BETTER CROPS

The Pocket B

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'H PLANT FOOD

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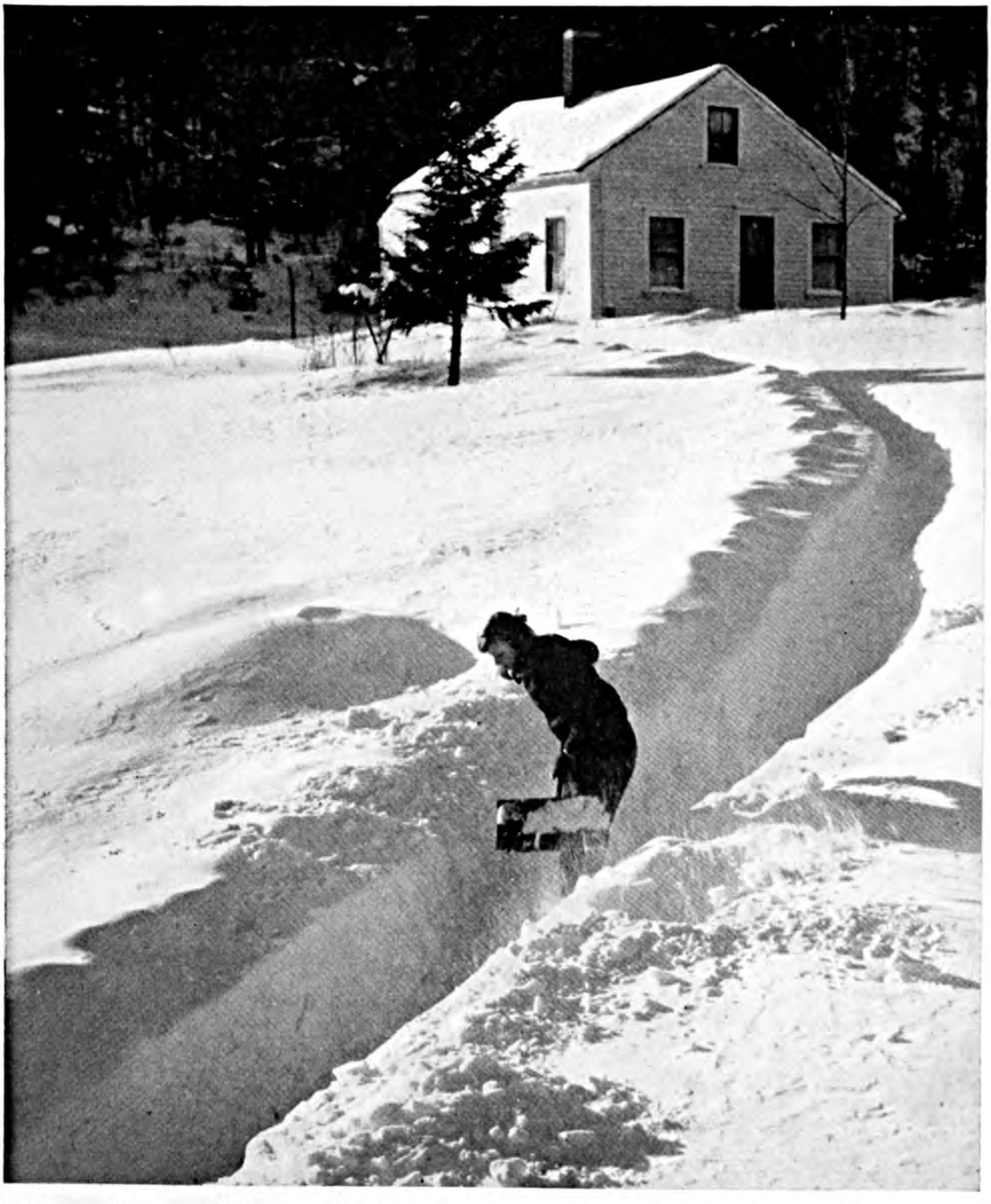

The Pocket Book of Agriculture

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 XXXV NO. 1

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The American Potash Institute, Inc.

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An Aftermath of Storms

Better Crops with PLANT FOOD

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VOL. XXXV WASHINGTON, D. C., JANUARY 1951 No. 1

Let's Keep Our . . .

Pledge to Youth

Jeff McDermid

THIS is the best of times and the worst of times, but certainly no time to forget the duties and privileges of seeing youth grow and expand, and being as considerate of their welfare as the hope of the world demands. And you can't buy it with appropriations. New Years is a threshold across which youth looks to a better day, even when visibility is "ceiling zero." Some of us elder gentry whose active parenthood responsibility is past (or who were never blessed with offspring) tend to lose ourselves in vain regrets and backward glances, and pay too little heed to the needs of the hour.

But when our grown-up children refer to some almost forgotten incident or household shrine or treasure of the past, as they remember "when we were little," it tugs mightily at your heart and revives once more the days of mixed delight and dilemma, and of great responsibility and family cheer. For you can relax a bit at that and feel glowing and grateful over having been able to provide a few of those endearing moments that now combine with their own adult realities to produce the God-fearing, upright kind of citizens our children have become.

It brings it all back with most of the worries left out and none of the old doubts and fears to plague us. No longer do we cringe and dodge to escape imaginary thrusts of fate or fret about that none-too-profitable job lest some of those real and fancied opportunities of America will be denied to those we cherish. We should not spend our declining period in vain regrets about the deeds we should have done to make our family name shine brighter for awhile, or mourn because we have not been as influential and forceful as we set out to be before the babies came, or when depression and war curbs cramped our courage.

Our kids do not seem to mind that noticeable lack of either fame or fortune in the least. They won't have too much "to live up to" in that way anyhow. They are comforted by their memories, just as we are. They are pleased no end by those things which they mutually enjoyed "when they were little."

AS we look about us now and see happy children on the road to school, busy playing hop-scotch, dressing dolls, or wearing all the accoutrements of two-gun Cassidy, it seems to mean that children are singularly blessed by indifference or ignorance of the selfish world of maturity. Of course, they probably do not entirely escape the facts of life and may be aware that all is not normal and hopeful in the soil wherein their roots are set.

Whatever they realize, their actions do not reveal anything but the usual carefree and trustful attitude which generations of our privileged youth have learned to adopt. On our part, we are aware that many promises cannot be kept with certainty during a period of grave unrest, yet this does not mean obliteration of old landmarks or uprooting of old goals that time has proved worthwhile.

Late in 1950 at the White House Conference on Children and Youth, some basic truths were woven into a series of pledges. Too few people took time to read them under the tensions of the tragic upheaval.

These may well be reviewed and pondered upon. The first two items were:

"From early infancy, we gave you our love, so that you might grow with trust in yourself and others . . . We will recognize your worth as a person and we will help you to strengthen your sense of belonging."

Next comes this one: "We will respect your right to be yourself and help you to understand the rights of others, so that you may experience cooperative living." This is so closely related to another point in the pledge that they belong together—namely, "We will illustrate by precept and example the value of integrity and the importance of moral courage."

Few of us with parental experience can overlook times when we slipped badly in this regard. Sins of harshness, anger, and the opposite evil—pampering — all work against training a youth to respect the rights of others and exhibit moral courage and personal integrity.

Short tempers and impetuous actions never become parents any more than they produce good state and federal leaders. When Dad breaks into an uproar and lets loose with tantrums, his kids lose some respect for his self-control and too often grow moody and selfish under such experiences.

At the other extreme we doting parents may magnify beyond all reason the position and privilege of the child in society. Every time we try to build super-defenses around the daily contacts of our kids as though they were deserving of much more consideration and protection than other folks, we breed draft-dodgers and slinks.

Then there's that old excuse for not using discipline that one of my neighbors practiced much to our disgust. His youngsters enjoyed no end playing wicked tricks on associates, and indulged in such playful adventures as breaking milk bottles on garage driveways to see the tires pop. When we mildly protested such banditry, he leaned over the fence and grinned in explaining, "Oh, in our house we have quit all those negative methods of dealing with childish growth and development. We are strong for the positive approach. So we never tell them *not* to do anything. Instead we put the emphasis always on *do* this or *do* that. It's the only sound way to make children use good judgment and work out their own destinies."

So I felt like telling his rebel boys to please come on over in front of their own garage and bust up some bottles for a change. It wouldn't do to forbid them in a negative way. You had to prove to them first that their

way was not conducive to genuine community welfare. (We are having similar difficulty dealing with certain nations on that basis now.)

Next on the agenda: "We will help you develop initiative and imagination so that you may have the chance freely to create; and we will encourage your curiosity and your pride in workmanship, so that you have the satisfaction that comes with achievement."

Not all fathers and mothers possess the skill or love of craftsmanship or the ingenuity needed to create or design, but there is usually some gifted and willing person in the community whose talent extends to the teaching field. One of my neighbors was himself a married man minus children, but he saw the craving of the lads in our suburb for manual arts outside of routine school work. So he devoted two nights each week in a nook over his garage to the inspiration and guidance of those eager fellows. When he was taken ill subsequently, his pupils mowed his lawn and shoveled his snowdrifts in a manly acknowledgment of the tutelage he had provided at the bench and forge. We didn't have to remind them to do that either.

Happy is the parent who can put zest and purpose into the doing of some handicraft and share its progress with the rising generation. To work nimbly with the hands and mind wards off mischief and provides an outlet of great value as an antidote to loneliness, worry, and frustration. It's one way to keep step with the marvels and the mechanisms which few alert young people fail to admire and emulate.

THEN comes this one: "We will provide the conditions for wholesome play that will add to your learning, to your social experience, and your happiness."

It's fine to have a "rec room" built into the premises to take care of those idle moments at home or to please and attract the best kind of "company" for the children. But too often parents measure the worth of the playtime facilities by what they cost or how modern they may be. This recalls the memory of a rugged old neighbor of ours away back at the turn of the century. Poor himself and unable to grant the meager indulgences of the times to the boys and girls of the township, he drew upon his own pioneer childhood for primitive pleasures in the open air.

One winter he took us all out to the thickly iced pond and helped us cut two large limbs from a locust tree on its frozen shore. One he showed us how to drive down and anchor below the ice, using the other lighter limb for a crosspiece fastened to the upright vertical pole so that it would swing and revolve in circular fashion. A sled was then attached front and rear to the

(*Turn to page* 48)

Fig. 1. Preparing soil samples for analyses.

Soil-testing Reduces Guesswork

By W. L. Nelson and C. D. Welch

Soil-testing Division, N. C. Department of Agriculture, Raleigh, North Carolina

A LIME and fertilizer recommendation based on a reliable soil test is important in profitable crop production.

Soils vary greatly in fertility levels. Much of this difference is due to past management practices as related to cropping, liming, and fertilization. However, these past practices have varied so greatly from farm to farm that a fertilization and liming program which will do well on one field may be entirely unsatisfactory on another field. Examples of the wide variations in the plant-nutrient levels of soils within a given county are shown in Table I.

TABLE I.—SOILS VARY GREATLY IN FERTILITY WITHIN A GIVEN COUNTY.*

County	No. of soils tested	Percentage of soils at each plant-nutrient level				
		Very low	Low	Medium	High	Very high
				Phosphorus		
Bladen	587	6	14	13	20	47
Buncombe	359	43	26	8	8	15
				Potash		
Bladen	587	19	55	19	4	3
Buncombe	359	3	21	24	13	39

*From a summary of soils tested in North Carolina in the period July 1949 to June 1950.

Evaluation of Soil Fertility

Several approaches have been used in evaluating the fertility levels in soils in order that the proper rate and kinds of lime and fertilizer be applied. These approaches might be listed as follows:

Knowledge of the liming, fertilization, and cropping history. The requirements can be predicted to a certain extent but with a considerable lack of accuracy—first, because it usually is difficult to obtain an accurate history from the farmer, and second, because the losses of plant nutrients due to crop removal, fixation, and leaching are difficult to evaluate.

Observance of deficiency symptoms on growing plants. Plants show symptoms of nutrient deficiency, if the lack is severe enough, and give good leads as to the fertilizer requirements. However, these symptoms are often complicated by disease or insect damage, and absolute identification of deficiencies may be difficult. In most instances, by the time the deficiency occurs, it is too late to obtain full benefit from fertilizer additions to that particular crop. In addition, plants may be mildly deficient and not show characteristic symptoms, yet yields might be increased by proper fertilization.

Tissue tests on fresh plant tissue. The plant is the end product of all the factors in the environment, and much information can be obtained from tests made directly on the growing plants. A notable example is the nitrate test on corn. Of course, as in the case of deficiency symptoms, if the plant is found to be lacking in a given nutrient it usually is too late to obtain maximum benefit from fertilization.

Soil tests. This method permits the soil to help answer the question as to plant-food deficiencies which can be corrected before the crops are planted. It should be kept in mind that soil tests are most effective when used in conjunction with tissue tests, deficiency symptoms, and management history. The coordinated and careful use of these four tools should make for more effective and more efficient use of lime and fertilizer.

It must be remembered that poor crop yields are not always due to plant-food deficiencies. Merely applying the right amount of lime and fertilizer will not insure getting a good crop yield. Careful attention must be given to good varieties, proper cultural practices, correct seeding date, and control of weeds, insects, and diseases if maximum benefits are to be realized from the lime and fertilizer applied.

Soil-testing Service in North Carolina

The service is carried on by the Soil-testing Division of the North Carolina State Department of Agriculture (Fig. 1). No charge is made for testing. As in many other states, the demand for soil tests is growing rapidly and in North Carolina the number of samples tested has doubled in the last two years (Fig. 2).

Soil sample containers, mailing cartons, and information sheets are furnished by the Soil-testing Division and are distributed in the county by the

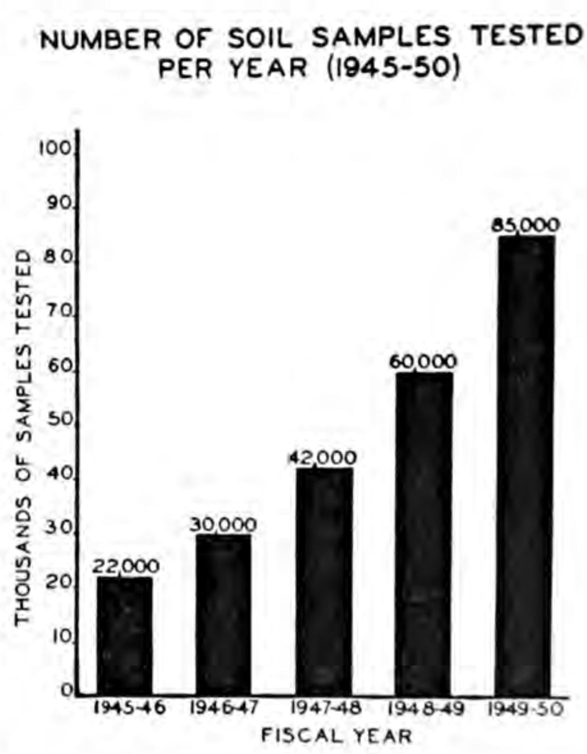

Fig. 2. The demand for soil testing is increasing rapidly and the number of soil samples tested in North Carolina has doubled in the last two years.

county farm agent, vocational teachers, Soil Conservation office, or P.M.A. office. The analyses and recommendations are made in a central laboratory at Raleigh. The original report goes to the farmer and a copy to the county agent, plus any other designated individuals.

Importance of Good Samples

Continual emphasis must be placed on the importance of good samples (Fig. 3). It is essential that the sample represent the field, as recommendations based on a poor sample may actually be misleading rather than helpful. In fields where yearly applications of complete fertilizers are made, the fertilizer from the previous year may be incompletely mixed with the soil. The same problem of incomplete mixing exists on fields limed within the last 3 or 4 years. Therefore, it is very important that the topsoil sample be composed of soil taken from at least 15 to 20 spots over each field.

In the North Carolina program, full instructions for taking the samples and for filling out the information sheets are given on the soil sample containers and on the information sheets. The county agricultural leaders are informed as to the necessity of following the instructions, and in turn these leaders teach the farmers.

Time of Taking Samples

One problem connected in part with sampling is related to the seasonal distribution of samples. In North Carolina one-half of the soil samples are sent in during the months of January, February, and March (Fig. 4). At this time, the North Carolina farmers are busy making plans for liming and fertilizing their spring crops. While the farmers are being encouraged to send in their soil samples well in advance of planting, this large number of samples in January, February, and March is to be expected. The extra load at this time is taken care of by increasing the laboratory and office staff by about 50 per cent through the use of temporary workers.

Soil testing should be considered on a long-time basis as the supplies of lime, phosphorus, and potash in the soil do not change rapidly. For example, if a soil is low in potash, high-potash fertilizers should be applied to the crops in that field for 4 or 5 years. At the end

Fig. 3. Good samples are essential and the instructions must be followed.

of that time, the soil should be tested again. Testing as often as this is enough to keep the lime in the soil at the proper level and to determine if the fertilization program is adequate for the crop rotation.

Determinations

If the soil tests are to be really used as a basis for recommendations, it is important to make the readings as quantitative as possible. This is desirable from the standpoint of accuracy of the lime and fertilizer recommendations and from the standpoint of the morale of the laboratory workers.

In the North Carolina laboratory, pH, lime requirement,* calcium, phosphorus, potassium, and organic matter are determined on all samples. The pH and lime requirement are obtained on the glass electrode, calcium and phosphorus on the photelometer, potassium on the flame photometer, and organic matter by titration.

Since soil testing on a service basis means handling relatively large numbers of samples, labor-saving equipment and devices are extremely valuable. Many laboratories are using such special equipment with greatly increased efficiency but yet are not sacrificing accuracy.

Uses of Soil Tests

Lime requirement. Soils vary greatly in acidity as well as in texture and organic matter content. These factors affect the amount of lime needed, and a soil test is the best guide in determining whether or not lime is needed, and if so how much. North Carolina farmers are using only a fraction of the amount of lime needed, and even some of this is used unwisely. Soil tests are very helpful in pointing out where the lime would be most beneficial.

Fertilizer requirement. The recommendations of the Experiment Station and Extension Service are of necessity based on average soil conditions, and in many instances ranges in grade of fertilizer and in rate of application are given. Since soils vary greatly in fertility level, each field must be considered a separate problem. Soil analyses help the farmer choose the proper grade and rate of fertilizer so as to correct for low levels of either phosphorus or potash in the soil.

*Modification of technique described by Woodruff—Soil Science. 66:53-64. 1948.

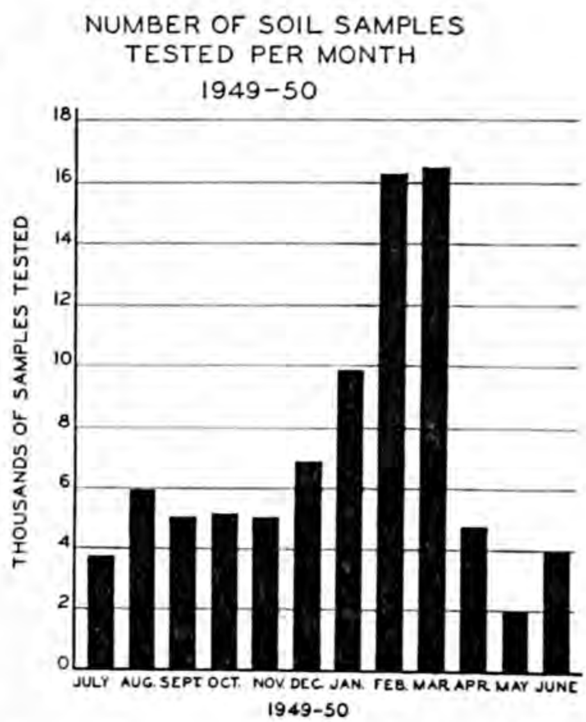

Fig. 4. The seasonal nature of the demand for soil tests is well illustrated by the number of samples tested monthly. In North Carolina, approximately one-half of the samples are received in the three-month period, January, February, and March.

The determination of the amount of organic matter in the soil is very important in the fertilization of certain crops. When organic matter decomposes, it releases nitrogen. With crops such as tobacco, which is adversely affected by too much nitrogen, the amount of nitrogen required in the fertilizer is greatly affected by the organic matter content of the soil.

Following up Recommendations

It is essential that the local agricultural leaders talk over the recommendations with the farmer. This is important, first, so that the farmers will understand the recommendations; second, to encourage the farmer to put the recommendations into practice; and third, because the leaders may have additional helpful information on the farmer's problem.

In connection with a study of the use of the recommendations based on soil tests, a postcard survey was conducted in North Carolina using questions which could be answered by "yes" or "no." One hundred farmers were selected at random in each of 15 counties. While recognizing the limitations of such a survey, a summary of the 614 cards received revealed the following encouraging information:

91 per cent applied the quantity of fertilizer recommended.

86 per cent applied the grade of fertilizer recommended. Only 9 per cent could not obtain the grade of fertilizer recommended.

83 per cent applied the rate of lime recommended.

77 per cent obtained a good crop yield. Of those not obtaining a good yield, only 1.3 per cent thought it was due to the recommendations.

93 per cent expected to have more soil samples tested.

An important phase of the follow-up work is related to the observations on growing crops where recommendations have been made. Observations of deficiency symptoms and the use of tissue tests can be of considerable assistance in obtaining further information and improving recommendations.

Calibrated Soil Tests Important

The recommendations based on a soil test will be no better than the calibration of the test. The calibration can be carried out only by the analysis of soils where the crop response is known. This can usually be done in conjunction with existing field experiments conducted by Experiment Station workers. These workers should be anxious for such cooperative work, as it provides a basis for projecting their fertility results to other areas. Studies of this nature carried on for a few years will provide a substantial basis for recommendations. Such cooperation insures that the recommendations based on soil tests will be in agreement with Experiment Station results. Standard samples accumulated from these experiments are also invaluable in developing new methods.

Cooperation of Agricultural Agencies

In addition to the Extension Service and the Experiment Station, the cooperation of those agricultural agencies such as vocational agriculture departments, Soil Conservation Service, and P.M.A. is important in carrying out a soil-testing program.

These groups have given splendid cooperation in North Carolina by stressing certain phases of the soil-testing program in their news releases. The vocational teachers are teaching their students, both in veterans' and in high school classes, how to take soil samples. In most counties the Soil Conservation Service is inserting the results of the soil tests and the recommendations in the farm plan. Recently P.M.A. distributed 4,700 copies of a circular on soil testing, one copy to each of the county committeemen. These agencies can be a great help in pointing up the value of soil tests in the effective use of lime and fertilizer.

The fertilizer industry can be and in many cases is being of tremendous assistance in the state soil-testing programs. The industry agronomists, salesmen, and dealers can encourage their customers to have their soils tested and then the dealers can make it a point to stock the recommended fertilizers. Some fertilizer companies have agronomists whose main work is to stress soil testing with the dealers and assist farmers in taking samples. These samples are sent to the state soil-testing laboratory for analysis and the results and recommendations are sent directly to the farmer.

It should be kept in mind that the main objective of all agencies cooperating in the soil-testing program is to reduce the guesswork in lime and fertilization practices and make for a more profitable agriculture.

Fig. 1. Members of a New England pasture tour stop to inspect a fine field of alfalfa on the Bahler Brothers' farm near Ellington, Connecticut.

ALFALFA, Queen of Forage Crops

By B. A. Brown

Department of Agronomy, University of Connecticut, Storrs, Connecticut

WHEN the land is seared by hot, dry winds and even the trees are brown with dust, what more appealing picture meets the eye than a verdant, green field of luxuriant alfalfa? Apparently drawing its food and drink from another unscorched world, this marvelous deep-rooted forage plant flourishes while all others wilt and die, or at best, await better days in a dormant state. No wonder men have long sought to solve the secrets and ways of improving the life of this Queen of Crops.

Since Colonial days New Englanders, faced with many unfavorable conditions for growing crops, have sought kinds of plants which would produce large yields of nutritious food on infertile soils and in a wintry climate. In this search, they have been unsuccessful; but success, at a price, has attended efforts to make the soil a satisfactory medium for desirable crops. Alfalfa is a good example of this statement.

The fabulous reputation of alfalfa to produce high yields of very nutritious forage in the western states soon stimulated attempts to grow it in this region. At the Storrs Experiment Station some work was done with alfalfa before the turn of the century. In that Station's report for 1902-03, it is stated alfalfa had not been generally successful in Connecticut but that in 1902, seed had been sent to some 80 farmers for trial with the object of learning what soil and other conditions were best suited for its growth. According to the report of 1904, very little success attended those farm trials, but alfalfa should not be ruled out until further tests had been made.

The more recent period and the one

with which the writer is familiar dates from 1914. In that year, former Agronomist W. L. Slate divided two-thirds of an acre on the old experimental field near the campus into 26 plots, each of which received a different fertilizer treatment. The purpose of that experiment was, of course, to learn how much lime, phosphoric acid, potash, and nitrogen from fertilizers or manure would be required to grow alfalfa well on the naturally acid, infertile Connecticut soils.

During the 30 years it was continued, that modest experiment yielded some important results. For example, it was learned during the first few years that alfalfa would not live long without additional potash from fertilizers or manure; that if the acidity of the top few inches of soil was counteracted with lime, the alfalfa thrived and extended its roots deep into the still acid sub-soil; that response was obtained from only moderate amounts of phosphoric acid; and that the growth of this legume, like many others, was little influenced by applying carriers of nitrogen. Since those early years, many experiments and experiences have corroborated those initial findings. Before leaving that experiment, however, it should be mentioned that some 20 years after the heavy and only liming (8 to 10 tons per acre of ground limestone) in the plow layer on some of those plots, the acidity of the sub-soil had been reduced to a depth of 36 inches. And without further liming, alfalfa continued to thrive for over a quarter of a century!

In more recent experiments, several other important soil fertility factors have been unearthed. Again, the first concerns potash and particularly the rate and frequency of application. Until about 10 years ago, it was customary to add certain amounts of fertilizers before seeding and expect alfalfa to grow through many seasons without further treatments. With lime and superphosphate, that practice was usually satisfactory; with potash, it wasn't. The reason for the difference is that plants absorb much more potash than they need when large available amounts of that nutrient are present in the soil. Thus, the first few crops of alfalfa after seeding get too much; the later ones too little potash. Without at least a moderate supply of potash, alfalfa soon dies. Therefore, it is now considered desirable in most cases to add potash at least once a year. It has not been very important whether the potash was added once, twice, or three times each season or supplied by fertilizers or manure. Now the general recommendation is to apply each year either 200 pounds of 60 per cent muriate of potash or 12 tons of well-preserved stable manure.

Boron Deficiency

Another milestone was reached in 1939, when it was clearly demonstrated on the experimental plots that most of the mysterious and widespread yellowing of alfalfa during dry periods was due to a deficiency of boron. Boron is one of the so-called "minor elements" necessary in small amounts for all plants. A ton of alfalfa hay contains about an ounce of boron or, in other words, 30 pounds of boron in a million pounds of hay. Although many experiments have shown that applications of borax, which contains approximately 11 per cent boron, have not increased greatly the longevity or yields of alfalfa in Connecticut, it seems advisable to prevent the yellowing and thereby improve both the feeding value of the hay and the morale of the farmers by adding 20 to 30 pounds of borax per acre once every four or five years. Borax is soon effective when either mixed with the soil or topdressed on the surface. Moreover, very heavy applications of lime have not been detrimental to alfalfa when accompanied by additions of borax.

On Charlton fine sandy loam soil, a common type on dairy farms, additions of the other minor elements—manganese, copper, zinc, and molybdenum

—have had no effects on the stands or yields of alfalfa.

Almost from the beginning, lime has been considered a necessity for alfalfa on our acid soils. Nevertheless, continued experimentation has brought to light new facts pertaining to this old subject. Of the greatest importance, perhaps, is that lime is most efficient for legume seedings when mixed with only the surface two or three inches of soil. A large part of plowed-under lime is positionally unavailable during the vital first few weeks of the young seedling's life. As mentioned earlier, lime gradually moves downward in the soils of this humid region and therefore one need worry little about the acidity of the subsoil if the top few inches are well limed. In general, three or four tons of ground limestone per acre are advisable for alfalfa on previously unlimed soils of the State. After the initial application, one ton per acre every four or five years will usually maintain the proper reaction.

Time of Mowing Important

Alfalfa grows so rapidly for a few weeks after each harvest that one gets the impression its store of nutrients and ability to flourish are inexhaustible. Such is not the case. Regardless of how well fertilized, alfalfa will die if mowed a few times when too immature. For example, two years of two "bud" stage cuttings annually reduced the stand to 27 per cent, while adjacent plots mowed when in full bloom had 71 per cent stands. The reason for such results is that during the first few weeks after cutting, the new growth of alfalfa is made largely at the expense of the nutrient reserves stored in its roots. If continually mowed when very young, those root reserves are never replenished. Many analyses of roots from alfalfa cut at various ages showed that the reserves were reduced to their lowest level about 20 days after removal of the tops. From this lowest point, the roots gradually became better fortified until a peak in reserves was reached when the tops had been growing for some 60 days. But, the first and second cutting hay from a 60-day-old growth has such coarse stems and such a small proportion of leaves that it makes poor feed.

It was found, also, that alfalfa will remain satisfactorily vigorous if the first and second cuttings are made after 45 days of growth. In Connecticut, this usually dates the mowings in mid-June and late July.

Most rules have to be broken occasionally and usually the "45-day" rule should not be followed for the third cutting. This exception arises because 45 days from late July is mid-September and if mowed then, the tops will grow 20 to 30 days afterwards, or long enough to reduce the root reserves to a very low level just at the time when further growth of tops and, of course, strengthening of the roots are stopped by cold weather. With low root reserves, many alfalfa plants will not survive, especially during the long winter months. The practical solution of

Fig. 2. When alfalfa cannot get enough potash, white spots appear on the leaves, at first around the edges and then over the entire surface. Later the leaves turn yellow and die.

this problem is to postpone the third cutting (or grazing) until mid-October, after which there will be little new growth to weaken the roots.

Variety testing was one of the first alfalfa activities at Storrs and is still being continued. In the early years, particular attention was paid to winter hardiness and gross yields; more recently, resistance to disease and feeding quality have been recognized as important factors.

Some 15 years ago, farmers who had grown alfalfa for many years found they could not maintain their stands nearly so long as when the crop was new to their land. In 1941, while seeking the causes of such failures, a new variety test was started at Storrs on land which had grown alfalfa for many previous years. Among the 12 strains in that test were two unnamed ones, A-11 and A-136. The former was bred in Kansas, the latter in Nebraska. During 1942 and 1943, A-11 and A-136 appeared no better than most of the others. But in 1944, and especially in 1945, marked differences in stands became evident. By the end of the 1945 season, the old stand-bys, such as Grimm and Variegated, had only 23 per cent stands while A-11 was first with 93 per cent and A-136 was second with 79 per cent. The reason for these striking differences is that Grimm and Variegated are not resistant to a serious soil-born disease—bacterial wilt—while A-11 and A-136 are little affected by that trouble. Because of their resistance to wilt, these unnamed varieties not only excelled the others in longevity but also had the highest total yields for the four harvest years.

Between 1941 and 1945, the numbered varieties were named. Now they are known as "Buffalo" and "Ranger." Further tests have supported the earlier results and either variety is recommended for fields where alfalfa has been grown before and one desires to maintain the stands for three or more years. Buffalo is preferable to Ranger, partly because of less infection with "leaf spot," a defoliating disease prevalent in humid mid-summer weather, and also because it has maintained better stands in the Storrs tests.

A few other promising varieties may be heard from later. "Narragansett" of Rhode Island origin and "Atlantic" from New Jersey are among them. It is probable these varieties are not as resistant to wilt as Buffalo and Ranger.

The most vigorous and highest yielding alfalfa during the 1947-1950 period is a variety developed at an experiment station in France. Its stems are very coarse, however, and its resistance to wilt has not been determined.

A few "creeping" varieties of alfalfa are now under test. They will be exposed to frequent cuttings to learn if they will stand grazing better than the ordinary kind.

Pure or Mixed Seedings?

Most of the Storrs experiments have dealt with pure seedings of alfalfa, but some tests of mixtures have been made. As far as yields and quality are concerned, nothing has been gained by diluting alfalfa with either clovers or grasses. During dry seasons, the second cutting yields have been reduced appreciably by having any grasses in the stand. This result traces to the much smaller growth of all grasses than alfalfa during the summer months, especially when those months are drier than usual.

On the other hand, the presence of grasses has reduced the heaving of alfalfa in springs following very cold winters. For this reason, it seems advisable to include some grass in alfalfa seedings on the more poorly drained soils. On very well-drained soils, however, grasses may well be omitted. When grasses are included, the present choice lies between timothy and brome. At Storrs, alfalfa-timothy mixtures have outyielded alfalfa-brome seedings.

Clovers in alfalfa mixtures have reduced the final stands of alfalfa. This is especially true of red clover which

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Soil Properties Influence Fertilizer Needs

By R. E. Stephenson

Soils Department, Oregon State College, Corvallis, Oregon

MOST of western Oregon soils have proved deficient in available nitrogen for any crop that requires much nitrogen for vegetative growth. Some of the soils are deficient in available phosphorus for crops with a high phosphorus requirement. The same condition exists with respect to boron, sulfur, and potassium. But the plant as well as the soil must be considered in specifying deficiencies.

In general, grasses respond to liberal use of nitrogen; the grains respond to phosphorus (on red hill soils); the legumes, to a carrier of sulfur such as landplaster; walnuts, to borax; and the sugar and starchy crops respond to potassium. Such general statements, however, are of little value as a fertilizer recommendation. Any adequate diagnosis must be more specific as to kind, quantity, method, and time of treatment to get results from fertilizing.

Quite commonly, two or more nutrient deficiencies must be corrected before there is satisfactory response to the fertilizer treatments. There are walnuts which fail to produce a harvest from the use of fertilizer until the boron deficiency is corrected, alfalfa that refuses to respond satisfactorily from the use of borax until a sulfur deficiency is corrected, failure of cover crops to respond to phosphorus because of lack of nitrogen, and other similar situations.

As soils become more depleted of humus and available nutrients, the risk of a poor response from the use of one or two elements of fertilizers becomes increasingly great. Extensive greenhouse studies, on many soils, have indicated that when sunflower is used as the indicator plant, nitrogen deficiency is most severe, but that response to nitrogen is greater when phosphorus is used with the nitrogen, still greater when sulfur is included, and greatest when potassium is also included to provide N-P-K-S treatment. But even this combination fails with sunflowers on some boron-deficient soils until borax or boric acid is included in the treatment.

Normally, in Oregon it is safe to guess that for non-legumes nitrogen deficiency will rank first in importance with phosphorus or sulfur next, according to the soil and the crop to be grown. Potassium will come third, except on some soils for some crops where the potassium needs are high. For a few crops on some soils, boron may rank even above nitrogen in importance, so much so that little or no harvest results unless boron is provided. Occasionally, potassium is severely deficient and quite often, for high potassium crops, moderately deficient.

Seller and User

Both the seller and the user of fertilizer should be interested in the crop response; the seller because good results mean more business, and the user because profits are the primary incentive for fertilizer use. Therefore, the right combination and the effective use of fertilizer are of vital importance. Use of fertilizer has proved fabulously profitable at times, and at other times nearly or a complete waste of money, because of improper use, unsuited soil, or lack of water to make its use effective.

In the use of fertilizer the fact that a soil deficiency may be physical as well as chemical is sometimes overlooked. Most farmers are aware that alfalfa fails in spite of any or all treatments on Dayton silty clay loam, because of heavy, tight claypan 12 to 15 inches thick and 12 to 15 inches below the surface of the soil. This heavy layer may contain more than 50 per cent of clay and is so impervious to roots, water, and air that no deep-rooted crop nor one that is sensitive to poor drainage can thrive, regardless of soil treatment or fertilizer use. A few grasses such as rye-grass or meadow foxtail may be grown quite successfully. Physical limitations are not always as apparent as this, however.

