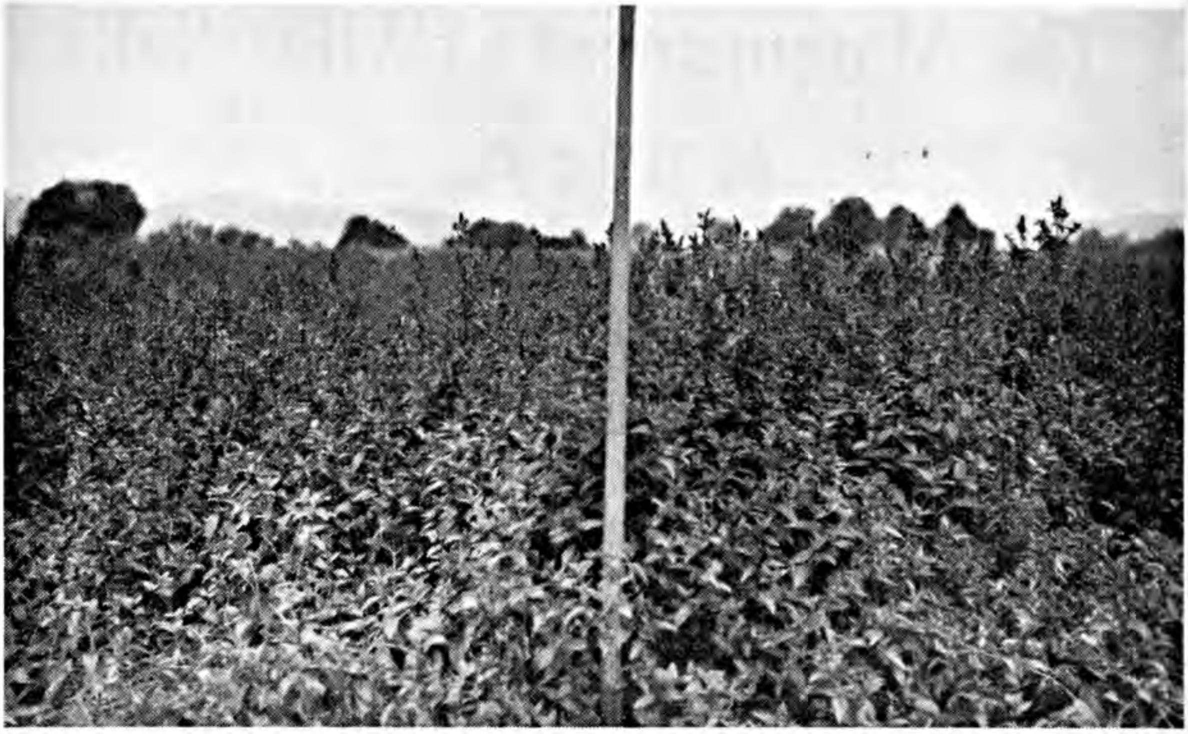

Fig. 2. Untreated (left) vs. Hi-potash (right). Potash lessens lodging and shattering.

shaken free of soil with a fork. Planting is done in early spring by preparing and furrowing out as for potatoes. Fertilizer use will vary with soil, previous crop, season, and management. The roots are placed in a continuous line at about four inches' depth. Another method is to set young shoots a foot apart in three-foot rows, in May, with a Kale planter. Frequent harrowing and pasturing with sheep will control weeds until midseason, when some hoeing and hand-weeding are required and may run to 40 man-hours an acre.

Irrigation is desirable, unless for sub-

TABLE 2. MINT YIELD AND OIL CONTENT WITH DIFFERENT TREATMENTS

Lake Labish Peat

Farm Treatment and Lbs./A.	Green Hay Tons/A.	Oil Lbs./A.	Total Menthol %
Hayes:			
None	10.0	57.8	53.12
160 KCl + 10 T* M*	12.0	70.3	56.70
KCl + 100 $NaNO_3$	12.0	74.7	...
N + 320 Ps* + KCl	11.5	54.1	...
KCl	11.5	65.1	58.39
None	10.5	58.8	...
160 K_2SO_4	14.0	91.9	...
K_2SO_4 + 1 T $MgCa(CO_3)_2$	14.5	73.4	58.58
Herrold:			
None	1.28	13.6	53.12
160 KCl	7.36	76.2	58.39
80 KCl + 80 K_2SO_4	7.68	74.6	55.08
KCl + 10 T Manure	4.64	58.6	56.70
KCl + M + 1 T Lime	10.88	76.8	58.58

*M = Manure.
Ps = Superphosphate.
T = Tons.

Anal. by Dept. of Agr'l. Chem., O. S. C.

The Management of Mint Soils

By W. L. Powers

Soils Department, Oregon State College, Corvallis, Oregon

PEPPERMINT has been cultivated in northern Indiana and southern Michigan for more than 100 years, and in western Oregon for some 40 years. The English or black variety is generally grown and is known botanically as *Mentha piperita.* Mint is a cash crop that can be grown with rather extensive methods. Under wartime prices the plantings expanded in Oregon to some 9,000 acres which produced 44 pounds of oil an acre or 396,000 pounds in 1946, worth approximately $3,000,000. This was nearly one-third of the nation's production, according to Professor H. H. White, Associate Extension Economist at Oregon State College.

The oil yield is higher here than in the Indiana-Michigan mint-growing area, and there is less frost, wind, or pest trouble thus far. The warm, late summer is favorable.

Mint Soils (Table 1) should be well drained yet moist, and should be mellow, well supplied with organic matter and fertility, and free from weeds. Peat and muck soils or recent alluvial lands of fine sandy loam to silt loam texture are suitable for this crop. Good yields have been obtained on soils varying in reaction from pH 4.8 to 7.3.

Fig. 1. Untreated mint (left) vs. Hi-potash complete fertilizer (right).

Culture

Planting stock is lifted from a pest-free field with a potato digger and

TABLE 1. CHARACTERISTICS OF MINT SOILS

Soil Type	Reaction value pH	Moisture equivalent %	Organic matter %	Total nitrogen %	Available phosphorus* Lbs./A.	Available K Lbs./A.
Labish Peat.	5.6	92.9	78.4	1.556	40	100
Clatskanie muck.	4.8	77.1	58.9	1.190	30	50
Chehalis Si C L. . .	5.9	29.4	3.25	.162	75	180
Newberg F S L. . .	6.2	25.1	1.92	.128	120	150
Olympic Si C L. .	5.4	27.9	3.40	.250	20	50

*Dets. by V. C. Bushnell.

Fig. 4. Boiler; truck with tight bottom and insulated hood for distillation; condenser in rear.

be decreased. Leaf scorch from potash deficiency or insect injury to foliage may decrease yield (Fig. 1, 2, and 3).

Mint is cut with an ordinary mower and thrown by a side-delivery rake into a windrow to wilt. A hay loader is used to convey the crop to a truck with a tight floor. A recent trend is to have a steam coil on the truck bed with a channel at the edge of the bed for water seal (Fig. 4). An insulated hood is clamped down and coils connected to the steam line at the still. The hood is connected with a condenser. Mint straw is returned directly to the field for fertilizer or may be ensiled or dried for feed.

Response of Mint to Fertilizers

Fertilizer trials were initiated at Lake Labish by the Soils Department in 1928 at the request of growers who reported decline in yield and quality.[1 2] A study has been made of soil, water, and nutrient requirements of mint in subsequent years in major mint-growing areas and is being continued. Hay yields are more readily secured than oil production from many fertilizer plots. The plan has been to get hay yields in all cases and then secure oil yields and analyses where definite growth response was found. Moisture determinations were usually made for samples of hay collected when test weights were made. Preliminary greenhouse trials simplified the field tests. Two or three replications have been provided in the field in most instances. Hay yields tend to parallel oil production or run near "a gallon of oil per ton." Heavy nitrate application in season and heavy irrigation tend to increase stem growth and decrease menthol. Phosphate tends to promote blooming and early maturity. Potash tends to prevent lodging and shattering and overcomes leaf scorch, premature defoliation, and loss of oil.

On Lake Labish peat (Table 2), several years' trials show that potassium sulphate increased CO_2 release, lowered the water requirement, approximately doubled the yield of hay and oil, and tended to improve oil quality as judged by chemical analyses. Menthol con-

[1] Powers, W. L. *Chemical Characteristics of peat, muck soils in Northwestern U. S.* Proc. 2nd Int. Cong. Soil Sci. 6:246-256. Pub. Moscow (1932).

[2] Powers, W. L., and Jones, J. S. *Peat Land, Fertilizers for Yield and Quality of Mint.* Soil Sci. Soc. Amer. 7:395-397. 1942.

TABLE 3. MINT YIELDS WITH VARIOUS TREATMENTS

Clatskanie Muck

R. W. Nusom Farm—6-year average

Treatment and Lbs./A.	Mint Hay yield Tons/A.	Rel. to check av. 100	Total Menthol %
None	4.15	....	
200 $Ca(NO_3)_2$ + 200 Pt*	4.60	107	
N + 120 KCl	5.71	135	
None	4.22	....	
200 Pt + KCl	5.05	117	
N + Pt + 120 K	5.01	116	
None	5.39	....	
N + Pt + 60 KCl	5.09	118	
N + P + 180 KCl	5.69	132	
None	4.42	....	
Check Av.	4.31	100	
1 T Lime	5.28	120	
40 Borax	5.14	117	
None	4.40	....	
40 $MnSO_4$	5.63	124	
2 yrs. only, 1/4 Acre plots			
200 KCl	4.44	96	50.91
200 K_2SO_4	4.97	107	53.46
None	4.66	....	51.39
Mn + 40 Borax	4.80	104	51.62
100 lb. 16–20–0 + 200 K_2SO_4	4.81	104	54.18

* Pt = Double superphosphate.

irrigated peat land. Sprinklers are used to apply two to three inches' depth of irrigation each 10 to 15 days beginning about June 1. The depth per season with sprinklers has been found to average about 12 inches in Willamette Valley. With surface irrigation, as much as 24 inches' depth a season is used. Supplemental fertilizer of soluble material is applied through the sprinklers.

Harvesting

Harvesting is started when the plants are coming into full bloom and oil globules are numerous on the under side of the leaves. When the weather is dry and warm and mint comes into full bloom, the maximum amount of oil is contained. The period of blooming may extend over several days. If rains cause lodging and loss of lower leaves and oil globules, recovery will

Fig. 3. Leaf scorch (right) leads to shattering, but is prevented by potash as shown at left.

boron gives definite increase in oil yield. Supplemental application through the sprinklers of 80 pounds of some soluble fertilizer such as ammonium nitrate is accomplished by dissolving the desired amount to be applied at one setting of the sprinklers in an oil drum from which a garden hose leads into the suction pipe just ahead of the pump (Fig. 5 and 6).

On Olympic silty clay (Table 4) near Lacomb, 100 pounds of 16-20-0 plus 240 pounds of 60 per cent potassium chloride, 40 pounds an acre each of borax and copper sulphate after plowing, and 80 pounds ammonium nitrate at the first irrigation have given largest hay yield. Menthol content on this soil ran high.

In general, potash fertilizer resulted in a marked increase in yield and tended to increase the quality of mint oil on peat and muck. On the Herrold field on Lake Labish, the increase was from 13.6 pounds oil untreated to 76.2 pounds with a pound per square rod of potassium chloride, or more than fivefold; on the Hayes field, from 57.8 tc 91.9, or 59 per cent increase. Increases from fertilizer on the Clatskanie muck have been general, with increases up to 43 per cent. On Newberg fine sandy loam, complete fertilizer with boron increased the yield 36 per cent, and on Olympic silty clay loam, 18 per cent.

If the information yielded by these experiments was applied in fertilizer practice, it should be possible to increase the present three million dollar crop by one-sixth, or a half million dollars a year.

Fertilizer and Mint Oil Quality

The yield of oil declines slightly after the full bloom while the per cent of menthol and esters continues to increase. Complete chemical analyses of several dozen oil samples from test plots show they generally meet government standards and show small differences, except in menthol. Formerly, menthol content was emphasized by purchasers. Buyers

TABLE 5. POTASSIUM CONTENT OF MINT LEAVES

Nusom Plots, Clatskanie, Determinations by L. K. Wood

Date Field Treatment	6-26-44 K%	9-8-44 K%
−K	2.100	0.800
None	2.166	1.127
Med. K	1.500	0.945
None	1.833	0.509
Lo K	2.100	0.364
Hi K	2.766	0.763
Hi K + Ca	2.700	1.200
Hi K + Mn	2.233	0.982
Hi K + B	3.166	2.400
None	1.700	0.545
Chartrey Plots		
−K	1.600	0.482
None	1.866	
Med. K	1.700	0.364
None	1.466	0.436
Lo K	1.033	0.364
Hi K	1.366	0.436
Hi K + Mn	1.900	
Hi K + B	1.833	
None		0.291
K variation none	1.833	0.593
K variation 240 KCl	1.666	0.556
K variation 120	1.333	0.593
K variation check		0.630
K variation 60	1.266	0.556
K variation B		0.630
K variation Mn		0.593
None—leaves separated		0.982
Hi K—leaves separated		1.500
None—blossoms		0.163
Hi K—blossoms		1.500
None—stems		3.527
Hi K—stems		0.581
Check "scorched leaves"		.22
100 lbs. 10-20-0		.22
" " 10-20-0 + 60 lbs. K_2SO_4		.44
" " 16-20-0 + 120 lbs. K_2SO_4		.67
" " 16-20-0 + 180 lbs. K_2SO_4		.91

now emphasize aroma, taste, and color. Clean fields harvested in warm, dry weather at or near full bloom usually yield good quality oil. Blossoms are rich in oil and menthol. Perhaps contamination as from corroded condensers may be avoided by use of aluminum or other sheet metal.