Fertilization of grass, particularly with a nitrogen carrier, gives wonderful responses in increased pasture and seed yields on nearly any Oregon soil. But the right fertilizer must be used and in the right way. On the poorer soil, nitrogen and phosphorus are needed for grass to produce its best. The general recommendation for nitrogen on grass is an early spring application at a liberal rate, or probably still better, a nitrogen application in the fall and again in the spring. But to use the nitrate form of nitrogen early on wet soils such as the Dayton is nearly sure loss, because this type of soil is more or less covered with water in early spring. Nitrate nitrogen is either washed away, leached, or lost by denitrification. The ammonia form of nitrogen should be used if fall application is made, or if the fertilizer is applied early in the spring. The nitrate form can be safely used only after most of the rainy season is over, which is likely to mean a May application.

An unfavorable biological condition in the soil may be mistaken sometimes for nutrient deficiency, as when a legume is poorly inoculated. This may be due only in part to lack of nutrients, or when the soil acquires symphilids which so completely destroy the root system of the crop that satisfactory growth is impossible. Some of the virus troubles so resemble nutrient deficiencies that the most expert cannot distinguish the difference. No nutrient correction has proved a satisfactory remedy for virus troubles. So simple a thing as the selection of the wrong variety for a particular soil and climate may make it impossible to secure satisfactory yields with any fertilizer treatment or management practice. Thus experimental variety tests with corn sometimes show yields from the best adapted varieties that are nearly double those of the least suited varieties. This is as great a yield difference as any use of fertilizer often makes. Of course, a high-yielding variety also means a greater requirement for plant nutrients.

Natural or Man-made

Nutrient deficiencies can be either natural or man-made. Calcium deficiency in some Oregon coast soils is so great, due to excessive leaching, that even the bent grasses, which are acid-tolerant, may respond to liming. These soils are also likely to be phosphorus-deficient, due in part to the highly acid condition which renders phosphorus unavailable. Deficiencies sometimes result from accelerated erosion, which is a man-made problem. Likewise, deficiencies which result from excessive cropping and humus depletion are man-made. Fertilizer use to become most effective under such conditions must be combined with modified or perhaps entirely new farming methods designed to hold the soil and renew the humus.

The age of the soil is some indication of possible deficiencies. Soils may develop claypans with age and they may become leached with age. Some of the old "red hill soils" have shown more potassium deficiency than was anticipated, probably because of the long-continued leaching of the past. In greenhouse trials, clover has failed on some of these soils when phosphorus,

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Know Your Soil

VII. Magnesium-potassium Relation for Sweet Potatoes on Sandy Soils

By J. B. Hester, F. A. Shelton, and R. L. Isaacs, Jr.

Department of Agricultural Research, Campbell Soup Co., Riverton, New Jersey

IT has been a proven fact for many years that adequate amounts of potassium in the soil or the use of high-potassium fertilizers increased the yield of root crops, particularly sweet potatoes. The literature on the research work on this subject is voluminous. However, some of this work is contradictory and the results inadequately explained.

Zimmerley of the Virginia Truck Experiment Station established in the twenties the fact that the best fertilizer mixture for sweet potatoes on the average Coastal Plain soil of Virginia was a 3-3-15. Present findings begin to point to the fact that under most conditions the relation of one available ion or plant nutrient in the soil in proportion to the other is the answer for the lack of response to the application of adequate amounts of potash for maximum production.

Working in Virginia in the late thirties with heavily fertilized and fertile truck soils[2] it was found that moderate applications of potash produced no increase in yield of potatoes. For example, on a Sassafras fine sandy loam no-fertilizer versus 1,000 pounds of 3-3-15 and 0-0-15 produced exactly the same yield, approximately 225 bushels per acre. However, 1,000 pounds of an 0-0-30 produced an increase over the other treatments of 85 bushels per acre. In other words, the cations and other plant nutrients were being brought into a more complete balance for sweet potatoes with the 300 pounds of potash.

About 1945 attention was focused on the fact that sweet potato growers in some sections were changing from the high-potash fertilizers to lower-potash fertilizers because they were getting better yields with the lower-potash fertilizers. Growers were changing from a 3-9-12 to a 3-12-6 fertilizer mixture, however, the general over-all yields declined. Field observations indicated that magnesium deficiency was prevalent and that the high-potash mixtures had a tendency to induce more magnesium deficiency than the low-potash mixtures.

Project Started in 1946

A project was started in 1946 with the Ranger sweet potato[1] to establish the amount of replaceable magnesium in the soil and magnesium-deficiency symptoms. It was found[3] that where the replaceable magnesium content of the soil was below 100 pounds per acre, magnesium deficiency was prevalent. Fertilizer experiments were then started to determine the influence of 2 per cent and 4 per cent magnesium oxide from two sources with 3-9-0, 3-9-6, 3-9-12, and 3-9-18 fertilizer mixtures used at the rate of 1,600 pounds per acre, one-half applied before planting and one-half as sidedressing.

TABLE I.

Treatment	Pounds per Acre			
	Round	Long	Seed	Total
Check	160	3,360	3,200	6,720
3-9-0	960	4,480	3,680	9,120
3-9-0 MgO	800	4,160	2,560	7,520
3-9-6	1,440	5,760	3,040	10,240
3-9-6 MgO	2,400	5,600	3,680	11,680
3-9-12	1,920	6,880	3,680	12,480
3-9-12 MgO	2,400	9,600	2,400	14,400
3-9-18	2,560	6,080	2,400	11,040
3-9-18 MgO	3,040	6,880	4,160	14,080

This established the fact that magnesium deficiency occurred first in the high-potash mixtures with the lower amounts of magnesium and that substantial increases in yield were established for both sources of magnesium, namely, dolomite and sulfate of magnesia. The 4 per cent magnesium oxide from dolomite with the 3-9-12 fertilizer mixture gave the largest yield, approximately 20,000 pounds per acre. The 3-9-18 without magnesium depressed the yield below the 3-9-12, and even with 4 per cent magnesium oxide, the yield was slightly depressed in respect to the 3-9-12 with 4 per cent magnesium oxide. Another interesting fact was brought out. The great increase in yield was with the long jumbo potatoes. However, the high-potash mixtures tended to increase the roundness of the potatoes. The yield of seed potatoes remained almost constant regardless of treatment. The 1949 data from the Sassafras sand is shown in Table I.

The foregoing studies seem to indicate that there is definitely a relationship between the yield and shape of potatoes and potassium and magnesium content of the fertilizer mixtures on soils with less than 100 pounds of replaceable magnesium.

In 1950 it was decided to use four fertilizer mixtures, 3-9-0, 3-9-6, 3-9-12, and 3-9-18 with 0, 2, 4, 6, and 8 per cent magnesium oxide, one-half derived from dolomite and one-half from sulfate of magnesia, applied 800 pounds underneath the row and 800 pounds by sidedressing. Each treatment was replicated five times on a Sassafras sand. The analysis of this soil is shown in Table II.

The summary of the results of this study is shown in Fig. 1. It is interesting to notice that in regard to the total yield, increasing the amounts of magnesium decreased the yield consistently with the 3-9-0; 2 per cent magnesium

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TABLE II.

Horizon	pH	CaO	MgO	Al	% Organic Matter	NH_4	P_2O_5	K_2O
0–10	5.5	136	12	T	0.5	Poor	33	86
10–33	5.7	125	11	N	0.2	Poor	7	24
33–60	5.9	100	9	N	0.1	Poor	3	44
60–	6.0	100	15	N	0.1	Poor	5	24

Expressed in pounds per acre (Hester sodium-acetate extraction procedure).

Fig. 1. Part of a herd of 400 brood cows that grazed all winter on a 125-acre field of fescue. They are seen here in early April grazing in an 80-acre field of fescue planted the previous October on a 2-year-old stand of sericea. Apparently they came through the winter in excellent shape.

Kentucky-31 Fescue for Grazing and Seed

By Barrington King

Soil Conservation Service, Spartanburg, South Carolina

"DON'T put this in your story because no one will believe it," Col. Carl Jones said, "but we pastured 400 head of cattle on this 125-acre field of fescue all last winter."

The car in which we were riding rolled across the firm, green carpet of fescue and came to a stop in the middle of the field. We got out and examined the sod and, frankly, it was hard to believe.

But we had seen enough that day to be in a believing mood. Six hundred and fifty head of sleek, white-face cattle were grazing on various parts of the 750 acres of Kentucky-31 fescue on the G. W. Jones and Sons farm. And 500 acres of the fescue was first-year growth. Nearly 200 acres had been planted in December on land that had been in cotton. The fescue came up to a perfect stand, but they wouldn't recommend planting it that late, ordinarily.

The 3,000-acre farm, near Huntsville, Ala., operated by Col. Jones and his brother, Brig. Gen. Edwin Jones, is using the fescue in a dual program, for grazing and seed production. They planted their first fescue in the fall of 1947, after having seen one of the five-acre observational plantings made from seed furnished by Soil Conservation Service nurseries to the Northeast Alabama

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Fig. 1. The use of ground limestone has been the backbone of the Vermont farmer's grassland program.

The Vermont Farmer Conserves His Soil

By Thomas H. Blow

Production and Marketing Administration, Burlington, Vermont

MORE than 10,000 Vermont farmers are proving to themselves annually that saving and rebuilding their soils through soil-conserving practices is like money in the bank. Farm soils, to these Vermont farmers, are their factories. Their crops, livestock, milk, maple, and lumber are as interest on their investment "in saving soil and good farm management."

The early years of agricultural extension work in Vermont found the county agents pounding away year in and year out on the need for adding lime and fertilizers. Actual demonstration on hundreds of farms throughout the State produced plenty of evidence that one of the soil's first needs was lime. Farm soils needed lime to produce more and better quality grasses than the farmers were growing. It was needed even more as roughage production changed to a legume program. Yet, in the face of this evidence, the increase in the recommended usages was very slow. Education alone did not seem to be sufficient to get the job done. Something else was needed to change the farmer's thinking into action. The U. S. Department of Agriculture, through its Agricultural Conservation Program, provided in 1936 the vehicle to get a soil-building program under way.

Prior to 1936, when the "ACP" program got under way, less than 3,500 tons of ground limestone were being used annually on the one million acres of the State's cropland. This was true, even in the face of the Vermont Agricultural Experiment Station's recommendations. These recommendations today are that Vermont's farm soils need upward of 400,000 tons of limestone per year. This large tonnage is needed, the Station feels, to adequately replace some of the already heavy calcium losses due to heavy cropping down through the years, and, likewise, to provide for the consistent crop production drain that occurs annually.

More Cattle Than People

Vermont, with its more cattle than people, is proud of the fact that it produces more than 140,000,000 gallons of milk annually. Yet, day in and day out, too little thought is given to the fact that this rich, white, body-building liquid takes away from the soil many thousands of pounds of calcium, phosphorus, potassium, and the minor mineral elements so necessary to plant and animal growth.

The layman, no doubt, will ask, "How far have we gone since those early years in replacing this tremendous drain of calcium through the medium of ground limestone or other materials in our Vermont soils?" In answer to this query, we do know that through the services of the Agricultural Conservation Program, the Vermont farmer has boosted the State's limestone usage to approximately 100,000 tons annually. But even with this increase, there still is a long way to go in doing the job of calcium replacement alone.

Other Replacements Necessary

In the same category, the trend is toward the lack of taking care of our soil's phosphorus needs. This trend, as with lime, is extremely critical.

The Vermont Experiment Station, through its soils studies, indicates a need of up to 225,000 tons of superphosphate annually. Through the Agricultural Conservation Program, the job of replacement of previous soil losses and taking care of current crop needs is going along at the slow rate of usage of 30,000 tons of 20 per cent superphosphate each year. Prior to 1936 the annual usage was less than 3,500 tons.

With calcium and phosphorus replacement, some progress is being made, but it is a far cry from the soil-rebuilding needs. Twenty-five per cent of the

Fig. 2. The early days of the Agricultural Conservation Program found many Vermont farmers broadcasting fertilizer on their fields by hand.

Fig. 3. Vermont County Agents have been prime boosters of the Agricultural Conservation Program since its inception in 1937. Here we see three of them—Messrs. Sinclair, Beebe, and Whitcomb—looking over an excellent ladino stand which has been well fed with lime, superphosphate, and potash.

job is being done through limestone and about 15 per cent with superphosphate, so there still is a long way to go.

The same is true of potassium, which reaches the soil through applications of potash, or farm manure. State Experiment Station findings point out that our soils can take and need 90,000 tons or more of potash annually. However, we shall not attempt to even quote the negligible amount that goes back to the soil yearly. Considerable progress was made, though, during the 1950 Agricultural Conservation Program when farmers used some 12,000 tons of a "phosphorus-potash" mixed fertilizer. Farmers can also contribute much potassium through the better use and conservation of farmyard manure.

Important Practices

The Vermont farmer is not confined to the use of lime, phosphorus, or potash practices alone under the program. In addition, he can and does make good use of such practices as clearing and reseeding for improved pastures. The orchardist gets help on mulching his producing trees, and the woodlot enthusiast can make greater progress through thinning, planting forest trees, and fencing out the sugar orchard from the grazing livestock. These and other supplemental practices on ditching, tile drainage, and building farm ponds round out an agricultural program of assistance that lends a hand to any farmer who is interested. It helps him in conserving his soil and managing his farm investment in a better manner than he could do it alone.

Farmer Committeemen

From the early years down to the present the Vermont farmer himself has played a tremendous part in seeing that the "ACP" work gets done. Each of the State's 14 counties has carried out its own program, applying it to the needs as they saw fit. Today, farmer-committeemen who are elected annually by their farmer neighbors supervise the annual sign-up for each year's program. On the same visit they check on the farm's performance under the previous year's practices.

It is doubtful if any more democratic procedure could be devised, because, through the farmer-committeemen idea, the program goes right back to the grassroots where it belongs.

Thomas Jefferson once said, "The farmers farm it, but the land belongs to the people."

How true, yet so many do not feel conservation is one of society's responsibilities. To them we say, "We have good schools and continue to make them better. Why?" Because our children and their education are a responsibility of every individual. No one parent can do the job alone. "We have improved roads and we want still better ones. Who pays for them?" You and I who use them, and rightly so.

We need good soil and good farming to produce our "daily bread." In doing this, the farmer has a twofold job, that of production and providing good management. He can provide the latter, but in many instances he cannot do the entire job of agricultural conservation alone. It therefore becomes the individual's responsibility, as folks who live off the land, to see that as a society we do our part in leaving the farms and their soils better than when they were taken over.

Farmer Pays His Way

There are those who will say, "Why give all this help to the farmer?" We ask, "Is the farmer getting all these helps for nothing?" No, certainly not.

Since 1936 the amount of Government funds put into the Vermont "ACP" program totals $12,937,000. In that same period the Vermont farmer has contributed in cash and services rendered, an estimated $12,710,886, or approximately 50 per cent of the program cost. Furthermore, during the last six years, 1945 through 1950, the farmers of the State will have contributed of their own money and services a total of one and three-quarter million dollars more than was provided by the Government for carrying out farm practices under the Agricultural Conservation Program in the same period.

As evidence for the need of a sound soil-building program and the part which the program is playing in doing the job, we quote from a statement recently made by Verle Houghaboom, Assistant Extension Economist for the University of Vermont: "The Agricultural Conservation Program has a definite stake in the management plans of Vermont farms. It is a tool which can be profitably used by farmers in attaining a well-founded farm business. For example, many farmers who want to increase the size of their business may do so without buying or renting additional land, by identifying production on their present acreage. This can be done by clearing land for tillage or pasture, by seeding pastures, or improving land by drainage. Nothing more than just liming and fertilizing hay and pasture crops will go far toward increasing the carrying capacity of many farms. Proper management of the farm woodlot is another means of increasing the size of some farm businesses. Trees can be a paying crop. Above all, the Agricultural Conservation Program can and should be of great help to farmers in maintaining and building up the productive capacity of their farms."

Fig. 4. G. N. Baldwin, Hinesburg, Vermont, farmer (right) shows Park Newton, PMA State Committee Chairman (left) and Associate Dean Paul Miller (center) some of the excellent alfalfa made possible on his dairy farm as a result of the program. Baldwin owns several hundred acres, produces a million or more pounds of milk annually, and is one of the largest users of lime, superphosphate, and potash in the State's program.

Permanent Tame Pastures—A Wise Use of Land

By W. M. Nixon

Soil Conservation Service, Fort Worth, Texas

GOOD permanent tame pastures conserve soil and moisture, improve the soil productivity, in addition to providing the lowest cost livestock feed on the farm or ranch. Such pastures contain at least one domesticated perennial grass and usually one or more legumes and other grasses in a mixture. Permanent pastures often remain unplowed for several years but maintenance of the domesticated plants requires cultural practices such as mowing, cultivation, and fertilization periodically.

At Batesville, Arkansas, in 1946, Bermuda grass pasture lost only .89 inches rainfall per acre, while rotational crops lost from 8.76 inches to 12.76 inches, depending on the crop and method of cultivation.

Six years of measurement at the Blackland Experiment Station, Temple, Texas, showed $6.76 per acre per year in plant-food elements lost by erosion from cotton, corn, and oats in rotation on terraced land, compared to a loss from Bermuda grass of but $0.09.

In Missouri, over a 14-year period, bluegrass averaged 680 pounds soil lost per acre with an annual value in plant food of $0.12, compared to 5,560 pounds lost from land in a corn, wheat, and clover rotation with an annual value in plant food of $9.15.

Good permanent tame pastures reduce erosion by furnishing effective cover against raindrop splash and increase infiltration rates by keeping soil structure permeable. They use untapped soil fertility from deeper soil levels, bringing much of this plant food to the surface for re-use. They build and hold high soil-productivity levels. They provide protective cover for surface runoff.

In order to be effective in these ways, the pastures must be well developed as cover. They must contain deep-rooted plants and ample legumes in mixture and be managed well to maintain density and vigor. In general, the larger the percentage of perennials in the stand, the more effective the pasture will be in soil and moisture conservation.

Forage Production Values

Feed grown on permanent pastures is usually the lowest cost feed produced on farms. A study in Mississippi from 1937-39 showed that a 20-acre pasture furnished hay, silage, and concentrate feed values equal to $37.84 per acre of pastures, and the livestock did all the harvesting. Studies at Clemson Agricultural College, reported in 1942, show higher feed costs to produce milk as dependence on permanent pastures decreases.

Per cent of total Feed	Pasture No. 1	Pasture No. 2	Pasture No. 3
Grain	61.1	49.8	27.5
Hay	21.0	17.7	15.9
Silage	14.5	12.8	18.8
Pasture	3.4	19.7	37.8
Feed Cost per gallon milk*	16.5¢	13.6¢	10.9¢

*Each dairy enterprise produced 813 gallons milk per cow per year.

Permanent tame pastures can safely and profitably make use of many physical conditions on farms not safely or profitably usable for growing cultivated crops. Wet lands, some areas subject to overflow, lands too steep or rough for cultivation, and places where installation of necessary soil conservation or drainage measures for cultivation are impossible or too expensive to install are examples of such conditions.

Permanent tame pastures provide a lot more dependable support for the farm livestock enterprise than most annual or supplemental pastures, though the carrying capacity of some of these supplemental pastures may be more than that of permanent pastures for the short periods they are available. Much of the costly seasonal fluctuations in milk production and in periodic losses of weight in beef production so characteristic of enterprises lacking an improved pasture program can be minimized by developing sufficient permanent tame pasture acreage, plus, of course, enough supplements to give good green grass pasturage nearly the year 'round.

Typical beef cattle gains from grazing per acre per year from experimental work in the region are:

Cotton Branch Experiment Station, Arkansas, 1930–1939	388 to 559 lbs.
Northeast Louisiana Experiment Station, 1941–1947	328 to 423 lbs.
Livestock and Forestry Branch, Experiment Station, Arkansas, 1944–1945	291 to 351 lbs.
Southeast Pasture—Fertility Research Station, Oklahoma, 1946–1948	58* to 217 lbs.

*Eroded timber soil with no fertilizer or lime applied.

Variations are caused both by differences in physical conditions and treatment given.

Selecting Sites

Since putting permanent tame pastures on an area involves decisions that affect land use for a long time, a conservation farmer or rancher needs to choose pasture areas carefully. Ample water for livestock must be available during any time that the pasture will be in use. If the land will support profitable mixtures of pasture plants, land unsuited for cultivation should be included in the permanent pasture area. However, those locations that will not allow development to high-producing tame pasture should be left for development to native vegetation—grass in the prairie and savannah areas, and trees in forested parts of the region.

Whenever tame pasture sites can be conditioned for mowing, it should be done, since this makes maintenance easier and allows supplemental hay use whenever a surplus of forage permits deferment. Occasionally seed crops of one or more pasture plants may be harvested for farm use or sale.

Determining Mixtures

Every permanent tame pasture should have a turf-forming perennial base grass as a foundation plant for erosion control and for pasture maintenance over long periods. In addition, each pasture mixture should include deep-rooted perennial plants to keep soil structure porous and to withstand periods of drought. Enough legumes should be in the mixture to keep nitrogen levels high and to develop a type of forage high in protein and total digestible nutrients. In a Georgia experiment, reported in the Georgia Experiment Station Fifty-second Annual Report, 1939-40, there were produced 1,609 pounds more forage per acre where winter clovers were in pasture sod, 998 pounds of which provided additional grass summer production following the period of growth of the winter clovers.

Mixtures that grow the best for physical conditions of site, produce most forage, will last the longest under grazing, and be most permanent, should be used. The mixtures must grow well together for the site conditions and maintain their vigor the best. They must furnish the best forage at times pasture will be used.

The following table contains some

pasture plants for use in various problem areas in soil conservation in the region. (See map.) Variations in physical conditions for a given pasture site may call for deleting, adding, or changing one or more plants in mixtures, but in general the species indicated will include the plants needed for effective soil and moisture conservation and profitable pasture use. For the site involved (left column) select a base grass (center column) and choose the legumes and grasses best for overseeding (right column) to develop desirable mixtures to use.

Cool-season perennial grasses should be planned in separate pastures from warm-season perennial grasses.

Maintenance and Management

A permanent tame pasture is not completely established until all the plants planned in the mixture have been established. This process, from base grass to last overseedings, will usually require two or more years and involve not only the sodding and seedings but all the application of soil amendments needed to develop thrifty stands. To keep pastures that have been so developed in a productive, thrifty condition, and to make optimum use of them, good pasture management is essential.

Some or all of the following jobs may be necessary to keep a given pasture vigorous.

1. ***Keep soil productivity levels high.***

a. Timely re-application of soil amendments. Phosphorus demands usually high; potash and lime requirements variable but often also high. Watch production, appearance, and vigor of plants as guide to soil amendment re-application needs; make use of reliable soil tests as much as possible.

b. Heavily fertilized seedings of annual legumes, periodically, to give extra boost to productivity levels. Heavily fertilized seedings of vetch or vetch-small grain mixture applied every 3 to 4 years to Bermuda grass base pastures in the humid parts of the region do wonders in increasing vigor and production of the succeeding grass crops as well as furnish a portion of needed winter supplemental green pasture. Singletary peas are also very valuable in increasing grass cover and vigor and provide good grazing. This pea is an excellent re-seeder.

2. ***Renovate base grasses periodically.*** This can often be done along with the periodic seeding of annual legumes. It is needed every 3 or 4 years or whenever either the vigor or density of the base grass shows noticeable decline. The invasion of broomsedge, weeds, and other hardy native plants is generally good evidence that such a base-grass renovation is needed. Sometimes, following this renovation process, it may be necessary to re-establish some annual species in the mixture. This is a good time to apply soil amendments.

3. ***Mow.*** Needed not only to prevent seeding of weed species but also to induce more palatable, more nutritious young growth of pasture plants. Mowing for weed control requires one or more clippings a year, timed carefully to prevent as many weed inflorescences from maturing seed as possible. Mowing to induce better growth of pasture plants should be timed to clip back maturing pasture plants about the time of translocation of plant food to below-ground plant parts—soon after seed maturity. New re-growth will be more succulent and nutritious. With Bermuda grass pastures a clipping a few weeks prior to the hot and often dry, late summer months will generally be profitable in inducing re-growth of good pasturage in late summer. When mowing can be done early enough, a good quality hay can often be harvested.

4. ***Use pastures with full regard for vigor of the plants.*** Plants get 95 per cent of their requirements from the air

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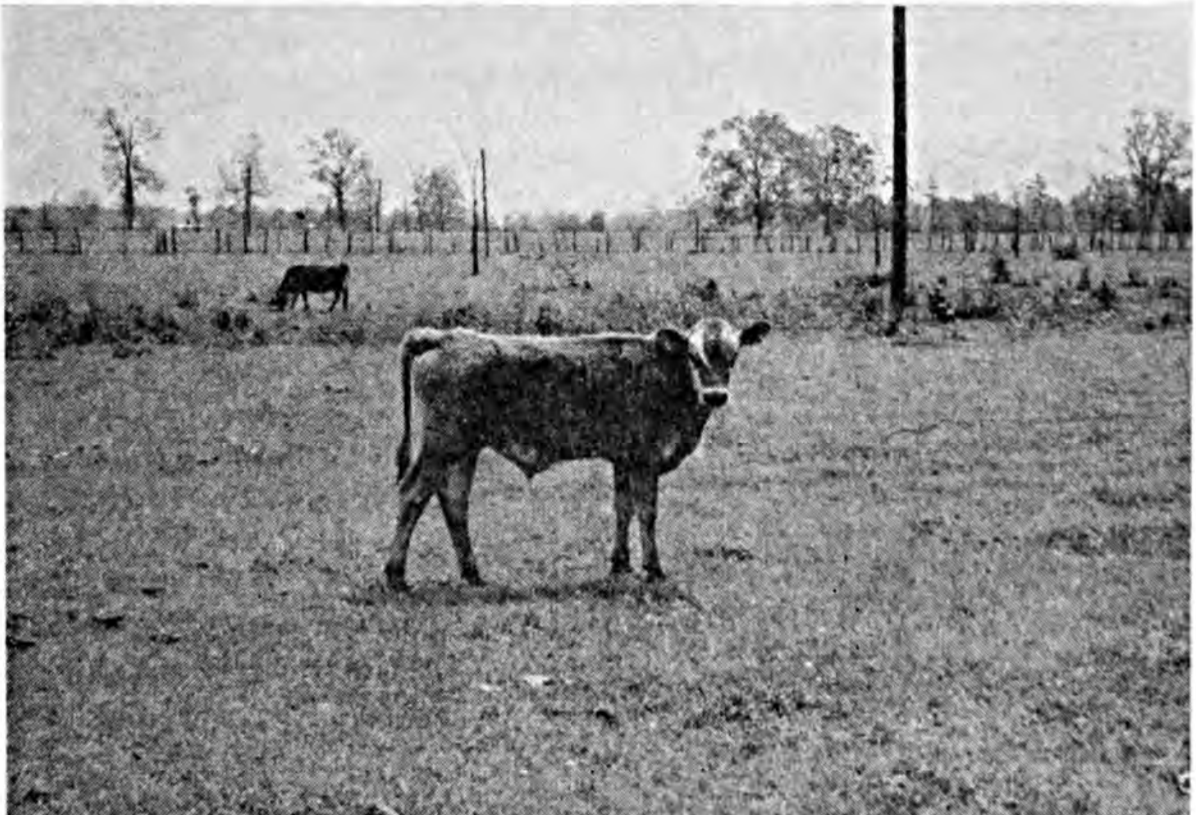
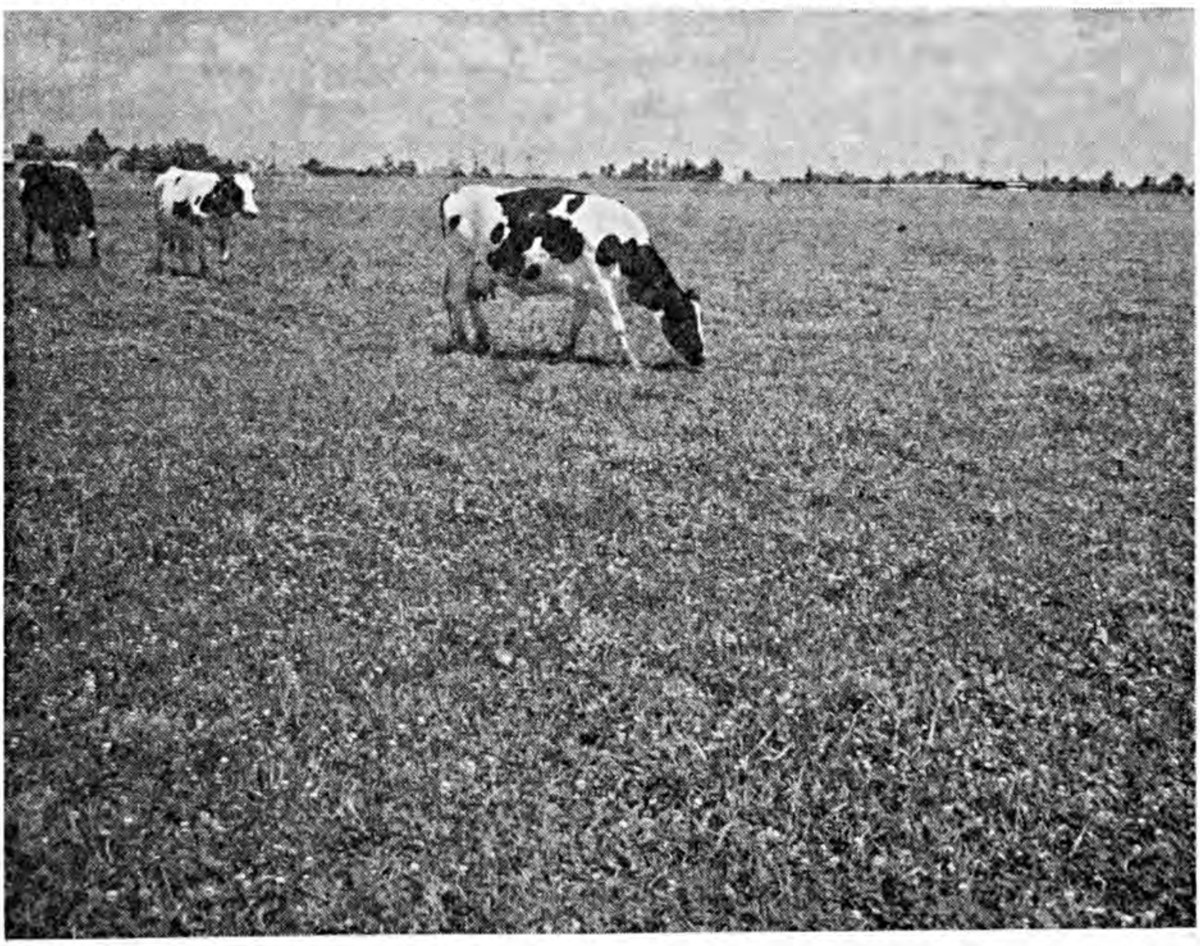
Above: **Problem areas in soil conservation in the Western Gulf Region, (Arkansas, Texas, Oklahoma, and Louisiana).**

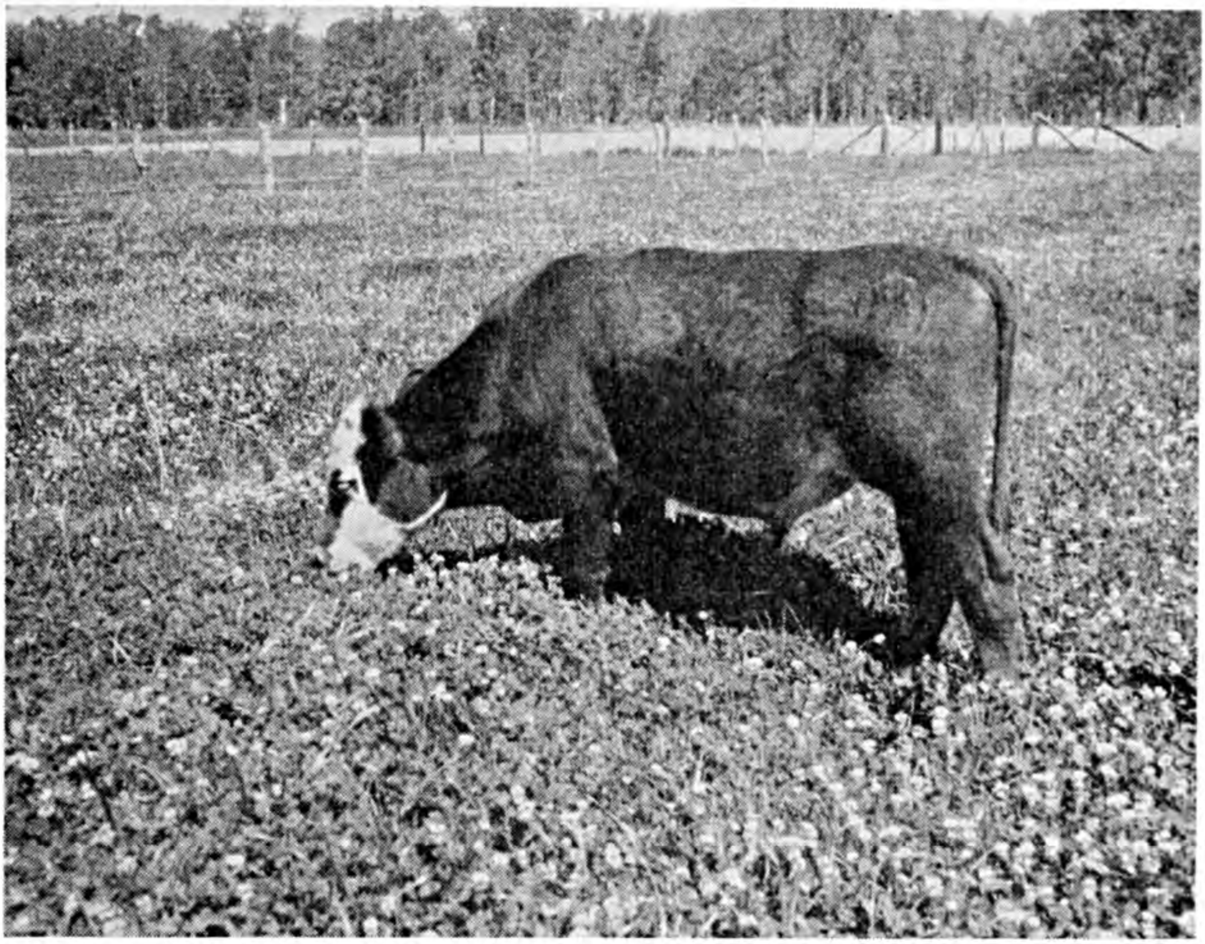
Below: **Poor pasture, poor calf. Pastures such as this do not yield profitable returns.**



Above: **This mixture of grass and legumes supported as many as three animal units per acre in spring months.**

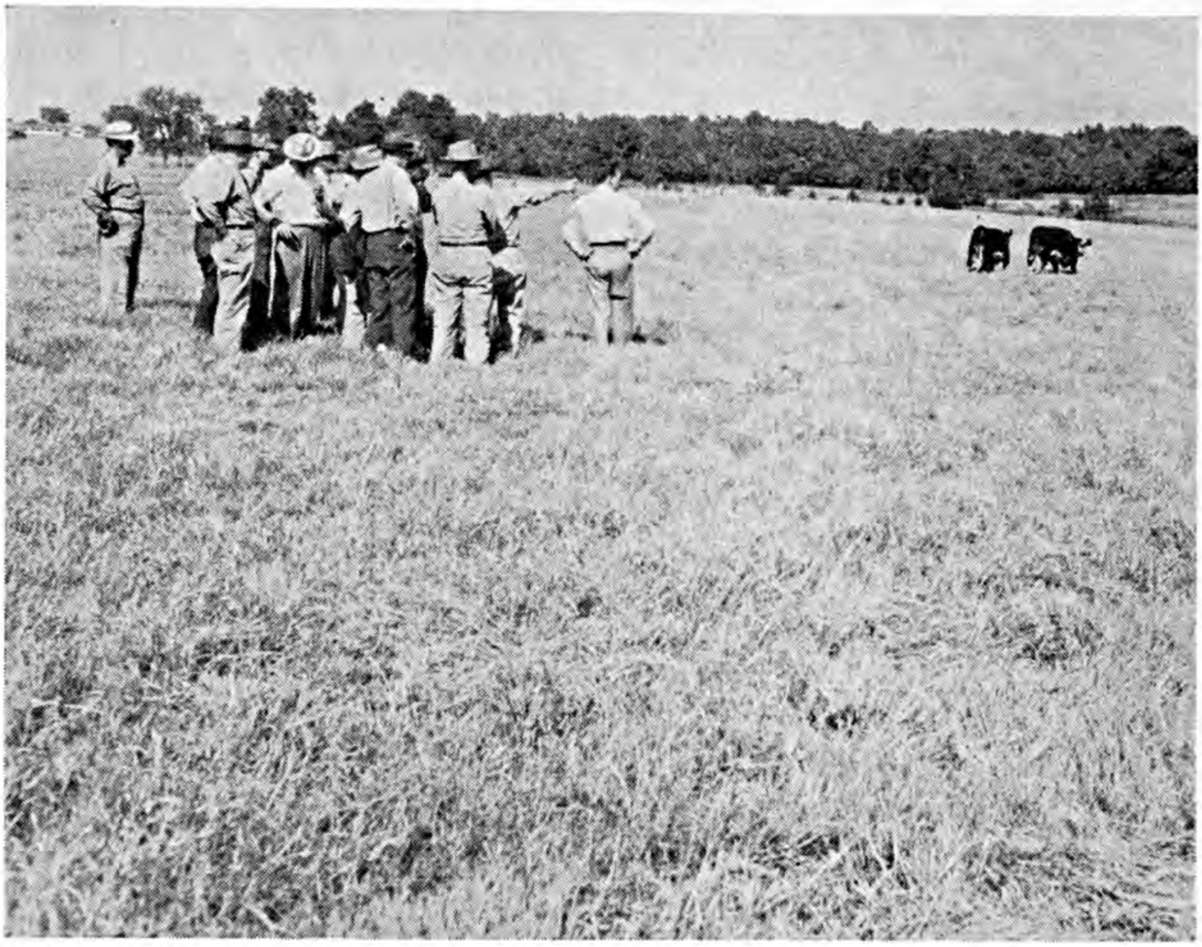
Below: **Thirty days grazing from this pasture resulted in enough increase in milk production and decrease in feed bill to more than pay the cost of land preparation, seeding, and fertilizing.**





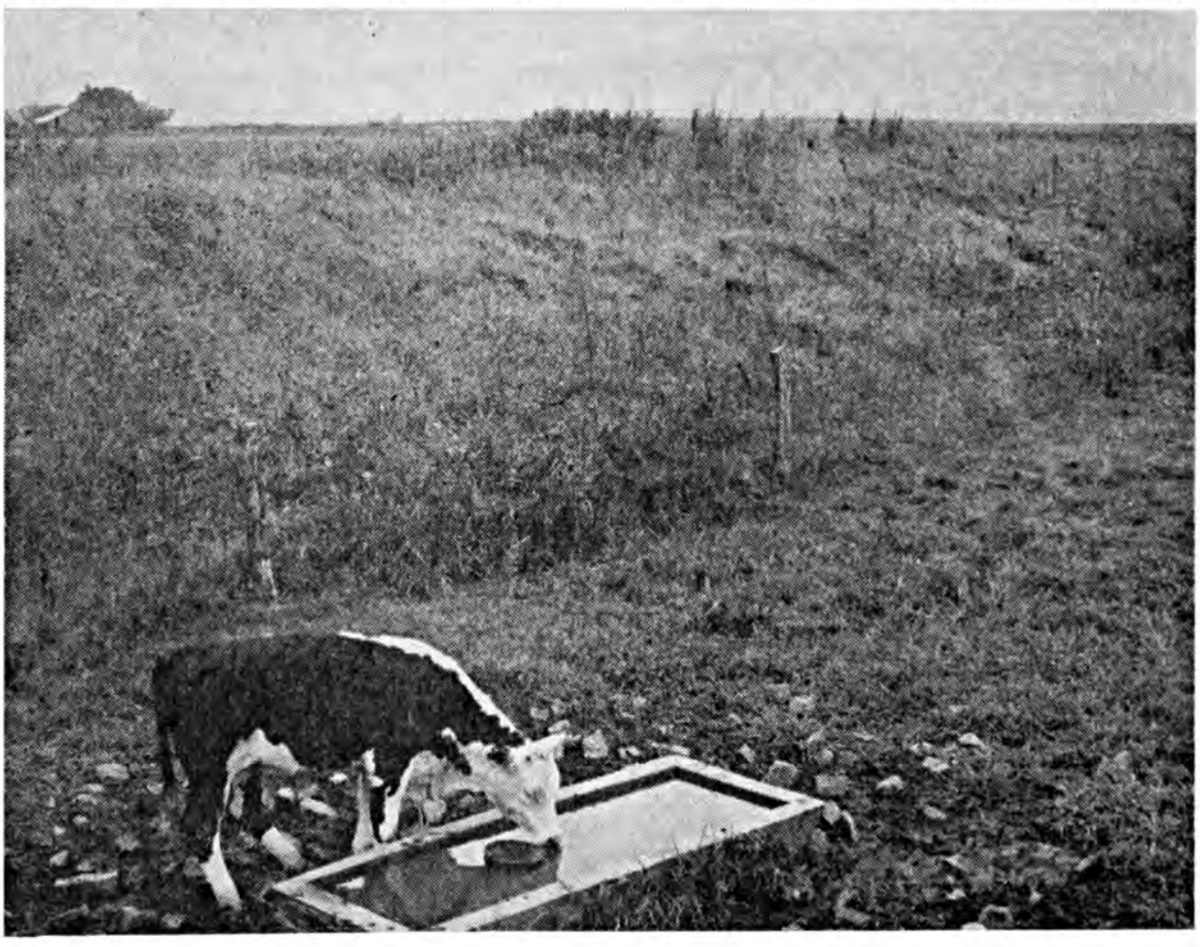
Above: **This pasture is fertilized with 300 lbs. superphosphate and 100 lbs. muriate of potash each year. From October 15 to March 15 this animal gained approximately 2 lbs. per day.**

Below: **A good Bermuda grass and clover pasture on the C. F. Cornelius farm near Idabel, Oklahoma.**



Above: **Members of a Pasture Improvement Contest tour see and discuss good pastures near Harrison, Arkansas.**

Below: **A watering trough below pond dam provides a readily accessible source of fresh, clean water.**



The Editors Talk

The Story of Soil Conservation

So much has been written and said about soil conservation in the United States that its importance is now fully recognized by almost everyone connected with agriculture and by great numbers in other industries. A million farmers in soil conservation districts and under other programs of the Service have now experienced first-hand the benefits to be derived personally from taking the best care of the Nation's greatest natural resource. And yet the job is far from completed and much more must be written and said to emphasize and re-emphasize the dangers of soil neglect, not only to our present but our future civilizations.

"It seems to me," Hugh H. Bennett, Chief of the Soil Conservation Service, says in his 1950 fiscal-year report to the Secretary of Agriculture, "that the very uncertainty of the world's political, economic, and military situations makes it imperative that we speed up our conservation work. In the near future, we must be able to say that our agricultural plant is stable and that its capacity for production, as far as we can see ahead, can be expanded to meet any anticipated needs without danger of serious damage to our future productive capacity."

By June 30, 1950, the report shows, 18.6 per cent of the conservation job had been completed, in addition to a considerable spread of unrecorded practices to farms both within soil conservation districts and outside. This is about one-fifth of the total job. Dr. Bennett expresses the belief that with adequate facilities, the job of applying basic conservation measures to the land could be completed in about 20 years, after which would remain the continuing task of maintaining the conservation improvements.

No better authority than Dr. Bennett can be quoted on this phase of our national welfare. Known as "The Father of Soil Conservation" he has become internationally famous for his practical approach to problems and the results obtained. Large numbers of technical and administrative representatives of foreign countries, despite many critical internal problems at home, have come to the United States to see and learn our methods of soil and water conservation. This is a fitting tribute to a long life's interest and devotion to a project for the betterment of all mankind.

Another fitting tribute is just appearing to the public in the form of a book—"Big Hugh" by Wellington Brink (Macmillan Company, New York, $2.75). This book not only is a factual and humorous recounting of a great man's life; it is the story of soil conservation. Louis Bromfield, in his preface, says, "I have seen, perhaps for the first time in history, a whole nation turning to right a wrong, to check an evil before it was forced to do so by utter disaster. I doubt that this could have been accomplished without the leadership and wisdom of Hugh Bennett. Certainly, without him the progress would have been infinitely slower."

The book will help to speed up the finishing of the "job."

New Rules for Good Pasture

"Research is setting up new rules for success with pastures and the results pay profitable returns in livestock gains," says Dr. W. M. Myers, Head of Forage Investigations for the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture. Many recent experiments demonstrate that improved pastures produce as much livestock feed per acre on comparable land as high-yielding corn crops and considerably more than other grain crops. The cost per unit of pasture production is lower than for corn and for other grains. Studies of comparative costs per 100 pounds of total digestible nutrients show that production on improved pastures costs less than a third of corn for grain, about a third of corn for silage, and only one-fourth of oats for grain. Returns from pasture per man hour of labor are strikingly higher than for other cultivated crops—six times more than from corn, nine times more than from oats, and nearly ten times more than from barley.

The first rule of success in today's improved pasture, according to Dr. Myers, is the use of the new large, deep-rooted grasses and legumes recently selected for adaptation to different areas in the United States. The up-to-date farmer no longer buys a shotgun mixture of 15 to 20 grass and legume species to plant at high seeding rates (25 to 30 pounds per acre) in the hope that some of them will establish a stand. Precise information on adapted species now makes it possible for growers to buy simple mixtures, usually one grass and one legume, no more than four or five species at most. These are seeded at much lower rates than formerly used.

Plenty of fertilizer is the next rule for success in productive pastures. Dr. Myers stresses the need for comparatively large initial applications of fertilizer to insure good stands and additional applications after the pasture is established to replace nutrients from the soil.

Grassland management, he says, begins with a farmwide plan to fit livestock needs and to make full use of soils and climate. Drawn up on the basis of acreage in permanent pasture, these plans differ from farm to farm, but they have certain features in common. Renovating existing pastures is a major advance on many farms. Rotation pastures on cropland are meeting increased forage needs and hold tremendous potentialities for higher yields.

Dr. Myers sees an even distribution of forage production through the growing season as one of the big problems research has yet to solve. The well-established, adapted species are not superior in this respect. They, too, have peaks of production and mid-season declines when stock must be fed from some other source. The solution to this problem, in his opinion, is not in any single pasture or pasture mixture, but in careful integration of the entire forage program, making use of permanent pastures when available, preserving surplus production as hay or silage, and developing supplemental pastures to fill seasonal production gaps.

With the anticipated shortages of labor on farms, the high output per man hour that can be obtained from pastures has an added significance in our national food production program. With a nationwide grasslands program being formulated and as far as possible put into effect this year, Dr. Myers' conclusions based on wide investigation assume an added importance. They should be of great value to advisory groups instituting local pasture improvement programs.

"Every blade of grass is a study; and to produce two where there was but one is both a profit and a pleasure."—ABRAHAM LINCOLN.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
January	26.47	39.7	136.0	215.0	115.0	192.0	17.15	43.60	....
February	27.50	34.1	133.0	221.0	116.0	193.0	16.75	43.60	....
March	28.05	32.0	132.0	222.0	119.0	198.0	16.45	43.00	....
April	28.74	....	134.0	228.0	126.0	201.0	16.65	44.40	....
May	29.24	48.5	128.0	228.0	134.0	204.0	17.25	45.20	....
June	29.91	49.7	127.0	211.0	136.0	193.0	16.05	46.20	....
July	33.05	45.5	127.0	208.0	144.0	199.0	15.15	52.00	....
August	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....

Index Numbers (Aug. 1909—July 1914 = 100)

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	89	81	109	74	87	110
1938	69	196	80	79	76	64	57	97	88
1939	73	154	100	84	88	78	67	94	91
1940	80	160	78	97	96	77	64	96	111
1941	137	264	116	105	117	107	82	211	129
1942	153	369	168	134	143	124	91	202	163
1943	160	405	188	235	174	154	125	231	245
1944	167	420	214	216	170	160	139	234	212
1945	181	366	205	232	198	170	127	227	207
1946	263	382	178	248	212	209	141	319	182
1947	257	380	232	248	336	259	148	381	226
1948	245	482	222	253	201	226	155	298	214
1949	231	463	184	244	210	210	139	192	201
1950									
January	213	397	195	245	179	217	144	193	261
February	222	341	191	252	181	218	141	193	203
March	226	320	189	253	185	224	139	191	168
April	232	...	192	260	196	227	140	197	205
May	236	485	184	260	209	231	145	200	178
June	241	497	182	240	212	218	135	205	182
July	267	455	182	237	224	225	128	231	200
August	298	531	175	248	224	223	130	314	164
September	322	554	151	219	224	219	131	349	126
October	314	551	123	175	213	216	134	361	138
November	332	525	126	169	213	219	139	436	188
December	325	472	128	197	226	230	144	452	211

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
January	3.00	2.32	10.27	13.79	10.26	10.08
February	3.00	2.32	9.37	13.45	8.96	8.96
March	3.00	2.32	9.70	13.01	10.17	9.34
April	3.00	2.32	10.34	12.58	10.39	8.19
May	3.00	2.05	10.74	11.97	10.14	7.59
June	3.00	1.71	10.55	10.79	9.41	7.36
July	3.00	1.71	11.53	10.71	9.35	8.74
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish scrap	Tankage	High grade ground blood
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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
January	112	81	293	391	304	286
February	112	81	268	381	266	255
March	112	81	277	369	302	265
April	112	81	295	356	308	233
May	112	72	307	339	301	216
June	112	60	301	306	279	209
July	112	60	329	303	277	248
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311

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[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
January	.762	3.76	5.47	.375	.720	14.50	.200
February	.760	3.76	5.47	.375	.720	14.50	.200
March	.760	3.76	5.47	.375	.720	14.50	.200
April	.760	3.76	5.47	.375	.720	14.50	.200
May	.760	3.76	5.47	.375	.720	14.50	.200
June	.760	3.76	5.47	.336	.647	12.77	.176
July	.760	3.76	5.47	.368	.704	13.98	.193
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.75	5.47	.368	.704	13.98	.193
October	.760	3.73	5.47	.386	.704	13.98	.193
November	.760	3.73	5.47	.386	.732	14.72	.193
December	.798	3.73	5.47	.420	.796	16.00	.210

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
January	142	104	112	68	76	60	83
February	142	104	112	68	76	60	83
March	142	104	112	68	76	60	83
April	142	104	112	68	76	60	83
May	142	104	112	68	76	60	83
June	142	104	112	63	68	53	80
July	142	104	112	67	74	58	82
August	142	104	112	67	74	58	82
September	142	104	112	67	74	58	82
October	142	103	112	70	74	58	82
November	142	103	112	70	77	61	82
December	149	103	112	75	84	66	85

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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
January	235	238	221	135	96	316	142	72
February	237	237	223	132	96	286	142	72
March	237	239	223	134	96	305	142	72
April	241	240	223	135	96	313	142	72
May	247	244	228	132	91	311	142	72
June	247	245	230	126	85	293	142	66
July	263	247	238	128	85	301	142	70
August	267	248	243	131	85	321	142	70
September	272	252	247	131	85	324	142	70
October	268	253	247	131	85	323	142	73
November	276	255	250	132	85	328	142	74
December	286	257	253	138	88	346	149	78

* U. S. D. A. figures, revised January 1950. 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] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] 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 is 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 Chemist of Florida, year ending Dec. 31, 1949," USDA, Tallahassee, Fla., J. J. Taylor.

"Effects of Fertilizers and Seeding on the Establishment of Grazed Firebreaks," Agr. Exp. Sta., Texas A & M College, College Station, Texas, P. R. 1247, May 11, 1950, T. H. Silker, L. E. Crane, and J. C. Smith.

"Efficient Use of Dairy Manure," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt., Pamp. No. 24, Aug. 1950, A. R. Midgley.

Soils

"Handling Northeastern Illinois Soils," Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 663, June 1950, W. F. Purnell, E. D. Walker.

"Potato Irrigation, Costs and Practices in Suffolk County, New York, 1946," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., Bul. 862, Sept. 1950, R. N. Hampton, R. G. Murphy, and P. R. Hoff.

"Soil Testing Reduces Guesswork," Ext. Serv., N. C. State College, Raleigh, N. C., Oct. 1950, W. L. Nelson and C. D. Welch.

"Upkeep of Southern Great Plains Wheatlands," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Mimeo. Cir. M-204, Aug. 1950, H. H. Finnell.

"Irrigation and Variety Trials with Lettuce in the Lower Rio Grande Valley," Agr. Exp. Sta., Texas A & M College, College Station, Texas, P. R. 1258, July 8, 1950, M. E. Bloodworth, N. P. Maxwell, P. E. Ross, and W. R. Cowley.

"Economic Land Classification of Essex County," Bul. 433, Mar. 1950, G. W. Patteson, Z. M. K. Fulton, and A. J. Harris; "Economic Land Classification of Madison County," Bul. 434, Mar. 1950, G. W. Patteson and A. J. Harris; "Economic Land Classification of Charlotte County," Bul. 441, Sept. 1950, G. W. Patteson, Z. M. K. Fulton, and A. J. Harris; "Economic Land Classification of Carroll County," Bul. 442, Sept. 1950, G. W. Patteson and Z. M. K. Fulton, Jr., Agr. Exp. Sta., Blacksburg, Virginia.

"Soil, Water, and Crop Management Investigations in The Columbia Basin Project," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. 520, Nov. 1950.

"Soil Survey, Marshall County, Kentucky," Agr. Exp. Sta., Lexington, Ky., Series 1938, No. 29, Sept. 1950, W. J. Leighty and C. E. Wyatt.

"Soil Survey, Otoe County, Nebraska," Agr. Exp. Sta., Lincoln, Neb., Series 1940, No. 6, Aug. 1950, T. E. Beasley, W. J. Moran, V. W. Filley, C. E. Pilcher, and C. R. Buzzard.

"Conservation Irrigation," USDA, Wash., D. C., Agr. Inf. Bul. 8, May 1950, A. W. McCulloch and W. D. Criddle.

"The Occurrence of Barium in Soils and Plants," USDA, Wash., D. C., Tech. Bul. 1013, Sept. 1950, W. O. Robinson, R. R. Whetstone, and Glen Edgington.

"Rates and Amounts of Runoff for the Blacklands of Texas," USDA, Wash., D. C., Tech. Bul. 1022, July 1950, R. W. Baird and W. D. Potter.

"Sound Land Classification Rests on Soil Surveys," USDA, Agr. Res. Adm., Beltsville, Md., June 1950.

"Southwest Region Annual Report, Fiscal Year Ending June 30, 1949," USDA, S. C. S., Albuquerque, New Mex., C. Luker.

"Southwest Region Annual Report, Fiscal Year Ending June 30, 1950," USDA, S. C. S., Albuquerque, New Mex., C. Luker.

Crops

"Tomato Production in California," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif., Cir. 167, June 1950, J. H. MacGillivray, A. E. Michelbacher, and C. E. Scott.

"Division of Field Husbandry, Soils and Agricultural Engineering," P. R. 1936-1948, Central Exp. Farm, Ottawa, Ontario, Canada, P. O. Ripley.

"Lawns, Their Preparation and Care," Manitoba Dept. of Agr. and Immigration, Winnipeg, Manitoba, Canada, Pub. No. 233, Mar. 1950, F. J. Weir.

"Strawberry Growing in Manitoba," Manitoba Dept. of Agr. and Immigration, Winnipeg, Manitoba, Canada, Pub. No. 234, Mar. 1950, E. T. Andersen.

"The Production, Harvesting and Curing of Cigar Tobacco," Dominion Exp. Sta., L'As-

somption, Que., Canada, Pub. 832, Farmers' Bul. 160, June 1950, R. Bordeleau.

"Raspberries and Blackberries," Dept. of Agr., Ottawa, Ontario, Canada, Pub. 836, Cir. 183, May 1950.

"Gooseberry Culture," Dept. of Agr., Ottawa, Ontario, Canada, Pub. 839, Cir. 185, July, 1950.

"Field Beans in Canada," Dept. of Agr., Ottawa, Ontario, Canada, Pub. 843, Farmers' Bul. 164, 1950, W. G. McGregor, A. J. MacLean, and V. R. Wallen.

"Small Fruit Growing in Alberta," Univ. of Alberta, Dept. of Ext., Edmonton, Alberta, Canada, Bul. 54, Mar. 1950, R. J. Hilton and O. D. Lancaster.

"Gardenias in Florida," Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla., Bul. 145, Aug. 1950, J. V. Watkins.

"Ground Covers for Florida Gardens," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 473, Sept. 1950, J. M. Crevasse, Jr.

"The Lychee in Florida," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 471, Aug. 1950, M. Cobin.

"Winter Grazing," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., E. D. Alexander, J. B. Preston, and J. R. Johnson.

"Watermelon Production in Hawaii," Univ. of Hawaii, Honolulu, Hawaii, Agr. Ext. Cir. 288, July 1950, Yukio Nakagawa.

"Report on Agricultural Research for the Year Ending June 30, 1949," Agr. Exp. Sta., Iowa State College, Ames, Iowa.

"Blueberry Culture in Massachusetts," Agr. Exp. Stat., Univ. of Mass., Amherst, Mass., Bul. 358, Rev. June 1950, J. S. Bailey, H. J. Franklin, and J. L. Kelley.

"The Home Fruit Planting," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Rev. June 1950, L. C. Snyder.

"Research for New Mexico Agriculture," 60th A. R., Agr. Exp. Sta., N. Mex. College of Agr., State College, N. Mex.

"Hay and Pasture Seedings," Cornell Univ., Ithaca, N. Y., Cornell Ext. Bul. 781, Jan. 1950.

"Newer Varieties of Vegetables for 1950," Cornell Univ., Ithaca, N. Y., Cornell Ext. Bul. 782, Jan. 1950, P. Work and G. O. Elle.

"Atlas Wheat," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Spec. Cir. No. 8, Sept. 1950, G. K. Middleton and T. T. Hebert.

"Murphy and Wolcott Blueberries," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Spec. Cir. No. 10, June 1950, E. B. Morrow and G. M. Darrow.

"Field Corn Production on the Umatilla Irrigation Project," Sta. Bul. 480, June 1950, C. A. Larson, F. S. Viets, and R. W. Leamer; "Sprouting Broccoli," Ext. Bul. 704, July 1950, A. G. B. Bouquet; "Growing Snap Beans for Market and for Manufacture," Ext. Bul. 705, July 1950, A. G. B. Bouquet; "Growing Sweet Corn for Market and Manufacture," Ext. Bul. 706, July 1950, A. G. B. Bouquet; "Forage Crops for Coast Counties of Oregon," Ext. Bul. 707, July 1950, H. B. Howell and A. S. King; Ext. Serv. Oreg. State College, Corvallis, Oreg.

"Some Interesting Perennials for the Home Grounds," Agr. Ext. Serv., Pa. State College, State College, Pa., Cir. 370, Oct. 1950, A. O. Rasmussen.

"Comparative Effects of Various Organic Mulches and Clean Cultivation on Yields of Certain Vegetable Crops," Agr. Exp. Sta., Pa. State College, State College, Pa., P. R. No. 35, August 1950, F. M. Isenberg and M. L. Odland.

"Grasses and Legumes for South Dakota," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Cir. 81, May 1950, M. W. Adams, J. G. Ross, W. W. Worzella, and A. N. Hume.

"A Handbook of Peanut Growing in the Southwest," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Bul. 727, also, Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Bul. B-361, November 1950.

"Cabbage Variety Trials in the Lower Rio Grande Valley, 1949-50," P. R. 1257, July 6, 1950, C. A. Burleson, J. S. Morris, P. W. Leeper, and W. R. Cowley; "Effect of Rootstocks on Yield of Grape Varieties at Montague," P. R. 1259, July 20, 1950, U. A. Randolph; "Greater Profits from Better Grape Varieties," P. R. 1260, July 20, 1950, U. A. Randolph; "Grain Sorghum Variety Tests at Lubbock, 1947-49," P. R. 1265, Aug. 7, 1950, D. L. Jones, J. Box, and E. L. Thaxton, Jr.; "Yield and Adaptation of Certain Forage Species in the Lower Rio Grande Valley," P. R. 1269, Sept. 1, 1950, E. M. Trew, Jr.; Agr. Exp. Sta., Texas A & M College, College Station, Texas.

"Vegetable Garden Suggestions for Virginia Farmers," Cir. 475, Feb. 1950, F. S. Andrews, L. C. Beamer, and F. H. Scott; "Growing Small Grain," Cir. 502, July 1950; "Boxwood," Cir. 503, July 1950, A. G. Smith, Jr.; "Winter Cover Crops," Cir. 505, Sept. 1950; "What's New in Oats?" Cir. 506, Sept. 1950; Agr. Ext. Serv., Va. Poly. Inst., Blacksburg, Va.

"Strawberries for West Virginia Farms," Agr. Exp. Sta., W. Va. Univ., Morgantown, W. Va., Cir. 64, Rev. May 1950, W. H. Childs.

"Performance of Regional Strains of Ranger Alfalfa," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Res. Bul. 171, Sept. 1950, D. Smith and L. F. Graber.

"Growing Raspberries & Blackberries in Wisconsin," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Sten. Cir. 240, Rev. Feb. 1950, J. G. Moore.

"Alfalfa Variety Trials in Wyoming," Agr. Exp. Sta., Univ. of Wyoming, Laramie, Wyoming, Bul. 297, May 1950, R. Lang.

"Ornamental Woody Vines for the Southern Great Plains," Farmers' Bul. No. 2015, July 1950, E. M. Johnson; "Commercial Growing and Harvesting of Sweetpotatoes," Farmers' Bul. No. 2020, Aug. 1950, V. R. Boswell; "Rice Culture in California," Farmers' Bul. 2022, Sept. 1950, J. W. Jones; USDA, Wash.

"Identification of Brassicas by Seedling Growth or Later Vegetative Stages," USDA, Wash., D. C., Cir. No. 857, Sept. 1950, A. F. Musil.

"Report on Exploratory Investigations of Agricultural Problems of Alaska," USDA, Wash., D. C., Misc. Pub. No. 700, December 1949.

"Imported Varieties of Dates in the United States," USDA, Wash., D. C., Cir. No. 834, July 1950, R. W. Nixon.

Economics

"Labor and Material Requirements, Costs of Production and Returns on Florida Irish Potatoes," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 472, Sept. 1950, D. L. Brooke and A. H. Spurlock.

"Labor and Material Requirements, Costs of Production and Returns on Florida Tomatoes," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 474, Sept. 1950, D. L. Brooke and A. H. Spurlock.

"Facts and Figures Annual Potato Summary, Crop of 1949," Dept. of Agr., Trenton, N. J., Cir. No. 377, May 1950.

"Inventory of Land Use in North Carolina," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Tech. Bul. No. 93, Nov. 1950, J. E. Mason and G. W. Forster.

"The Economics of Grass Seed Production in the Willamette Valley, Oregon," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Bul. 484, Sept. 1950, E. A. Hyer, M. H. Becker, and D. C. Mumford.

"An Economic Study of Family-Sized Farms in Puerto Rico—III. La Plata Farm Security Administration Farms, 1943-44, 1944-45," Agr. Exp. Sta., Univ. of Puerto Rico, Rio Piedras, P. R., Bul. No. 79, Apr. 1950, G. Serra and M. Pinero.

"Keeping Up on the Farm Outlook," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 165, Oct. 31, 1950, K. Hobson.

"Keeping Up on the Farm Outlook," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 167, Nov. 30, 1950, K. Hobson.

"Peppermint Oil—An Economic Study," Agr. Exp. Sta. State College of Wash., Pullman, Wash., Pop. Bul. No. 199, Aug. 1950, L. N. Liebel.

"The 1951 Handbook of Conservation Practices for: 1061, N. J.; 1061, Minn.; 1061, Ark.; 1061, Del.; 1061, La.; 1061, Md.; 1061, Miss.; 1061, N. H.; 1061, N. Dak.; 1061, Pa.; 1061, R. I.," Pro. and Mkt. Adm., USDA, Wash., D. C.

"Supplement for 1949 to Consumption of Food in the United States 1909-48," USDA, Wash., D. C., Misc. Pub. No. 691, Sept. 1950.

"Agricultural Outlook Charts, 1951," USDA, Wash., D. C., Oct. 1950.

"Foreign Agricultural Outlook Charts 1951," USDA, Wash., D. C., Oct. 1950.

"Crops and Markets," USDA, Wash., D. C., 1950 Edition, Vol. 27.

Soil Properties . . .

(*From page* 16)

sulfur, and nitrogen were provided, but grew well when potassium was added to the above combination. Deficiencies are likely to increase in number and severity as the soil ages. Much can happen to a soil or the material from which it is formed in a period of a few hundred thousand or perhaps a few million years, over which nature's tools have been operating to develop certain properties that are sometimes limitations to plant growth.

The most fertile soils of western Oregon, such as the Chehalis series, sometimes called second bottom, are probably some of the more recent formations. The best of these soils are deep and permeable, due to a porous, granular sponge structure; and they are well supplied with nutrients, including calcium which keeps the soil near neutral. The soils are too young to have claypan subsoils, in fact there is little differentiation of horizons anywhere in the profile. But not all Chehalis soils are good, and the name Chehalis is not a guarantee against a deficiency. Any soil may develop one or more deficiencies in time.

The need for lime, governed by the reaction of the soil, may determine availability of the natural phosphate of the soil, and therefore the need or the response to phosphate fertilization. Experimental data have shown that as an acid soil approaches neutrality due to liming, phosphate availability increases, sometimes to the extent that a soil which responded to phosphate fertilization in the acid condition no longer responds after liming. Considering the common crops of agriculture, soils are most productive when kept near neutral in reaction.

Greenhouse trials may be used to exaggerate nutrient deficiencies and thus sometimes to eliminate doubts about probable responses. Using the sunflower as an indicator plant, one soil showed a rather minor response to either phosphorus or nitrogen when each was used alone. The response to treble superphosphate was about 17 per cent increase in growth and to nitrogen 52 per cent, indicating that the deficiency was greater for nitrogen than for phosphorus. The same rate of application, using both nitrogen and phosphorus, increased the growth by 319 per cent. When the phosphorus deficiency was corrected, use of nitrogen gave six times as much increase as when the phosphorus deficiency was not corrected. Correction of the nitrogen deficiency enabled the phosphorus treatment to produce 16 times as much increase as when the same amount of phosphorus was supplied without application of nitrogen. These data indicate that the soil was seriously in need of both nitrogen and phosphorus, but that the need for nitrogen was somewhat greater than the need for phosphorus for sunflower growth.

In judging fertilizer needs of soils and in evaluating crop responses, therefore, it becomes necessary to know the properties of the soil, physical as well as chemical, and to know the plant and the biological significance attached to both the plant and its soil environment. It is necessary to recognize that there are probably several limiting factors operating to keep yields down. Among these may be climate, available soil moisture, and the presence or absence of destructive or beneficial soil organisms, as well as the past fertilizer program, crop rotation, crop variety, humus renewal, tillage operations, and other things that may affect yields.

Fertilizer rates are also significantly related to the appearance of nutrient deficiency. As the most prominent deficiencies are corrected and yields are increased, other deficiencies may appear. What is enough of any element for a 30-bushel yield of grain may prove inadequate as the yields rise to 50 to 60 bushels. On small experimental plots, wheat yields have been pushed to better than 80 bushels in western Oregon and slightly over 100 bushels in eastern Oregon. Such yields require much of everything that plants use from the soil. Big yields naturally exhaust fertility faster (for those elements not in the fertilizer) and therefore require more complete fertilization and better farming practices generally to keep the soil in a high state of productivity. The farmer who said that he fertilizes rented land heavily but that he didn't fertilize his own because he didn't want to exhaust his soil may have been partially right, but probably he was overlooking his best chance for some profitable crop increases from his own land. And he failed to realize that fertilizers can be used to improve the soil and that their use can be profitably combined with other good soil-improving practices.

The ever-increasing use of fertilizers in Oregon is associated with greater interest in all the factors which affect yields and profits in crop production, whether it be sprays for insects, disease, weed control, humus renewal, better varieties, or some other problem. The rate of fertilizer application is increasing. To use 100 pounds of nitrogen per acre in some form of fertilizer (more sometimes) is not uncommon. On valuable crops, especially small fruits and vegetables, and on specialty crops of high acre value, such as mint, use of a complete fertilizer is common practice. Farmers are definitely striving for bigger yields, 1,500 pounds or more of ryegrass seed, sometimes 1,500 pounds of cabbage seed, 14 tons of snap beans, a carrying capacity of four cows per acre on irrigated and fertilized pastures, and similar record production of other crops. While these yields are much above average, they are more and more sought after. Good soil, good management, and adequate fertilizer use are making crop yield records that at one time would have been thought impossible.

Progress has not been halted by difficulties, such as increasing disease and insect pests, which both the scientist and the farmer have ably attacked. Even the present top yields are nearly sure to be surpassed in the not too distant future. There is some glamour and usually both profit and satisfaction to stimulate efforts to reach high production.

Permanent Tame Pastures

(*From page* 26)

through photosynthesis. If too great a proportion of the green, leafy parts of the plants are consumed and trampled by livestock, the plants are starved and weakened. Though only broad terms can be applied to pasture plants in general, good management will compromise on a 50-50—consume half and leave half—basis. The taller the habit of growth of the pasture plant, the greater the minimum height below which it should not be grazed. The taller grasses and legumes may require minimum heights of 6 inches or more, if they are to be fully productive and maintain themselves well in the pasture mixture. Low-growing turf grasses may be grazed lower if rested intermittently. Grazing should be rotated and deferred for a given pasture each year to allow a recovery of plants and development of new growth of high forage value. Heavy grazing towards the normal end of the growing season of a perennial may lessen the translocation of plant food to the crowns and underground parts and weaken the plant during dormancy and for emergence the following year.

Winter-killing in the northern part of the region and lowered yields in succeeding years are results of too heavy grazing too late in the growing season. It is poor soil and moisture conservation, too. After-frost grazing does not decrease vigor since only dead material is taken; however, this type of grazing usually requires heavy concentrate feeding as the cured grass growth is not high in essential elements for animal nutrition.

5. ***Rest pastures seasonally.*** This can best be done by being sure that each conservation farm plan provides for enough seasonal supplemental pasture crops. Having both cool-season and warm-season permanent pastures also assures the opportunity to rest each pasture seasonally.

6. ***Re-seed pasture plants that have gradually disappeared from the mixtures.*** The maintenance of desired mixtures is a delicate balancing feat and is easily upset by use, vagaries of the weather, and by fluctuation in available plant-food elements. In spite of careful attention to use and soil-amendment details, one or more species may need re-establishment periodically. Keep a careful check on how well each plant is maintaining itself in the mixture. Deferment or careful use may need to follow re-seeding operations.

7. ***Be sure that ample water distribution, salting and feeding locations, fences and gates are planned to allow for desired confinement and movement of stock.***

a. Each pasture needs ample water, distributed properly to prevent concentrations.

b. Salting and feeding locations should be chosen to prevent undue livestock concentration, and should be on areas not highly erodible.

c. Pastures to be used at different times should be fenced separately.