Potassium Content of Mint

Some determinations of potassium in

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Fig. 5. Sprinkler irrigation of mint.

tent especially was increased. From 160 to 200 pounds of 50 per cent potassium sulphate was the economic rate of application. Lime and other major or minor elements gave small increases in yields.

On Clatskanie muck (Table 3), six years data indicate potassium chloride, 60 per cent K_2O, applied at the rate of 240 pounds an acre has been of major importance; yet inclusion of 100 pounds an acre of 16-20-0 has proven helpful (Fig. 1 and 2). Potassium has tended to improve menthol content.

Some increase in yield of hay has resulted there from inclusion of 40 pounds an acre of borax or manganese sulphate. Borax has tended to improve menthol content of the oil.

With Chehalis silty clay loam near Jefferson, 200 to 300 pounds an acre of 16-20-0 are commonly used; yet experiments show inclusion of 100 pounds an acre of 50 per cent sulphate of potash increased yields. On Newberg sandy loam, inclusion of potash and

TABLE 4. EFFECT OF FERTILIZER ON YIELD AND QUALITY OF MINT OIL

MINT	BARTRUFF		Olympic Si Cl L		
	1945		1946		
Plot Treatment Lbs./A.	Hay T/A. Baby Mint	Total Menthol %	Hay T/A.	Oil Lb./A.	Free Menthol %
300 lb. 16–20–0	2.00	63.84	5.12	46.0	54.73
16–20–0 + 240 KCl	2.60	63.21	5.02	30.0	54.28
Check	2.28	64.62	3.52	26.0	52.63
N–P–K + 40 lb. Borax	2.68	63.26	5.44	40.0	51.70
N–P–K + 40 lb. $CuCl_2$	2.68	58.45	10.24	52.0	50.50
N–P + 80 NH_4NO_3	2.56	59.26	10.34	48.0	50.52

TABLE I.[1]—PLANT-FOOD ELEMENTS ADDED OR REMOVED BY VARIOUS CROPS
(Data compiled from various sources)

Crop	Acre-yield	Nutrient elements per acre					
		Added N	Removed				
			N	P	K	Ca	Mg
		lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Corn	40 bu.	....	40	7	8	.4	2.8
Oats	40 bu.	....	26	4.5	6.5	.8	1.6
Wheat	25 bu.	....	36	6	7.5	.5	2
Soybeans[a]	20 bu.	16	....	8	25	2.8	3
Soybeans[b]	2¼ tons	....	30	13	40	72	31
Alfalfa[b]	3 tons	....	....	13	96	120	24
Red clover[b]	2 tons	....	....	10	60	64	18

[a] Soybeans sold, straw returned. [b] Hay sold, no manure returned.
[1] See literature cited.

beans are heavy feeders of phosphate and potash and the deficiency of either or both essential elements can seriously affect stands and yields of clover.

Frequently soil acidity can be blamed for the lack of success with clover. Sweet clover and alfalfa are most sensitive to acid soil while red clover will sometimes grow on soils too acid for sweet clover. According to Table II most of our common legumes make their best growth just below the neutral point. Soybeans may still give fair results on medium acid soil (pH 5.6) which is not uncommon in the Midwest, but the yields of most other legumes fall off very sharply at that point.

With soybeans leaving the soil loose and friable, heavy seedbed preparation for subsequent small grains may sometimes cause the clover to be covered too deeply. Such practice can also make the seedbed liable to drying out, thereby interrupting the water supply for the legume seedling or the small plants.

One factor that definitely should not be overlooked is the competition of the companion crop. In all of the longtime crop-rotation tests which are discussed later in this article, small grains after soybeans have outyielded small grains after corn, and this experience has been confirmed by farmers throughout the Corn Belt. If the growth of the companion crop is very heavy, it can weaken or even kill legume stands by robbing them of moisture and plant-food nutrients or by shading or lodging. Quite obviously this danger will become greater with the expanded use of new heavier-yielding varieties of wheat and oats with stiffer straw and broader leaves.

In this connection the disposal and distribution of the straw of the combined small grain crop should be taken into consideration. Observations and tests in Indiana and Ohio have shown that heavy combined straw and stubble left undisturbed seriously injured clover and timothy stands on many farms.

There are many more causes for clover failures including the use of poor or unadapted seed, lack of inoculation, poor seeding methods, competition of weeds, and damage by insects or diseases. But those singled out in detail above may be especially serious if proper precautions are not taken.

Soybeans Benefit Subsequent Crops

A review of longtime crop-rotation experiments throughout Indiana shows

Fig. 1. A good crop of soybeans.

Do Soybeans Cause Clover Failures?

By F. A. Frank

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THE RAPID INCREASE of the soybean acreage in the United States during the last decade from about three million to approximately ten million acres has created new problems for the farmer, especially in the five Corn Belt states * where about 90 per cent of the crop is grown. While with adequate fertilization of the rotation and proper tillage methods soybeans have proven a valuable addition to the crop sequence on many Midwest farms, some farmers have experienced low yields or even failures of alfalfa and clover seeded in small grain following soybeans. Such losses must be considered serious and it is likely that soybeans, being a comparatively new crop, are often blamed for clover failures that are due to other causes.

Why Legume Seedings Fail

Legume seedings on soybean or any other cropland may fail for a wide variety of reasons, among which lack of plant food and lime and unsuitable soil preparation for and competition of the nurse or companion crop probably are the most prominent.

For instance Table I shows the removal of plant food by various crops. Obviously most legumes including soy-

* Indiana, Illinois, Ohio, Iowa, and Missouri.

a spring top-dressing for wheat. Five hundred pounds of 3-12-12 were supplied to tomatoes, but only 200 pounds of 0-12-12 to soybeans. In spite of the lighter fertilization the rotation with soybeans outyielded the rotation without soybeans in both wheat and hay.

On the dark-colored acid Newton fine sandy loam of the Pinney Purdue Experiment Field in LaPorte County, the average yield of mixed hay for the period from 1925-1940 was 2,460 pounds per acre for the corn-corn-oats-mixed hay rotation and 2,575 pounds per acre for the corn-soybean-oats-mixed hay rotation.[5]

Small grain in these rotations received 300 pounds of 0-12-12 per acre and corn 100 pounds of 0-12-12 while soybeans received no fertilizer. Regardless of this disadvantage, the soybean rotation produced slightly more hay than the rotation with two corn crops.

In the southern part of the State, the hay yields on the Clermont silt loam of the Jennings County Experiment Field were 3,104 pounds per acre for the corn-wheat-clover rotation and 3,335 pounds for the corn-soybean-wheat-clover rotation. These yields are averaged for the period from 1922-1938.[6] All plots in this test received three tons of ground limestone per acre in 1921. Each corn crop received manure in an amount equal to the weight of produce removed during the previous round of the rotation except wheat grain. Fertilizer was applied at the rate of 100 pounds 0-12-6 per acre in the row for corn, 300 pounds 2-12-6 for wheat, and 200 pounds of 0-12-6 for soybeans.

In all these rotations manure and crop residues were returned to the land and enough commercial fertilizer was used to fully maintain the phosphorus supply and to replace some of the potash that was removed but not returned in manure. By following good farming practices the inclusion of soybeans in various rotations not only kept up soil fertility but proved beneficial by increasing subsequent grain and hay yields.

Special Experiments Show No Failures

However, continued reports of clover failures on soybean ground as compared with corn ground prompted several Agricultural Experiment Stations in the Midwest in recent years to study this particular problem. Only Willard and Thatcher of the Ohio Agricultural Experiment Station have published any actual experimental results lately.[7] In their tests they found with one exception no significant differences in the number of legume plants regardless of the preceding crop. In tests at Colum-

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TABLE IV.—RESULT OF PURDUE SOIL TESTS FOR SOME CLOVER EXPERIMENTS 1945-46

Cooperator	Crop preceding companion crop and legume	Fertilization	Avail. P_2O_5	Avail. K_2O
W. Gerke, Decatur	Corn	125 lbs. 0–12–12	very low	medium +
	Soybeans	....	low	high
W. Hubenthal, Lucerne	Corn	200 lbs. 0–12–12	low	very low
	Soybeans	125 lbs. 0–12–12	low	low
F. Maxwell, Martinsville	Corn	100 lbs. 0–12–12	very low	medium
	Soybeans	....	very low	low

TABLE II.—RELATIVE YIELDS OF LEGUMES AT DIFFERENT SOIL REACTIONS SEVEN-YEAR AVERAGE, WOOSTER, OHIO [2]

Fertilizer treatment = 400 pounds of 20 per cent superphosphate and 50 pounds of muriate of potash per acre on the small grains in which the legumes were seeded. Lime was applied in varying amounts according to the reaction desired.

Relative average yields—highest yield equals 100

Soil reaction	Alfalfa	Sweet Clover	Medium Red Clover	Mammoth Red clover	Alsike Clover	Soybeans
pH						
4.6	3	0	16	17	14	67
5.0	9	2	30	30	28	79
5.6	41	44	58	67	74	78
6.8	100	90	100	100	100	100
7.7	99	100	98	91	94	95

that legume hay yields after soybeans have at least equalled those after corn. For instance, on mixed Brookston-Crosby silt loam soil the commonly called black and clay land of Central Indiana on the Soils and Crops Experiment Farm in Lafayette, the following average hay yields in pounds per acre were obtained during two periods, 12 and 13 years each.[3]

TABLE III.—CLOVER HAY YIELDS ON THE SOILS AND CROPS FARM, LAFAYETTE, IND.

Rotation	1916–1927 lbs./acre	1928–1940 lbs./acre
1. Corn, corn, wheat, clover	3,510	4,590
2. Corn, soybeans, wheat, clover	3,504	4,911
3. Corn, corn, soybeans, wheat, clover	3,462	5,014

In all these rotations manure was applied at the rate of 1,000 pounds per 1,000 pounds of produce removed, except the small grain. Wheat after corn was top-dressed with two tons of manure in winter while the rest of the manure produced by the rotation was plowed under for corn. Soybean straw was returned for the following wheat crop. Wheat received 200 pounds of 2-12-6 fertilizer and corn 100 pounds of 0-16-0 prior to 1936 when the analysis was changed to 0-12-12. In spite of the fact that the introduction of soybeans did not increase, but in case of Rotation 2 actually decreased the amount of plant food supplied per rotation, the hay yields in the rotations with soybeans compared favorably with those in the rotation without soybeans during the first period. In the second period hay yields in soybean rotations showed a definite increase over those in the corn rotation. Over the entire 25-year period wheat after soybeans averaged 33.6 bushels per acre while wheat following - n yielded only 27 bushels. Comparing the two periods in general it appears that crop yields cannot only be economically maintained but even substantially increased provided each rotation contains a legume at least once in five years and the crops are reasonably fertilized.

On the light-colored Plainfield fine sand of the Sand Experiment Field in Marshall County, a corn-tomato-wheat-hay rotation averaged 1,838 pounds hay per acre over the 10-year period from 1928 to 1938 as compared to 2,141 pounds of hay per acre in a corn-soybean-wheat-hay rotation.[4] In both rotations corn and wheat received 100 and 200 pounds of 3-12-12 respectively with an additional 16 pounds of nitrogen as

Another new grass receiving much favorable attention is Pangola, introduced from Africa. Best adapted to moist soils, this perennial will grow also on well-drained lands, attaining a height of two to four feet. Producing palatable and nutritious herbage, it is one of the earliest of the improved grasses to make new growth in spring and stays green until frost. Plants, stems, and runners may be spread two to three feet apart in four-foot rows during April, May, and June and sprigged in or partially covered with dirt. Pangola can be scattered and disked in when moisture conditions are favorable. It should not be covered completely.

On the muck soils of southern Florida, where it grows from three to five feet tall, Para grass has attained considerable popularity. Established by spreading runners or mature stems and disking them in, it should not be grazed until it is around two to three feet tall. Rotational grazing and occasional diskings are desirable.