Problem area in soil conservation, and site	Suitable base grasses	Legumes and grasses for overseeding
Ozark Highlands—deep, heavy, moist soils from limestone, and the waxy colluvial soils from limestone, mostly north and east exposures.	Canada bluegrass (on less productive sites) Kentucky bluegrass (best sites only) Smooth brome (best sites only) Tall fescue	Orchard grass Timothy Alsike clover Hop, bighop clover White, ladino clover Red clover Annual lespedezas Black medic
Ozark Highlands—Upland with chert mantles, major limestone influence, average or better moisture, mostly north and east exposures.	Orchard grass	Hop, bighop clover Red clover Annual lespedezas
Ozark Highlands—Soils without chert mantles, lighter, sandier, drier, and more acid soils, mostly south and west exposures.	Bermuda grass	Hop, bighop clover Annual lespedezas Sericea lespedeza
Ozark Highlands—Imperfectly drained flatwoods.	Bermuda grass Tall fescue Red top	Alsike clover Hop, bighop clover White clover Annual lespedezas
Ouachita Highlands—All heavier and more moist soils, including bottomlands except very sandy bottomlands.	Bermuda grass Dallis grass (southern part) Tall fescue Red top	Dallis grass Italian ryegrass Alsike clover Crimson clover Hop, bighop clover White, ladino clover Annual lespedezas Singletary peas (from central Arkansas south)
Ouachita Highlands—All lighter, sandier soils, usually drier upland sites, and sandy bottomlands.	Bermuda grass	Hop, bighop clover Annual lespedezas Sericea lespedeza Vetch
Cherokee Prairies—Moist to wet sites; heavy soils.	Bermuda grass Smooth brome (north) Tall fescue Red top	Italian ryegrass Alsike clover Crimson clover Hop, bighop clover White, ladino clover Annual lespedezas
Cherokee Prairies—Lighter soils of good depth (shallow and very shallow uplands better for native range).	Bermuda grass KR bluestem	Italian ryegrass Hop, bighop clover Annual lespedezas Sericea lespedeza Vetch
Bluestem Hills—Moist, fertile sites only (all other conditions better for native range).	Bermuda grass Smooth brome Tall fescue	Italian ryegrass Hop, bighop clover White, ladino clover Annual lespedezas Black medic Biennial sweetclovers Sericea lespedeza

Problem area in soil conservation, and site	Suitable base grasses	Legumes and grasses for overseeding
Cross Timbers—Bottomland sites with favorable moisture conditions.	Bermuda grass KR bluestem Tall fescue	Burclovers Crimson clover Hop, bighop clover White, ladino clover Annual lespedezas Sericea lespedeza Black medic Vetch
Cross Timbers—Upland sites.	Bermuda grass KR bluestem	Annual lespedezas Sericea lespedeza Vetch
Reddish Prairies—Bottomland and moist upland sites only (other conditions better for native range).	Bermuda grass KR bluestem Tall fescue	Sweetclovers Vetch
Rolling Red Plains—Sites with favorable moisture only (other conditions better for native range).	Bermuda grass KR bluestem	Sweetclovers Vetch
Bottomland—All sites.	Bermuda grass Smooth brome (north) Carpet grass (south) Dallis grass (from central Arkansas south) Tall fescue	Dallis grass Italian ryegrass Alyce clover (south) Burclovers Alsike clover (wet lands) Crimson clover Hop, bighop clover Persian clover (south) White, ladino clover Annual lespedezas (except on calcareous soils) Black medic (calcareous) Singletary peas (from central Arkansas south)
Loessial Upland and Terrace—All sites	Bermuda grass Carpet grass (south) Dallis grass (from central Arkansas south). Tall fescue	Alyce clover Dallis grass Italian ryegrass Alsike clover (wet sites) Crimson clover Hop, bighop clover Persian clover (south) White, ladino clover Annual lespedezas Sericea lespedeza Singletary peas (from central Arkansas south) Burclovers
Forested Coastal Plain—Upland sites in 40″ or less rainfall areas	Bermuda grass KR bluestem	Annual lespedezas Sericea lespedezas Singletary peas Vetch

Problem area in soil conservation, and site	Suitable base grasses	Legumes and grasses for overseeding
Forested Coastal Plain—Bottomland sites and upland sites in areas with more than 40″ rainfall, average or better moisture conditions.	Bahia grass (south only) Bermuda grass KR bluestem (flatwoods) Carpet grass (south) Dallis grass Tall fescue	Dallis grass Italian ryegrass Alyce clover Burclovers Crimson clover Hop, bighop clover Persian clover White, ladino clover Annual lespedezas Sericea lespedeza Singletary peas Vetch
Forested Coastal Plain—Coarse, sandier soils sites with less favorable moisture conditions (deep sands better for growing pine or to establish to pure stands of kudzu or sericea lespedeza).	Bermuda grass KR bluestem	Annual lespedezas Sericea lespedeza Singletary peas Vetch
Coast Prairie—Sandy sites.	Bermuda grass Angleton bluestem (west) KR bluestem	Annual lespedezas Singletary peas Sweetclovers (west) Vetch
Coast Prairie—Mixed land sites.	Bahia grass Bermuda grass Angleton bluestem KR bluestem (west) Carpet grass (east)	Annual lespedezas Singletary peas Sweetclovers (west)
Coast Prairie—Tight land sites.	Bermuda grass Angleton bluestem KR bluestem (west) Carpet grass (east) Dallis grass Tall fescue Rhodes grass (west)	Dallis grass Italian ryegrass Crimson clover Persian clover (east) White, ladino clover Annual lespedezas (east) Singletary peas Sweetclovers (west)
Blackland Prairies—Deep, favorable moisture sites (other conditions better in native range).	Bermuda grass KR bluestem Buffalo grass Tall fescue	Dallis grass Rescue grass Burclovers Black medic Sweetclovers Vetch
Grand Prairie—Sites with favorable moisture (other conditions better in native range).	Bermuda grass (best bottomland sites only) KR bluestem Buffalo grass Tall fescue (bottomland)	Burclovers Black medic Sweetclovers Vetch
Rio Grande Plains—Sites with favorable moisture only (other conditions better in native range).	Angleton bluestem (along coast) KR bluestem Rhodes grass	Sweetclovers

ALFALFA, Queen of Forage Crops

(*From page* 14)

competes very strongly with alfalfa the first year and then disappears, leaving much space for seeded or volunteer grasses.

Ladino clover and alfalfa do best under such widely varying cutting or grazing systems and on such different types of soils that it appears unwise to include both in the same seeding.

Without any doubt, alfalfa is the highest yielding hay or "grass" silage crop yet grown in Connecticut. This is true whether the comparisons are based on dry matter or digestible nutrients. When one considers that these high yields may be produced on soils too sandy for other forages, during droughty as well as favorable seasons, for 5 to 10 years without reseeding, and at an annual fertilizer cost of not over $15 per acre, the remarkable fact is the relatively small area now growing alfalfa. In recent years, some Connecticut dairymen have purchased alfalfa hay from other states at more than $50 per ton, while nearby land, capable of growing three tons per acre annually, lies practically idle. In view of this situation, will anyone deny "thar is gold in them hills?"

Kentucky-31 Fescue

(*From page* 19)

Soil Conservation District.

The Jones brothers were so impressed by the new grass that they made a special trip to Kentucky, where they visited "every field of fescue in the State." They got their foundation stock from Pembroke, Ky., where the original planting of the University of Kentucky was made with seed from the B. F. Suiter farm. Two years later, in 1949, the Jones farm produced more than 90 per cent of the certified Kentucky-31 fescue seed grown in Alabama.

"Of course," Col. Jones went on to explain after we had examined the sod where the 400 head had grazed during the winter, "we don't advocate such heavy grazing under ordinary conditions. The fescue in this field was over knee-high when we turned the cows on it on November 13. They stayed right here until March 13. And during that period we had more than 30 inches of rain. But you can see for yourself, the ground's not marked. We fed them some meal and hulls," he added, "but only during extremely cold weather and when the grass had been hit by a heavy frost. We haven't a cow on this farm that has ever been in a barn."

We had seen the herd of 400 brood cows earlier that day grazing on an 80-acre field of fescue that had been planted November 19, 1949, on a two-year-old stand of sericea. They had been there since they came off the winter pasture three weeks before. The weather had been cold for the past few weeks and the sericea had not yet put out new growth, but the fescue was furnishing plenty of green grazing.

The fescue was planted on the sericea at the rate of 20 pounds to the acre with the drill on top of the ground. The land had been disked twice, with most of the angle out of the disk.

In another field of 75 acres, 150 young heifers that had been cut out for brood cows were grazing fescue planted last October in what had been an old pasture that had grown up in weeds. Another herd could be seen grazing in an adjoining field and a low-lying area nearby was being cleared for planting more land to fescue.

At seeding time, Col. Jones told us, they drill in 300 pounds of 6-8-8 with the seed. About March 1 they add an application of 100 pounds of ammonium nitrate per acre. He said they planned to add an equal amount of ammonium nitrate in the fall if they expected to graze the fescue, and would add potash and phosphate as the soils needed it.

The Jones brothers use 2, 4-D to kill wild onions and other weeds to keep impurities out of the fescue seed. This also kills the clover, but Col. Jones pointed out that they could add clover any time, in fact, it is coming back naturally in some of the fields.

One of the farmers among the group of visitors thought this over for a minute and commented:

"I don't see where you've got room for anything else to grow."

Know Your Soil

(*From page* 18)

oxide increased the yield with the 3-9-6, but larger amounts of magnesium oxide depressed it. The 3-9-12 and 3-9-18 mixtures produced rather constant increases in yield as the magnesium increased. The sweet potatoes were divided into chunky (mostly round), jumbo long and irregular, and seed potatoes.

Figure 2 shows the round and chunky

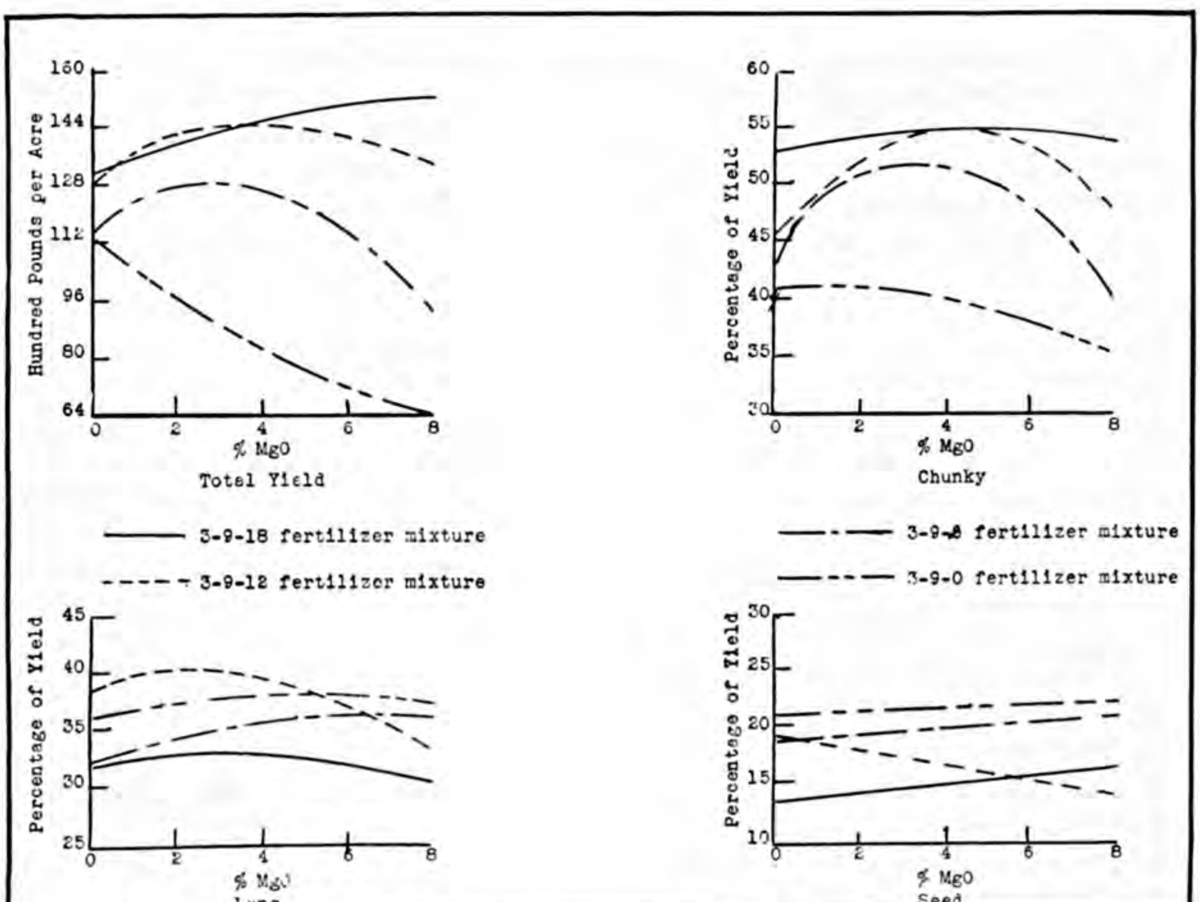


Fig. 1. Influence of different amounts of magnesium in relation to different amounts of potash upon the yield and shape of the Ranger sweet potato.

Fig. 2. The tendency toward chunky Ranger sweet potatoes results from high potash and magnesium. The long potatoes tend to result from high magesium and low potash.

potatoes as compared with the long potatoes. The percentage yield of chunky potatoes remained high with the 3-9-18 fertilizer mixtures throughout the magnesium series. The percentage of the chunky potatoes was increased considerably with the 3-9-12 fertilizer mixture up to 4 per cent magnesium oxide. The percentage yield of chunky potatoes was not increased with the lesser amounts of potash. In general, the percentage yield of the long, irregular shaped potatoes was in reverse to the chunky potatoes. The yield of seed potatoes remained fairly constant.

It appears that a definite relationship exists between the yield of sweet potatoes and potassium application and the available magnesium present, either in the soil or added with the fertilizer mixture. Working with soils of low available magnesium content, the addition of magnesium to the fertilizer mixtures is highly desirable. Two to 4 per cent magnesium oxide is necessary. With the use of magnesium in the fertilizer, growers are now returning to a 3-9-12 and higher potash fertilizer mixtures with successful production. Most of the soils on the Eastern Seaboard that are used for sweet potato production are sandy in nature and low in magnesium. Therefore, for the maximum production of high quality potatoes through the proper use of potash, the magnesium status of the soil is of concern.

Literature

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[2] Hester, Jackson B. and J. M. Blume. 1937. Results with potash in Eastern Virginia. Better Crops with Plant Food.

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Pledge to Youth

(*From page* 5)

outer end of the swinging crosspiece. By pushing the other end we moved the sled in whirligig style over the smooth ice. Not only did we have days of rare fun riding the sled in a wide circle, but by deft manipulation of the tie rope we could free the sled from the revolving arm so that it shot out like a gun across the pond.

For the smaller ones he rigged up double barrel staves with a short-sawn log attached for a seat, and they careened down woody hills in sitting fashion and with no more than the normal spills and bruises. For evening hours around the stove, this gentle, obliging neighbor made pastime games of an ancient day—like checker boards and nine-men-morris outfits. He won our hearts and has them still in his keeping as he lies in the grave above the hillside and the pond.

Being a good parent to be proud of in your old age is as much of a life job as anyone with normal ambition can seek. Too many of us overemphasized this part of the pledge to youth: "We will work to lift the standard of living and to improve our economic practices, so that you may have the material basis for a full life."

That goal is worthy all right and highly important, but we have seen otherwise purposeful parents lay it on too thick on the money-getting side. Far too many dads tore into the business routine at such a steady pace that they were too tired or crotchety to relax and enjoy the companionship of the children. Or they imagined it was mother's duty to take active part in the rearing business, as long as she never had to dodge the bill collector. But those of us who found some time, all too short at best, in which to just be a kid again and live over the wonders and enthusiasm common to youth, will never regret it. To us, the mundane earning of a living was merely a means to permit us to finish the real job nature and life had entrusted to us. Thus when all the go-getting days are over, it is happily our lot to feel that in recognizing what our best job was, we have really laid a foundation for success in at least two generations after our own. Your kids with a good start and a sound example will usually follow through with their offspring, using the same old recipe mixed with some new ingredients.

In dwelling thus on the material security phase of the pledge, it must not be forgotten, however, that poverty, eternal financial fretting, and poor, makeshift living accommodations drag down many of the best-intentioned parents in the world. Bad luck, sickness, some turn of fortune's wheel against the wind conspire to frustrate and bedevil the best laid plans for family welfare. It ill behooves us, if we largely escaped the harshest strokes of fate, to preach the doctrine that one should forget the daily bread and the anchor to windward in carefree commingling with the boys and girls.

"We will encourage you always to seek the truth." Now this plank in the pledge needs to be interpreted two ways. When kids are small and their choice of right and wrong or this and that remains narrow and circumscribed, it is relatively simple to insist on knowing what is true and repeating nothing else but. Some youngsters love to stretch the truth and embellish it with their idle fancy. This streak of imagination has to be deftly handled, possibly not too severely punished or curbed.

But just wait until these children grow and develop and begin to see the ways of their elders and observe the vainglory and the nonsense that poses as perfection all about them. Wait until they get to taste some of the pros and cons of scholastic theory, or start to study civics, or begin to read political speeches and analyze the various vagaries of some deliberative body—maybe your city aldermen or even the United Nations.

Just about that time you and your good old truth medicine are apt to be in for a rugged test. All of which goes back to that fleeting wish of the weary philosopher, "Oh, to be as simple as my days of childish candor!" When we are young we can stick to the truth, but as we get opinionated and faction-minded, we must face the vexing fact: But after all, what *is* truth? I guess even scientists can't agree on that.

I presume that if we might rear a generation of leaders free of guile and prejudice, open-minded, honest-hearted, and devoted to what is best and enduring, then perhaps we could hope for a new set of values to be universally recognized as the one true good. Maybe such a wild yen is pretty fancy thinking under the conditions of the hour.

ALL of which brings us to what is to me the strongest point in the whole pledge adopted at Washington by the friends of youth: "We will provide you with all opportunities possible to develop your own faith in God."

My first hunch in scanning that one is to say, "You can lead a horse to water, but you can't make him drink." By this I mean that you can be an elder, a religious school teacher, or even a mighty potent preacher, and still not be able to induce your offspring to go the glory road themselves — of their own free will and accord. You can't lick good behavior into a child. You yourself are a better inducement than any big stick when it comes to spiritual things.

Delinquency in growing youth is a menace. Yet the juvenile delinquent is not depraved—he is just deprived. Someone somehow has either neglected him or misguided him. You hear many excuses made by parents when some tragedy exposes a family to the misdeeds of a delinquent. For one thing, they will often lay it all to poor health, rickets, malnutrition, dental caries maybe, or weak eyes. A recent accepted survey showed that only one-sixth of the boys taken to a reformatory were victims of poor health. All the rest were robust specimens.

Next you'll see the trouble blamed on mental illnesses. But recent records taken in juvenile courts in Chicago and Boston show that fully seventy per cent were mentally sound and alert. When that excuse slips, everybody falls back on the theory that delinquency is mostly found in poor families. A lot of that got started because they went out and took their statistics by areas. That left the square mile of space in a crowded tenement district with more kids to count noses on than was the case in a rich neighborhood where gardens, lawns, and wide streets prevail. Besides, wealthy kids seldom get stuck into institutions anyhow, and when a rich dad makes good on a misdemeanor it may not be reported to the police record.

You can hunt far and wide for the principal reason for juvenile misbehavior and finally come right back to the lack of spiritual guidance and adjustment. The delinquency committee of the White House Conference said that over thirty-seven per cent of nearly three thousand delinquent children had absolutely no church connections whatever. Only a few boasted any home training in religion or ethics.

One need but to sense the upsurge of spiritual feeling and the final reliance on ethical and moral belief that has characterized our nation during the months of uncertainty. That alone tells us that the source of strength comes from within.

Great plans for organized aid to growing youth marked the final deliberations of the recent conference. Every aspect of home and community life and all its manifold facilities were brought into the picture. People who had studied youth and helped youth to overcome pitfalls and discouragements made splendid recommendations. Such meetings have been fruitful in other years and will continue to be.

But there was too much bemoaning the "terrible" time for successful conduct of this potent enterprise. Somehow the delegates got mixed up in their reactions and imagined they were selling some scarce goods which could easily be rationed in wartime. They forgot that they were dealing with American youth—heirs of the best land to grow faith and strength that the world knows today.

What if youth does have to sacrifice some goal for awhile or deny itself some privilege? What if youth does have to learn what a good country is worth in its own terms of duty rather than to read it out of musty books that give faint pictures of old heroes?

I WOULD insist that even as the saints of old found a place in the Bible because they suffered and triumphed, so do modern men learn to bear crosses manfully. Like my favorite monk of an ancient time, Thomas á Kempis, we can follow this course from youth to old age:

"Do what you *are* doing. Loyally work in the vineyard. . . . Write, read, sing, mourn, be silent, pray. Bear crosses manfully. Life eternal is worth all these battles, and greater.

"Peace will come in a day that is known to the Master, and it will not be the day or the night of the age that is, but an everlasting light, an unlimited brightness, a settled peace and a safe rest. . . .

"Not then will you say, who will deliver me from the body of this death; nor cry out, woe is me that my stay is prolonged: for death will be cast headlong down, and health will be unfailing, anxiety unknown, joy a blessedness, fellowship sweet and beautiful."

With so much that is hopeful and refreshing and inspiring in our youth today, it takes no forced good feeling for me to say to you, at this late hour: "Happy New Year and God Bless America!"

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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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THE AMERICAN POTASH INSTITUTE

1155 16TH STREET, N. W. WASHINGTON 6, D. C.

A Few Whinnies

The Texan had been launched on a 45-minute eulogy of Texas, the superior fighting qualities of its men, etc., when a New Englander broke in to ask: "Ever hear of Paul Revere?"

"Sure, he's the guy that ran for help," was the quick comeback.

* * *

"Where's the manager?" demanded an irate-looking lady. "I want to return the washing machine I bought."

"What's the matter with it, madame?" inquired the salesman.

"Well, every time I get into it, the paddles knock me off my feet."

* * *

Mistress: "Mandy, I'm delighted to learn you're engaged to be married. When are your nuptials coming off?"

Mandy: "On mah weddin' night, Miz Jones, an' not a minit befo'!"

* * *

"Is it possible for a man to make a fool of himself without knowing it?"

"Not if he has a wife."

* * *

An old sailor sat on his bunk, stripped to the waist. On his chest were tattooed three women. On his back were tattooed three more women. On each arm were tattooed even more women.

There entered a young fellow only just joined up. He glanced at the old tar, and to the latter's disgust, inquired: "Hallo, old man! Been in the Navy long?"

A young couple, very anxious to be married, went to see a local judge. "Impossible," said the judge. "Even a special license would take two days."

The would-be bride and groom exchanged a look of misery, then a smile appeared across the man's face. "Well," he suggested, "couldn't you say a few words just to tide us over the weekend?

* * *

Drunk: "Ho! Lady, you got two ver' beautiful legs."

Girl (snapping): "How would you know?"

Drunk (brightly): "I counted 'em."

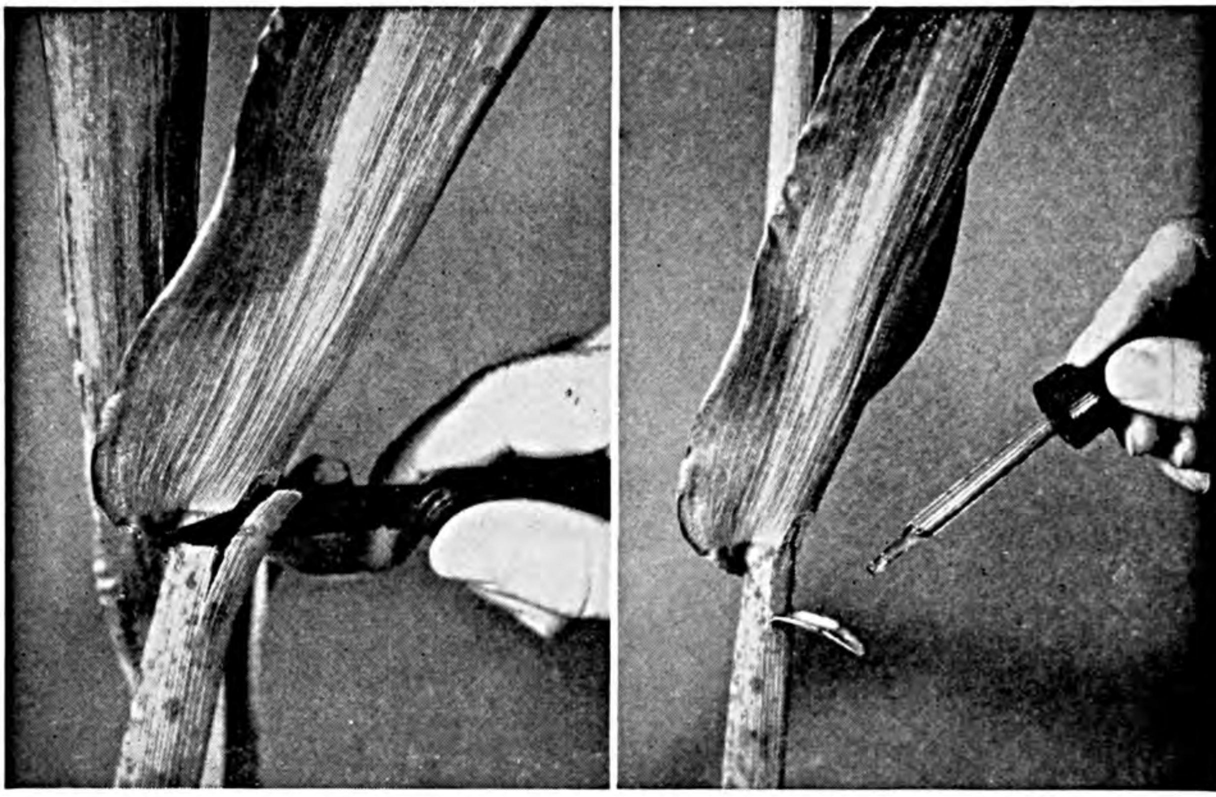
* * *

In our public schools today teachers are afraid of the principals; the principals are afraid of the superintendents; the superintendents are afraid of the school boards; the school boards are afraid of the parents; the parents are afraid of the children; and the children are afraid of nobody.

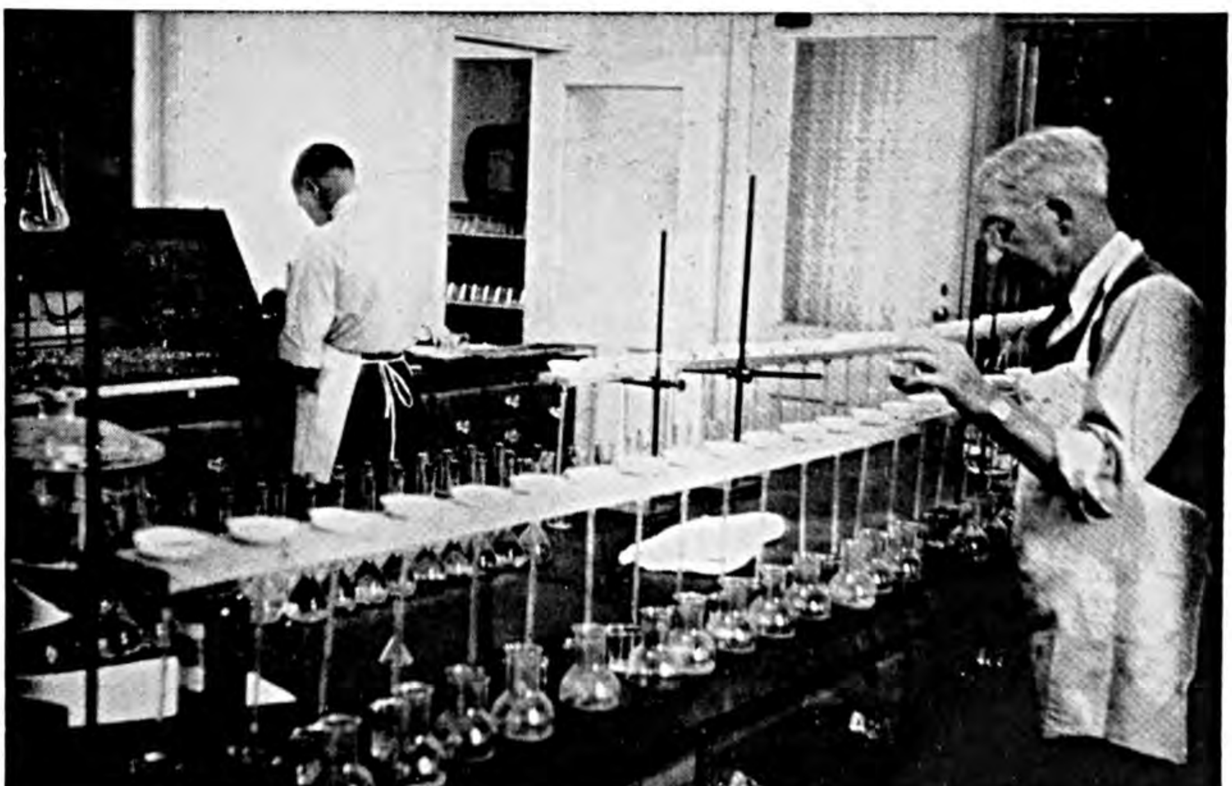
* * *

Displaying her wedding gifts, the bride came to one from the groom's Army buddy. "I just adore these personalized gifts," she said. "We received towels and washcloths with HIS and HERS on them, but," she blushed, "this is even more personal."

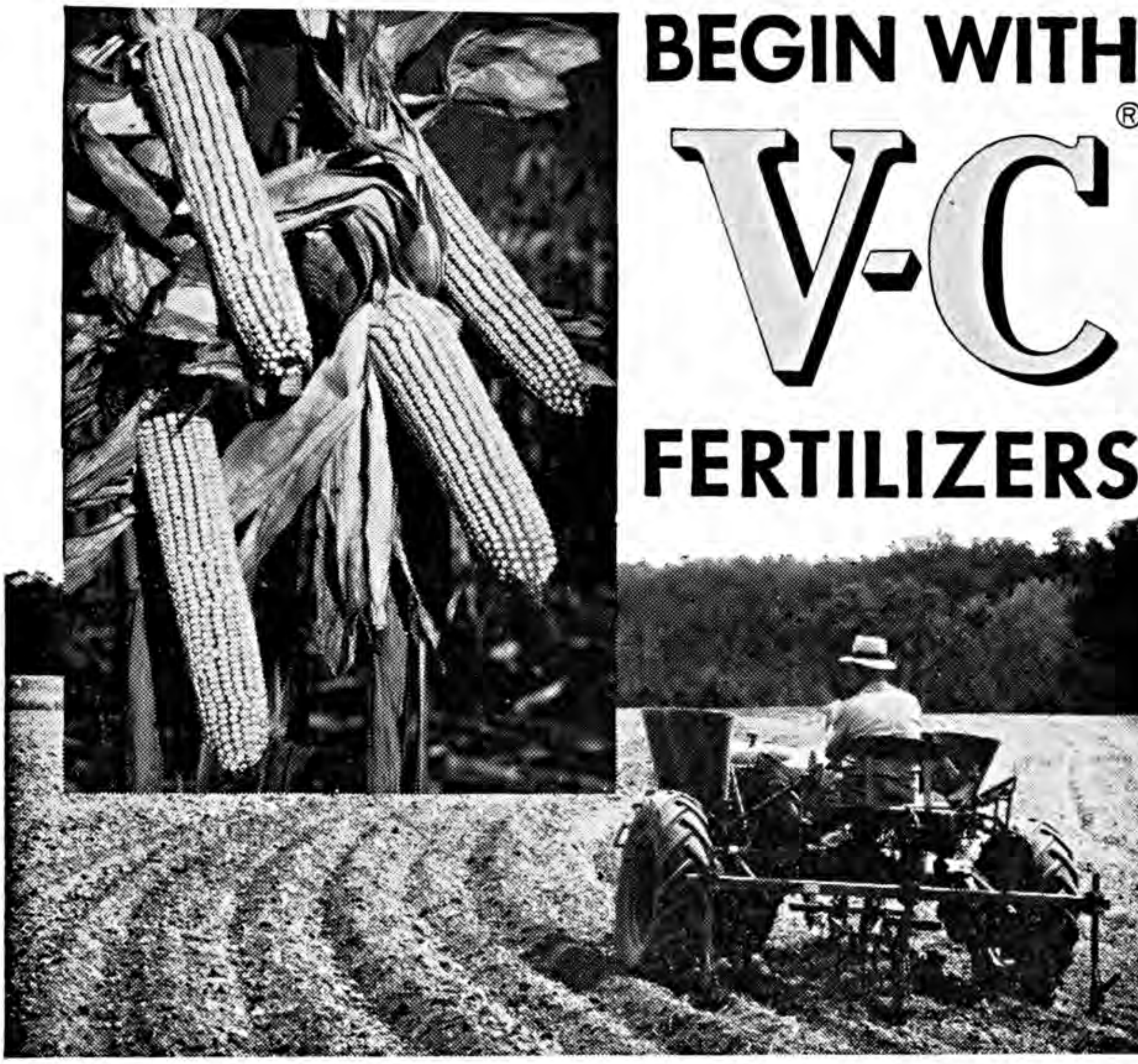
And she held up an olive-drab blanket with the letters US stamped in the middle.



Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



Equipment used in a well-developed laboratory for soil analyses.



Better Crops WITH PLANT FOOD

February 1951 10 Cents

The Pocket Book of Agriculture

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

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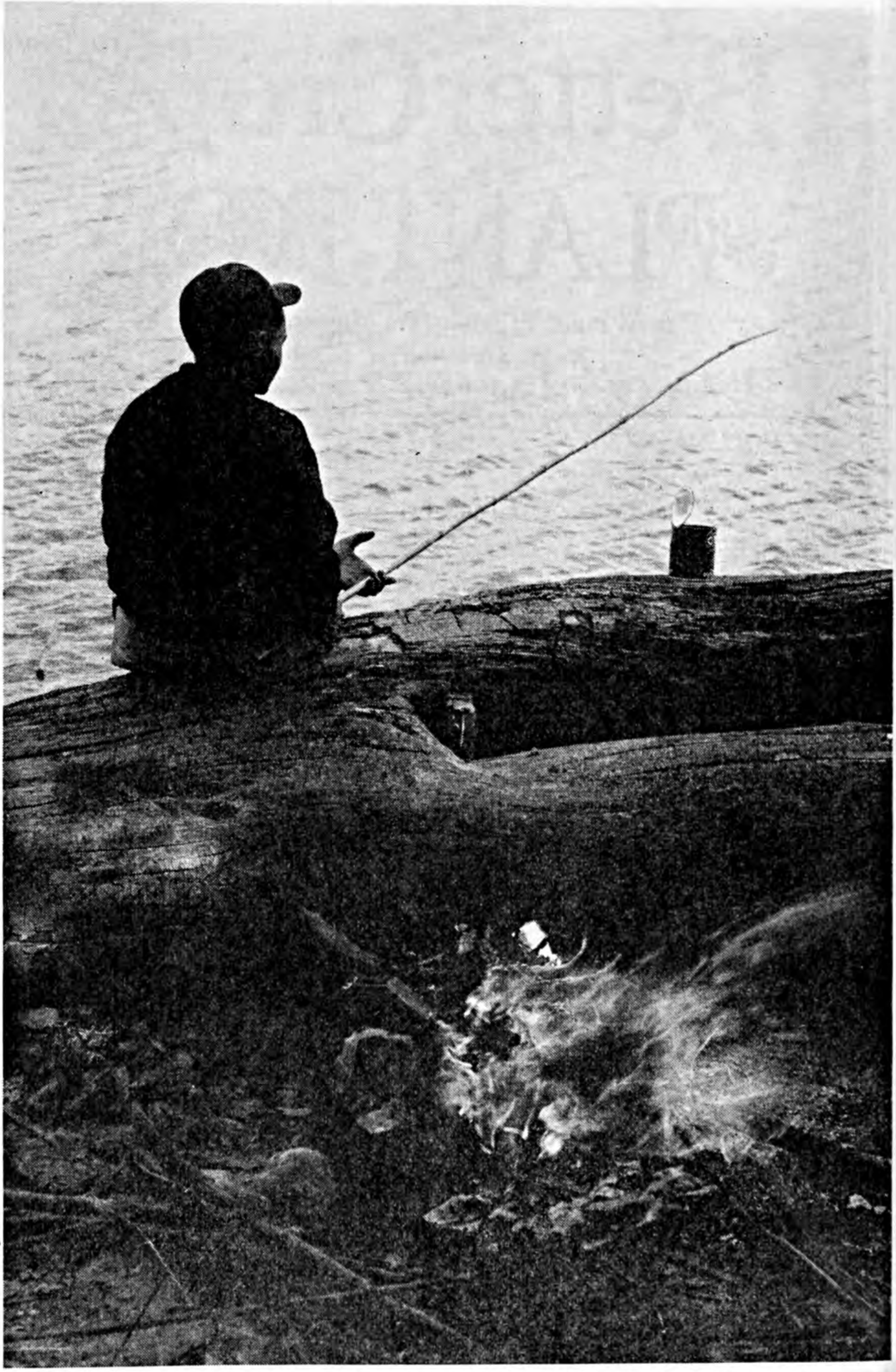

THIS ARDENT FISHERMAN BELIEVES IN COMFORT.

Better Crops with PLANT FOOD

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VOL. XXXV WASHINGTON, D. C., FEBRUARY 1951 No. 2

The Management of . . .

Uncle Sam's Acres

Jeff McDermid

DO you remember when our old geographies contained colored maps of the United States with a large unbroken area defined in a vague way as the Great American Desert? And beyond that was California, a long strip of territory but sparsely settled and still reeking with the traditional romances of Bret Harte and Mark Twain. Those were the times when there were a few homesteaders still hiking out to try their luck in the raw wilderness without any neighbors within a hoot and a holler or maybe a long day's march.

Well, as we have had occasion to say many times since, "How vastly times have changed!" California is now bragging about being the fastest growing state in the Union. Livestock raisers are hard at it trying to furnish enough meat and other provisions for the bulging maw of a populous and hungry horde. And incidentally, all of the best land is settled or citified, and the word "desert" is narrowed down to just a few scenic attractions which are often more profitable to local residents than the black loams of the Corn Belt.

Today the unappropriated public domain still owned by Uncle Sam exists mainly in 11 Western states. These 170 million acres are all that are left after the rush of homesteading. They are what remain after the national forests were separated, and after the creation of all the national parks and Indian reservations, the game preserves and similar tracts dedicated to particular uses.

Now we face a keen demand for any and all forms of land, mostly but not entirely for grazing cattle and sheep to fill the aforesaid booming populations beyond the mountains. But that's not all of the demand, by any means, which those who are hired by Uncle Sam to manage this domain are urged to satisfy. There's a new land rush going on. Keen developers are hunting hard for valuable deposits underneath the surface of much of that area we knew as the "great desert."

Opportunity seekers want to lease the mineral rights so that new and pressing needs can be met. In any hectic defense organization when the ordinary supply of raw materials is not enough to fill the bill, we are duty bound to glean and scrape and ferret out every nook of the public domain to secure the vital replacements.

THE surface use of these public lands is likewise in high demand because of the forage as well as the timber. Timber is especially scarce. In the course of the last war period, forestry experts tell us that enough wood was utilized by the armed forces for boxes, crates, packing materials, and camp construction to build anew the city of Chicago.

Folks far removed from these stretches of public domain often fail to see their importance or why Uncle Sam's land managers are always up against a keen game in acting as our trustees. We hear so many tall tales of the reckless waste and incompetent management of government property that we need to be instructed and reminded a bit relative to handling the affairs of the federal acreage.

In recent years about seven dollars in revenue has come to the federal treasury for every dollar spent in looking after the proper safeguarding of Uncle Sam's land. But this could easily lead to a pinch-penny philosophy, because it takes a good steady investment to improve these lands and oversee them, and a seven to one ratio might obscure the need to be alert and up-to-date in maintenance and operation of these land leases and other returns.

Employment of personnel is surely not the cost-eating end of the present guardianship on these lands, at any rate. The man power hired to do the job is spread very thin. The average local range boss has nearly 10 million acres to travel across and look after.

Let's take the grazing business first. It's been a rather bitter point of argument sometimes, but things are easing up some on that score. There are about 134 million acres of the public domain set up under 58 organized grazing districts. They are all managed under the Taylor grazing law. A few other stray particles which do not join and are mixed up with private tracts are handled separately under Section 15 of that same law, and hence are known as "Section 15" lands.

Now as a rule most of the Taylor grazing law lands are quite dry and unsuited to plowing and cropping. Their value does not lie so much in what each acre will produce as in the huge size and immensity of them. They were once the home of the buffalo, wild deer, and antelope, and it's the sum total of what these lands grow in fodder that counts. Fully 10 million head of livestock normally graze part of each season on them. Besides, several hundred thousand wild game get part of their subsistence from them. The startling thing to know is that while acre-income rates on these arid empires are low, the actual income per man whose livestock grazes them is about equal to the highest enjoyed by many major types of farming in the whole country.

Both the Taylor grazing tracts and the smaller and scattered Section 15 lands are managed by the Division of Range Management in the Department of the Interior. Some large areas of the national forests are handled by Forest Service. In general a policy of decentralization of management has been the rule, making the man close to the problem more responsible for this stewardship.

THERE are urgent and often conflicting demands faced by the men whom Uncle Sam entrusts with his wild domain. Even in the face of price controls and perhaps rationing, the meat makers of the big ranges who furnish the stock for others to fatten are going to be insistent seekers after grazing rights. This points to a need on the part of the land bosses to check carefully on grass capacity over these ranges and avoid over-stocking them with the bad results sure to come for users and the land itself.

Replanting and productive improvement of this grazing land are foremost issues. In a broad way the management and the improvement under the law are vested partly in regional and state advisory committees. These committees meet at intervals, size up conditions, and make official recommendations. Lately, by a large majority of votes in the advisory bodies, a new grazing rate schedule was adopted—some of the income to be spent in improvement for mutual benefit.

As endorsed by majority of the district boards, the fees charged after May 1, 1951, for grazing these lands will be increased from six cents to ten cents per animal unit per month. In addition to this, the currently charged range improvement fee of two cents per animal unit month remains the same.

Besides mineral and gas leases, the problem of the land managers is complicated by major withdrawals of public lands for national defense. Just recently the Atomic Energy Commission got 400,000 acres for experimental tests in Idaho's Lost River district. Most of the arrangements for the withdrawal were made by local rangers.

While we are on this subject of adding to and taking from the land holdings by Uncle Sam, a glance at the facts as they were just before and since World War II may be enlightening. Before the start of the war, about 1,505,000 acres were owned by the War Department. They were used for camps, air fields, bombing and artillery ranges, and for ordnance plants and depots. At the same time the Navy owned 480,000 acres.

During the four war years the Army bought 5,726,870 acres and the Navy acquired about 1,017,000 acres. That wasn't all. The government agencies entered into agreements with other owners. They leased private land and borrowed some from state and local governments. The total thus obtained was 10,285,000 acres. Hence by the end of the war about 20 million acres were under control of the Army and Navy for war uses. Moreover, the services also temporarily secured 33 million more acres from other branches of the federal government and various departments, some of them from the

(*Turn to page* 48)

The Land-use-pattern Scale[1]

By Otis J. Osgood

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AGRICULTURAL workers generally have recognized that adapted farming practices and results from the different practices are associated with soils. Some have recognized that certain of the soils are associated geographically with certain other soils in what they have referred to as soil-association areas or soils areas. A few of these workers have even observed that there is an order, a rather high degree of uniformity, in the way some of the soils are associated with others to form a soil pattern. Yet, all attempts at obtaining specific results with reference to soils and making similarly specific recommendations for their use and management have been confronted with two major problems: (1) The *wide variation* in broad groups such as soil associations; and (2) the *large number* of most meaningful groups such as soil conditions.[2]

The result has been that recommendations for a broad area often include a range, as in rates of application of materials for a given crop, with little or no indication of which end of the range might be more nearly applicable to a given soil on any particular farm. Similarly, results from cultural practice tests, for example different planting dates and spacing rates for corn, may be reported only in terms of yields, often with nothing more than the name of a station or a statement of the general area to indicate the situation in which the results were obtained. Further, many land-use and farm-management studies have been made and reported with the direct or implied suggestion that findings on the most successful farms could be duplicated with similar results on other farms of the general area, even though it was known that soils in the area vary widely.

As an approach to being more specific as to soils in spite of the large number of soil conditions, and as a means toward developing a principle or guide for determining adapted practices, a most involved question appears to be in order: Is it possible within a soils and type-of-farming area to develop a system of classification of soil conditions that will permit rather specific answers to questions on adapted uses and management practices, the answers varying directly with place of the soil condition in the classification?

A positive answer to this question would mean that the system would be so designed that definite and reasonably uniform patterns in land use, yields, relative yields, production potentials, and adapted management practices run through it. A positive answer would also mean that it should be possible to group or classify farms on the basis of the proportion of their soils that are in any particular part of the classification, i.e., in any section of the soil pattern on which the classification is based.

It is the thesis of this statement that such a development is not only possible but that results from first efforts at solution of the many problems involved are most encouraging.

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[1] For a more complete statement, see "The Land-use Pattern Scale Method of Land and Farm Classification," by the same author, Mississippi Experiment Station Bulletin.

The project, in which developments reported in this statement were made in the Mississippi Experiment Station, is in cooperation with the Mississippi Extension Service and the Tennessee Valley Authority.

[2] The term "soil condition," as used in this statement, refers to the mapping unit in soil survey, a combination of soil type, slope, and degree of erosion, as Atwood fine sandy loam C slope 2 erosion.

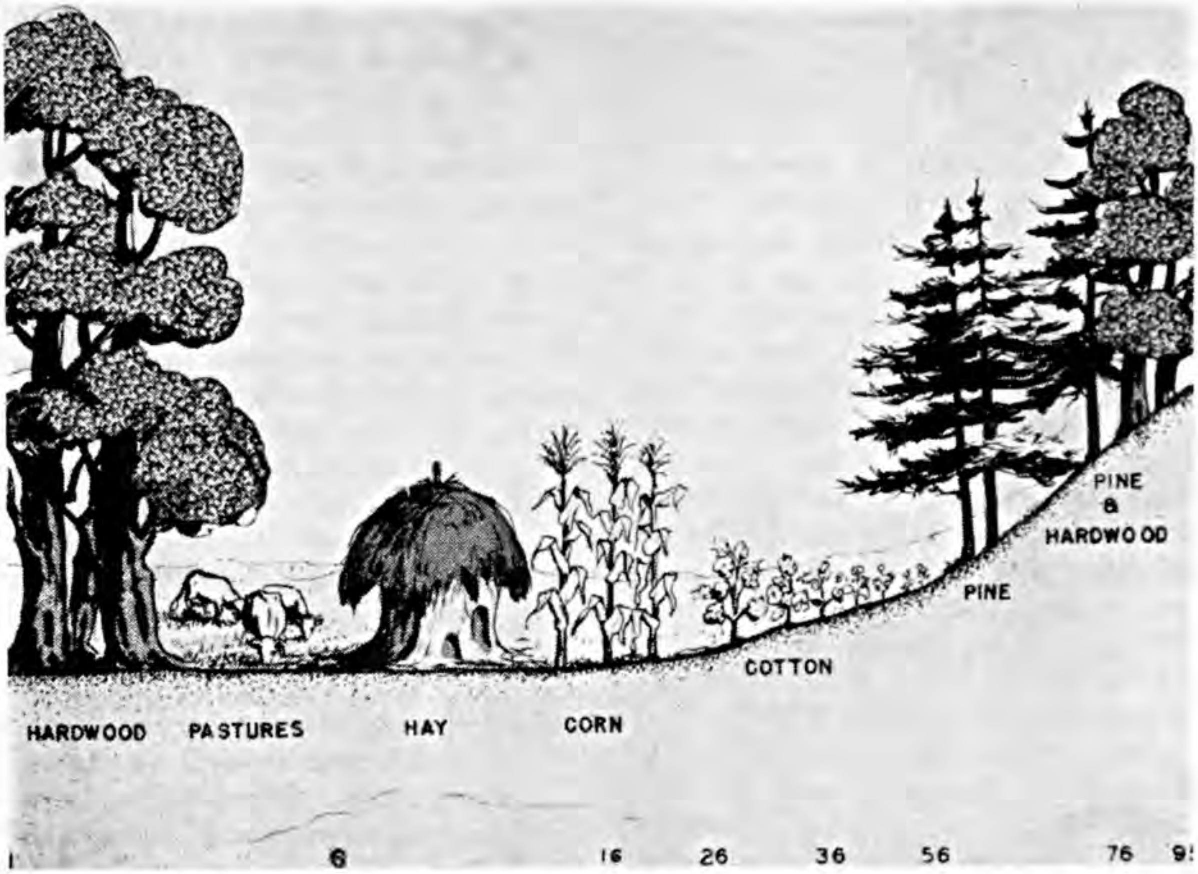

Fig. 1. Land-Use Pattern of Upper Coastal Plain Soils. The most poorly drained soils of the area tend to remain in hardwood timber production; soils with slightly better drainage are used for pastures; those with drainage suitable for a minimum of cultivation tend to be used for production of hay; soils that are well enough drained for regular cultivation but still too wet for good cotton land tend to be used for corn; well to excessively drained cropland soils, including the dry sandy hillsides, are used for production of cotton; and soils that are severely eroded, rugged in topography, or otherwise unprofitable for continued cultivation tend to return to or remain in pines and mixed-pine-hardwood timber production. (The numerals at the bottom of the chart are soil-condition-placement numbers.)

It is obvious that stability required in such a question as suggested would require that the classification be based on natural features that are physical determinants of suitable uses, relative yields, and adapted management practices. Indications of how these factors influence land use and production can be seen in tendencies of farm operators in a soils and type-of-farming area to use similar soils for similar purposes. This tendency, based on trial-and-error experience over the years and seen in relation to its physical determinants, may provide a framework for such a basic interpretive natural classification.

The sandy Upper Coastal Plain soils of the Tennessee Valley area of northeastern Mississippi were selected as the laboratory area for attempts at developing a method for classifying farms into groups within which farms would have a reasonable degree of uniformity as to adapted land uses and management practices. Figure 1 shows the land-use pattern of the area which reflects the underlying soil pattern, including drainage, elevation, topography, depth of topsoil, and degree of soil erosion.[3] In this chart the most poorly drained soils are represented at the extreme left, as indicated by the bottomland hardwood timber production. The slightly better drained soils, most of which are suitable for only a minimum of cultivation during the drier parts of the year, are represented in the area labeled "pasture" and "hay." Next in order in the land-use-pattern arrangement for this area are the "corn

[3] The land-use pattern sets out the uses to which the various soils tend to be put in current farm practices in an area. To those who are familiar with requirements for these uses, it also indicates other uses that would be adapted to soils underlying some of these uses.

soils," good, deep soils that are well enough drained for regular cultivation at least during the late spring and summer months but are not well enough drained for profitable production of such deep-rooted crops as cotton. Good, deep, well-drained, general-purpose soils are represented next in the chart by the heaviest cotton production; then the excessively drained, more eroded soils by the smaller "bumble-bee" cotton. Soils that are most severely eroded, most rugged in topography, or otherwise unsuited to cotton production and tend to be returned to or left in pines and mixed pines and hardwoods are represented still farther to the right in the chart in their order of decreasing relative suitability for pine timber production.

Other soil-association areas, of course, have other land-use patterns. Most of them, for example, have some eroded "pasture" soils between the upland "crop" and upland "forest" soils, that is, soils that are no longer profitable for production of field crops but that would still give a higher net return from pasture uses than from forest production.

The land-use-pattern scale is a systematic arrangement of the soil conditions according to their relative suitability for the different uses indicated in the land-use pattern. It is a list of the soil conditions (mapping units) in the order in which they occur in the soil pattern as it underlies the land-use pattern. In attempting arrangement of such a list, each soil condition was given a placement number. The most poorly drained bottomland soil with the shallowest usable topsoil, represented at the left edge of the chart in Figure 1, was assigned number 1. Other numbers assigned ranged up to number 95 for the most eroded upland soil with the most rugged topography and practically no topsoil, represented at the right edge of the chart in Figure 1. In the placement of the various soil conditions in the scale, studies of results of the various land uses and treatments on farms in the soil association area were made. These studies were made in collaboration with soils technicians, agronomists, county agents, and others working with the soils.

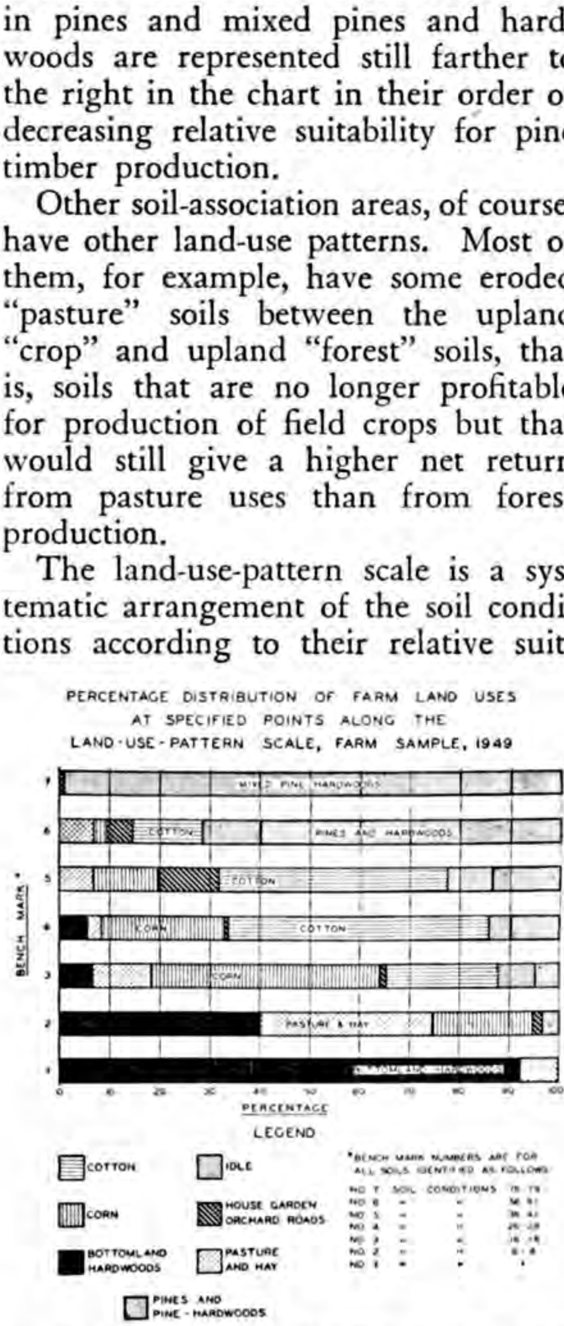

Fig. 2. Land uses shifted rather gradually and uniformly through the different points in the land-use-pattern scale.

For testing the land-use-pattern scale as a method of land classification and as a basis for classification of farms, a representative cross-section sample of farms was drawn from Production and Marketing Administration aerial photographs. Detailed soils maps of the farms were made on copies of the aerial photographs. The soil pattern, the land-use pattern, and production on these farms were studied. The 95 soil conditions identified in the area were grouped into 35 segments varying from one soil condition per segment for the first five segments, represented at the left of the chart in Figure 1, to four soil conditions per segment for the last 15 segments represented at the right of the chart. A sample of soils within the sample of farms was then drawn by starting at random and taking every fifth segment or group of soil conditions along the scale as indicated by the location of the various soil-condition numbers along the bottom of the chart in Figure 1. Soil conditions drawn in these sample segments were called "benchmark soils." Production per acre, as well as land use, was recorded for all these soils as found on the sample farms. These data served as a beginning for establishment of "benchmarks" along a continuous scale, points between which interpolations could be made for other parts of the "land-use-pattern" scale.

The areas for all the soil conditions at the various benchmarks were plani-metered and the total acreage figures distributed among the uses to which they were put in 1949. The distributions of land uses at the various sample or benchmark points are set out on a percentage basis in Figure 2.

Tendencies in land use for the various kinds of soils in the area for which this report is made are set out in Figure 1. The strength of these tendencies at the points indicated by the soil-condition-placement numbers along the bottom of the chart is indicated by the corresponding 100 per cent bars in Figure 2. It will be observed that the benchmark numbers in Figure 2 correspond to the points indicated by the various soil-condition numbers along the bottom of the chart in Figure 1.

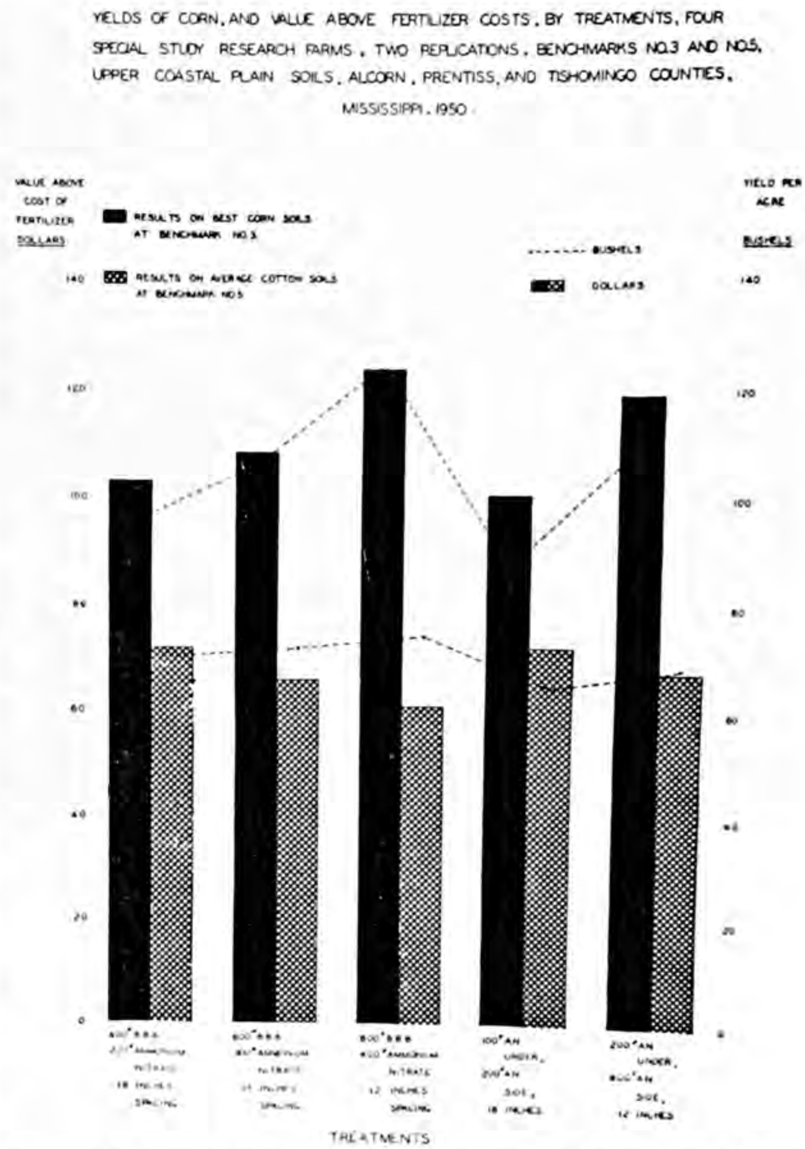

Fig. 3. Heavy fertilization and thick spacing of corn paid best on the best corn soils at benchmark No. 3, while less fertilizer and thinner spacing paid better on the less productive soils at benchmark No. 5.

As illustrated in Figure 2, land uses shifted rather gradually through the different benchmark points from about 92 per cent in bottomland hardwoods on the Bibb silt loam soils at benchmark No. 1 to about 99 per cent in mixed pines and hardwoods on the most rugged Guin, Guthbert, and Shubuta soils at benchmark No. 7. At benchmark No. 2, on the Stough soils, the bottomland hardwoods occupied less than one-half as high a proportion of the land as at benchmark No. 1, while the proportion in pasture and hay uses was more than four times as great. Some corn was also grown on these soils. At benchmark No. 3, more than 40 per cent of the uneroded Prentiss silt loam soils and others with similar use-suitabilities were used for corn production, and some cotton was grown. At benchmark No. 4, three-fourths of the better drained Prentiss fine sandy loam soils with only moderate erosion and less than five per cent slopes, along with other soils with similar use-suitabilities, were used for cotton and corn. At benchmark No. 5,

Above: **100 bushels of corn per acre as contrasted to a State average of about 24 bushels is a reasonable goal for the uneroded, moderately drained Iuka, Jamison, and Prentiss soils centering around benchmark No. 3.**

Below: **The best permanent pastures on the Upper Coastal Plain soils are on the poorly drained Bibb, Stough, and Guntown soils centering around benchmark No. 2.**

Above: **90 to 100 bushels of corn and considerably more than a bale of cotton per acre are possible on the good, well-drained, Ducker, Tilden, and Atwood soils centering around benchmark No. 4.**

Below: **Production was poor for cotton and good for pines on the severely eroded Ruston and Ora soils at benchmark No. 6.**

on the Ruston and Savannah fine sandy loam soils with only moderate erosion and less than five per cent slopes, on the best of the Ora soils, and on the Tilden and Cahaba fine sandy loam soils with moderate erosion and slopes of 5 to 12 per cent, along with other soils with similar use-suitabilities, cotton production was the principal use. Also, the proportion of these soils used for buildings, gardens, truck crops, and orchards was much greater than at any other point in the scale. In fact, the concentration of farm homes on these soils was so great as to remind one of the concentration in location of old Indian campsites of the area on the well-drained Cahaba soils near the streams. At benchmark No. 6, on Ruston soils with three-fourths or more of the topsoil gone or with slopes of more than 12 per cent and on Shubuta soils with slightly less erosion and slopes and on other soils with similar use-suitabilities, production possibilities, and erosion-control problems, about two-thirds of the land was either in pines and pines and hardwoods or idle or pastured in the process of returning to these woodland uses. The only crop attempted to any extent on these soils was cotton. About 99 per cent of the Ruston, Cuthbert, and Shubuta soils with their red clay subsoils at benchmark No. 7, near the rugged end of the scale, were in pines and mixed pines and hardwood uses. Yet, it was another land use at this point in the scale that illustrated the extreme to which people of the area go in their tendency toward use of similar soils for similar purposes. All cemeteries were located here.

In the forest areas of the sample, patterns in forest type and stocking condition ran through the various benchmark points just as definitely and uniformly as any of the other patterns. For example, the proportion of the forest area on which 66 to 100 per cent of the stands were pines was 6%, 14%, 63%, 33%, and 7% at the points represented by benchmarks No. 3, No. 4, No. 5, No. 6, and No. 7, respectively. For the same points in the scale, in the same order, the proportions of the stands for which foresters gave a rating of "good" for condition of stocking, the corresponding figures were 5%, 16%, 39% 25%, and 5%. These two paterns could be approximated by normal distribution curves rising from low points at benchmark No. 3 to their highest points at benchmark No. 5 and returning to similarly low points at benchmark No. 7.

Table I shows yields and relative yields and production for the two major field crops of the area, corn and cotton, at the benchmark points over which both crops are grown. Figures in the column showing relative yields, pounds of lint cotton per bushel of corn, indicate reasons for the land-use tendencies illustrated in Figure 1. Figures for relative production, in the last column at the right of the table, show results of these yields and tendencies.

The patterns in productive capacities of these soils appear to correspond closely to the patterns in yields set out in Table 1. Results to date indicate that soils at benchmark No. 4 for cotton and No. 3 for corn may be able to use profitably more than twice as heavy applications of commercial fertilizers as those at benchmark No. 6. As to relative proportions of fertilizer materials in relation to the land-use-pattern scale, substantial increases in cotton production from relatively high proportions of nitrogen have been obtained at benchmark No. 6, while decreases have been obtained from application of the same relatively high proportions of nitrogen at benchmark No. 3. Preliminary results indicate that the pattern for response to relatively high proportions of potash may run in the opposite direction along the scale.

Further information on both productive capacity and proportions of materials for the benchmark points was obtained during the 1950 crop-year by

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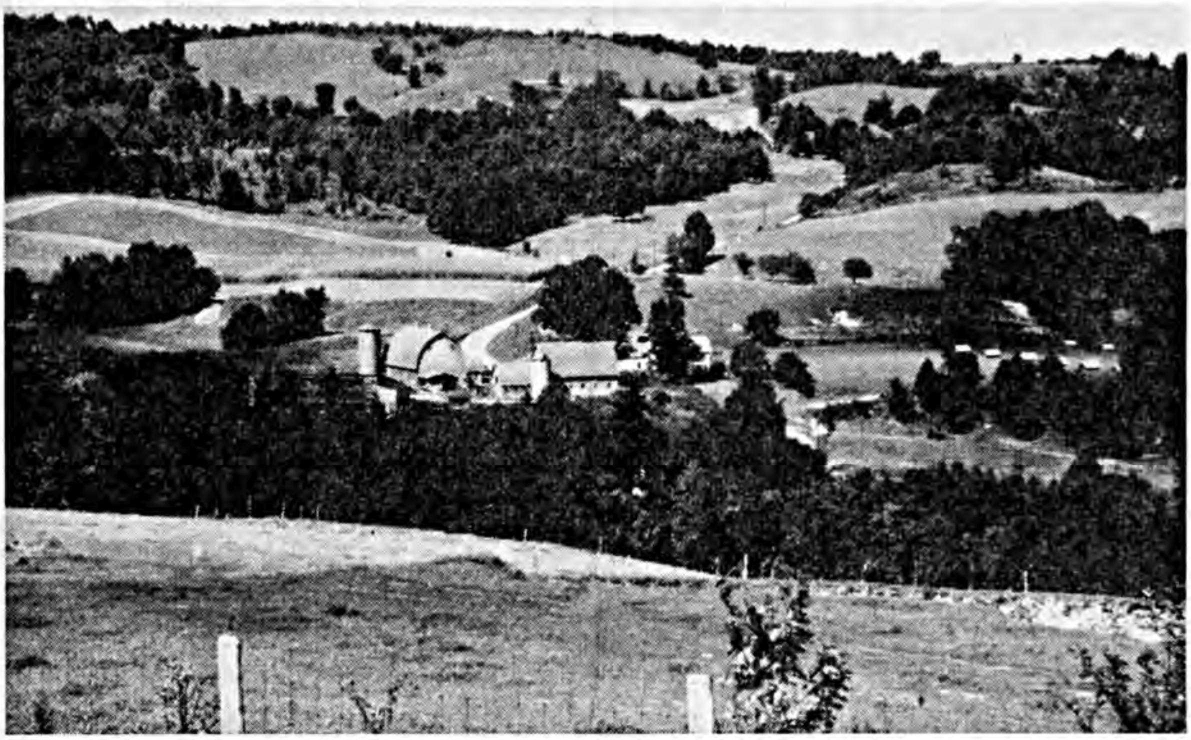

Fig. 1. A general view of the J. B. Abbott Farm in Rockingham, near Bellows Falls, Vermont.

Grassland Farming Brings New Management Problems

By John B. Abbott

Bellows Falls, Vermont

THE Corn Belt farmer who decides to change over to grassland farming may be making a very wise move but he will find that he has some new problems to solve.

The first problem is to decide what meadow crops to grow. That, of course, is a local problem but in so far as practicable the meadow crop should be a mixture of grasses and perennial legumes—preferably brome or timothy with ladino clover for grazing and with alfalfa for winter feed.

The second problem, without doubt, is to decide what kind of livestock husbandry he is going to follow, since the meadow crops can not be marketed as such on any large scale. (Imagine trying to sell as hay all the hay which could be grown in Iowa or Illinois!) The meadow crops simply have to be transformed into livestock or livestock products in order to find a market.

The third problem is allocation of fertilizer among crops. It is generally conceded that, in the typical short rotation grain crop farming of the Corn Belt, it is more profitable to use most of the fertilizer for the grain crops and let the meadow crops, mainly clover, eat the leavings. This, however, is not the more profitable practice in long rotation grassland farming. The meadow crops need plant food just as much as the grain crops do in order to produce profitable yields. If they get it, all well and good. They will produce as many pounds of TDN per acre as corn and more than any of the other grain crops. If they do not get it, the meadow crops of the first year may be fairly good, due to residues from the grain crop fertilizer. After that yields will very soon fall to an unprofitable level.

What fertilizer for the meadow crops? Soil deficiencies, of course, vary from region to region and even from farm to farm. In general, for the small grain nurse crop and the new seeded meadow crop with it, the story is this: Use a little nitrogen to start the seedling plants plus a liberal amount of such minerals as are deficient. In some instances phosphorus alone is enough. More frequently potash also is required. And lime should not be forgotten in case the soil is acid and the supply of calcium and magnesium not adequate. On my own farm a moderate application of dolomitic limestone plus a 4-12-16 fertilizer carrying 100 pounds of borax per ton at rate of 500 pounds per acre is about right.

In the typical Corn Belt short rotation with only one year of meadow crops, such fertilization for the small grain nurse crop and new seeding would be quite adequate. It is not adequate if you are going over to grassland farming and planning to leave the sod crop down for 6 or 8 years. You can not get the TDN equivalent of 75 to 100 bushels of corn from half-starved meadow crops.

What further fertilization does the meadow crop need? Again it is a local problem but, in general, an annual light topdressing in late fall or very early spring with such manure as is available plus such mineral fertilizers as are needed by the legumes will meet the needs of the meadow crop as long as legumes dominate the stand. When the legumes give way to grass, nitrogen also is needed. My own practice is to topdress the legumes with 0-20-20 at the rate of 500 pounds per acre and when the legumes give way to grass, as is bound to happen sooner or later, change over to 10-10-10 in an amount sufficient to supply at least 50 pounds of nitrogen per acre.

It is not a hard job—in fact, it is an easy one—to grow as many pounds of TDN per acre in a meadow crop long rotation as in a grain crop short rotation but it isn't an easy job—in fact, it is a hard one—to harvest the crop without impairing the stand of legumes or suffering a lot of waste.

Take pasture, for example. The cows need the same amount of feed every day all summer long. Pasture plants do not grow that way. They make about two-thirds of their growth in one-third of the season—May and June. How are you going to keep the lush grass of the May-June flush from smothering out the clover? How are you going to prevent waste of a considerable part of the May-June surplus? And how are you going to provide feed for the July-August shortage period?

There is a lot to be said for modern assembly-line, mass-production methods of making hay if the weather is perfect, which it frequently isn't. There is quite as much to be said against such methods when the hay curing weather is foul, as it sometimes is. The fact is, rain-leached, sun-bleached, defoliated stems or badly over-ripe hay contain, at best, little more than half the TDN originally contained in the crop. There is a lot more to the harvesting and curing process than merely achieving a high degree of mechanized efficiency.

After more than 25 years of struggling with them, I seem to have these pasture and hay crop problems pretty well licked so far as this farm is concerned. The basic principles involved and the practices which I follow will, I think, apply to many other farms.

I have to deal with four land conditions: (1) smooth, non-erosive, readily arable fields which can be farmed in a short rotation if it seems desirable; (2) sloping, somewhat erosive, less readily arable fields which should remain in sod most of the time but which can be plowed and reseeded when renovation of the sod becomes necessary;

Fig. 2. With insufficient application of mineral fertilizers, legumes in hay and pasture stands are difficult to maintain. In this field, alfalfa has disappeared except on the strips which had received a topdressing of wood ashes in addition to the usual fertilizers. The extra calcium, magnesium, potash, and boron in the ashes made the difference.

(3) more steeply sloping, erosive fields which would wash badly if plowed and which are not suitable for mechanized agriculture anyway but which can be fertilized mechanically and clipped with the mowing machine to control weeds; and (4) land suitable only for forest.

Quite obviously (1) tends to a shorter, row-crop rotation; (2) tends to a longer, meadow-crop rotation; (3) tends to really permanent pasture, although some of it has to be smoothed up with a bulldozer first; and (4) to

Courtesy William W. Stone, County Agent, Woodstock, Vermont

Fig. 3. Industry salesmen, agronomists, and representatives of the farm press viewing a well-fertilized, well-managed pasture on the John B. Abbott farm.

forest, natural or planted.

At best, in this latitude we can expect no more than six months of grazing and not all of that good, so at the outset I plan on some 60 per cent of my usable acreage for grazing and 40 per cent for winter feed. Experience has shown that it is easier to manage pasture right if the pasture is divided into several lots to permit rotational grazing. Mine happens to be divided into seven separate enclosures. Probably five could be made to serve about equally well.

With this set up I can solve the May-June grazing surplus problem by grazing only three or four of the seven enclosures—the rougher ones, of course—and harvesting the crop on the others. (As long as I tried to cure this early cut ladino-brome mixture for hay I had little success but ensiling it solved that problem.) Native pastures, of course, wouldn't produce much grass silage. Well-fertilized ladino-brome is good for five to eight tons per acre, and barring a June drought the second crop is ready to graze by the first of July.