Cogon has attracted considerable attention for the "scrub" lands. It grows well even in dry sands. Its ability to spread by underground rootstalks and its persistency make it feared for crop lands.

Dallis grass needs a higher fertility level than carpet and the Bahias and is best suited to planting on muck soils and in combination with the clovers. It grows 25 to 50 inches tall. Seed produced in this country are subject to ergot disease and most seed are imported from Australia. Seeding is at the rate of 15 to 25 pounds per acre.

St. Augustine, a common lawn grass, has given outstanding results for pasture on the muck lands of the Florida Everglades. It furnishes more winter grazing there than Para. Since it does not produce seed, it is established by planting runners. Its companion lawn grass, centipede, should be kept out of pastures.

Vasey grass resembles Dallis, growing taller and more erect. Only a small quantity of commercial seed is available, but Vasey seeds prolifically along roadsides and railroads.

Torpedo grass, a sod-forming native perennial, has given a good account of itself. It has to be planted vegetatively.

Clovers Are Comers

Interest in clover has spread like a prairie wildfire in Florida during recent years and the research agronomists are beginning to obtain the answers to clover questions. First success obtained with clover in Florida came 10 to 15 years ago with White Dutch on moist lands. More recently Crimson has been growing up the hillside, especially on the clay hills of western Florida.

Principal things required for success with clovers are seed of strains adapted to growing in the Southeast and proper fertilization and liming.

For moist soils the Florida agronomists recommend White (or White Dutch), Hop, Black Medic, and others. For the higher lands Dixie Crimson or other Crimson known to have volunteered in the Southeast is outstanding. Hubam and annual yellow sweet clover grow on either fairly moist or fairly well-drained soils.

Most of the clovers, when planted alone, are seeded at the rate of 7 to 12 pounds per acre. When several are included in a mixture, the total seed for an acre usually runs 12 to 15 pounds.

Common, Kobe, and Tennessee 76 lespedezas furnish a desirable addition to the summer grazing in many pastures on clay soils or on moist sands. Like clover, they require lime, phosphate, and potash. Perennial lespedeza (*sericea*) is grown to a limited extent on clay soils in western Florida.

Feeding Grass to Get It Started

The realization that good grazing means cheap feed and plenty of it has caused Florida farmers and cattlemen to use more fertilizer on pastures than ever before. The Florida Station's research has shown that plant foods applied in establishing and maintaining

(*Turn to page* 40)

Florida Grows Good Pasture on Coastal Plain Soils

By J. Francis Cooper

Agricultural Extension Service, Gainesville, Florida

PASTURES are growing greener than ever before in Florida and other Southeastern States. Research by the Florida Agricultural Experiment Station has helped materially in developing a pasture program which provides copious grazing and cheap feed over most of the year. During the last 15 years Florida cattlemen and farmers have established over 800,000 acres of improved pasture—more than had been put in during the 400 years since cattle first reached American shores on the ships of early Spanish explorers.

Pasture is now big business in Florida, where there is always a dearth of field crops for feed and where cattle have been an important agricultural enterprise for centuries. Improved grasses for summer, adapted clovers for winter, and proper methods of fertilization and management are now being employed throughout the State. Native wiregrass, which after burning provides good early spring grazing but soon becomes tough and unpalatable, is being replaced by the better grasses which furnish good grazing all summer.

Parade of the Grasses

Grasses now widely used for pasture development in Florida include Pangola, the Bahias, Coastal Bermuda, carpet, and Para. Others used to a certain extent include Dallis, cogon, Vasey, Torpedo (*Panicum repens*), and St. Augustine. The fescues, particularly Kentucky 31, are being tried.

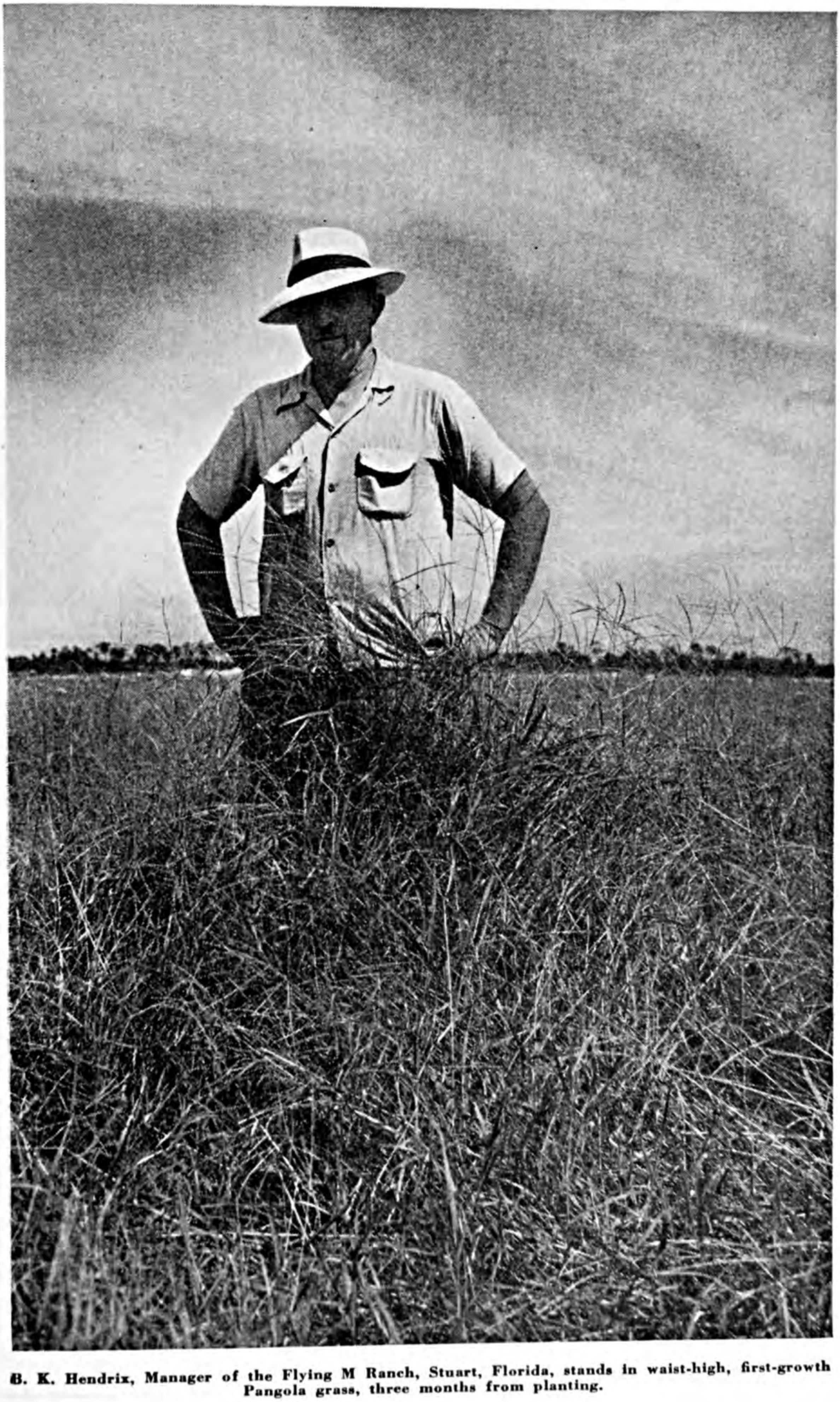
The Bahias are especially adapted to higher lands, since their roots grow deep into the ground and will reach moisture in dry soils, but grow well on lower soils. Common Bahia was introduced by the U. S. Department of Agriculture and has been available for several years. Pensacola Bahia was discovered growing wild on vacant lots in Pensacola, Florida, several years ago by County Agent E. H. Finlayson. It has finer leaves than common, comes out early in spring and stays green late in fall, but has a tendency to become slightly tough during late summer. It seeds well and is being widely planted. Paraguay Bahia was introduced from Paraguay. It, too, has fine leaves, more hairy than those of Pensacola. The Bahias are seeded at the rate of 10 to 20 pounds per acre.

Coastal Bermuda and Bermuda No. 99 were developed at the Georgia Coastal Plain Experiment Station, Tifton. Like common Bermuda, both are perennials and develop underground runners. The new strains grow knee high or higher on good soils and can be mowed for hay. St. Lucie Bermuda has no underground runners and is grown on the muck and sandy muck soils underlaid with lime on Florida's lower East Coast. The Bermudas are best adapted to fertile soils not subject to flooding and are established by planting underground runners or stems.

Carpet grass, the old reliable, is adapted to moist soils, seeds bountifully, and is still the most common permanent pasture grass in Florida. It is low-growing on most soils but can be mowed for hay on more fertile lands. The rate of seeding is 10 pounds per acre.

Above: **This fertilizer distributor and seeder will spread at the rate of 15 tons per day.**

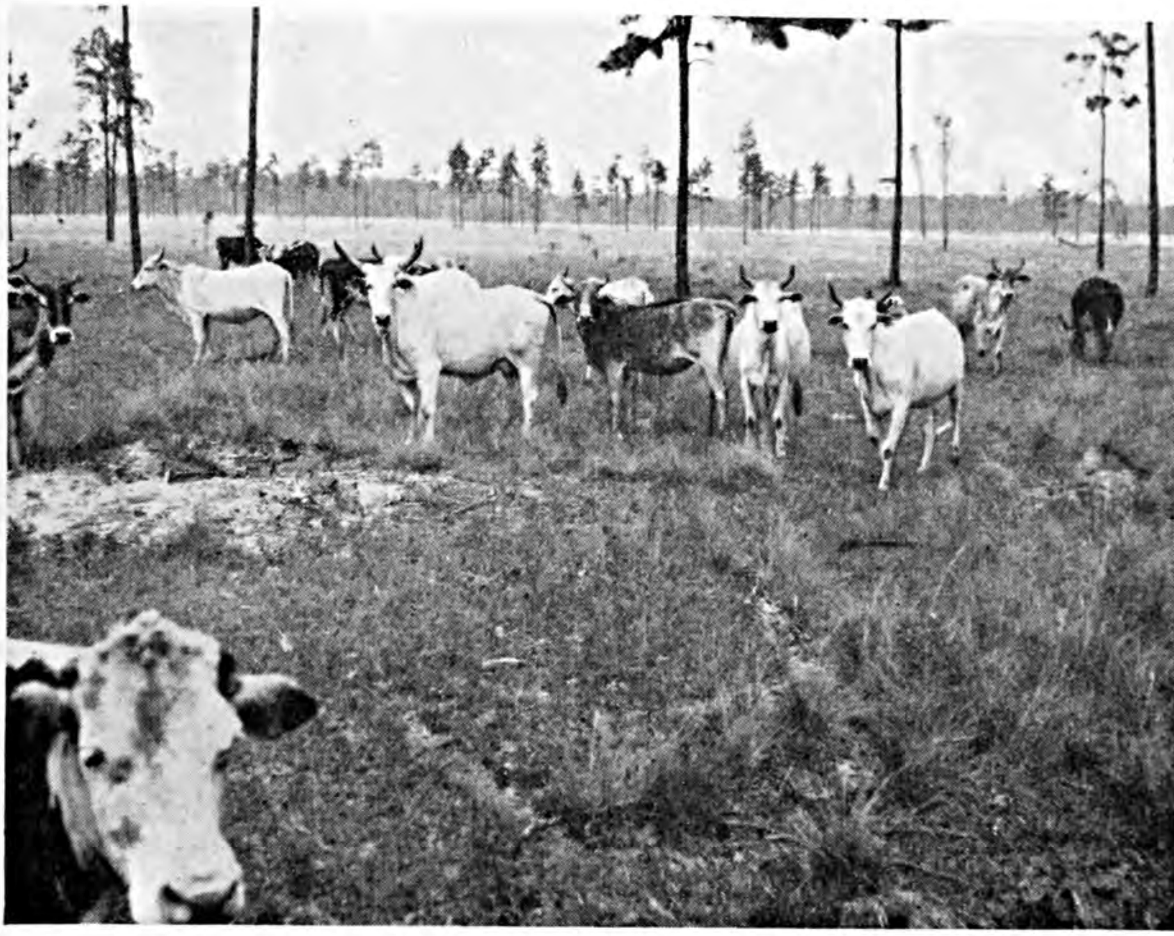
Below: **Coastal Bermuda grass sprigged in 42-inch rows July 1944. Photo made July 1945.**



B. K. Hendrix, Manager of the Flying M Ranch, Stuart, Florida, stands in waist-high, first-growth Pangola grass, three months from planting.

Above: **When Pensacola Bahia was first becoming established, children were hired to strip seeds by hand from grass growing on vacant lots in Pensacola.**

Below: **Harvesting grass from Experiment Station nursery plots, June 1947.**



Above: **Cattle are on typical unimproved pasture at Clarksville, Florida. Photographed in 1946.**

Below: **A purebred Brahma herd on a large improved pasture, Osceola County, Florida, 1947.**

insect killers. Farmland will itself be changed by soil conservation measures to preserve fertility and give greater protection against the erosion that has damaged so much of our land in the past.

"We are learning more about how to eat for good health. Science is tackling the problems of distribution—to help move the abundance of our farms to consumers with less waste and at lower cost.

"The benefits of the changes you will see on the farms of tomorrow will radiate out to our industries and homes so that your diminishing patch of land—smaller than three football fields—can actually raise your standard of living in tomorrow's world.

"But to assure this we must build lasting peace; we must maintain full employment; we must conserve our soil; we must keep our agriculture strong."

Winter Covers

To those of us brought up in northern climes where winter means cold and snow, a deep snow that lay on the ground for weeks was considered a good "winter cover." It protected seedings, held the topsoil, and its gradual thawing in the spring restored the moisture content of the soil. However, since erosion has been named the No. 1 culprit in our soil conservation programs and the losses due to spring "run-offs" realistically measured, the term "winter cover" has assumed quite a different meaning.

North and south, winter covers now mean crops which are especially planted for the purpose of checking erosion, adding organic matter to the soil, and improving its fertility. The advantages of such covers are readily seen and experienced in the reduction of the run-off caused by melting snows and rains, the improvement of soil tilth, and the lessened leaching of plant food. In addition, in many areas they have lengthened the grazing season for livestock, and in the South have made possible the year-round grazing programs.

Legumes, wherever adaptable, are preferred for their nitrogen-gathering ability. Those commonly grown in the South where climate and the use of fertilizers encourage good stands include hairy vetch, smooth vetch, Austrian winter pea, crimson clover, bur-clover, and sour clover. In the North, where the growing season after harvest of the cash crop is short, rye or rye grass is commonly used. A winter cover also can be provided by planning the rotation so as to include sods of various types which are very efficient, especially on soils most subject to erosion. Leaving a trash cover of crop residues is to be considered.

The increasing interest in winter protection for our soils reflects the growing importance being accorded the maintenance of their fertility. This interest should be furthered wherever possible, for in it is a powerful weapon for thwarting erosion, the silent and more or less evident thief of soil fertility. It is to be hoped that "winter covers," already a term which has outgrown the household, will become familiar to all good farm management.

To Our Readers:

Heartiest Greetings of the Season

The Editors Talk

A Concise Tribute to Agricultural Science

In a short talk over the Columbia broadcasting system on December 7, Secretary of Agriculture Clinton P. Anderson paid a concise, well-worded, and thought-provoking tribute to American agricultural science and all of its thousands of workers. It is worth repeating here for our readers, for it helps in these uncertain times for everyone to take stock of himself especially in relation to his being an asset to the welfare of our country.

"If American croplands were fenced into equal shares," Secretary Anderson said, "your plot would be smaller than three football fields. That's only about three acres, compared with about four at the end of the first world war. And if our population grows as we expect, your share by 1970 will be reduced to about two and three-quarters acres.

"Think of your future in terms of your diminishing share of land. You will have to depend on it because there is very little more that we can bring into use through drainage and irrigation. And we are still using up our soil resources faster than we rebuild them. Yet, your little patch of cropland, together with the permanent pasture and range, is giving you a higher standard of living and providing a great deal of food to relieve hunger abroad.

"In the future, on the same land we have today, fewer farmers will furnish greater abundance for more people. The matchless science of agriculture already enables the average farm worker to turn out nearly two-thirds more than he did 20 years ago.

"We shall have increasingly better crop varieties, including more hybrids. Our plant explorers, after a wartime lapse, are searching the world for new plants. With the old and the new parent stock, scientists will create improved varieties to resist new strains of disease and insects that continually threaten our crops. They will give us progressively higher yields. They will make possible finer quality and greater food value.

"Besides creating new varieties, our plant breeders now are using a discovery so new that they have only begun to see its possibilities. By applying to certain plants a drug commonly used to treat gout in humans they can produce larger and finer specimens and hybrids that would otherwise be impossible. With other chemicals, they can regulate the growth of plants. They can feed a plant radioactive atoms of food, trace their progress through the plant tissue, and thus gain new knowledge about plants and their soil and fertilizer needs.

"In livestock production we are just beginning to use the principle of hybrid vigor, so successful in plant breeding. Farmers are beginning commercial production of hybrid hogs that bear larger litters, make quicker gains, and produce a larger percentage of bacon and chops. Hybrid chickens and cattle may come next.

"New machinery that saves labor or does better work will increase our farming efficiency. We are beginning to make great progress with powerful new chemical

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
February	2.41	1.46	10.01	11.06	12.14	10.17
March	2.41	1.46	11.98	11.06	12.50	10.50
April	2.41	1.51	11.72	10.79	12.75	11.39
May	2.41	1.51	10.55	9.98	12.75	8.80
June	2.41	1.51	10.94	9.98	12.75	8.26
July	2.41	1.59	12.56	9.98	12.75	8.66
August	2.53	1.60	13.01	9.98	12.75	8.73
September	2.66	1.73	13.65	10.41	12.75	10.72
October	2.66	1.78	15.00	10.85	12.75	13.66

Index Numbers (1910-14 = 100)

1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293
February	90	51	286	313	360	289
March	90	51	342	313	371	298
April	90	53	335	306	378	324
May	90	53	301	283	378	250
June	90	53	313	283	378	234
July	90	56	359	283	378	246
August	94	56	372	283	378	248
September	99	61	390	295	378	305
October	99	62	429	307	378	388

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1922...........	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923...........	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924...........	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925...........	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926...........	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927...........	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928...........	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929...........	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930...........	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931...........	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932...........	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933...........	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934...........	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935...........	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936...........	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937...........	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941...........	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942...........	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943...........	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945...........	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
November....	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December....	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	..
1947									
January......	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	....
February.....	30.56	31.9	131.0	228.0	123.0	199.0	17.50	88.20	....
March.......	31.89	33.6	139.0	235.0	150.0	244.0	17.40	88.00	....
April........	32.26	30.1	147.0	233.0	163.0	240.0	17.20	88.00	....
May.........	33.50	44.6	153.0	233.0	159.0	239.0	16.80	83.70	....
June.........	34.07	46.0	156.0	249.0	185.0	218.0	16.00	79.60	....
July.........	35.88	48.5	169.0	251.0	201.0	214.0	15.10	79.00	....
August......	33.15	38.1	161.0	270.0	219.0	210.0	15.30	75.50	..
September...	31.21	40.7	149.0	240.0	240.0	243.0	16.10	75.60	..
October......	30.65	41.6	150.0	205.0	223.0	266.0	16.80	90.60	....

Index Numbers (Aug. 1909—July 1914 = 100)

1922...........	185	228	95	114	116	109	98	135	....
1923...........	231	190	133	137	129	105	110	183	....
1924...........	185	190	98	170	166	141	107	147	143
1925...........	158	168	245	188	109	163	108	140	143
1926...........	101	179	189	134	116	138	112	98	139
1927...........	163	207	146	124	132	135	87	154	127
1928...........	145	200	76	134	131	113	95	152	154
1929...........	135	183	189	133	124	117	92	137	137
1930...........	77	128	131	123	93	76	93	98	129
1931...........	46	82	66	83	50	44	73	40	115
1932...........	52	105	55	62	50	43	52	46	102
1933...........	82	130	118	79	81	84	68	57	91
1934...........	100	213	64	91	127	96	111	146	95
1935...........	90	184	85	80	102	94	63	135	119
1936...........	100	236	164	106	163	116	94	148	104
1937...........	68	204	76	93	81	109	74	87	110
1938...........	69	196	80	83	76	64	57	97	88
1939...........	73	154	100	85	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	107	117	107	81	211	129
1942...........	153	369	168	136	143	124	91	202	163
1943...........	160	405	188	232	174	154	125	231	245
1944...........	167	420	214	219	170	160	138	234	212
1945...........	181	435	199	228	178	169	127	230	224
1946									
November....	236	438	176	228	198	214	145	399	207
December....	242	435	181	239	190	217	149	406	166
1947									
January......	240	390	185	351	188	216	147	401	238
February.....	246	319	188	260	192	225	147	391	275
March.......	257	336	199	268	234	276	147	390	299
April........	260	301	211	265	254	271	145	390	295
May.........	270	446	220	265	248	270	142	371	286
June.........	275	460	224	284	288	247	135	353	215
July.........	289	485	242	286	313	242	127	350	189
August......	267	381	231	308	341	238	129	335	211
September...	252	407	214	273	374	275	136	335	179
October......	247	416	214	233	347	301	142	402	238

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	206	126	69	359	131	78
February	262	234	209	124	70	329	134	78
March	280	240	216	128	70	354	138	78
April	276	243	215	129	71	354	138	78
May	272	242	215	127	71	339	138	78
June	271	244	215	125	71	343	140	63
July	276	244	219	128	72	359	142	67
August	276	249	223	130	75	364	142	67
September	286	253	230	133	79	372	142	67
October	289	254	230	136	80	387	142	71

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367[1]
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January	.700	2.60	6.60	.535	.797	26.00	.200
February	.720	2.60	6.60	.535	.799	26.00	.200
March	.740	2.75	6.60	.535	.797	26.00	.200
April	.740	2.97	6.60	.535	.797	26.00	.200
May	.740	2.97	6.60	.535	.797	26.00	.200
June	.752	2.97	6.60	.330[1]	.589[1]	12.76[1]	.176
July	.760	2.97	6.60	.353	.629	13.63	.188
August	.760	3.08	6.60	.353	.629	13.63	.188
September	.760	3.42	6.60	.353	.629	13.63	.188
October	.760	3.42	6.60	.375	.669	14.50	.200

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83
1947							
January	131	72	135	75	84	108	83
February	134	72	135	75	84	108	83
March	138	76	135	75	84	108	83
April	138	82	135	75	84	108	83
May	138	82	135	75	84	108	83
June	140	82	135	60	62	53	80
July	142	82	135	64	66	56	82
August	142	85	135	64	66	56	82
September	142	95	135	64	66	56	82
October	142	95	135	68	70	60	83

Period ending June 30, 1946," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind.

"Report of the Director, July 1, 1944 to June 30, 1945," Agr. Ext. Serv., Purdue Univ., Lafayette, Ind.

"Soil Type and Soil Management Factors in Hemp Production," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Research Bul. 352, July 1947, A. J. Vessel and C. A. Black.

"Growing the Gladiolus," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Bul. P 85, July 1947, L. C. Grove.

"Forty-first Biennial Report for the Two Years Ending June 30, 1946," Kans. State College of Agr. and Applied Science, Manhattan, Kans.

"Osage and Neosho Oats," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Cir. 242, Feb. 1947, E. G. Heyne, C. O. Johnston, E. D. Hansing, and A. L Clapp.

"Fifty-ninth Annual Report of the Director, for the Year 1946," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky.

"The Relation of Curing Conditions to Quality in Burley Tobacco," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 496, Dec. 1946, R. N. Jeffrey.

"Commercial Strawberry Project for 4-H Club Members," Agr. Ext. Div., Univ. of Ky., Lexington, Ky., Cir. 430, March 1947, W. W. Magill.

"High Yields of Corn per Acre, Results of a Statewide Corn-Growing Demonstration in Kentucky, 1946," Agr. Ext. Div., Univ. of Ky., Lexington, Ky., Cir. 433, April 1947, W. C. Johnstone.

"Research in Agriculture, Annual Report 1944-1945," Agr. Exp. Sta., La. State Univ., Baton Rouge, La.

"Watermelon Production in Louisiana," Agr. Ext. Serv., La. State Univ., Baton Rouge, La., Ext. Cir. 202, May 1946 (Rev. June 1947), Ralph S. Woodward, John A. Cox, and Joseph Montelaro.

"Fifty-ninth Annual Report for the Fiscal Year ending June 30, 1946," Agr. Exp. Sta., Univ. of Md., College Park, Md., Volume 59, W. B. Kemp.

"Strawberry Growing in Massachusetts," Agr. Ext. Serv., Mass. State College, Amherst, Mass., Leaflet No. 29 (Rev. April 1947), A. P. French.

"Grape Culture in Massachusetts," Agr. Ext. Serv., Univ. of Mass., Amherst, Mass., Ext. Leaflet No. 64 (Rev. April 1947), O. C. Roberts.

"Blueberries in the Garden," Agr. Ext. Serv., Mass. State College, Amherst, Mass., Leaflet No. 240, April 1947, John S. Bailey.

"Twelfth Biennial Report for the Fiscal Years ending June 30, 1945 and June 30, 1946," State Dept. of Agr., Lansing, Mich.

"Tests of Cotton Varieties for the Hill Soils of Mississippi 1946," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 442, Feb. 1947, J. F. O'Kelly.

"Commercial Potato Production in Nebraska," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Bul. 384, June 1947, H. E. Werner.