This plan permits expanding the acreage available for grazing at the end of the normal flush season from three fields to six or seven fields. On moist soil and in favorable seasons this expansion of grazing acreage may meet the requirements of the herd through July and August fairly well. On droughty soil and in droughty seasons it will not, in which case it may be desirable to graze second crop in some of the hay fields or to feed out some of the grass silage. On the basis of such experience as I have had, I prefer feeding the grass silage to grazing the fields, as such grazing does a stand of alfalfa no good at all. Besides, I need that second crop for winter feed.

That midsummer feed problem seems to boil down to this: The seasonal growth habits of grass and clover being what they are, it is swimming *against* the tide to try to produce grazing for current needs in July and August but *with* the tide to produce a considerable excess of it in May and June. So I grow all I can in May and June when I can grow it most efficiently. I am virtually forced to ensile part of this May-June flush because I can't cure it for hay in the average season without serious impairment of quality and a lot of expense, and I certainly can not afford to waste it.

And while I am about the job of ensiling part of this May-June flush from the pasture fields, I go right ahead and finish filling a couple of silos from some of the hay fields. That practice solves several grassland management problems. (1) It saves the surplus feed from the May-June flush. (2) It gets the grass off before it smothers the ladino. (3) It permits harvesting, curing, and storing first-cutting alfalfa-grass and clover-grass mixtures on time without weather damage or other impairment of quality—something which I seldom succeeded in doing when I tried to field-cure the hay. (4) It gets the first crop off the land in time to give the second crop a good start. (5) It provides a supply of first-class feed to carry the herd through the probable summer drought. (6) It eliminates the bother and cost of growing supplemental grazing crops. (7) It eliminates the damage which frequently is done to stands of alfalfa by grazing the crop when the herd needs it rather than when the crop can stand it.

Handling the meadow crops in this way costs a lot of money but it saves a lot of money too. It saves the entire cost of haying the first crop. It eliminates the risk of weather damage to the first crop which, in some years with rainy June weather, has been several hundred dollars even on this small farm. It saves stands of ladino which likely would be smothered out or at least badly damaged if the associated grass is allowed to overtop it for too long. And by supplying silage of very superior quality, it maintains milk production at a high level with only moderate grain feeding.

Kay-two-oh in California

By George P. Gray

Oakland, California

POTASH, otherwise known as kay-two-oh, is the aristocrat of the plant-food triumvirate. It is rated the highest for quality production. Quality is made up of many factors and each must be measured to evaluate quality differences. When quantity production is being studied, only yield needs to be measured. The more laborious procedure, of observing quality may be one of the reasons why information on the need for potash has been slow to develop. Some soils in the semi-arid regions contain enough available potash to sustain plant growth without evident symptoms of serious deficiency, yet will respond to applications of potash. If no increase in production is noted, the quality of the crop, not being easily measured, may be entirely overlooked.

Extensive study by the California Agricultural Experiment Station in co-operation with the American Potash Institute is finding more and more soil areas of California in which the level of potash availability is too low to allow maximum production of top-quality crops. Constantly improved techniques of foliar diagnosis, that is, leaf analysis, have been most helpful in disclosing any shortage of potash in the tissues of growing plants. This method of study accounts, in a large measure, for the increasing number of locations where inclusion of potash in the fertilizer program has been found to be a paying proposition both in yield and in quality. The rapid chemical methods of estimating potash availability in soils have been helpful, too, especially in extreme cases. They, however, lack the precision of leaf analysis.

It has been estimated, for the United States as a whole, that the removal of potash by harvesting crops exceeds the quantity returned in fertilizers by 55 per cent. If this condition prevails in California, then sooner or later, the original store of potash in our soils will be depleted to the point where potash must be applied to most crops in order to insure maximum yields. Data on a mass of soil samples from Southern California, south of Fresno, collected and analyzed by the Growers Advisory Service of a fertilizer concern, showed that about 20 per cent of the soils collected were decidedly low in potassium.

Response to Potash

At the second annual Prune Day held in October 1949 on the campus of the College of Agriculture, Davis, California, Professor E. L. Proebsting told of the results of fertilizer experiments on prunes carried on for five years in Sutter County. It was reported that while nitrogen additions failed to show any increase in size of fruit or change in drying ratio, prune trees are among the first to respond to potassium. He pointed out, however, that returns from application to trees which have not shown deficiency symptoms were not profitable.

In an article, "Leaf Analysis," published in this magazine December 1944, M. E. McCollam cites an instance of the successful use of leaf analysis on the 3,000-acre ranch of the California Packing Corporation near Merced, California. He quotes from a report by P. D. Caldis, A. R. Brown, and R. T. Marks of that organization. Highlights of this report are as follows: Comparative leaf analyses were made yearly since 1937 in this and neighboring orchards. The potassium content of the leaves of the Cal-Pack ranch was found to be low, 0.87 to 2.73 per cent, while better yielding and sizing orchards in neighboring counties, but on different soil types, analyzed 2.72 and 5.19 per cent. It was stated that the trees in the Cal-Pack orchard, fertilized adequately with nitrogen, appeared normal in many respects and that no symptoms of potash deficiency could be observed.

Fairly large applications of potassium and phosphorus, 900 pounds per acre each, showed no response. A wholesale dose of 4,000 pounds per acre was then put on in one application. It was found that this drastic treatment gradually increased the K_2O content of the leaves from 0.87 per cent to 2.53 per cent at the end of the fourth year without further application of potash. The mean diameter of the fruit was increased by 2 mm., and the yield was increased 4.8 tons per acre.

Experiments by the California Agricultural Experiment Station, as well as by commercial interests, are in agreement about the value of potash in the fertilization of ladino clover on certain soils in the interior valleys. The best three-horse team for this purpose appears to be phosphate, potash, and lime with a little touch of a nitrogen whip, especially for new seedings of clover and grasses. An occasional touch of the whip may be needed on old stands to stimulate the growth of grass. An application of 1,000 pounds of lime per acre, enough to last two or three years, has been recommended together with 200 pounds each per acre, annually, of superphosphate and potash, either the muriate or sulphate.

Trials at Oakdale, California, have shown that the yield of ladino clover fertilized with the phosphate-potash combination was double that of the unfertilized crop. Phosphate alone was beneficial but the yield in this case was 1.6 times that of the unfertilized instead of 2.2 times as in the case of the combination treatment. Similar, but less spectacular, increases were obtained on more naturally fertile soil at Galt, California. The benefit here from phosphate-potash fertilization was considerably bettered by the use of lime.

Leaf scorch and die-back in prune, peach, and almond orchards, as well as in olive groves, seemingly caused by serious potassium deficiency, are being intensively studied by Dr. O. Lilleland and by J. G. Brown of the University of California. Potash is now being recommended in Butte County almond orchards and olive groves on the basis of potash-deficiency symptoms on the trees. Extensive use of leaf analysis technique is being made by Dr. A. Ulrich, also of the University of California, in the study of the nutrition of grapes, clover, sugar beets, and tomatoes.

It is anticipated that the results of all this experimental activity will be made public in the near future and that, as a result, potash will be placed higher up on the list of the requirements of California crops for greatest production and highest quality.

Definitions

The terminology of the various compounds of potassium is somewhat confusing. Names used by chemists, fertilizer manufacturers, and by the early operators for the recovery of the values in wood ashes have all crept into our language. Some clarification of the terms appears to be in order.

Potassium (K) is the proper designation of the element itself. The chemical symbol is "K" from the Arabic "Kalium." This metallic element is a soft, silvery substance, lighter than water, very active chemically, and so it is never found free in nature.

Potash: This name has an ancient origin. Originally it was applied to the product derived from leaching wood ashes with water in huge iron pots, hence the word "pot-ash." Strictly speaking, the word should refer to potassium carbonate only, the product so recovered. In later years, however, the name, potash, came to be applied as a generic term to most any compound of potassium whether it be oxide, sulphate, chloride, nitrate, etc.

Kay-two-oh (K_2O): The percentage of potassium in all articles of commerce, in fertilizer materials, and in mixed fertilizers is always stated in terms of the equivalent of potassium oxide (K_2O) rather than in percentage of the element, even though the oxide is not present as such. In this way the various commodities are rated based upon a common denominator. The chemical symbol, K_2O, signifies that two atoms of potassium (K) are in combination with one atom of oxygen (O).

Potassium Chloride (KCl): When potassium is chemically combined with the element chlorine (Cl), the compound is called potassium chloride by the chemist and called muriate of potash by the trade. ("Muriate" is from muriatic acid, the trade name for hydrochloric acid, HCl.) This salt enjoys the greatest use as a fertilizer.

Potassium Sulphate (K_2SO_4): This is the correct chemical term when two atoms of potassium are chemically combined with one atom of sulphur and four atoms of oxygen, the sulphate radical (SO_4). It can be made by treating potassium chloride with sulphuric acid (H_2SO_4). Hydrochloric acid (HCl) is expelled as a vapor and the sulphate remains behind as a residue. At Searles Lake, Trona, California, the sulphate is made by the double decomposition of the chloride and sodium sulphate.

Increased Consumption in California

Data compiled by the Bureau of Chemistry, California Department of Agriculture, testify to the steadily increasing interest and use of potash by the State's farmers. The Bureau has estimated, by year, the approximate total tonnage of nitrogen, phosphoric acid, and potash sold in the State. The 1948 estimated consumption of potash, 13,810 tons, was 2.4 times that of 1938 which was 5,720 tons. These figures included the potash marketed in mixed fertilizers and the potash salts sold as such. As might be expected, this increase closely parallels that of the total tonnage of all fertilizers sold. Potash is included in the majority of mixed fertilizers.

Of greater significance, however, are the reports of segregated tonnage sales filed quarterly with the Bureau. In this tabulation we find that 6,535 tons of potash salts, both muriate and sulphate, were sold for direct application during 1948. The reported sales for 1938 were 1,828 tons. This is to say that the use of straight potash fertilization has increased more than 3.5 times in 10 years.

Muriate or Sulphate?

A recent and very definite trend in California toward a greater use of muriate is indicated by the Bureau's estimates and segregated tonnage reports. Until 1948 much greater preference was shown for the sulphate than for the muriate. In 1947 the sulphate out-sold the muriate better than two to one. But one year later, 1948, more than half of the tonnage reported was the muriate. Reducing the figures to K_2O equivalents for a better comparison, it is found that about 2,000 tons of K_2O were derived from muriate in 1948 against only 1,600 tons from the sulphate.

There should be some agronomic consideration given to the distribution of the two forms of potash in California. We have some situations where the chloride, already in the soil, limits plant growth at times. In these situations the sulphate of potash would be the most desirable form to use. As massive applications of potash come to be used to correct cases of serious deficiency, much more care must be exercised in applying the chloride this way. Heavy sulphate of potash applications on the other hand have rarely caused trouble. On soils which have a very high sulphate content, the muriate of potash might be the preferable one to use.

Potash exists in the form of the

chloride in the high-grade sylvinite deposits being worked in New Mexico and in the brine of Searles Lake, California. Obviously, the purified chloride salt can be sold, and is sold, at a lower price than is the case when additional processes are used to convert the chloride to the sulphate. The price per ton is not only less but this salt contains 10 per cent more potash than the sulphate.

Potash Deposits of the West

Agriculture and industry were brought up with a jerk when the first world war completely cut off imports of potash from Germany. Previous to 1914 the United States had been entirely dependent upon imports to supply the needs of agriculture and industry. When imports were stopped by the war, what little potash was obtainable was quoted as high as 10 times the pre-war price of about $35 per ton for 50 per cent muriate. California users were asked as much as 30 cents a pound, or $600 per ton for the preferred sulphate.

Of the many potash plants operating in 1918, the only major domestic producer to survive the World War I period was the American Trona Corporation operating on the brines of Searles Lake, Trona, California. This firm, now known as the American Potash and Chemical Corporation, has developed into one of the finest chemical plants in the country. They are operating on an area of about 12 square miles of a layer of crystallized salts 50 to 75 feet thick on the bottom of a partly-evaporated lake in the Mojave Desert. Intermingled in this crust of crystals is found a mineral-rich brine containing such salts as potassium chloride, sodium chloride, sodium sulphate, sodium carbonate, and borax.

Following the first world war, a small group of Congressmen and government scientists did not feel the general discouragement and pessimism about finding a domestic source of potash. They succeeded in persuading Congress to appropriate money for exploration of the promising areas of western Texas and southwestern New Mexico. It was hoped that deposits would be found similar to the enormous Stassfurt deposits of Germany which heretofore had supplied the world's hunger for potash.

The so-called Permian Basin in the southwest section of the United States and extending northward as far as Kansas was known to have large deposits of salt buried under hundreds of feet of soil. According to geologists, these deposits had been laid down by the evaporation of sea water during the Permian era and were covered by soil erosion of following geologic ages. It seemed reasonable to hope that intensive exploration would disclose strata in which potash salts had crystallized out in sufficient concentration for exploitation.

Core drilling made possible by Federal appropriation, while disappointing, disclosed a wide area in which potash minerals occurred but in too small amounts for practical recovery. The big strike was made near the city of Carlsbad, New Mexico, by the Snowden and McSweeney Company when drilling for oil. Thick beds of high-grade, water-soluble potash minerals were encountered at a depth of 1,000 feet below the surface. The oil-drillers were reorganized as the United States Potash Company in 1926, started mining operations, and constructed a refinery. Mining and refining operations were started in 1931 and 1940 by two more companies, the Potash Company of America and the Union Potash Company later taken over by the International Minerals and Chemical Corporation.

The deposit being mined in New Mexico is a mixture of sodium chloride and potassium chloride known as sylvinite. It lies in horizontal strata 6 to 12 feet thick and averaging around 25 per cent K_2O.

As a result of all this development,

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Soil Treatment Improves Soybeans

By H. J. Snider

Agronomy Department, University of Illinois, Urbana, Illinois

SOYBEANS like many other farm crops are used mainly for food and feed. Oil, the part generally used for food, makes up approximately 20 per cent of the bean; and protein, the part used for feed, about 40 per cent. Since oil and protein are the commercial constituents in soybeans, it is only logical that they are given consideration in selecting and recommending varieties to be grown. However, acre yield is given first consideration in determining the desirability of a variety. A few bushels increase in yield will more than compensate for fractional shortage in oil or protein.

The U. S. Regional Soybean Laboratory emphasizes nine factors in presenting comparisons of various varieties which are grown throughout the north-central states region. This Federal Laboratory works with the experiment stations in the region and through this cooperative effort new varieties are originated, developed, and disseminated. The factors used in comparing varieties are: acre yield, maturity, lodging, height in inches, seed quality, seed weight, percentage protein, percentage oil, and the iodine number of the oil. A variety may be found lacking in some of these factors and still retain a place among those recommended for the region. If it is too deficient in acre yield, it will be discarded regardless of a high rating in other qualities.

Soybean growers are interested in high acre yield because income is directly influenced by this factor. Growers may also be interested more or less in the other factors which make a variety acceptable. They may not care to grow a variety which may lodge badly, is too tall or too short, one that matures too early or too late, or one which will be discriminated against on the market because of low percentages of oil or protein.

Processors want the highest possible oil and protein content that can be had in soybeans. They probably have the full right to expect beans of high oil and high protein content. If the desire for high percentage oil is too insistent, it may work a hardship on both the grower and the processor. It sometimes happens that high oil content is associated with low acre yield which means less total oil and also less protein.

Effect of Potash

Soil condition influences acre yield as well as oil and protein content of soybeans. The fact that potassium treatment has a tendency to increase the oil content of soybeans was illustrated on the Willow Hill field shown in Table I. On land without potassium treatment (LsPN), the percentage oil was 17.9. Where 50 pounds of muriate of potash were added, the percentage of oil went up to 18.9 and increased with each increment of potassium up to 19.8 where 300 pounds of muriate of potash were added to the soil. The acre yield of oil also increased from 225 pounds where no potassium was used and went up to 404 pounds where the 300 pounds of muriate were added. The acre yield of beans also increased from 21 bushels up to 34. These are substantial increases both in bushels and percentage oil. However, 140 pounds of the acre

Fig. 1. Soybeans grown on the Joliet Field, each bundle from 8 sq. ft.

	No treatment	Treated R L rP K
Bu. acre	24	32
% oil	21.8	23.2
% protein	39.4	39.2
Lbs. oil	314	445
Lbs. protein	567	752

increase in oil were due to the increase in bushels and only 39 pounds were due to the percentage increase in oil because of the potassium treatment. The percentage protein went gradually down from 43.9 where no potassium was used to 39.0 where the 300 pounds of muriate of potash were added to the soil. On the other hand, the acre yield of protein increased from 553 pounds up to 796 pounds per acre due to the increase in the acre yield of beans. In this comparison the high acre yield and high percentage oil went along together while the percentage protein went down to 39, but the acre yield of each was greatly increased.

The Willow Hill plots were located on the light-colored soil of southern Illinois. This land is decidedly acid, deficient in organic matter, nitrogen, available phosphorus, and potassium.

On the Ewing experiment field, also representing the light-colored southern Illinois soils, the soybean yield on untreated land was relatively low, 10 bushels per acre. The oil content of the beans was also low, 20.6 per cent, and the protein content was extremely low, 33.8 per cent. Where an 0-10-20 fertilizer (1,000 pounds every four years) was added, the acre yield of beans was not increased, but the percentage oil was unusually high, 24.9 per cent, and the protein remained low.

TABLE I. OIL AND PROTEIN CONTENT OF SOYBEANS WITH ACRE YIELD. WILLOW HILL 1948, FARM OF C. E. UREFER REPRESENTING LIGHT-COLORED SOIL.

Soil treatment	Beans bu/A	Oil %	Protein %	Oil lbs.	Protein lbs.
Lime	20	18.9	41.4	227	497
LsPN	21	17.9	43.9	225	553
LsPNK 50 lbs.	29	18.9	41.5	329	722
LsPNK 100 lbs.	30	19.1	40.2	344	722
LsPNK 150 lbs.	32	19.2	39.5	369	758
LsPNK 300 lbs.	34	19.8	39.0	404	796

L—limestone; sP—superphosphate; N—ammonium sulphate; K—muriate of potash

On land which was limed and some of the organic matter was restored by crop residues (R L) and then the 0-10-20 fertilizer added, the bushels of beans increased nearly three times or up to 27 bushels. The oil and protein percentages were relatively high and the acre yields of oil and protein went up to substantial figures, (Table II).

On the Brownstown experiment field, (Table II), also a light-colored southern Illinois soil, the highest percentage of oil was in the beans on untreated land. Here also the unlimed land gave a low yield of beans and a low protein content. On this field the potassium treatment gave a substantial increase in soybeans but failed to give increase in percentage of oil.

Fig. 2. Soybeans grown on the Ewing Field, each bundle from 8 sq. ft.

	No treatment	Treated R L 0-10-20
Bu. acre	10	27
% oil	20.6	22.7
% protein	33.8	41.2
Lbs. oil	124	368
Lbs. protein	203	667

On the Joliet and Carthage experiment fields, (Table III), representing dark-colored soils of a high productive

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TABLE II. OIL AND PROTEIN CONTENT OF SOYBEANS ALONG WITH ACRE YIELD. EWING AND BROWNSTOWN EXPERIMENT FIELDS, REPRESENTING LIGHT-COLORED SOILS.

Soil treatment	Beans bu/A	Oil %	Protein %	Oil lbs.	Protein lbs.
Ewing 1949					
None	10	20.6	33.8	124	203
0–10–20	9	24.9	35.4	134	191
RL 0–10–20	27	22.7	41.2	368	667
Brownstown 1949					
None	13	22.8	35.4	178	269
Lime	18	21.6	41.2	233	445
LK	25	21.8	37.9	327	569
LsP	20	22.0	41.5	264	498
LsPK	24	21.8	40.0	314	576
LrPK	27	22.0	39.5	365	656

R—crop residues; L—limestone; K—muriate of potash; sP—superphosphate; rP—rock phosphate

You Can't Be a "Compass" Farmer And Build Up Run-down Soil

By W. H. Lathrop

Milwaukee, Wisconsin

IF you're one of several million farmers who are trying to build up run-down land, talk to Edgar Wilson. You'll find him on a farm two miles east of Wingate in Montgomery County, Indiana. Here lush crops grow on once threadbare land that Edgar took over back in 1930. From ragged soil to the richest labor income per acre of any farmer in central Indiana, that's the amazing story of the Wilson farm.

Your talk with Wilson about building up soil will soon get around to "compass farming." That's his name for rows that run straight east and west or north and south with the compass. Soil conservation workers consider these compass rows a serious threat to the soil because on sloping land they are sure to run up hill. And that means a lot of water and soil are going to come down hill. But as Edgar points out, compass rows are just as sure to run through several different kinds of land —land that needs different crops and different treatment if it's going to be built up or even kept productive. You can't have one end of a row in corn and the other in grass.

This seems simple as Edgar explains it, pointing to the various crops that make natural patterns around the slopes. But it wasn't so easy getting the system started. Until 1944 he had to get along with only 70 acres of land. That's not enough for efficient farming, but it's even worse if the soil is thin. And Edgar's soil certainly was thin. He was not only short of land; he was short of soil. He was even losing soil from winter erosion, a kind of soil movement that occurs when thawing makes a fluid layer of thick soup along the surface of bare ground.

Corn and grain yields were low and forage scarce. Edgar needed more livestock, but he couldn't grow the necessary feed. When visitors comment on the present "new look" of his farm, he points to a gully-scarred hillside on an adjoining farm. "Some of my land would have had a very old and worn-out look like that hill over there," he says, "if I hadn't changed my way of using it."

Signed Agreement

That's how it was in 1941 when the Montgomery Soil Conservation District was organized. Here was a chance to get exactly the kind of help he needed, and Edgar lost no time in getting it. If you look at the district's list of soil conservation farms in the Soil Conservation Service headquarters at Crawfordsville, you'll find Edgar's name at the top of the list: AGREEMENT NO. 1, EDGAR E. WILSON. Because of his active interest in organizing the new district, Edgar was elected vice-chairman of the board of supervisors and has been on the board ever since.

With the soil conservation plan, which he developed with the help of Arnold Beck of the U. S. Soil Conservation Service, was a map showing the various kinds of land on his farm and a colored key indicating the recommended uses for each. At last Edgar was ready to put his soil-building plan to work. Right then and there he began ripping out the old compass fences. Since that time a "field" on the Wilson farm has meant a certain class of land, not an area enclosed by a fence. With this change made, he could now plan for rotations, fertilizer, and other treatment best suited for each land class. Since slope is one factor considered in determining land classes, the new field boundaries run level around the hillsides—a natural arrangement for contour farming.

"If an emergency now forced me to push my land for cereal crops," he said, "I could safely grow more corn and grain than I could before because I could put it on the more level land and leave the steeper land in meadow."

The next step was to build terraces to keep heavy rains from damaging the longer slopes. The terrace lines had to be laid out with a level by an agricultural worker. Edgar did the work with his own plow. The first heavy rain after the terracing of a new slope was an event anxiously watched for. Disobligingly, many of these came in the middle of the night, but Edgar was out with a lantern to see if the outlets had enough capacity to carry the runoff water.

With contour farming there would be less runoff to cause gullying in the draws but when draws are cultivated it doesn't take much water to do a lot of damage. Taking no chances, Edgar left all natural waterways in grass or seeded them if they were cultivated.

The first test of the new system came at harvest time in 1942. Edgar knew months ahead what the answer was going to be. With better yields and better farm prices, he was able in 1944 to buy an adjoining 40 acres. In 1946 his longer rotations and new land-use plan began to pay off. A farm survey made that year by Purdue University indicated that his per-acre labor income of $172 was the highest in the central Indiana group in which his farm was included.

Things were definitely looking brighter on the Wilson farm. With added confidence in his ability to build up run-down soil, he bought another 50 acres in 1948. This tract had sold for taxes in the '30s and was so poor that no tenant with experience and

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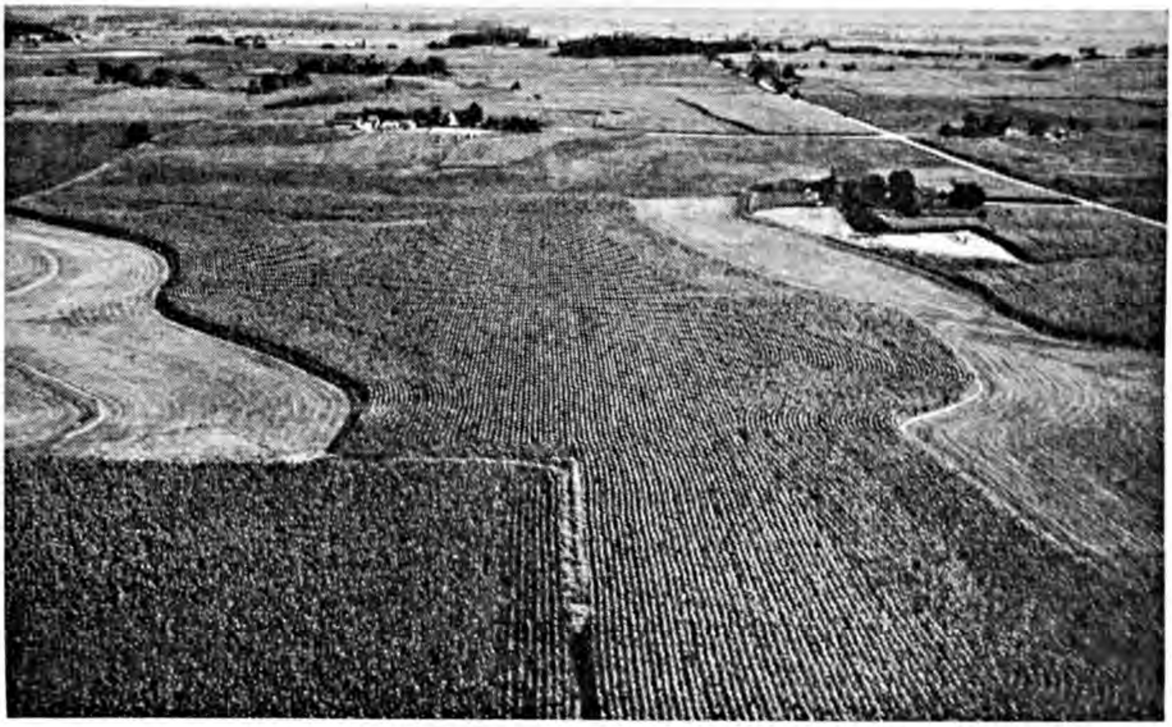

Fig. 1. This is the way the Wilson farm looked in late August of 1949. Wilson's married son Kenneth lives at the right. Edgar and his wife and daughter Mary Jane, 17, occupy the farmstead farther away at the left.

What Is Fertilizer Worth?

By L. Glenn Zinn

Instructor of Veterans in Agriculture, Philippi, West Virginia

THIS is the third year that our class of Veteran Farm Trainees have run a contest to see how much corn could be grown on the average hill land in West Virginia. They attempt the use of enough fertilizer to insure sufficient plant food to enable the corn to make its maximum yield under the conditions that are present in their particular soil. Our experiences so far show that it makes very little difference about the soil if we have enough stalks on the ground and apply enough plant food.

This is rather a strong statement and many authorities will take issue with us on the matter. However, we believe we have proof which will show up in what we say below.

Eight men completed the test in 1950, with the results shown in the table below.

Now let's look at some of the conditions under which these fields of corn were grown. Ira Yost planted his on a hill with slope of about 30%. It was a sandy clay and the erosion was bad as the soil had been cropped until it would not produce and then had been abandoned. It was in corn in 1944 and had not been plowed since, but had grown up in weeds. There was little topsoil so it was plowed only six inches deep, and that turned up a lot of subsoil. Yost plowed down 800 lbs. of 5-10-10 fertilizer, disked in 400 lbs. of 2-12-12, put 200 lbs. of 5-10-10 in the row, and sidedressed with 200 lbs. of nitrate of soda, making a total of 1,600 lbs.

This sidedressing was put on July 7 which was a little late for best results. The corn was cultivated three times and hoed once. It was planted on May 20 and husked on October 18 and was well matured.

James Kerns, who won first place last season, planted in the same field this year. He plowed down the fodder after grazing it with a herd of cattle in the fall, applied 10 tons of manure per acre, plowed down 750 lbs. of 5-10-10, and applied 300 lbs. of same in the row. He did not topdress.

James had a good plot of three acres of nearly level upland which had been well treated in the past and should have

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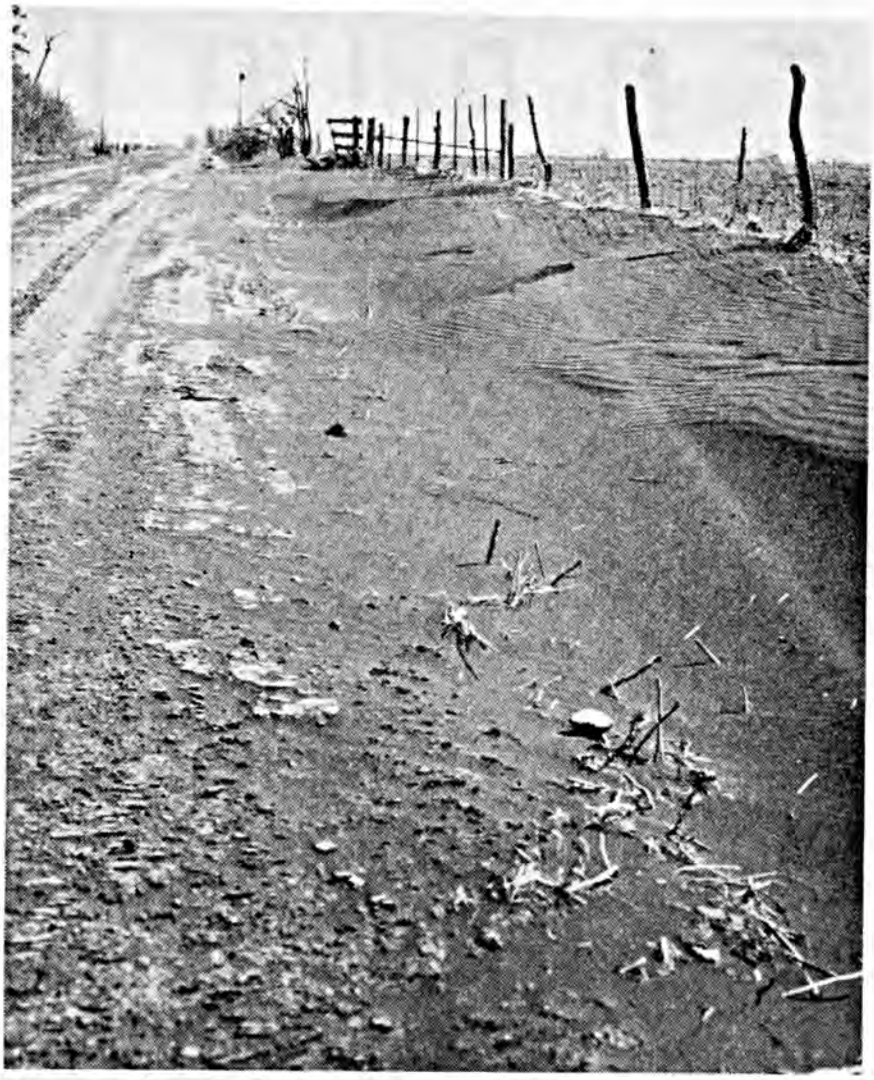
Grower	Yield Bu.	Variety	Fert. Cost	Stalk Count	Fert. Cost per Bu.
Ira Yost	126	WVaB17	$40.00	15,600	31.7 cents
James Kerns	122	WVaB25	40.00	16,890	32.8
Henry Vincent	106	WVaB25&17	42.00	13,318	39.6
Adren Gough	98	WVaB25	50.00	9,289	51.0
Junior Bolyard	92	Ohio W17	33.00	12,500	35.8
William Mitchell	89	WVaB25	44.00	12,450	49.4
Arnett Sayres	83	WVaB25	40.00	8,160	48.2
Beryl Hardin	80	WVaB25	30.00	10,304	37.5
Average	99.5		$39.87	12,313	40.7

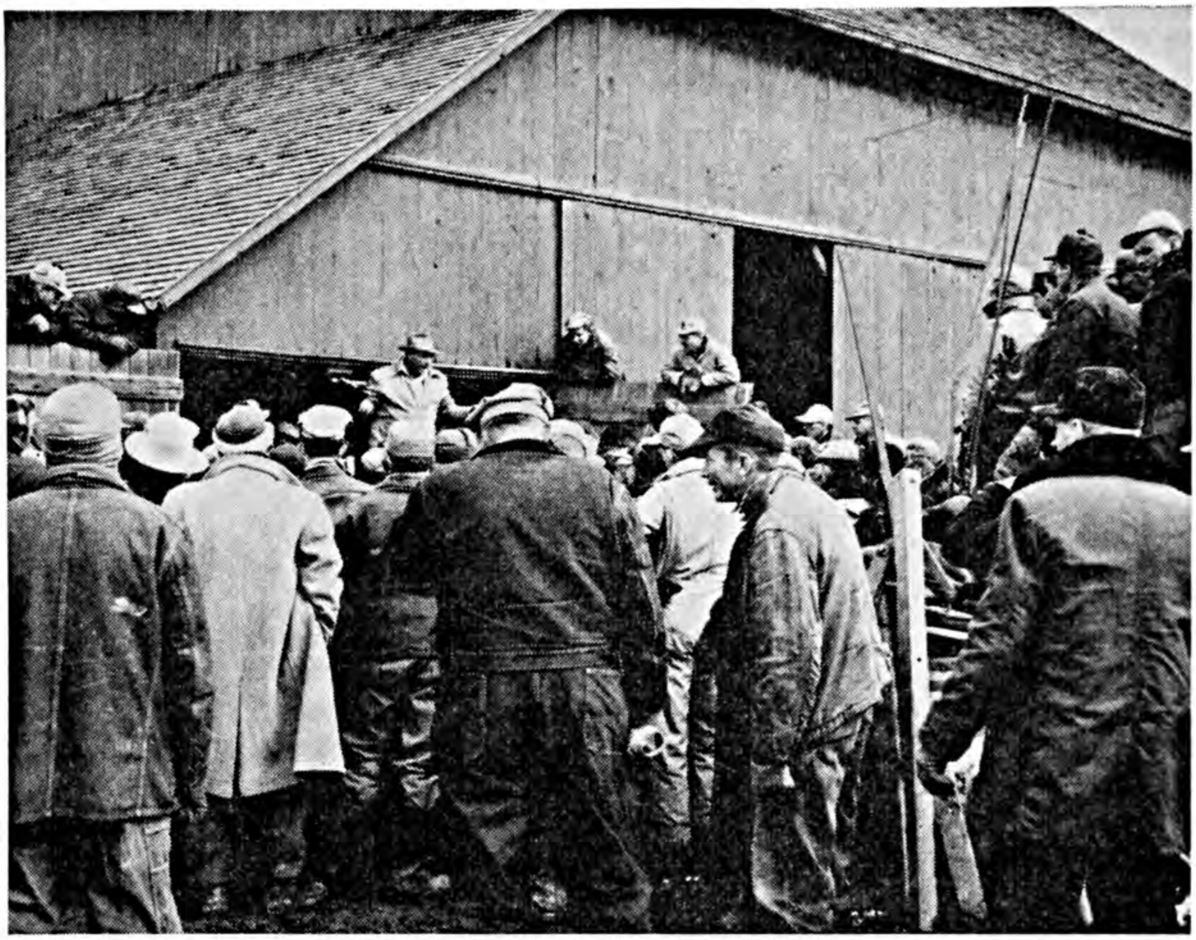
PICTORIAL

The Frolic Architecture of the Snow . . . Emerson



Left: **Drifts of prairie silt resulting from a heavy windstorm.**

Below: **Cornstalks washed from a field by an early-season flood.**

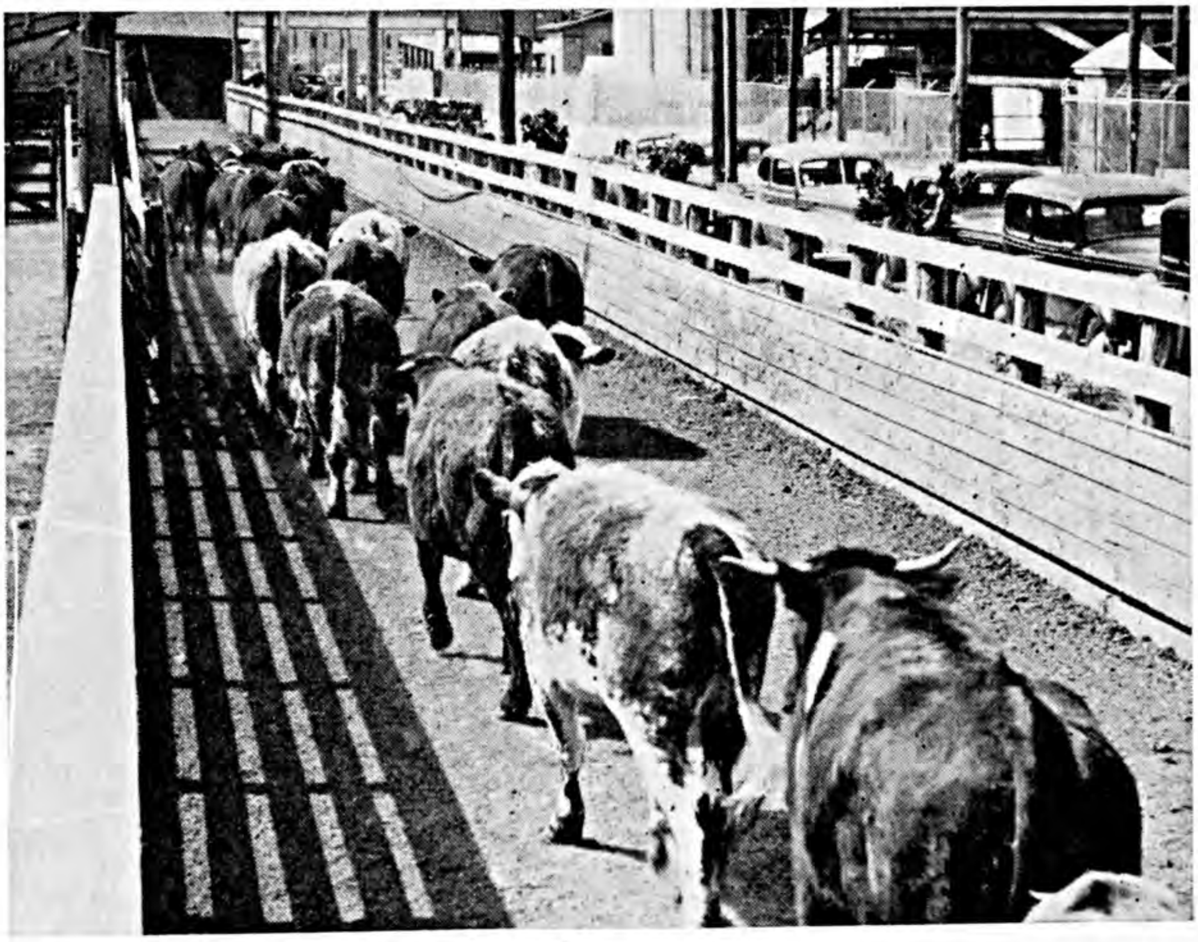


Above: **Late winter auctions find most farmers with time to attend.**

Right: **Tender, white, young feet must be protected in sloppy weather.**

Above: **For once, beautifully clean.**

Below: **The last mile.**



The Editors Talk

National Pasture Consciousness

Grassland farming is not a new idea. It is as old as agriculture. From the beginning, farmers have depended on grassland crops as the chief source of feed for livestock.