"Science and the Land, 67th Annual Report, 1945-46," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J.

"Thirty-first Annual Report of the New Jersey State Department of Agriculture, July 1, 1945-June 30, 1946," Trenton, N. J.

"Raspberry Growing, Culture, Diseases and Insects," Agr. Ext. Serv., Cornell Univ., Ithaca, N. Y., Ext. Bul. 719, May 1947, G. L. Slate, A. J. Braun, and F. G. Mundinger.

"The Grasses: Their Growth and Development," State Agr. Exp. Sta., Wooster, Ohio, Agron. Mimeo. No. 105, 1946, Morgan W. Evans.

"Results of Crop Rotation Studies, Soil Fertility Experiments, and Corn, Sorghum, and Small-grain Variety Tests at the Agronomy Farm, Perkins," Agr. Exp. Sta., Okla. A. & M., Stillwater, Okla., Mimeo. Cir. M-167, May 1947, Horace J. Harper.

"Wheat Production in Oklahoma," Agr. Ext. Serv., Okla. A & M, Stillwater, Okla., Cir. 447.

"Year Book 1946," State Dept. of Agr., Columbia, S. C.

"Agronomy Handbook for South Carolina," Ext. Agron. Div., Clemson Agr. College, Clemson, S. C., Bul. 104, June 1947.

"Handbook of Standard Forestry Practices for South Carolina," Forestry Committee of S. C., Clemson Agr. College, Clemson, S. C., Bul. 107, Reprinted March 1947.

"1945-1946 Annual Report of the Department of Agriculture to the Governor of the State of South Dakota, for the Fiscal Year Ending June 30, 1946," Pierre, S. D.

"Forage from Kochia," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Bul. 384, Feb. 1947, E. L. Erickson.

"Feebar Barley," Agr. Exp. Sta., State College, Brookings, S. D., Cir. 67, April 1947, J. E. Grafius.

"Small Grain Variety Tests in South Dakota, 1946," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Pamph. No. 11, Feb. 1947, J. E. Grafius.

"Barley Variety Studies in Tennessee," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Bul. No. 203, April 1947, N. I. Hancock and O. H. Long.

"Jellicorse Corn," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Cir. No. 96, March 1947, Ben P. Hazlewood.

"Peach Varieties for Central East Texas," Agr. Exp. Sta., Texas A. & M., College Station, Texas, Bul. No. 687, March 1947, H. F. Morris.

"Sweet Corn Tests in the Lower Rio Grande Valley," Agr. Exp. Sta., Texas A & M, College Station, Texas, Bul. No. 689, June 1947, B. S. Pickett.

"Fruit Varieties for Texas," Agr. Ext. Serv., Texas A & M, College Station, Texas, C-150, 1946, J. F. Rosborough and C .R. Heaton.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizing Avocados on Rockdale Limestone Soils," Sub-Tropical Experiment Station, Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Press Bul. 635, Sept. 1947, Geo. D. Ruehle.

"Inspection of Commercial Fertilizers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 327, June 1947.

"Soil Survey of Bartholomew County, Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Series 1936, No. 27, July 1947, H. P. Ulrich, T. E. Barnes, Sutton Myers, O. C. Rogers, and A. T. Wiancko.

"Commercial Fertilizers in Kentucky, 1946," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Regulatory Bul. 55, April 1947.

"The Potash Problem in Kentucky Agriculture," Agr. Ext. Div., Univ. of Ky., Lexington, Ky., Cir. 432, May 1947, George Roberts.

"Inspection of Commercial Fertilizers and Agricultural Lime Products," Agr. Exp. Sta., Univ. of Mass., Amherst, Mass., Control Series, Bul. No. 133, July 1947.

"Report of Fertilizer Sales in Michigan from January 1 to June 30, 1947," Agr. Ext. Serv., Mich. State College, East Lansing, Mich., Oct. 21, 1947, C. E. Millar.

"Analyses of Commercial Fertilizers, Manures, and Agricultural Lime, 1946," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Insp. Series 26, April 1947, Stacy B. Randle.

"Diagnosis and Improvement of Saline and Alkali Soils," Bu. of Plant Industry, U.S.D.A., Washington, D. C., July 1947.

Soils

"Liming Soils," Agr. Ext. Serv., Univ. of Mass., Amherst, Mass., Leaflet No. 134, Rev. April 1947, Ralph W. Donaldson.

"Fertility Maintenance and Management of South Dakota Soils," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Cir. 68, May 1947, Leo F. Puhr and W. W. Worzella.

"Soil Survey of Swain County, North Carolina," Agr. Research Admin., U. S. D. A., Washington, D. C., Series 1937, No. 18, July 1947, S. O. Perkins and William Gettys.

"Soil Survey of Niagara County, New York," Agr. Research Admin., U. S. D. A., Washington, D. C., Series 1937, No. 20, Sept. 1, 1947, C. S. Pearson, Wilber Secor, D. F. Kinsman, J. C. Bryant, J. E. Dalrymple, C. B. Lawrence, Herbert Hopper, and A. T. Sweet.

"The Agricultural Conservation Program on California's Farms and Ranches," Prod. and Marketing Admin., U. S. D. A., Washington, D. C., PA-31, July 1947.

Crops

"The Effect of Common Salt on Rice Production," Agr Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 465, Feb. 1947, L. C. Kapp.

"Apple, Quince, & Pear Rootstocks in California," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Bul. 700, May 1947, Leonard H. Day.

"The Effects of Immaturity and Artificial Drying upon the Quality of Seed Corn," Div. of Forage Plants, Central Exp. Farm, Ottawa, Can., Publ. No. 790, June 1947, F. Dimmock.

"Guide to Crop Production in Ontario," Standing Committee on Field Crop Improvement, Ontario Dept. of Agr., Toronto, Ontario, Can., Ext. Cir. No. 68, Rev. May 1947.

"Horticultural Experiment Station, Report for 1945 and 1946," Ontario Dept. of Agr., Vineland, Ont., Can.

"Barley in Colorado," Agr. Ext. Serv., Colo. A & M, Fort Collins, Colo., Cir. 150-A (Rev. of D-27), July 1947, R. H. Tucker and D. W. Robertson.

"Alfalfa Varieties and Seed Mixtures," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Bul. 258, March 1947, B. A. Brown and R. I. Munsell.

"Management of Cigar-Wrapper Tobacco Plant Beds in Florida," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Press Bul. 637, Sept. 1947, Randall R. Kincaid.

"Growing Pecans in Georgia," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Bul. 501, Reprinted April 1947, Theodore L. Bissell and George H. Firor.

"Small Grains in Georgia," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Ext. Cir. 314, Rev. Sept. 1946, E. D. Alexander.

"Fifty-Ninth Report of the Director, for the

"Price and Production Trends in Virginia Truck Crops," State Agr. Exp. Sta., Blacksburg, Va., Tech. Bul. 105, Feb. 1947, Maynard C. Conner.

"Farmer, Forester—What's the Difference?" Agr. Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 116, Oct. 1947, Knut Lunnum.

"Don't Waste Feed," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 118, Oct. 1947.

"Nutritive Value of the Per Capita Food Supply, 1909-45," U.S.D.A., Wash., D. C., Misc. Publ. No. 616, Jan. 1947.

"The Farmer's Share of the Consumer's Food Dollar," U.S.D.A., Wash., D. C., Leaflet No. 123, Oct. 1946.

"Tree Nuts; Acreage, Production, Farm Disposition, Value and Utilization of Sales, 1909-45," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Oct. 1947.

"Selected List of American Agricultural Books," U.S.D.A. Library, List No. 1, Rev., April 1947, Washington 25, D. C.

"Bibliography of Marketing Publications Issued by the U.S.D.A. from 1937 through 1946," U.S.D.A., Washington, D. C., Appendix, Exhibit 3.

Alfalfa May Rob Soil, Tests Reveal

THE removal of three cuttings of alfalfa draws heavily on the soil for phosphorus, potassium, and lime. When alfalfa is grown for several years on the same land, these elements must be replenished in the soil or the crop will suffer, declares H. J. Snider, Agronomy Department, University of Illinois College of Agriculture. Under suitable conditions alfalfa may supply a large part of the soil's nitrogen supply.

In some tests on the farm of Jeff Beazly near Mansfield, Piatt County, three cuttings of alfalfa in 1946 removed plant-food elements worth approximately $24 an acre. This alfalfa yielded about four and one-half tons of hay an acre, which contained a total of 260 pounds of nitrogen, 18 pounds of phosphorus, 220 pounds of potassium, and about 400 pounds of lime.

To replace these amounts in fertilizers and limestone would require an outlay of about $24. The nitrogen is largely charged off on the basis that legumes may take only about one-third of this element from the soil.

Florida Grows Good Pasture . . .

(*From page* 26)

pastures bring returns comparable to applications to field crops and groves. As a result, cowboys are now riding jeeps pulling fertilizer distributors over thousands of acres—all the while muttering because they are not astride their ponies. But the fertilizer materials they distribute are bringing better cattle for the roundups.

Lime and the major nutrients, nitrogen, phosphorus, and potash, are being supplemented by the minors as cattlemen are learning to feed their animals through grass more and through the mineral box less. Records kept by Dr. W. G. Kirk at the Range Cattle Station during the winter of 1945-46 revealed that cattle on unburned native range consumed 76 pounds of supplemental minerals, while those on partially fertilized pasture ate only 11 pounds.

The age-old plague known as salt-sick formerly caused cattlemen heavy losses on certain ranges every year. Their animals became unthrifty, even in the midst of bountiful grazing, and lost weight; some died, and others had to be moved to healthy ranges to regain their thrift. In 1931 Florida Station workers discovered that salt-sick

"Cotton Varieties in the Lower Rio Grande Valley, 1946," Agr. Exp. Sta., Texas A. & M., College Station, Texas, P. R. 1079, May 22, 1947, W. H. Friend.

"Good Dairy Cows Will Turn Feed Into Profit," Agr. Ext. Serv., Va. Polytechnic Institute, Blacksburg, Va., Cir. 411, April 1947.

"Crop Rotations under Irrigation at the Irrigation Branch Experiment Station, Near Prosser, Washington," Agr. Exp. Sta., Pullman, Wash., Bul. No. 481, Nov. 1946, C. Emil Nelson and Carl A. Larson.

"Grain Feeding Cattle on Pasture," Agr. Exp. Sta., Pullman, Wash., Bul. No. 483, Jan. 1947, M. E. Ensminger, A. G. Law, T. J. Cunha, and J. L. Schwendiman.

"Marfed Wheat," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. No. 485, March 1947, O. A. Vogel, S. P. Swenson, Harley D. Jacquot, and C. S. Holton.

"Legumes for Greater Production in Washington," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 109, July 1947.

"Lawns," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Bul. 364, May 1947, E. J. Kreizinger.

"Wisconsin Dept. of Agriculture Bulletin," Madison, Wis., No. 275, Sept. 1946.

"Vetch on Sandy Soils," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Stencil Cir. 254, May 1947, A. R. Albert and H. L. Ahlgren.

"Fifty-Sixth Annual Report, 1945-46," Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo.

"Improvement and Industrial Utilization of Soybeans," Agr. Research Admin., U. S. D. A., Washington, D. C., Misc. Publ. No. 623, Sept. 1947.

"Seed for Regrassing Great Plains Areas," U.S.D.A., Washington, D. C., Farmers' Bul. No. 1985, July 1947, Max M. Hoover, James E. Smith, Jr., A. E. Ferber, and D. R. Cornelius.

"Russian Dandelion (Kok-Saghyz), An Emergency Source of Natural Rubber," U. S. D. A., Washington, D. C., Misc. Publ. 618, June 1947, W. Gordon Whaley and John S. Bowen.

Economics

"Canning Tomatoes Situation in California, 1947," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Cir. 369, June 1947, Walter D. Fisher.

"California Olives Situation and Outlook, 1947," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Cir. 370, July 1947, Arthur Shultis.

"Avocado Production Cost Analysis, Orange County, 1946," Agr. Ext. Serv., Univ. of Calif., Santa Ana, Calif., Seventeenth Annual Summary.

"Statistical Information Pertaining to the Marketing of Agricultural Products in Connecticut, 1946," State Dept. of Farms and Markets, State Office Bldg., Hartford, Conn., Sept. 1947.

"Delaware 1947 Outlook for Agriculture and Farm Family Living," Agr. Ext. Serv., Univ. of Delaware, Newark, Del., Ext. Folder No. 12, Jan. 1947, Louise R. Whitcomb and R. O. Bausman.

"Georgia's 1947 Agricultural Outlook," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Bul. 538, Dec. 1946.

"Your Farm and Business Report—1946: Farming-type Area Three, Western Livestock and Grain Area, AE-2449; Farming-type Area Four, East Central Cash Grain Area, AE-2450; Farming-type Area Five, West Central General Farming Area, AE-2451; Farming-type Area Six, St. Louis Dairy and Wheat Area, AE-2452; Farming-type Area Seven, South Central Mixed Farming Area, AE-2453; Farming-type Area Eight, Wabash Valley Grain and Livestock Area, AE-2454; Farming-type Area Nine, Southern Fruit and Vegetable Area, AE-2455," Dept. of Agr. Econ., Univ. of Ill., Urbana, Ill.

"Seasonal Patterns of Tobacco Sales and Prices from River-Warehouse Days to the Present Looseleaf Auctions," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 497, Jan. 1947, Carl M. Clark.

"People and Resources in Eastern Kentucky, A Study of a Representative Area in Breathitt, Knott, and Perry Counties," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 500, May 1947, Howard W. Beers and Catherine P. Heflin.

"Cost and Utilization of Power and Equipment on Farms in the Mississippi River Delta Cotton Area of Louisiana," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. No. 417, May 1947, Frank D. Barlow, Jr. and Leo J. Fenske.

"Costs and Returns on Family-type Sugar Cane Farms in Louisiana, 1938 to 1945," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. No. 420, June 1947, J. Norman Efferson.

"An Analysis of Changes in Sweet Potato Prices," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. No. 421, June 1947, M. E. Miller and M. D. Woodin.

"Comparative Census of Maryland Agriculture by Counties," Agr. Exp. Sta., Univ. of Md., College Park, Md., Misc. Publ. No. 52, Dec. 1946, A. B. Hamilton.

"Combination Ranching in Southeastern New Mexico," Agr. Exp. Sta., N. M. A. & M., State College, N. M., Bul. 332, June 1946, H. B. Pingrey.

"Ranching in Northwestern South Dakota," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Bul. 385, April 1947, C. R. Hoglund and M. B. Johnson.

"Graphic Summary of Changes in Use of Crop Land in Tennessee," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Rural Research Series, Monograph No. 218, April 25, 1947, B. H. Luebke.

"Farmers' Cooperative Handbook," Agr. Ext. Serv., Texas A. & M., College Station, Texas, B-152, 1947, M. C. Jaynes.

as the soil and previous fertilizer applications. The Bermudas, Dallis, and Pangola require much higher levels of fertility than the Bahias and carpet. Under low fertility levels carpet grass tends to crowd out such species as Bermuda and Dallis.

Nitrogen is the most important single element necessary in the maintenance of established pastures, as shown by results of four years of tests on Leon, Plummer, Bladen, and Fellowship fine sands. Complete fertilizers containing phosphorus and potash, however, gave still better results. The addition of lime gave only slight additional increases in yields.

Reporting on results of these experiments, Mr. Stokes cites the following percentage increases in yields over no fertilizer, as averaged for the four soil series: 36 pounds nitrogen, 35 per cent increase; 72 pounds nitrogen, 64 per cent; 144 pounds phosphoric acid and 50 pounds potash, 11 per cent; 36-144-50 pounds NPK, 49 per cent; 72-144-50 pounds NPK, 84 per cent; 72-144-50 pounds NPK plus 2,000 pounds dolomitic limestone, 91 per cent; and 72-144-50 pounds NPK plus 2,000 pounds calcic limestone, 85 per cent increase in yield.

The Florida results indicate that phosphorus, lime, and potash can be applied every three or four years, if nitrogen is applied annually, with about as good effect on grass yields as annual applications of the minerals. The infrequent applications should be heavy.

Where the agronomists applied annually 72-36-25-500 pounds of NPK and lime, mean yields of dry carpet grass herbage for four years were 3,085 pounds. Where they applied 72 pounds of nitrogen annually and 72-50-1,000 pounds of PK and lime every other year, mean yields for four years were 2,870 pounds. Where they applied 72 pounds of nitrogen annually and 144-100-2,000 pounds of PK and lime the first year only, average yields for the four years were 2,930 pounds of dried herbage.

Fertilizers, of course, affect the mineral content as well as yield of grass. Carpet grass receiving nitrogen fertilizer only contained lower percentages of calcium, phosphorus, and potash than unfertilized grass. On the other hand, carpet grass receiving lime, nitrogen, phosphorus, and potash was 61 per cent higher in calcium, 75 per cent higher in phosphorus, and 24 per cent higher in potassium than unfertilized grass. Thus the grasses receiving complete fertilizer carried much higher nutritive qualities.

Mr. Stokes and his fellow agronomists recommend either of the following four programs for maintaining carpet or Bahia grass pastures on mineral soils:

1. Apply 300 to 500 pounds of 6-6-6, 5-7-5, 4-8-8, or similar fertilizer every other year. On years when complete fertilizer is not applied, fertilize with 100 to 200 pounds per acre of sulphate of ammonia, nitrate of soda, or their equivalent. May apply lime at the rate of one ton per acre every five to seven years.

2. Superphosphate at the rate of 200 to 400 pounds per acre every three to five years generally will improve the phosphorus and calcium contents of the forage and stimulate growth.

3. From 1,000 to 1,800 pounds of rock or colloidal phosphate increase the phosphorus and calcium contents of grass and generally stimulate growth. The addition of nitrogen and potash would improve growth. (This treatment is not recommended for the red soils of western Florida.)

4. Basic slag at the rate of 500 to 1,000 pounds per acre every three to five years may be used.

For maintaining Bermuda, Pangola, Dallis, and Napier grasses where legumes are not present, they recommend either of the following programs:

1. Apply 400 to 500 pounds of a 6-6-6 or similar fertilizer annually. Additional nitrogen would be desirable. Complete fertilizers can be applied

was a nutritional deficiency due to lack of iron and copper in the herbage grazed. Later it was learned that cobalt is deficient on some ranges also. The grasses may not show the deficiency, but animals grazing them do.

Deficiencies of iron, copper, and cobalt usually are found together and are more prevalent on soils of the Lakeland, Leon, Immokalee, Blanton, and Portsmouth series—which include most of the palmetto flatwoods areas, as well as yellow soils in the sandy ridge land growing blackjack oaks. Where minor elements are necessary, the Florida agronomists recommend alone or in a mixture at the following rates: Copper sulphate, 10 to 20 pounds per acre; zinc sulphate, 5 to 10 pounds; manganese sulphate, 10 to 20 pounds; and borax, 5 to 10 pounds per acre. Minor elements have proven most beneficial on soils of southern and central Florida.

Another deficiency—lack of phosphorus, which causes sweeney—often occurs independently. It can be corrected by fertilizing the pasture with phosphate or allowing the cattle access to feeding bone meal or defluorinated superphosphate.

Starting the Pasture

Cattlemen are well aware of the fact that briers, saw-palmettos, bushes, and trees furnish little or no feed for animals and prevent the growth of grasses which would feed the animals. Consequently, they are clearing their lands with bulldozers and heavy cutters and disking them thoroughly before they attempt to start grasses or clovers. Pasture plants, like other crops, require a good seedbed for best results.

Where a natural supply of fresh, clean water is not already available, windmills or pumps not over two miles apart, so the cattle never have to walk more than a mile to water, are installed to serve from two to four pastures each.

Fertilization according to the needs of the soil and the plants to be grown gives the newly planted pasture grasses or legumes a rapid start and increases the nutritive value of the herbage. On most soils clovers require the application of from one to two tons of limestone, 600 pounds superphosphate, and 100 pounds muriate of potash per acre. Lespedeza requires almost as much.

W. E. Stokes, Head of the Florida Station's agronomy department, says carpet and Bahia grasses make better growth when given an application of 400 pounds per acre of 4-8-8 fertilizer before seeding on less acid soils. On more acid soils a ton of limestone per acre in addition is desirable, especially for Bahia.

Bermuda, Dallis, and Pangola require more fertile soils than carpet and Bahia. Liming at the rate of one ton per acre and fertilizing with 400 to 600 pounds per acre of 4-8-8 or similar mixtures are desirable.

The late Dr. W. A. Leukel, Station Agronomist, evolved an economical method of establishing carpet grass on flatwoods range free of palmettos and other objectionable growth. At the beginning of the rainy summer season, usually in late June, he burned native wiregrass and seeded the carpet. He found it best to select an area which had not been burned for two years, place adequate fire lines to prevent the fire from spreading to areas where it was not wanted, and widen these barriers by backfiring against the wind before firing into the wind. After two or three days, when the ash has settled and preferably just before a rain, seed with 10 to 15 pounds of carpet grass per acre. Keep the burned and seeded area accessible to grazing cattle at all times—they trample in the seed and help to get a sod. Adjacent areas can be burned in following seasons.

This method gives a good stand of carpet and, if done in the early part of the rainy season, almost completely eliminates wiregrass.

Fertilizing Established Pastures

Fertilizer and lime requirements for maintaining pasture grasses depend upon the species being grown, as well that of native wiregrass range is now well recognized. Where 20 and sometimes even 40 acres of native range are required for one animal, the improved pastures often carry a cow to the acre for a good part of the year, especially if the improved pastures contain lespedezas and clovers in addition to grasses. Pasture legumes are of better feeding value than grasses, increase the grass growth, and improve its quality.

Animal husbandmen have been cooperating with agronomists in Florida for several years in testing the carrying capacity and beef-producing ability of improved permanent pastures, and they have learned pretty well what the average results will be. On the basis of their data, various pasture plants when grazed with steers may be expected to yield the following gains in pounds of beef per acre during a grazing season: Wiregrass, 5 to 10 pounds; carpet, Bahia, Napier, or Bermuda grass, 50 to 300 pounds; carpet and lespedeza or other grass-lespedeza mixture, 100 to 250 pounds; and carpet and clover or other grass-clover mixtures, 200 to 675 pounds per acre.

Animal Husbandman R. S. Glasscock says you can sit in the shade—after your pasture is doing good—and harvest $100 worth of beef per acre during a season. Perhaps it isn't quite that soft, but improved pastures are now found all over Florida and are proving that they are the most profitable use to which large acreages of land can be put.

Soil Aeration . . . . Fertilizers

(*From page* 12)

Midwest Agriculturist for the American Cyanamid Company, on October 7, 1947. While making dozens of soil profile studies during the day in Illinois in various fields showing the typical symptoms of compacted-soil troubles as shown in Fig. 1, and with invariably the same conclusion, we came upon the uncommon situation where one good-looking field of healthy corn plants was next to another field showing the tight soil difficulties of root-rotted and lodged plants. In this State where the ratio of one acre of deep-rooted legumes to 16 of corn exists, this combination was really worthy of study. The soil profiles and corn stalks shown in Fig. 7 tell the story. Tight soil to the plow depth and poorly developed, rotted roots were in the field to the left. Good porosity and tilth in the sample to the right provided the better soil environment for healthy roots and vigorous plants.

Dr. Boyd then visited the grower of the better field, Ben Apke, on Route 119 about eight miles west of Rantoul, Illinois, and got the cropping history of both fields. Three years of good alfalfa preceded the corn in the better field, and a red clover pasture preceded the poorer corn. The compacted soil in the corn field following red clover sod convinced all of us of the superiority of alfalfa as a tilth-improving crop. The same weather conditions affected both these fields this year. The conclusion is too good to omit: Had more soils in the Midwest been in better tilth the damage to the corn crop attributed to wet weather, drought, and root-rots would have been greatly reduced in severity.

Discussion

Numerous other case histories could be cited to expand this story. The evidence is conclusive and points to the need for more deep-rooted legumes in the rotations in the states showing the widest ratios of acreages planted to deep-rooted legumes and corn. The every other year, with nitrogen applied in the alternate years.

2. If rock, colloidal, superphosphate, or other phosphate is used, it should be supplemented with nitrogen and potash. Lime may be needed every three to six years.

For sandy soils underlaid with lime, they suggest applying a complete fertilizer and nitrogen as recommended for acid sandy soils, but lime will not be needed.

For muck soils apply 200 to 400 pounds of 0-8-12 or 0-8-24 per acre every one or two years. The agronomists do not recommend rock or colloidal phosphate for non-acid sands and mucks.

As yet they do not know how frequently it will be necessary to apply the minor elements. If established sods have not been fertilized with copper and manganese they should receive the same applications recommended for establishing pastures—10 to 20 pounds each of copper and manganese sulphate per acre.

Management for Maintenance

Weed control and sufficient grazing, without overgrazing, are essential for pastures to return their highest yields. Weeds are controlled by mowing machines or rotary choppers, the latter being more satisfactory for rough land and pastures containing woody plants. Annual weeds can be exterminated generally by mowing during the bloom stage to prevent seeding. Roy Blaser, former Agronomist at the Florida Station, found that dogfennel cut one inch from the ground on July 7 was practically eliminated for that year, while field thistles cut two inches above ground on May 31 also were practically eliminated. When these weeds were cut six to eight inches above ground with a rotary chopper, many revived sufficiently to produce seed.