During the last half century when livestock farming in this country was making great strides, the production of grain crops also increased enormously. Depletion of soil fertility from soil erosion in grain farming has brought us face to face with the necessity for doing something to conserve our soil resources in order that we may be assured of a continued abundance of nutritious food.

Development of national soil and water conservation programs is making great progress in many areas. Leaders in the movement believe that much of our land, particularly that subject to erosion, should be shifted from soil-depleting crops to soil-conserving crops, such as grasses and legumes. Such a shift will not only reduce losses from erosion and tend to reduce the recurring grain surpluses that have plagued us in the past, but greatly increase the production of livestock.

It is well for everyone connected with agriculture, as the planting season approaches, to review the ten tasks set forth to attain the goal of a system of balanced farming in which grasses and legumes are given a full opportunity to enrich our diets as well as our soil. This goal was set up last November by the U. S. Department of Agriculture and the Association of Land-Grant Colleges and Universities, and the tasks include:

1. Cooperate with farmers in fitting grasses, legumes, and livestock in their plans for balanced, profitable farming.

2. Encourage the wise use of lime, fertilizers, and farm manures in line with local soil requirements, future cropping needs, and ascertained research results.

3. Grow more high quality forage by renovating pastures, reseeding pastures, hayland, and range with legumes and grasses in proper mixture, adopting improved rotations based on desirable legumes and grasses, planting cover crops, and converting suitable land to grass of good character.

4. Employ modern and scientific practices of proven quality in the development and management of livestock herds and the pastures and ranges on which they graze.

5. Provide and conserve water for livestock and forage production by installing stockwater ponds, wells, waterspreaders, contour furrows, terraces, irrigation systems, and similar improvements.

6. Control weeds, brush, insect pests, and livestock parasites and diseases.

7. Furnish farmers the best scientific information on harvesting and storing forage, as hay or silage, so as to conserve maximum feed and maintain nutritional quality.

8. Assure adequate stocks of adopted legume and grass seeds and encourage their best utilization through efficient methods of production, harvesting, storing, distributing, and planting them in good seedbeds.

9. Reduce farm costs and raise net income by employing suitable combinations of grasslands and livestock improvement practices in balanced farm plans.

10. Make available to farmers and ranchers the appropriate financial aid in the form of credit and conservation payments and encourage leasing arrangements which will make improvements profitable for both tenants and landlords.

It has been estimated that the production of livestock products, particularly those from cattle and sheep which are currently in high market demand among consumers, could be lifted 20 to 25 per cent by the complete and continuing application of known and tested measures for improving and managing grasslands. To some extent the improved practices are being used in various parts of the country, and probably one-fourth of the Nation's grasslands have been improved by one, two, or even more of the recommendations. However, from reliable sources comes the estimate that as much as 90 per cent of the grasslands in this country still require improvements. In this, lies the urgent need for assistance from everyone who can further our National Pasture Consciousness.

Custom-mixed, Delivered, and Applied

It is safe to guess that many a farmer in the rush of his spring work and with a shortage of help would be glad to step to his telephone and order his fertilizer, mixed according to his needs, delivered, and applied on a certain day. This for most of these farmers may still be a long way in the future, but it is being done in some scattered sections of the country. And it not only is proving practical but in many cases as cheap as where the farmer purchases the fertilizer, hauls it to his farm, and spreads it himself. The fertilizer company can offset much of the cost of this service by saving the cost of bagging; the farmer saves labor costs and time sorely needed for other planting operations.

One of the factors involved in such a service is the possibility of a farmer's being able to get a mixture of the plant foods most closely satisfying the needs of the crop he is to plant and the deficiencies of the soil in the field in which this crop is to be planted. The greatly increased number of soil-testing laboratories being set up over large sections of the country gives the farmer better information on these needs than he had in the past.

Difficulties are being encountered, of course. There have been and will be many technical problems and matters of proper equipment to settle. Spring weather cannot be depended upon and often fields are too wet to allow spreading by the heavy trucks at specified times. The service appears to be better adapted to broadcast than to row-crop applications. However, a lot of people believe that its advantages out-weigh the disadvantages. The progress of this new development in the fertilizer industry will be interesting to watch.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay[1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941...........	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942...........	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943...........	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945...........	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946...........	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947...........	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948...........	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949...........	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
February....	27.50	34.1	133.0	221.0	116.0	193.0	16.75	43.60	....
March........	28.05	32.0	132.0	222.0	119.0	198.0	16.45	43.00	....
April........	28.74	.....	134.0	228.0	126.0	201.0	16.65	44.40	....
May........	29.24	48.5	128.0	228.0	134.0	204.0	17.25	45.20	....
June........	29.91	49.7	127.0	211.0	136.0	193.0	16.05	46.20	....
July.........	33.05	45.5	127.0	208.0	144.0	199.0	15.15	52.00	....
August......	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September...	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October......	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
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	89	81	109	74	87	110
1938...........	69	196	80	79	76	64	57	97	88
1939...........	73	154	100	84	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	105	117	107	82	211	129
1942...........	153	369	168	134	143	124	91	202	163
1943...........	160	405	188	235	174	154	125	231	245
1944...........	167	420	214	216	170	160	139	234	212
1945...........	181	366	205	232	198	170	127	227	207
1946...........	263	382	178	248	212	209	141	319	182
1947...........	257	380	232	248	336	259	148	381	226
1948...........	245	482	222	253	201	226	155	298	214
1949...........	231	463	184	244	210	210	139	192	201
1950									
February....	222	341	191	252	181	218	141	193	203
March........	226	320	189	253	185	224	139	191	168
April........	232	...	192	260	196	227	140	197	205
May........	236	485	184	260	209	231	145	200	178
June........	241	497	182	240	212	218	135	205	182
July.........	267	455	182	237	224	225	128	231	200
August......	298	531	175	248	224	223	130	314	164
September...	322	554	151	219	224	219	131	349	126
October......	314	551	123	175	213	216	134	361	138
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
February	3.00	2.32	9.37	13.45	8.96	8.96
March	3.00	2.32	9.70	13.01	10.17	9.34
April	3.00	2.32	10.34	12.58	10.39	8.19
May	3.00	2.05	10.74	11.97	10.14	7.59
June	3.00	1.71	10.55	10.79	9.41	7.36
July	3.00	1.71	11.53	10.71	9.35	8.74
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish scrap	Tankage	High grade ground blood
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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
February	112	81	268	381	266	255
March	112	81	277	369	302	265
April	112	81	295	356	308	233
May	112	72	307	339	301	216
June	112	60	301	306	279	209
July	112	60	329	303	277	248
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316

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
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
February	.760	3.76	5.47	.375	.720	14.50	.200
March	.760	3.76	5.47	.375	.720	14.50	.200
April	.760	3.76	5.47	.375	.720	14.50	.200
May	.760	3.76	5.47	.375	.720	14.50	.200
June	.760	3.76	5.47	.336	.647	12.77	.176
July	.760	3.76	5.47	.368	.704	13.98	.193
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.75	5.47	.368	.704	13.98	.193
October	.760	3.73	5.47	.386	.704	13.98	.193
November	.760	3.73	5.47	.386	.732	14.72	.193
December	.798	3.73	5.47	.420	.796	16.00	.210
1951							
January	.810	3.73	5.47	.420	.796	16.00	.210

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash	Sulphate of potash magnesia	Manure salts
1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
February	142	104	112	68	76	60	83
March	142	104	112	68	76	60	83
April	142	104	112	68	76	60	83
May	142	104	112	68	76	60	83
June	142	104	112	63	68	53	80
July	142	104	112	67	74	58	82
August	142	104	112	67	74	58	82
September	142	104	112	67	74	58	82
October	142	103	112	70	74	58	82
November	142	103	112	70	77	61	82
December	149	103	112	75	84	66	85
1951							
January	151	103	112	75	84	66	85

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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
February	237	237	223	132	96	286	142	72
March	237	239	223	134	96	305	142	72
April	241	240	223	135	96	313	142	72
May	247	244	228	132	91	311	142	72
June	247	245	230	126	85	293	142	66
July	263	247	238	128	85	301	142	70
August	267	248	243	131	85	321	142	70
September	272	252	247	131	85	324	142	70
October	268	253	247	131	85	323	142	73
November	276	255	251	132	85	328	142	74
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78

* U. S. D. A. figures, revised January 1950. 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] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] 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 is 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.**

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

"Behavior of Nitrogenous Fertilizers in Alkaline Calcareous Soils: I. Nitrifying Characteristics of Some Organic Compounds Under Controlled Conditions," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Tech. Bul. No. 120, Oct. 1950, W. H. Fuller, A. B. Caster, and W. T. McGeorge.

"The Fertilizer Trade July 1, 1949-June 30, 1950," Dominion Bur. of Stat., Dept. of Trade and Commerce, Ottawa, Ont., Can., Vol. 2—Part XVIII-D-1.

"The Care and Use of Poultry Manure," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Inf-13, Apr. 1950, S. Papanos and B. A. Brown.

"Louisiana Fertilizer Report, 1949-1950," La. Dept. of Agr. and Immigration, Baton Rouge, La., E. A. Epps, Jr.

"Effect of Rate and Source of Potash on Yield and Starch Content of Potatoes," Agr. Exp. Sta., Univ. of Me., Orono, Me., Bul. 481, May, 1950, G. L. Terman.

"Plant Food Recommendations for Maryland Horticultural Crops," Ext. Serv., Univ. of Md., College Park, Md., Misc. Ext. Pub. 1, Jan. 1, 1951.

"Fertilizer Grades and Ratios for Minnesota," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Folder 145, Rev. Jan. 1950, C. O. Rost, P. M. Burson, E. R. Duncan, and H. E. Jones.

"An Economic Appraisal of Anhydrous Ammonia as a Nitrogenous Fertilizer," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 152, June 1950, J. P. Gaines and G. B. Crowe.

"General Fertilizer Recommendations for Eastern Nebraska," Ext. Serv., Univ. of Neb., Lincoln, Neb., CC 105, M. D. Weldon and W. E. Ringler.

"Fertilizer and Lime Recommendations for New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 539, Nov. 1950.

"North Carolina Fertilizer Report 1949-1950," N. C. Dept. of Agr., Raleigh, N. C., No. 121, Dec. 1950.

"Fertilizer Report for the Year 1949," Pa. Dept. of Agr., Harrisburg, Pa., Vol. 33, No. 3, May-June 1950.

"Commercial Fertilizers in 1949-50," Agr. Exp. Sta., College Station, Texas, Bul. 726, Sept. 1950, J. F. Fudge and T. L. Ogier.

"The Inspection of Commercial Fertilizers and Agricultural Lime Products for 1950," Univ. of Vt., Burlington, Vt., Rpt. 16, Nov. 1950, L. S. Walker and E. F. Boyce.

"Order and Store Fertilizer and Insecticides Early for Your 1951 Cotton Crop," P.M.A., USDA, Wash., D. C., Pa. 141, Nov. 1950.

Soils

"Efficiency in Public Soil Conservation Programs," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Prod. Econ. No. 3, Feb. 1950, E. O. Heady.

"Land Resources and Recommended Conservation Practices in Nebraska," Agr. Exp. Sta., Univ. of Neb., Lincoln, Neb., Bul. 395, Nov. 1949, F. Miller and A. Anderson.

"Salt Accumulation in Irrigated Soils The Prospect in Oklahoma," Agr. Exp. Sta., Okla. A&M College, Stillwater, Okla., Bul. No. B-360, Oct. 1950, H. J. Harper and O. E. Stout.

"Deep Plowing to Improve Sandy Land," Agr. Exp. Sta., Okla. A&M College, Stillwater, Okla., Bul. No. B-362, Dec. 1950, H. J. Harper and O. H. Brensing.

"The Relation of Soil Texture to Soluble Salt Accumulation in 29 Irrigated Soils in Oklahoma," Agr. Exp. Sta., Okla. A&M College, Stillwater, Okla., Tech. Bul. No. T-39, Oct. 1950, H. J. Harper and O. E. Stout.

"Drainage Practices for Oregon," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Bul. 492, Nov. 1950, W. L. Powers and A. S. King.

"Soil Conservation for 4-H Clubs," Clemson Agr. College, Clemson, S. C., Cir. 355, July 1950, E. C. Turner.

"Getting Acquainted with Our Soil," Cir. 4-H 62, Mar. 1950; "Our Land Our Living," Cir. 4-H 63, May 1950, Ext. Serv., Univ. of Wis., Madison, Wis., I. O. Hembre, W. McNeel, N. O. Stephenson, D. W. Niendorf, and E. O. Baker.

"Report of the Chief of The Soil Conservation Service 1950," USDA, Wash., D. C.

Crops

"Better Forage for Alaska," Agr. Exp. Sta., Univ. of Alaska, Palmer, Alaska, Cir. 12, June 1950, W. J. Sweetman, H. J. Hodgson, and A. H. Mick.

"Strawberry Growing," Inf. Serv., Dept. of Agr., Ottawa, Ont., Can., Pub. 838, Cir. 184, Aug. 1950.

"Progress Report 1939-1948," Dept. of Agr., Exp. Farms Service, Fort Vermilion, Alberta, Can.

"Research on the Management of Ladino Clover," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Inf-8, Jan. 1950, B. A. Brown.

"Field Corn Report Mt. Carmel and Windson, Connecticut 1950," Agr. Exp. Sta., New Haven, Conn., P.R. 50GI, Jan. 2, 1951, D. F. Jones and H. L. Everett.

"Annual Flowers," Bul. 133, Oct. 1950, J. V. Watkins; "Citrus Propagation," Bul. 139, Rev. Aug. 1950, A. F. Camp; Agr. Ext. Serv., Gainesville, Fla.

"Torpedo Grass," Cir. S-14, June 1950, E. M. Hodges and D. W. Jones; "Dixie Runner Peanuts," Cir. S-16, June 1950, W. A. Carver and F. H. Hull; Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla.

"1949 Annual Report," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Bul. 566, June 1950.

"Lespedeza," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Cir. 307, Rev. July 1950, E. D. Alexander, J. B. Preston, and J. R. Johnson.

"Sixteenth Biennial Report July 1, 1948 to June 30, 1950," Dept. of Agr., Boise, Idaho.

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A prominent salesman, now retired, summed up his success in three simple words: "And Then Some."

"I discovered at an early age," he said, "that most of the differences between average people and top people could be explained in three words. The top people did what was expected of them—*and then some!*"

—*Manager's Handbook*

Many years ago at a prayer meeting, a reader reminds us, a man prayed: "Lord, give every poor family a barrel of flour," and some member replied, "Amen"; a barrel of sugar brought another amen and a barrel of salt another amen. Then followed a barrel of pepper and one man, noted for his profanity said: "Oh, hell, that's too much pepper." —*Wall St. Journal*

The Land-use-pattern Scale

(*From page* 12)

experimental plot tests on special study research farms, farms on which complete farm plans are in operation. In these tests, five treatments were replicated twice on each of four farms at each of benchmarks 2, 3, 4, and 5 for corn and at each of benchmarks 3, 4, 5, and 6 for cotton. The treatments used and results obtained in corn production in these tests, showing how treatments that will pay best vary with positions in the land-use-pattern scale, are shown in Table II. The contrast in returns above fertilizer costs from light and heavy applications of fertilizers at benchmarks No. 3 and No. 5 are illustrated in Figure 3. This contrast in relative returns above fertilizer costs on these two groups of soils is a reflection of the different capacities of these soils for use of fertilizers in the production of corn. The better corn soils were able to use on a paying basis much heavier applications of fertilizers. The contrast in net returns from heavy rates of applications of fertilizers on these two groups of soils would have been still greater in a normal year than they were in the wet year of 1950 when corn yields were relatively very high on the drier cotton soils at benchmark No. 5.

In spite of general recommendations of around 12,000 corn plants per acre for the area, 6,000 plants per acre for benchmark No. 6, 8000 for benchmark No. 5, and 10,000 for benchmark No. 4 may be nearer the correct numbers for these soils. Some of the soils at benchmark No. 3, on the other hand, are

TABLE I.—YIELDS, RELATIVE YIELDS, AND RELATIVE PRODUCTION OF CORN AND COTTON AT DESIGNATED POINTS IN THE LAND-USE-PATTERN SCALE, ON UPPER COASTAL PLAIN SOILS, NORTHEASTERN MISSISSIPPI, 1949.

Benchmark number	Corn yield per acre	Cotton yield per acre	Pounds of lint cotton per bushel of corn	
			Relative yield per acre	Relative total per acre
	Bu.	*Lbs.*	*Lbs.*	*Lbs.*
6 (Soil conditions 56–61, Tilden fine sandy loam D slope, 3 erosion—Ruston fine sandy loam, E slope, 2 erosion)	12.1	200.0	16.5	91.6
5 (Soil conditions 36–41, Tilden fine sandy loam C slope, 2 erosion—Savannah fine sandy loam B slope, 2 erosion)	22.4	321.0	14.3	46.7
4 (Soil conditions 26–28, Jamison fine sandy loam B 2 to Prentiss fine sandy loam B slope, 2 erosion)	35.6	395.0	11.1	23.7
3 (Soil conditions 16–18, Prentiss silt loam A slope, 1 erosion, undifferentiated colluvial B slope, 1 erosion)	37.0	276.0	7.5	.4

able to support somewhat more than 12,000 plants for those who are willing to sacrifice quality for top yields. Similarly, suitable planting dates for corn may range from about April 10 for benchmark No. 6 to June 10 for benchmark No. 2. The association of erosion control and drainage problems and methods of planting and other management practices with place of the soil in the scale should be obvious. Also obvious should be the influence of a change in relative prices in changing production of any product near the ends of the range over which it is produced.

When farms were classified according to their general position in the scale as represented by the proportion of their cropland that was on soil conditions 1 to 35, and placed in three groups, the contrasts in distributions of soils illustrated in Figure 4 for the first and third groups were obtained. The extent to which operators of these farms recognized these differences in proportions of the various soils as bases for differences in land uses is indicated by the contrasts in land uses illustrated in Figure 5 for the same groups of farms. When farms in the sample were further sub-grouped according to size as measured by acres of open land in a kind-of-land and size-of-farm classification, the percentage distribution of farms among the various groups indicated a strong tendency for farms in the rugged end of the scale to be small and those in the better part of it to be large. This distribution showed that size of farm, instead of being the independent variable that it has been assumed to be in farm-management studies, is to a very large extent determined by general position of the farm in the land-use-pattern scale, or kind-of-land. One obvious reason for this is illustrated in Figure 2: Much higher proportions of the better soils are in cultivation. Other reasons, of course, are the relative sizes, shapes, and topographies of fields, and relative use-adaptations of the soils in opposite ends of the scale. Fields averaged three times as large in the group of largest farms on the best soils as in the group of smallest farms on the poorest soils.

Is it possible that, within a soils and type-of-farming area, research on relative use adaptations and adapted management practices can be done most efficiently by concentration on definite soil conditions as specific points in a continuous scale and that entire farms

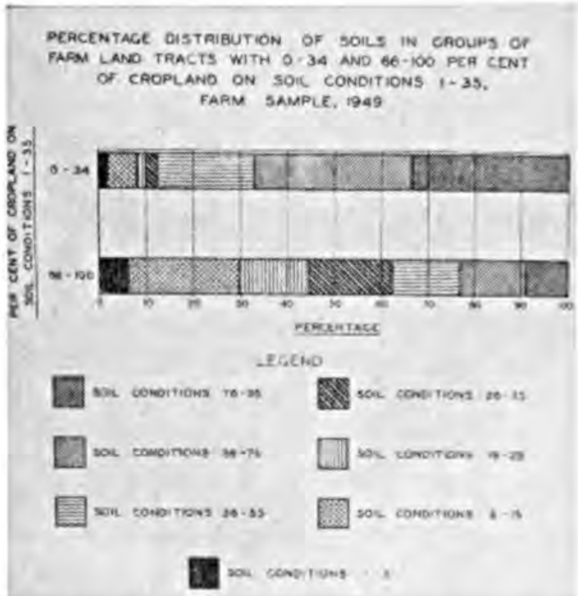


Fig. 4. When farms were separated into three groups based on proportion of cropland in the better end of the land-use-pattern scale, marked contrasts between the first and third groups were obtained in distribution among the various general groups of soil conditions.

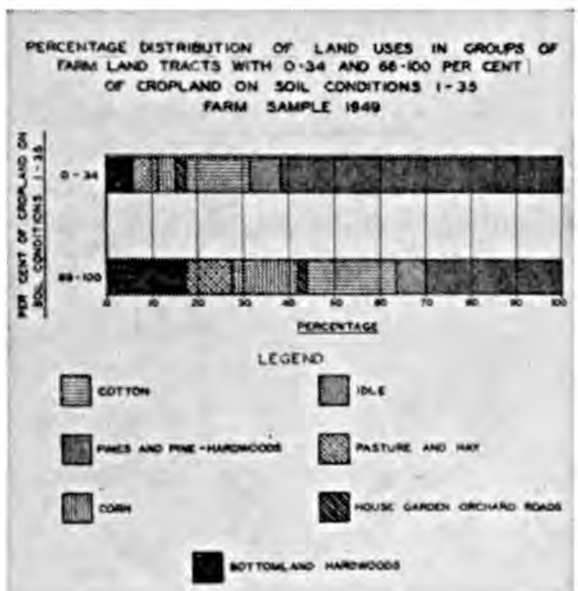


Fig. 5. Contrasts in land uses for the farms for which the distributions of soils are shown in Fig. 4 were only slightly less striking than the contrasts in distribution of soils.

TABLE II.—YIELDS OF CORN, AND VALUE ABOVE FERTILIZER COST, BY BENCHMARK POSITION IN THE LAND-USE-PATTERN SCALE, FOUR SPECIAL STUDY RESEARCH FARMS, TWO REPLICATIONS, UPPER COASTAL PLAIN SOILS, ALCORN, PRENTISS, AND TISHOMINGO COUNTIES MISSISSIPPI, 1950.*

Benchmark number	Treatments									
	400# 8–8–8 200# ammonium nitrate 18 inches spacing		600# 8–8–8 300# ammonium nitrate 15 inches spacing		800# 8–8–8 400# ammonium nitrate 12 inches spacing		100# ammonium nitrate under 200# ammonium nitrate side 18 inches spacing		200# ammonium nitrate under 400# ammonium nitrate side 12 inches spacing	
	Bushels per acre	Dollars above cost of fertilizer	Bushels per acre	Dollars above cost of fertilizer	Bushels per acre	Dollars above cost of fertilizer	Bushels per acre	Dollars above cost of fertilizer	Bushels per acre	Dollars above cost of fertilizer
5 (Drier and somewhat eroded cotton soils)	70.2	71.75	71.8	65.75	74.3	60.88	64.8	72.00	68.4	67.50
4 (Best cotton soils)	81.6	86.00	92.4	91.50	98.1	90.62	78.1	88.62	88.6	92.75
3 (Best corn soils)	94.8	102.50	105.6	108.00	124.2	123.25	87.4	100.25	109.4	118.75
2 (Wet corn soils)	47.0	42.75	56.2	46.25	58.7	41.38	31.6	30.50	36.3	27.38

* Prices used for calculating return above cost of fertilizers were $2.50 per cwt. for 8-8-8, $3.00 per cwt. for ammonium nitrate, and $1.25 per bu. for corn.

may best be studied as examples of possibilities for farms with similar distributions and acreages of soils? Such procedures would provide agronomists, animal husbandmen, and other technicians with specific guides and systematic bases for use of available information and development of further information on adapted practices that vary with soils. They would provide farm-management workers with objective bases for classifying farm records, describing farms on which similar results might reasonably be expected, and determining representativeness of farms under study. Such procedures should provide all agricultural workers with systematic objective bases for selecting adapted management practices and recording and predicting, even describing, general patterns of variation in results. Certainly, results of much agricultural research would be more usable if we could provide even approximate guides to the variations in their practical application.

You Can't Be a "Compass" Farmer

(*From page* 25)

equipment would move to it. A subsequent trade with his son Kenneth brought his total acreage to 132.

On the 132 acres Edgar has built more than 3½ miles of terraces and has 2 miles of grassed waterways. Most of his land is in a 5-year rotation of corn, grain, and 3 years of meadow. Some land that is more level is in a 3-year rotation, with a small acreage in a 2-year rotation. He uses 200 pounds of 3-12-12 fertilizer per acre with corn and grain plus manure and heavy crops of legumes which he plows under.

As a result of Edgar's changed use of the land made possible when he stopped "compass farming," he now raises three times as much livestock per acre as he could in 1940. This increased livestock production results from higher yields of both grain and

Fig. 2. Edgar Wilson finishes the last swath in mowing a grass waterway. Mowing keeps the sod tough to resist the action of concentrated water which might cause gullying.

grass crops. Hay yields are up 50 per cent and forage 300 per cent. With increased yields have come lower production costs and higher income.

He has put a basement under his house and installed a furnace and water system. There are new shrubs around the house, a new concrete floor in the barn, and a new concrete feed lot. With lower production costs and his capital assets secure, he spends less time worrying about what is going to happen down in Washington.

A gratifying recognition of Wilson's farming skill came when he was named the best conservation farmer in Indiana in a contest conducted by the Baltimore and Ohio Railroad.

Edgar makes it clear that he has stopped "compass farming" for good. A visitor looking out over the winding green strips is led to estimate what the Wilson treatment would mean to millions of farms whose lifeblood in precious soil is carried by each spring flood down to the eternal graveyard of American farm land. From a farm business whose very existence was endangered by erosion to a $172-an-acre return for labor in five years, that is what free enterprise and astute planning did for one American farmer.

Kay-two-oh in California

(*From page* 20)

the situation during World War II was in sharp contrast to our former dependence upon foreign potash. Production from the brines of Searles Lake, California, and from the more recently discovered deposits of New Mexico had made the United States entirely independent of any foreign source for its potash requirements. The selling price, instead of skyrocketing as it did in 1914, remained at a price level some 10 dollars lower than the price previous to the first world war.

Potash Reserves

Estimates of the world's reserve supply of potash, and that of the proved and potential deposits of the Western States, are in agreement on one point. Investigators all agree that at present and foreseeable future rates of consumption, European and American deposits will last hundreds of years.

Dr. Firman E. Bear sounded an optimistic note in his presidential address before the 1949 annual meeting of the American Society of Agronomy. He said: "At present rate of consumption, totaling about 800,000 tons of the element annually, the known deposits in the United States, amounting to about 1 billion tons, are enough to last about 1,250 years. Our present consumption is only about half the estimated need."

He then added this thought, mindful of possible exhaustion of our potash supplies after 1,250 years. "But every cubic mile of ocean water contains about 1¾ million tons of potassium. If the price of potash salts rises to about twice their present level, sea-water potash will enter the picture." It is a safe assumption that the farmers of the year 3200 will still require the element potassium for quantity production and for quality as they do today.

Dr. J. W. Turrentine probably is as well-informed on the potash situation as anyone. His forecast, based on presently known, easily workable deposits, is more conservative than that of Dr. Bear. Writing in 1946 of "Past Consumption and Future (1950) Requirements of Potash Salts in American Agriculture," he said, ". . . they will be ample for a minimum of 500 years at the rates of consumption projected by official forecasters and for such other longer terms of years as determined by the volume of future imports. These reserves, it may be safely concluded, will be further augmented by exploration and technological research."

What Is Fertilizer Worth?

(*From page* 26)

had a higher yield than Yost, since he had a higher stalk count. However, he had considerable damage from Japanese beetles, and the lack of a topdressing showed up in the size and maturity of the ears, which no doubt cut down his yield.

Adren Gough, who stood fourth place in yield with only a stalk count of 9,289 but with the most fertilizer, planted his corn on a hill with from 15 to 30% slope on sandy clay loam that had been in meadow for several years but had not been built up. It had no other treatment except lime sometime in the past and was rather a poor type of soil. Had he obtained a good stand, he would have stood close to if not at the top.

Junior Bolyard, the only one using an out-of-state hybrid, and the Ohio W17 has not been yielding in this section nearly as well as some of the State hybrids, planted his corn on a hill with from 18 to 30% slope on sandy loan that is considered poor land. It had been limed in 1936 with two tons lime and 8 tons of manure and 600 lbs. of 0-14-7 had been applied and plowed down. He applied 400 lbs. of 5-10-10 in the row and side-dressed with 300 lbs. of nitrate of soda. Bolyard had the best filled out and most solid corn of all the contestants.

Outstanding Demonstration

Of all the plots, William Mitchell's was the most outstanding demonstration of what the application of plant food will do. He planted on a hill top. The soils specialist said all of the topsoil was gone and there was little hope of ever bringing this land back to production. It had lain idle for several years and would not produce enough vegetation to cover the soil in the summertime. It was a sandy clay underlaid with shale, and six inches was all that could be plowed. However, Mitchell applied 10 tons of manure and plowed down with it 200 lbs. of 5-10-10 and 400 lbs. of 0-20-20. He disked in 100 lbs. of 5-10-10 and 200 lbs. of 0-20-0. A row application of 300 lbs. of 5-10-10 was made and he sidedressed with 200 lbs. of nitrate of soda. The topdressing was not put on until the corn was starting to tassel, which was late. He left a few rows without this dressing and they could be seen the rest of the season by the color and growth of the corn. His yield on this poor land was over twice the average for the State.

The Answer

But we have not answered the question we used as the title of this story. What is fertilizer worth if applied in the right amounts and at the right time for the various crops?

At first thought we would say it was worth just the amount that it would increase the yield of that crop plus any additional yield to future crops. But if we study the subject we find that there are a lot of other things that enter into it, and this is more true in the hills of West Virginia where we must stop plowing our hill lands or we will not have any to plow.

We kept pretty close records this year to see just what it cost to grow an acre of corn including the labor and fertilizer, and we found that if we allowed the farmer for his labor the amount per day that he could earn if he were working for another farmer or that he would have to pay for like labor, the average for an acre of corn in this section was $39 labor cost. This would be high, of course, in the Corn Belt where all the work is done with machinery and on large scale but here on our hills it will cost that much.

We allowed $4 per acre for rent of land, which would not pay for it until it was worn out under the average farmer's practice if it were corned continually. This gives us a cost of $43 plus the average cost of fertilizer of the eight contestants of $39.87 or a total of $82.87 per acre.

The average yield for the eight was 99.5 bushels, shelled basis. Corn was selling in the field here this fall for $1.50 per bushel. Then the acre of corn was worth $149.25. We did not allow anything for the fodder, for most of the contestants left it on the land. We believe it is worth as much plowed down as it would be cut off and fed, and a lot less labor cost. So we have a profit of $66.38 above our labor and fertilizer cost plus rent of land.

Comparisons

Now let's see what the average farmer makes on his corn when he applies an average of about 600 lbs. of 4-12-4, which is what most of the farmers use. This will cost him about $12.

He has the same amount of labor in his acre and the same rent, which means that his acre of corn has cost him $55. But he only has a yield of 44 bushels, according to the State average; and if he planted it on some of the land we planted on, he would not have had any. Then his corn was worth $66, or he had a profit of $10 for his acre.

Let us reduce it to a tonnage basis. We used an average of 1,480 lbs. per acre or 70% of a ton. Then if he used 600 lbs. or 30% of a ton, we received $56.38 for the difference of 40% of a ton, or a ton was worth to us approximately $140.

But wait, the other fellow did not have half the yield per acre that we had, so in order to grow that much corn he will have to put out over two acres. We will give him the advantage of the 11.5 bushels over twice as much as he had. He had the labor cost of two acres instead of one, so his cost for labor is $78, fertilizer for two acres is $24 and rent on land $8. Since we only plowed one acre, we had one more left in meadow which would be worth at least $20 for hay. We would have to charge that to him, making his corn cost him $130. His 88 bushels would be worth $132, or a profit of $2.

Now let's go back and see what our acre would be worth on the same basis. Our 99.5 bushels were worth at market price $149.25, but we only plowed one acre so we had that other acre to cut hay from and that was worth $20. We add that to what our corn was worth and we have $169.25. Our expense is still the same, but we have $20 worth of hay extra, or a profit of $86.38.

On a tonnage basis again, we still used the same tonnage but he doubled his on his two acres. Then he used 60% of a ton and we used 70%, so our tonnage was only 10% greater than his but our profit for the same amount of corn was $84.38 greater than his.

You know the old saying that figures won't lie but that liars will figure. We have been called all kinds of liars for claiming we produced this much corn on an acre, and on the face of these figures it may look as though we have stretched the facts somewhat. If you will study them you will see that we have not.

The Intangibles

There are a lot of intangible things in our favor that we cannot figure in dollars and cents at this time, some of them never, yet we know that they are there. Take for instance the less land we will have to plow to grow what grain we need, or other crops for that matter, if we use enough fertilizer. What will be the value to our farms and to the country in the less erosion?