Pasture plants in the vegetative stage are growing rapidly, producing new leafage, taking in a maximum of minerals, high in protein and minerals and low in fibers and woody materials. As they mature or approach the reproductive stage, when they begin to form seed heads, they are more fibrous and lower in mineral content.

Where there are not enough animals on the pasture to keep the grasses in a vegetative stage, mowing will aid materially in doing this. Mowing is especially beneficial during the summer months when the grasses have a tendency to seed heavily. It is desirable, however, to permit some pastures to grow to, or nearly to, maturity in September or October to furnish winter feed. Many good cattlemen take their animals off of certain pastures by early September to have a reserve of winter grazing of mature and frosted grasses.

Overgrazing will kill out practically any of the improved pasture grasses and is to be avoided.

Harvesting Seed

Until recent years Florida has looked to other areas for practically all of its grass and legume seed. Now, however, it has a well-established seed industry that has come as a companion to the improved pasture program. Florida seed often are superior to those of the same kinds of grasses and legumes obtained from other areas. They are adapted to the State's climatic conditions.

Carpet and Bahia grass seed have been gathered with combines or with seedpan attachment to mowing machines, and a special seed stripper has been devised for use in harvesting Pensacola Bahia seed which do not mature all at the same time. Dallis grass also seeds prolifically in Florida, as do the clovers grown there and annual lespedeza. It is hoped that the fescues will become the source of another seed industry.

Reaping the Harvest of Beef

That the carrying capacity and quality of feed produced on improved permanent pastures is much superior to

The Management of Mint Soils

(*From page* 20)

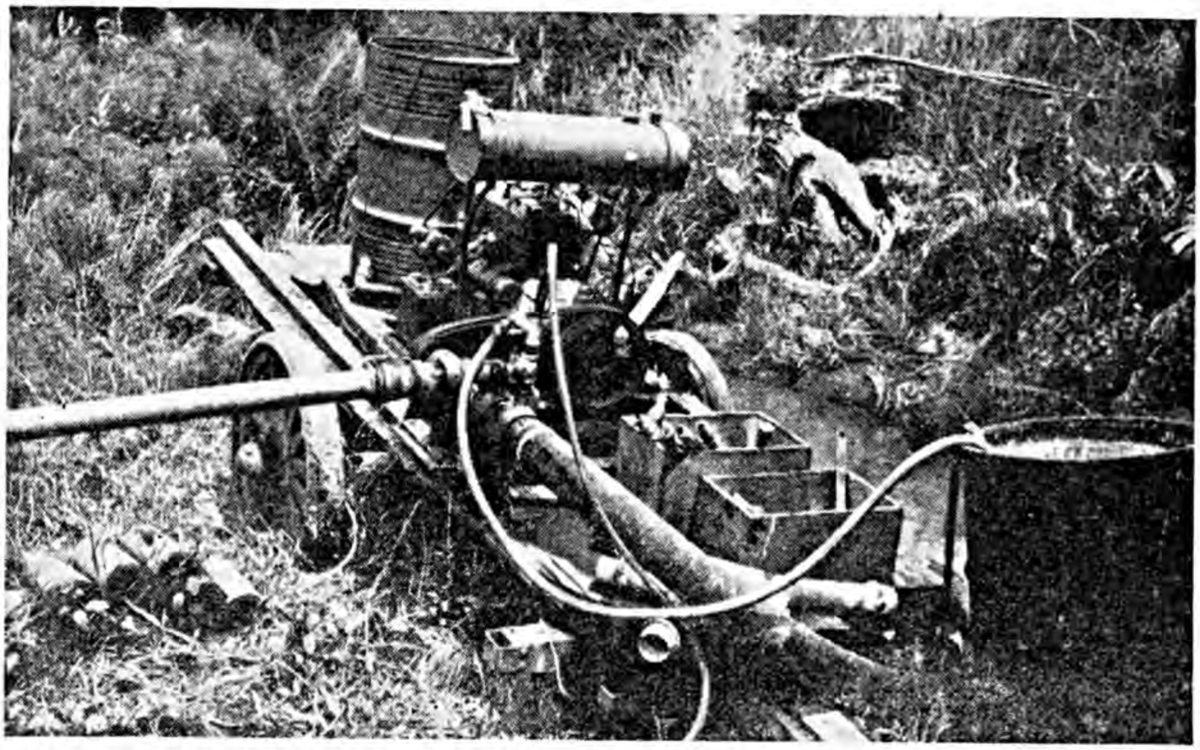


Fig. 6. Soluble fertilizer is drawn through here into suction side of irrigation pump for application through sprinklers.

mint leaves and other plant parts have been made. These are summarized in Table 5. Leaf samples taken in June contain more potash than those collected in August. Rate of application of potassium is reflected in increased leaf potash. Potassium content appears to be higher in stems than in blossoms or leaves. Scorched leaves from plots without potash fertilizer contained one-third the amount of potassium that was found in leaves from plots where a medium amount of potash had been applied in the fertilizer.

Production of mint oil of high quality and adequate tariff should protect from ruinous foreign competition.

Further study is needed of fertilizer, rotation, and irrigation problems, use of spent mint straw, control of weeds and pests, and mechanical facilities for quick, clean distillation.

Do Soybeans Cause Clover Failures?

(*From page* 24)

bus, Ohio, in 1946, hay yields from all treatments as well as different seeding methods averaged slightly higher on soybean ground than on corn ground with the legumes sown in either wheat or oats.

The Agricultural Experiment Station at Lafayette, Indiana, set up a project to study the effect of soybeans on subsequent legume crops, mainly red clover and alfalfa. The part dealt with here was designed especially to determine whether applications of lime and fertilizer will equalize stand and yields of clover seedings in small grains following soybeans and corn.*

In 1944 and 1945 a number of com-

* This research was made possible by a fellowship grant from the Central Soya Co., Fort Wayne, Indiana.

opportunities for more studies on soil and plant interrelations are great, and the efforts of graduate students in agronomy should be directed to these problems. The fundamental importance of adequate oxygen for root respiration and nutrient absorption has received consideration recently by Lawton,[1 2] Smith and Cook.[3] These workers have duplicated field soil compactions in greenhouse studies with corn and sugar beets. The cultures were fertilized in various ways and both aerated and non-aerated pots at different moisture levels were used to study the effects of the soil compactions on the growth and composition of the plants.

Further studies should be made with corn hybrids to determine definitely what the critical conditions are when the aeration, moisture, and nutrient supply factors predispose the roots of these plants to infection by the common root-rotting organisms. Field observations showed clearly that the roots were less affected under the soil tilth conditions following deep-rooted legumes this year. One of the most common organisms causing root rots of corn this year was the wheat scab fungus, *Gibberella saubinetti*. Tons of this inoculum are widespread and if favorable conditions of wet weather and temperatures prevail next spring, the wheat crop may have an unwelcome visitation of scab troubles. If this should happen, the effect of the soil compactions in 1947 might interest the plant pathologists.

Further, the soil physicists should find it interesting to determine all of the factors involved when the repeated pulverizations of clay soils by rubber tires, plows, discs, and other friction equipment contribute to the soil compactions which develop by eluviation. The soil chemists should also adjust the interpretation of the commonly used soil tests for making recommendations for the use of fertilizers to include the soil structure-tilth conditions under which the crops will be grown.

Thus it is seen that the current status of compacted soils, especially the clay soils with low organic matter contents, needs the attention of all groups interested in soil fertility conservation and crop production. This field for research remains wide open and attractive from the standpoint of practical agriculture. The case histories reported herein support these last statements.

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(2) Lawton, Kirk. *Soil aeration affects fertilizer needs.* Better Crops With Plant Food, Oct. 1946.

(3) Smith, F. W. and Cook, R. L. *Sugar beets require adequate soil aeration.* Better Crops With Plant Food, March 1947.

Pasturing Cattle in Tung Orchards

(*From page* 14)

grazing in November, December, and January. By removing the cattle, the oats can be harvested for grain in May. This same land can be used for Alyce clover or other legume hay crops during the summer months and is good insurance for a successful cattle production program.

Some of the larger orchardists, particularly in St. Tammany Parish, are doing only a limited amount of grazing because of summer cultivation of tung orchards and the extra work involved in shifting stock from one part of the orchard to the other. However, according to County Agent W. P. Knight of St. Tammany Parish, all of them are continuing to graze to some extent.

TABLE VI.—INFLUENCE OF LIMING ON THE UPPER TWO INCHES OF SOIL

Treatment	None		Fine Lime	400 lbs. 0–12–12 + Lime	800 lbs. 0–12–12 + Lime
	Plow Depth 6″	Upper 2″	Upper 2″	Upper 2″	Upper 2″
	pH	pH	pH	pH	pH
Wright Farm.......	5.1	5.5	6.1	6.4	6.7
Gerke Farm........	6.7	6.9	7.4	7.4	7.3
Heiman Farm......	6.5	6.7	7.5	7.5	7.5

is believed to be due to looseness of the soybean ground.

Average rainfall during the winter of 1944-45 and an ample, well-distributed supply of moisture in a relatively cool summer created favorable conditions for the establishment and development of clover seedings in 1945.

A total of ten tests (five in wheat and five in oats) was harvested in 1945 and 1946. As customary in Indiana only one cutting was made of clover and two of alfalfa with the fields then generally left for pasture. With the exception of one test in wheat where the yield of clover was substantially reduced by anthracnose in the spring of 1946, there was no noticeable loss through diseases or insects.

The results of these tests (Table V) show that legumes following soybeans have outyielded legumes following corn by an average of 170 pounds of hay per acre regardless of companion crop and fertilization.

With increases of over 800 pounds of hay per acre for the first 400 pounds of 0-12-12 and additional increases of about 500 and 300 pounds per acre on soybean and corn ground respectively for the second increment of fertilizer, the treatments have done reasonably well in oats considering that only in one test two cuttings of alfalfa were taken.

In the wheat tests the yield increases were considerably smaller with only about 300 pounds of hay per acre for each of the two fertilizer increments.

The effect of the fertilizer on the yield of hay was about the same whether the legume followed soybeans or corn. The method of application, however, made a considerable difference. Discing the fertilizer in, though only slightly, as in preparation for oats, was far more effective than top-dressing without further mixing with the soil.

Liming had little effect on the yield of hay because, especially in 1945, most test fields were for all practical purposes high enough in lime to warrant the growing of clover. When disced in in preparation for oats, the application of lime usually increased the amount of hay slightly in comparison with the corresponding unlimed plot. But when fine lime was top-dressed on wheat in amounts calculated to bring the surface soil up to an only very slight acid reaction, which required from 500 to 2,000 pounds per acre, yield depressions of varied magnitude were experienced.

The change in soil reaction by liming wheat following soybeans is shown in Table VI. The reaction of the test fields as represented by the untreated plots was determined in January 1945 before the lime was applied. The determinations from the upper two inches of the limed plots were made at harvest time in June 1946. In each of these tests the hay yield from the limed plots was lower than the unlimed plots. Likewise ground limestone applied to the surface of the soil on permanent parative tests were placed with farmers throughout Central Indiana where most of the complaints originate. In all cases comparisons for legumes were provided by locating these tests in fields which in the preceding season had been partly in soybeans and partly in corn. Care was taken in selecting fields where the seedbed preparation for the companion crop was identical regardless of the preceding crop. A special effort also was made to choose fields high enough in lime content to guarantee legume growth and so to eliminate one of the most common and sorely neglected causes for clover failures.

In spite of the fact that in nearly all tests the corn preceding the small grain was fertilized while the soybeans were not, differences between available P_2O_5 and K_2O respectively after corn and after soybeans were almost non-existent according to test. (Table IV)

Two rates of fertilizer (400 and 800 pounds of 0-12-12 per acre), with and without additional lime as well as lime alone, were applied on replicated plots laid out at right angles across the soybean and corn strips. For seedings in winter wheat the treatments were applied as top-dressings in early spring previous to the sowing of the legumes. In preparation for oats, fertilizer and lime were disced in lightly before seeding. Rainfall was short during most of 1944 and the severe drought during midsummer proved damaging to all crops. It was especially severe on clover and, as evidenced by stand counts, affected legumes after soybeans more than after corn. Clover stands on soybean ground were about 25 per cent poorer in oats than in wheat. This

TABLE V.—RESULT OF CLOVER FERTILIZATION TESTS ON SOYBEAN AND CORN GROUND. YIELD OF LEGUME HAY IN POUNDS PER ACRE (COMPANION CROP—OATS)

Average of 5 tests 1944–45 and 1945–46

Treatment	After Soybeans lbs./acre	After Corn lbs./acre	Increase After Soybeans lbs./acre
No treatment*	3,380	3,309	71
Lime only	3,708	3,553	155
400# 0–12–12	4,321	4,217	104
400# 0–12–12 + lime	4,449	4,255	194
800# 0–12–12	4,782	4,441	341
800# 0–12–12 + lime	4,959	4,661	298

Companion Crop = Wheat
Average of 5 Tests 1944–45 and 1945–46

Treatment	After Soybeans lbs./acre	After Corn lbs./acre	Increase After Soybeans lbs./acre
No treatment*	2,967	2,608	359
Lime only	2,702	2,696	6
400# 0–12–12	3,117	3,061	56
400# 0–12–12 + lime	3,081	2,963	118
800# 0–12–12	3,534	3,309	225
800# 0–12–12 + lime	3,229	3,115	114

* "No Treatment" disregards whatever over-all fertilization has been applied to the companion crop.

this is the period in which the awful figure of Old Scrooge stands watchful guard against your natural inclination "not to be bothered."

Whether the doors of Home Sweet Home be wreathed in roses or sparkling with icicles on December 25th—it's the only fit place to be as the curtain rolls down on another long year of striving.

IT'S THE PLACE to be lazy without self-condemnation. It's the place to read old dog-eared childish books and to poke through old boxes of keys, mibs, jackknives, and stamp collections. It's the place to smile at Mother once more for just awhile, or else to hunt up her faded picture in the walnut dresser and lovingly smooth the quaint patch-work quilt, stitched by patient fingers, long since quiet and at peace.

It's returning to the old gate, yearning for the old dog at the empty kennel, beckoning to old chums now too fat or fashionable to follow you. It's listening to the rasping chimes of the family clock as you doze off in the little bedroom with the dormer windows—trying to believe in fairies and to banish the bogies. (Just as you have been doing so often these forty years since.)

It's awakening to the creak of wagon wheels on the frosty snow, the blessed batter cake aroma; and to listen in vain to hear Father at the staircase calling cheerfully, "Time to get up, Buckshot!"

Consulting my Mother's penciled diary, I find evidence that for her Christmas began along in gooseberry canning time the summer previous and continued unabated through autumn evenings, as long as there was kerosene to light the lamps to sew by. To be sure, she didn't say so right out loud, but a fellow who lived with her and noted her objectives is able to read into that old diary a heap more than her brown penny pencil ever dreamed she had up her sleeve.

I guess all good Mothers with healthy, careless families are like that; and my wife's own habit of never sitting down idly with empty hands proves that the best American women of all generations eternally think of the present in terms of future comfort and preparedness.

Mother's kitchen was needlessly large, and the floor uneven and hard to keep clean. Water for cooking and dish washing had to be carried from an outer well and a cistern pump in the "summer house." Too often we forgot to fill the pails or split the kindlings. Cooking was done over a low, cast-iron stove, with a sagging oven door and no thermometer, the pipes bubbling with creosote at joints and chimney piece. Every week or oftener the greasy coal-oil lamps had to be refilled and the chimneys washed and polished. The parlor hanging lamp, with its purple bowl and crimson shade, circled with glass pendants, must receive the once-over. Chunks of firewood thumped down on the "zinc" mat near the heater left more litter and dust to be gathered up. Our dogs were forever nosing and tracking in and out; and our closet floors held more duds than the wall hooks intended for them.

Yet somehow, out of the dear past, I cannot recall ever hearing Mother bewail her lot in life, even when all she got out of Christmas was the things she sacrificed to give to us.

AFTER A LONG DAY'S trudging and bending, she would stand at the threshold of the "sitting room" pushing her dark hair away from a flushed and tired face, and remark "how nice and cozy it is to come in here and do my darning by the fire, with all my family around me." Maybe at this point some of us would grab away her work basket and hand her a library book to read aloud, because she had such a rich, soothing voice, and she would stop and sniffle with us at the sad parts of Tiny Tim or Little Nell.

And one winter she had Father search the woods for spruce boughs and sewed them neatly on cardboard cut-pastures in Indiana was found by Mott to have reduced yields in some cases as much as 10 and 15%.[8]

The reduction of clover yields in these cases is probably due to the depressing action of lime upon the availability of soil nutrients. Pierre and Browning as well as others have found the injurious effect of overliming associated with a disturbed nutrition of the plants, mainly with phosphate.[9] However, soil tests of our clover tests and of the earlier pasture tests did not show any marked difference in available phosphorus and potassium between the limed and unlimed plots.

Considering the data from all the tests presented here, it is evident that the claim of the adverse effect of soybeans on subsequent legume crops cannot be generalized.

Additional work on the subject of clover failures following soybeans is still in progress. Besides continuing fertilization tests, a study of the influence of soybeans, corn, and an alfalfa-brome grass mixture on the physical and chemical properties of several important Indiana soils and on the growth of subsequent legumes is under way. Furthermore, different tillage methods are compared in order to determine which practice will improve the physical condition of the soil after soybeans so as to give subsequent legumes the best start. In addition, the growth and yield of various legume species sown in wheat and oats on soybean and corn ground are carefully checked in several tests.

In the meantime most disappointments in stands and yields of legumes in rotations with and without soybeans can be avoided by providing conditions suitable for their growing. Main requirements are sufficient plant food and lime, a firm seedbed, and the proper use of reliable, inoculated seed. With favorable weather and in the absence of insects and diseases, which unknown and unnoticed by the farmer can take a heavy toll in legume seedings but should not be confused with poor soil condition, clover failures should be sharply reduced.

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Yours for Yuletide

(*From page* 5)

for Christmas morning. Young voices and pattering feet will be your reveille."

Then as the years pass and the youngsters vanish from your sphere and perchance a slightly larger revenue is yours to use, the chance once more arrives to brighten some other Christmas home in memory of bygone family tapers. For

But regardless of creeds and national systems, I have felt that folks all over the world were striving hard for much the same goal. This goal is probably envisioned in other religions than ours, but it has a very plaintive and human attribute—that some good must come to folks on earth, and not all be saved up to reward achievers of the life to come. If I could play a harp I'd like to begin my lessons here, and not postpone the symphony until I sprouted wings. If I could do some good I'd like to do it now—I fear the angels will not need my kind attention. (And if assigned elsewhere, I wouldn't have the courage or the opportunity.)

JUST IN THIS WAY, the Christmas season is dedicated to sweetness and light. In our pursuit of such ideals we must be set to music allegro, with cheerful song and time out for warmth and jest. For this is part of the new picture we hope to paint on a large world canvas, and the realm in which the world wants to dwell. Any other mode of approach is fatal, because it smacks of the dungeon and the prison camp, the woes of war and the fears unknown.

Dour, long-faced, solemn, and foreboding faces have too long reigned and spread disaster. If all we can offer is more harsh discipline, more sacrifice, more dumb acquiescence in half-baked doctrines, then all we have learned at Christmas is just so much lost effort.

So poke the fire, light the candles, and enjoy the fullest of the season's cheer. But do not draw the shades or bar the door, for if there was ever a time to let our lights so shine before men upon the snows of despond, this is the hour.

My heartiest wishes for readers of BETTER CROPS WITH PLANT FOOD is a world-wide program to uphold the *principles* of Christmas, even if all of the population doesn't believe in Santa Claus.

out letters made to spell "Merry Christmas at Home." That was the same year I gave up my faith in Santa Claus; but sensing that I was the last one of the clan to retain that tradition, and the youngest, I hung up my home-made knits behind the base-burner, just to please my Mother once more.

MY FATHER was denied a bookish education, but he wanted us kids to have a few books at Christmas, which he picked out himself. As I think it over now and recall the ones he gave us, it seems he must have had a little help from Mother. On my shelves today are a few leftovers from boyhood fiction favorites. Here is one of them, bound in faded red, with coarse, thick brown leaves, bearing the title, "Tanglewood Tales from Hawthorne." On the flyleaf in Mother's hand it says, "Christmas 1900, from your Father, with Best Wishes." But on the back inner cover is left a tiny pasted label, "I was bought at the Fair Store," with a dim notation by the clerk, "25 cents."

Pray, after all, what was 25 cents if you wanted to give your kid a pretty good book for Christmas? You wouldn't miss it six weeks later. Since then on many occasions I have met those same heroes of Hawthorne's classic fable, dressed in finer garb and presented in nobler folios. Yet the Golden Fleece, the greedy Minotaur, and Ulysses and the crafty sirens have never stepped forth in more dramatic pageantry than they did upon our first acquaintance in that little book at Christmas more than forty years ago. So you also may bear similar witness, my friends, that the gift without the giver is bare; and that the old, the simple, and the tender things remain the longest and leave us fully satisfied.

Yes, and I had a brother, too, a lad grown up and gone from home, who purchased sundry books of high adventure and made me conversant with the noble and the just and great. Valued in terms of edition or of style, none of these ranked high; but I knew he had to skimp himself a trifle to make them mine. These and a limp leather Testament presented to me by a neighbor lady are at the bottom of a storage box, waiting to be read some day again—I hope as thoroughly and potently. Of such were our common family experiences.

All this was our mutual heritage, our joint privilege for many a holiday interval we have shared in this best land of all lands, trying our best to translate it into peace and joy forevermore.

Amid much wrangling, much bitterness, and kindred suspicions we of the country that granted us so many pleasant Yuletides carry at bottom nothing but good will and hearty respect for the basic needs and yearnings of mankind for better and wiser ways of living.

Most of us here in the United States are people who have little to do personally with the tragic forces that direct our fates. Just as the farmer plows and prepares the soil for a hopeful harvest and plans to do his humble part in a spot of small world-wide consequence, so the majority of us without real power to achieve peace and good will beyond our local zones intends to uphold that domestic tradition.

WE HAVE SEEN that heart's desire falter and fizzle out in the wake of remorseless greed and thirst for power. Some of us have even offered human sacrifice on such pagan altars. But we did it in fond hope that this would be the last of sordid sorrows and useless misery.

Religion means different things to different people. Ours happens to be one of simplicity and peace, devoid of vainglory and selfish lust. Yet somehow certain other landed leaders choose to regard us as interlopers instead of kindly helpers; as connivers for corruption instead of "eager beavers" for justice and fair play.

Samuel Hopkins Adams, who was always willing to try anything once, had accepted an invitation to a nudist party. Describing the experience to some friends the next day, he said, "They certainly didn't do things by halves. Even the butler who opened the door for me was completely nude."

"If he wasn't uniformed, how did you know it was the butler?" asked Mr. Adams' literal-minded publisher.

"Well," said Mr. Adams, "it certainly wasn't the maid."

* * *

Mose was brought up for the fourth speeding offense. He muttered under his breath something that sounded a lot like an oath.

"Repeat that!" snapped the judge.

"Ah says, God am de jedge, God am de jedge!"

* * *

TOO BAD

A man hitched up the family nag and took his daughter for a drive. At a lonely stretch in the road, a masked bandit held them up. The man barely had time to whisper to his daughter, "Hide your diamond bracelet in your mouth."

The bandit took everything they had and drove off in the gig, but he never found the bracelet. When he was out of sight, the father observed, "It's too bad we didn't bring Mama. We could have saved the horse and buggy."

* * *

Most women would be more spic if they had less span.

A motorcycle cop pulled up beside a parked car on a country road in the wee small hours of the morning.

"Hey," he yelled, "what business have you got to be out here at this time of the night?"

"This isn't business," came a voice from within, "it's a pleasure."

* * *

A minister was riding on a train when a big, strapping rough fellow came in and sat down beside him. Sizing up the prelate, he exclaimed, "Where in hell have I seen you before?" to which the minister replied, "I don't know; what part of hell are you from?"

PREMATURE

Young Bride: "That baby tonic you advertised—," she began, "does it really make babies bigger and stronger?"

Druggist: "We sell lots of it, and we've never had a complaint."

"Well, I'll take a bottle."

In five minutes she was back. "I forgot to ask about this baby tonic, who takes it—me or my husband?"

* * *

Rastus (throwing down four aces): "There, guess I win this ole pot, all right."

Sambo (angrily): "You play this game honest, boy; play it honest! I know what cards I dealt you!"

* * *

Doctor: "You must avoid excitement."

Bachelor: "Oh gee, Doc, can't I even look at 'em across the street?"

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

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Tomatoes (General)
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Vine Crops (General)
Sweet Potatoes (General)
Better Corn (Midwest) and (Northeast)
The Cow and Her Pasture (General)

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II-12-42 Wartime Contribution of the American Potash Industry
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A new four-reel series of 16 mm., sound, color films which may be booked independently or in any combination. They may be used to best advantage when shown at least one day apart and in the following sequence:

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THE PLANT SPEAKS, SOIL TESTS TELL US WHY depicts taking soil samples on the farm and the interpretation of soil tests. (Running time 10 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU TISSUE TESTS shows the value of tissue testing and the procedure for testing plant tissues in the field. (Running time 14 min. on 400-ft. reel.)

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We shall be pleased to loan these films to agricultural colleges, experiment stations, county agents, vocational teachers, responsible farm organizations, and members of the fertilizer trade.

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IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of time of loan.

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