We do not have the figure yet but we do know that in two years' time we have been able to see the increased production in small grains and grasses on the fields of high fertilization. We did not rob the land with our corn crop.

There is also the fact that as we learn to grow more crops with less labor, the farmers of the country can better feed the growing population at less cost and still make more profit themselves. These are things that we know are there but cannot figure them in dollars and cents.

There is a satisfaction in producing a bountiful crop that is worth a lot to a farmer. Also there is more leisure for him if he produces the crop with less labor.

We wish in closing this story to emphasize that we are not trying to get farmers to grow corn on land that is not suitable, nor are we advocating the growing of more corn on our hill land. We tell the class that most of them would be better off to grow none at all. Most of them are growing less acres all the time, but have more corn to feed.

Soil Treatment Improves Soybeans

(*From page* 23)

level, the acre yield of soybeans was relatively high on the untreated land. Soil treatment consisting of crop residues, limestone, rock phosphate, and muriate of potash (RLrPK) increased the bean yields on these more productive soils. The oil and protein contents of the soybeans showed some variation on both fields, but in all cases were relatively high. The acre yield of both oil and protein was relatively high on these dark-colored soils.

It seems that soybean growers should aim at 500 pounds of oil per acre and 1,000 pounds of protein. These yields are entirely within the scope of possibility. It would require a 40-bushel-an-acre yield of beans. With such a yield the beans would have to have approximately 21 per cent oil and 42 per cent protein. Soybean research men are about ready to give the growers varieties which will meet these specifications. On the part of the grower it would require a selection of the best in seed and varieties and the use of the utmost in cultural skill. It would also require a careful study of the soil's needs and a wise application of the best in soil-treatment practices particularly adapted to the production of soybeans.

TABLE III. OIL AND PROTEIN CONTENT OF SOYBEANS ALONG WITH ACRE YIELD. JOLIET AND CARTHAGE EXPERIMENT FIELDS, REPRESENTING DARK-COLORED SOILS.

Soil treatment	Beans bu/A	Oil %	Protein %	Oil lbs.	Protein lbs.
Joliet 1949					
None	24	21.8	39.4	314	567
RLrPK	32	23.2	39.2	445	752
Carthage 1949					
None	28	21.1	43.9	354	738
RLrPK	33	21.2	41.8	420	828

Uncle Sam's Acres

(*From page* 5)

parks and open range lands. So with the precedent already set for acquiring nearly 53 million acres of land for withdrawal and control by the armed forces, we may not be surprised to see another round of leasing and buying.

Last summer the government sent a water resources policy commission on tour, taking testimony and experiences about wise use of scant water supplies. The commission members were astonished to get the mass of facts and suggestions and to see the awareness of the western people concerning conservation of the public domain.

More than 20 million acres of these ranges owned by the federal government need revegetation badly. At least half of them can safely be reseeded, often by using airplanes. One key to growing this seed once it is well sown is in water-spreading methods and facilities. In attempting to perform water spreading, a series of low dikes are built to retard the rapid runoff from the surrounding highlands. This water is caught as it washes down and is gradually spread fanwise over the parched but hopeful land. Much of this excess rainfall and snow moisture will seep down and percolate through the soil.

One of the best known of these artificial water-spreading systems is that located in southeastern Montana in the Little Missouri area. An original tract of 1,000 acres on which to undertake the test was mapped out. Today after a few seasons of trial, the grazing capacity of the section adjacent to Thompson Creek has increased more than thrice. Appraisal of the financial returns so far indicates that a net return of more than 12 per cent on the investment each year is being realized. Soil erosion on the one hand and flood irrigation on the other are also side benefits coming from engineered water-spreading conservation.

Recent attention has been riveted on noxious and poisonous weeds and useless brush growth which interfere with maximum grazing on all of the best western ranges. Halogeton, the sheep-killing Russian thistle type of wild plant which has spread too far and wide for comfort, is an example of the puzzle picture which range users must fit together. The chief practical way to kill out halogeton is to build up the quality of the most valuable and resistant native grasses. This is being done.

Not only are the government rangers tackling this whole range quality project, but stockmen using the pastures are contributing mightily to every phase of it. They supply labor, materials and funds. Just last year alone, the range managers said that land users paid in the equivalent of a million dollars toward rebuilding the beef-making grazing areas. This is in addition to regular fees charged for improvement budgets, and represents at least half of the cost for range improvements. It is nice to point out real cooperation between government men and western stockmen. The reverse has caught too many headlines.

But the biggest headache and dilemma for the federal rangers come when there are more than one or maybe more than two forms of land use sought, possibly on the same tract. To give each honest citizen just about what he wants and will settle for, without hurting the welfare of the others who apply, is a knotty angle to management.

Surveying and recording titles and boundaries and attending to such legalities of land management are likewise bounden duties assigned to the project bosses. Few persons are aware that all transfer records of deals made with public land are kept stored and filed in Washington. Thousands of farms in the country were homesteads away back then. I have seen these ancient treasures unfolded and laid reverently before visitors on many farms. Sometimes they showed the signature of our earlier presidents—back when presidents did not have much more to do than a third-class postmaster, and no foreign frills to dabble in.

If any of these original title parchments get lost or burned, the heirs and assignees on any homestead farm can rest easy because all copies of patents ever issued for public land from the United States to the first owner are on file. Requests for copies of these records are received by the hundreds every week. Better yet, the newest idea is one which will finally result in depositing microfilm copies of such patents outside of Washington, probably in regional vaults.

Of course, we know that too much of the public domain has in years past been frittered away, wasted and injured, despoiled and exploited. Americans have always been like a kid in a jam closet, and in need of discipline to prevent damage and indigestion.

Some say there are too many different bureaus and divisions of federal government engaged in management of public ranges and parks and forests. It admittedly is often hard to get things all straight and to find the right agency which manages an area in question. Now with all the multiple defense alphabeticals added to the mystic circle, and some of them claiming some need for land in their work, the matter of keeping track of who's who and where will be tougher than usual.

Not only in outright management is there some confusion. More of it shows up in the various mortgages and loans involving private land to which some of the federal departments are a party of the first part. But most of us are hopeful that in due time much of this hazy and muddled situation will be corrected—although whoever gets the job of handling *all* of the real estate to which Uncle Sam is a contracting party will have a worse tangle to unravel than a price and wage dictator.

Some of us who have loitered in federal corridors a little get another angle to this debate. You see, even if a merger takes place and a shotgun wedding unites two or more of the agencies that manage a given business, the same old jobs must be done and the same people will be dropping in and writing for services. In the end, with a certain task to perform in an allotted time, almost as many if not more employees will be needed.

You may succeed in laying all your complaints and requests at one single door, instead of wandering around in a daze hunting the right pigeonhole, but don't forget that it takes manpower and experience to answer those queries and make those decisions and carry out those actions.

Then there is the final point of background. It takes more than a surveyor or an abstract lawyer to service and manage the lands owned by Uncle Sam. Somebody must be there to know what has been done before and how well it worked out; and although we all hate those confounded legal "precedents" in court cases, we admit that experience in any land matter is a vital thing to successful stewardship.

How would you like to have a green and inexpert person undertake to pull a tooth or write a will or draw a mortgage for you? How would you enjoy having some raw newcomer take over the post of township assessor? Background is necessary to any foreground I ever knew. Otherwise when you step back a little, over you go!

So now I have completed this small outline of Uncle Sam's land business. It's a big story, worth a book to tell. Our only object in doing this is to spark the idea that there are really some trained and conscientious men and women acting as our trustees. And a good many more cooperating farmers and stockmen and promoters of business are able to make headway intelligently with these land managers of ours than we "hear tell about" in lurid yarns and feature thrillers.

The old lady in the East had just finished reading that it was so cold in the West that when the cattle laid down their tails froze to the ground and broke off when they got up.

"Well," she exclaimed, "this is the first time I have really understood why this extensive business of retailing cattle!"

* * *

"Gud mornin', Missus Flannigan. How er yu? And how is Mister Flannigan? Not that I gives a damn, yu know, but jist to be sociable."

* * *

Girl: "I saw you the other day at the corner winking at the girls."

Wolf: "I wasn't winking. That's a windy corner. Something got in my eye."

Girl: "She got into your car, too."

* * *

"Say, Pat . . . what's this I'm hearing about ye joining up with thim communists? Be ye daft, man?"

"It's the God's truth, Mike . . . I signed up last week. Ye see the doctor told me I had but 10 days to live and 'tis better one o' thim communists die than a good Irishman."

* * *

He was a retired businessman, turned gentleman farmer. Back in the city for a day, he was extolling the joys of farm living to an old acquaintance. "Fred, you can't beat it for relaxation. When I'm feeling low, I go out and milk a cow."

"That's the only way you could, when I was a boy," replied his friend.

* * *

Shipwrecked on a desert island, the young man proposed marriage to the beautiful lady:

Young Man (urging): "We might as well settle down because we'll never be rescued anyway."

Beautiful Lady: "But there are no ministers and it wouldn't be legal."

Young Man: "I'm not worried about that. I don't see any policemen around, either."

* * *

"My Ma don't allow me to play with you," said the boy with the freckles. "She says you're a bad boy."

"My Ma don't allow me to play with you, neither," retorted the redheaded one. "She says you're the worst boy in the neighborhood."

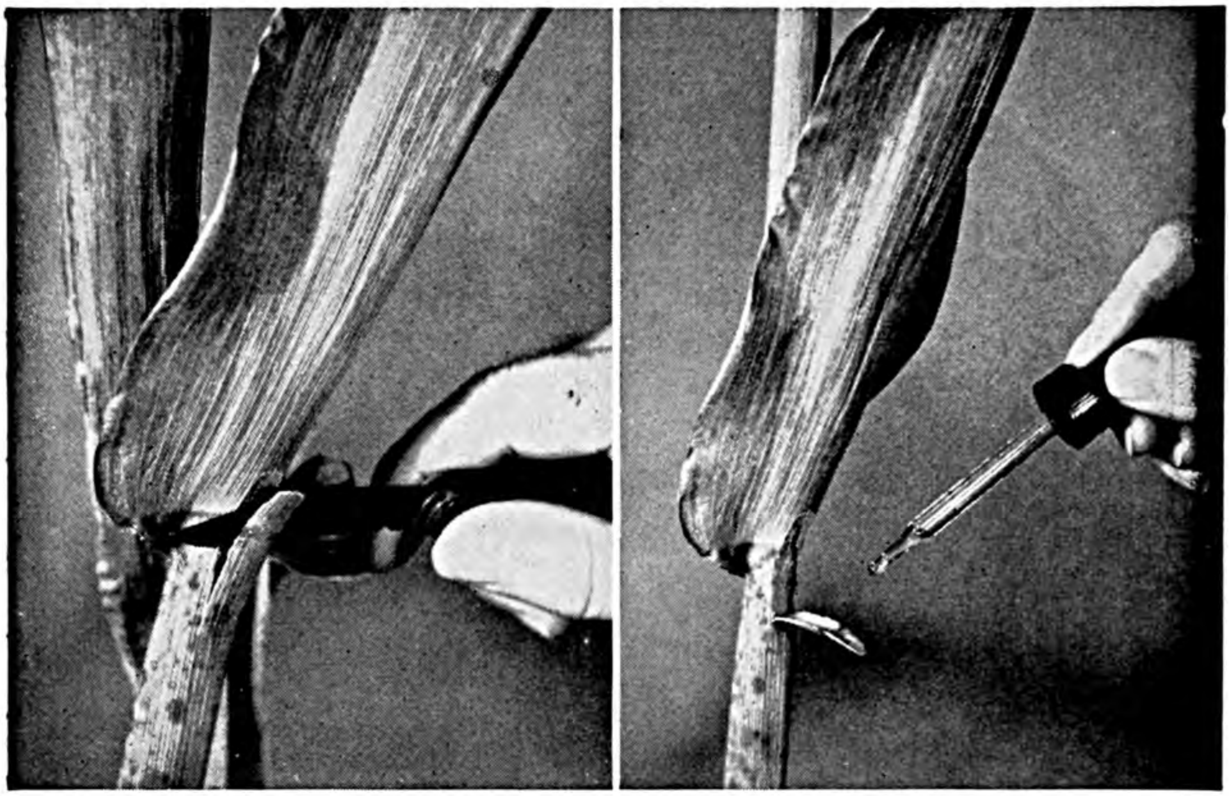
"Gee! We're both regular fellers, ain't we?"

* * *

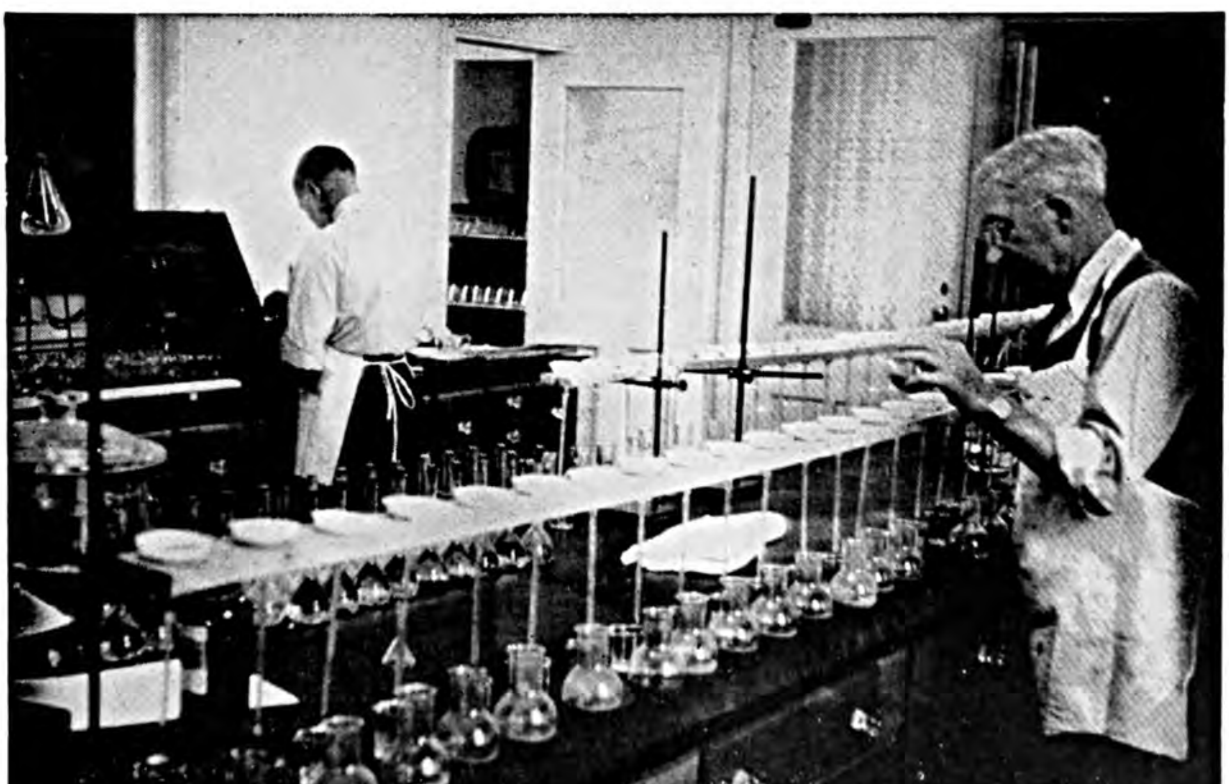
It is said that at the age of 75 there are 18 per cent more women than men. But at age 75, who cares?

* * *

The hillbilly boy walked into the town confectionery and asked for an ice cream soda. The clerk presented the drink, all done up with a cherry and two straws. After a few minutes the boy called the clerk and said, "Mind ef I take them holler sticks out? They keep a-knockin' my hat off."



Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



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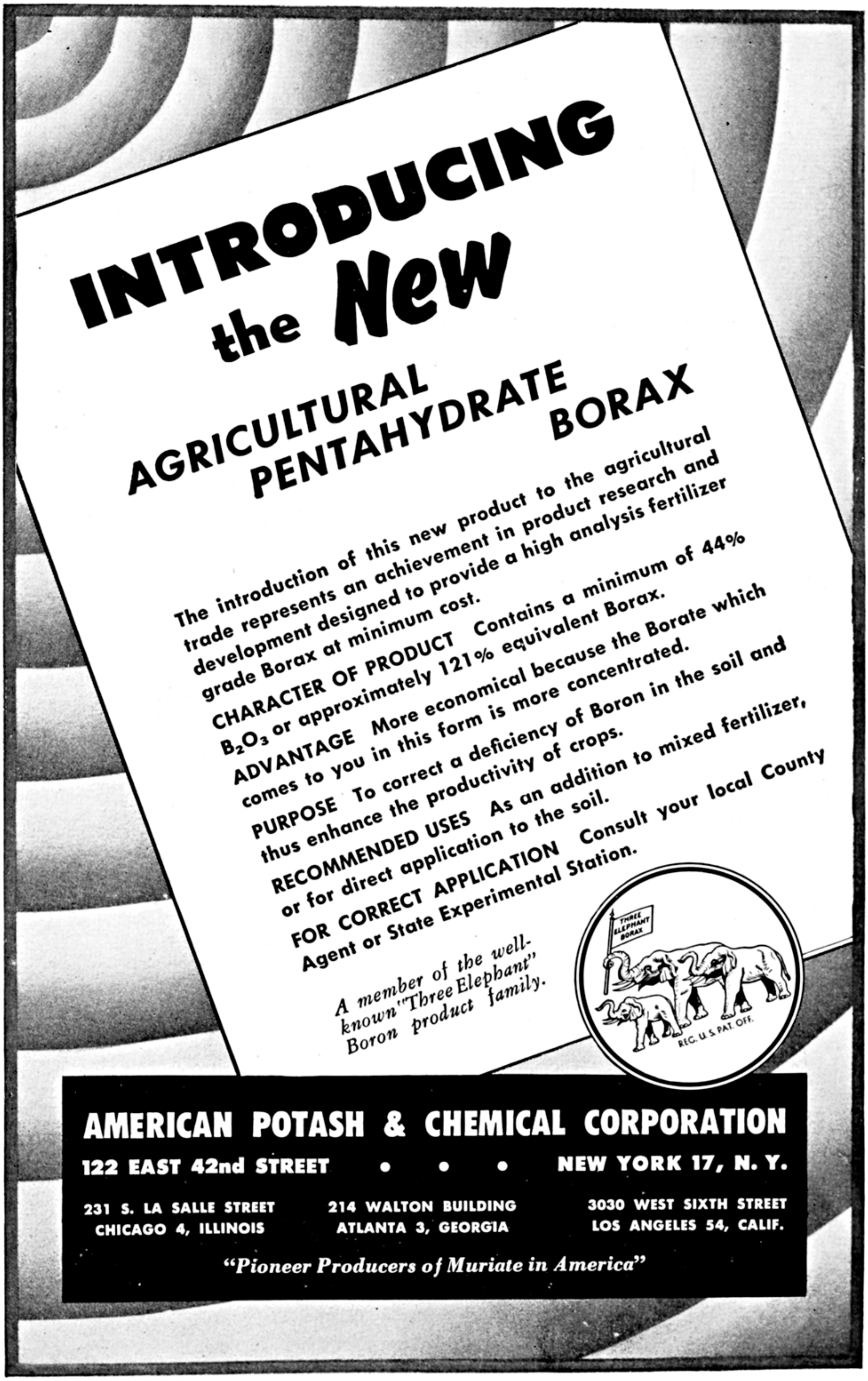
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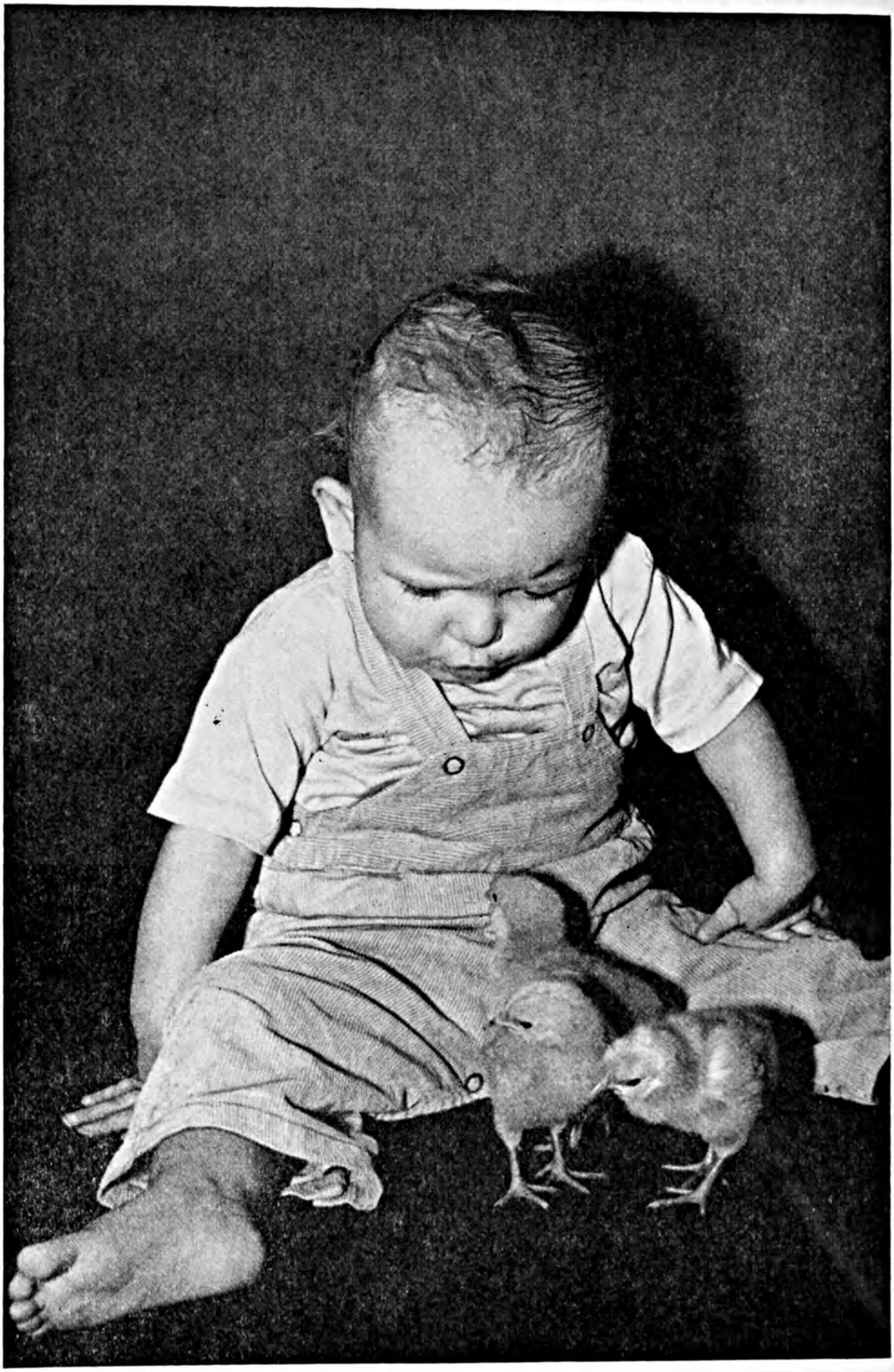

Getting Acquainted

Better Crops with PLANT FOOD

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Are We Giving . . .

Too Much Velvet?

Jeff McDermid

YES, sir, I can recall almost to a "date dot" when the first signs of this extravagant, highfalutin, and pampered era emerged on our humble horizon back in that old Midwest settlement of some time ago. I don't recall that pleasant and innocent and awkward time with any great degree of remorse or wishfulness. No, it's just something else, like looking back as it were to some definite point of departure from one phase or mode of life to another and a new one.

It comes to pass in a sort of imperceptible way, like when you finally grow from a kid in short pants to a young marriageable person planning to conquer your part of the universe and settle down—or even that distasteful period when you begin to get oldish and hate to admit it, or even think of it. So most of us didn't fully realize what we were plunging into back there when we got those three important improvements on our premises—well, maybe it was four of them, if you count the newfangled breakfast food.

They seemed strange enough at first and we were not quite sure what to do with the new things after we got them. I refer to three innovations that blasted us clean out of the old pioneer fumbling era, smack dab into the outer fringes of this extravagant and easy-soft kind of living that everybody takes for granted now.

We got a cookstove for use in summertime which burned kerosene oil. We got ourselves a funny looking wall telephone with a curving, out-thrusting receiver and a handy crank on the box to ring up central. We had the local plumber put us in a fancy indoor privy. Then, if you count in the cornflakes and the shredded wheat biscuits for our breakfast fodder, in place of hot oatmeal and cream of wheat porridge or good old cornmeal mush, you have the best of rudimentary evidence. It's all any smart detective would want to solve the guilt pertaining to the shiftless era we had moved right into.

MAYBE you think Ma was the chief beneficiary of that oilstove. She wasn't, because I ask you who was it sawed and chopped and lugged in all the confounded wood that the crazy old cookstove used to consume? Besides, for awhile we used the new oil-burning stove just in summertime out in the lean-to kitchen. It wasn't so miserable to run as a wood-burner with forced drafts during the torrid July days. We fired up the regular cookstove most of the time between November and May.

It worked all right for awhile. We got the new contraption second hand and didn't know much about cleaning burners or such rules, and so one time the blamed gadget blew up with a whoosh and set fire to a mess of batter cakes. As luck would have it, Ma was setting the table and didn't get scorched. Then we sold it to the junk man and waited for a few weeks until we'd saved up enough to get us a brand new oilstove—complete with directions. You see, even an explosion wasn't sufficient to warn us not to go too fast into the new era. We'd had a taste of something different, and I was relieved some from heavy-duty timber chores. So, figuring that kerosene was dirt cheap and wood getting more costly, we launched ourselves for good on the trail of progress.

I can't recollect that the meals Ma fixed up for us were any nicer or tasted any better after she used the oil-burners, but it seemed easier for her anyhow on several counts.

Meantime, Ma didn't yet have running water for cooking and dish washing. She used the old cistern pump at the kitchen sink. We used to smell the water often and when it got pretty foul, we'd grab our ladders and crawl under the house and attempt to clean it out—that is, after a long dry spell when the water line was low.

THAT new telephone was really a needless extravagance, if there ever was one. Except for possibly being able to call the doctor or the veterinary surgeon quicker, that phone represented about as much intrinsic value as a television set does now. Sure, it looked right nice and modern to have up there on the kitchen wall beneath the clock-shelf and alongside the hooks where we hung the almanacs and home-medicine booklets.

I recall the first time I answered that phone was when a neighbor rung us up to say Merry Christmas—or maybe to wish me a happy birthday, one or the other, I forget which. I was scared stiff, as I used to be when they told ghost stories or war yarns. Mr. Haselton's voice didn't sound natural, like it usually did when he just went outdoors at his house and hollered like time over to our place. There was a big echoing hollow place in the valley between us, and sometimes his voice repeated itself so often you never made a mistake about what he wanted. Pa's voice was the largest and most penetrating one in the whole community. Haselton and three other neighbors always heard him plainly—sometimes too much so when he was jawing at me or the dog. So I ask you what did we need a phone for anyhow? Especially, because when Pa used the receiver he didn't tone down his vocality much and it almost tore out the insulation.

But there it was—right on the wall, because the home telephone company wanted subscribers and it would be lots cheaper for more homes to hitch onto the line. I doubt if it saved us many steps or meant much in a marketing way. We always went downtown twice each week regularly. Ma simply wouldn't order groceries unsight and unseen, and Pa had some old cronies at the lodge hall who liked to play old sledge and pinochle pretty well. So you can't hang that excuse up to the credit of the telephone. However, it didn't cost us much, probably a dollar a month. It usually worked too, except when you forgot to put in the lightning plug before a summer

storm. It's main advantage was at election time. You didn't have to go down to the courthouse chambers and hang around there all evening waiting for the slow telegraph messengers to dawdle in with the dispatches. You could call up somebody every half hour and learn the worst.

But the gadget that broke down the redoubtable fiber of the pioneers and opened a wedge for all the pamperings we have enjoyed was the chemical closet in the corner room, which replaced that bulwark of rugged Americanism—the backyard outhouse. The once famous actor, vaudeville impersonator, and raconteur, Chick Sale, was a sort of neighbor of mine, just about 25 miles away. He it was whose little booklet of the 1920's immortalized the "family-size three-holers."

Like the dogs and cats of those days, the human family always moseyed out into the ozone somewhere for their alimentary chores. Even decrepit grandsires hobbled out back without a murmur of complaint or sign of rebellion—unless ill and bedridden. As Chick reminded us, there was usually a handy woodpile out there near the privy, so that one could render double duty by lugging in a few sticks or kindlings en route indoors from the "necessity."

It usually stood under a shade tree with a few annual wild cucumber vines gracefully entwined around its battlements. Various ornamental moons and crescents were hacked into the rough door for visual and ventilating purposes. The flies of summertime did not bother the users so much as the frigid drafts and heaped snowdrifts of January. Those were the times that tried men's souls and probably led to the surrender of our generation to the self-indulgence of a toilet with less direct rear exposure.

THEN, finally, we got that new kind of morning chow. Father discovered it first, when the grocer unpacked one of the first cases of cornflakes ever to reach our community. I think it was named "Granose." The package looked just like the ones they sell now, but the coupons for prizes and the advertising urges for small boys to partake of flakes so they could become Hopalongs were a much later feature of the dish. It was novel enough to sell itself.

It saved Mother quite a lot of cooking and preparation of gruels and oatmeal the night before. You could just dump the stuff into a cereal dish and sprinkle on the sugar and cream, and then imagine you had something that would stick to your ribs. "Easier to chew and easier to eat." Those longish lumps of shredded wheat also arrived soon after the cornflakes, and they went well with soft-boiled eggs on top. That was also the time when toast began to take a back seat in the day's first meal—but only a few of us could say we saved much by this

(*Turn to page* 48)

Fig. 1. "Starter" fertilizer gets corn off to a vigorous start and in Wisconsin is prerequisite to all other fertilizer treatment. It is especially important that rather liberal applications (200 to 300 lbs. per acre) be drilled in with cornplanter attachment where sidedressing with nitrogen fertilizer is contemplated and especially where no manure or other commercial fertilizer has been applied.

Fertilizing the Corn Crop in Wisconsin

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wisconsin

THE average yield of corn in Wisconsin could be doubled if all of our 2½ million acres were given the proper soil and fertilizer treatment, the stands were stepped up to safe limits, and adapted strains of good hybrids were planted.

By soil treatment I mean proper and adequate preparation of seedbed, timely cultivation of the crop for weed control and soil aeration, and the use of adequate amounts of plant food. A mellow, deep, and well-prepared seedbed adequately supplied with organic matter and plenty of plant food is the secret to high yields of corn. The cultivation of our corn at the right time in order to stir the soil for good aeration and as well to form a dust mulch which helps prevent losses of moisture by evaporation is likewise an important factor in the production of good crops of corn.

By "safe stands" I mean the increasing of the number of stalks per acre to a point where over-crowding and moisture limitations do not become depressants. This may mean stepping up our stands from the old 42″ x 42″ with 3 kernels per hill (which gave us about 10,000 stalks per acre) to stands of from 12,000 to 16,000 stalks per acre.

What About Plant-food Requirements?

Lack of nitrogen is more responsible for poor crops of corn in Wisconsin than is the lack of any other element. But in making this statement I must also say that adequate and abundant supplies of phosphorus, potash, and lime are prerequisite to the full utilization of nitrogen whether supplied in the form of commercial fertilizer or derived from the soil's mineral or organic residue sources.

Let us consider for a minute those fertility factors that combine to give us 100-bushel crops of corn. First of all, corn is a heavy feeder on nitrogen. A 100-bushel crop of corn plus fodder requires about 157 lbs. of this element. Corn is likewise a heavy feeder on potash, a 100-bushel crop requiring about 110 lbs. of K_2O (equivalent to the potash contained in 550 lbs. of an 0-20-20 fertilizer). The phosphorus required for a 100-bushel crop of corn amounts to about 56 lbs. of phosphoric acid (P_2O_5). Manure, we all know, is a wonderful corn fertilizer and 10 tons of it contains about 100 lbs. of nitrogen, 50 lbs. of phosphoric acid (P_2O_5), and 100 lbs. of potash (K_2O). Manure is relatively low in phosphorus and it is for this reason that most of the common "hill-drop" or "starter" fertilizers recommended for corn are relatively high in their content of phosphorus. A lack of phosphorus may result in soft, immature corn. Abundant supplies of phosphorus, potassium, and nitrogen make for good yields of well-formed ears of hard, mature, protein-rich corn.

Build Up High Level Fertility

Soils low in phosphorus and potassium should be given liberal applications of fertilizers at the time of seeding down to small grain and clover or alfalfa. Our soils should be limed and maintained at a pH of 6.5 (very slightly acid). We should aim toward the restoration of the original virgin state of productiveness through this more fundamental practice of soil building. The regular application of fertilizers (about

Fig. 2. Sidedressing attachments for all makes of tractors are available. The application of from 125 to 150 lbs. of ammonium nitrate (or its equivalent in other nitrogen fertilizers) is recommended when corn is about knee-high.

Fig. 3. Here on the Victor Jonas farm at Muscoda, Wis., 67 lbs. of nitrogen (200 lbs. of ammonium nitrate) applied as a sidedressing in mid-July increased the yield of corn from 18 to 57 bushels per acre. "Starter" fertilizer (3-12-12 at 150 lbs. per acre) was applied to the entire field with an attachment on the cornplanter. (Sandy soil—no manure).

300 to 500 lbs. per acre of 0-20-20 or 0-10-30) every rotation plus the top-dressing of alfalfa every fall (or spring) with high-potash mixtures will in the course of several rotations raise the general level of fertility of our farms as a whole. Some farmers may wish to raise the general level of fertility at once by applying up to 1,000 lbs. per acre of 0-20-20 or 0-10-30 and then maintain this high fertility level with the application of smaller amounts of fertilizer every rotation.

Where we have built up and maintained a good level of fertility in our soils by this more general practice of applying fertilizer at the time of seeding down to legumes and where manure is applied and plowed under or disced in for corn, we believe that the practice of hill-dropping or drilling of small amounts of fertilizers with an attachment on the corn planter is about all that is needed to produce these high yields of corn. This small "shot in the hill" can be thought of as "starter" fertilizer. In Wisconsin on our upland silt and clay loam soils we recommend such mixtures as 3-12-12, 4-16-8, or 5-20-20 at from 150 to 300 lbs. per acre. Where corn is checked we suggest not more than 125-150 lbs. in the hill, but where drilled or hill-dropped it is safe to increase the rate of application up to 200 to 300 lbs. per acre. On the dark-colored muck or bottomland soils we recommend high-potash mixtures such as 0-10-30 or 3-9-18 at rates up to 400 lbs. per acre with the attachment on the cornplanter. (On some of the muck soils it may be necessary to plow under or disc in from 200 to 400 lbs. of pure potash in addition to the hill or drill treatment.)

Sidedress Corn with Nitrogen

I have already said that the lack of nitrogen is the bottleneck which over a period of years has held our average yields to about 44 bushels per acre. Nitrogen fertilizer applied as a sidedressing at the time of the second or third cultivation has produced some amazing and spectacular increases in yields. Thousands of farmers in the Midwest are now following this practice of sidedressing their corn early in the growing season.

Fig. 4. A sidedressing of 45 lbs. of nitrogen in the form of calcium nitrate applied on July 16 raised silage yields from 16,000 to 25,000 lbs. per acre on the Jos. Sharratt farm at Mazomanie, Wis. (Other carriers of nitrogen such as ammonium nitrate, ammonium sulphate, cyanamid, or urea might have been used with equally good results).

It is true that even where we have raised the general level of fertility in our soils through the continued application of phosphate and potash fertilizers and where our soils have been adequately limed, the lack of nitrogen may still be the cause of low yields of corn. Where a good legume sod is plowed under and where manure is generously applied, the only fertilizer we recommend is "starter." But where corn follows corn or grain and where we know the soil is short on nitrogen (the element that gives us the dark-green, lush growth of stalks), this sidedressing of corn with nitrogen fertilizer at the time of the second or third cultivation offers a great opportunity for larger yields on our Wisconsin farms. In fact, I predict that the sidedressing of corn with nitrogen will do more to increase yields than any practice ever recommended.

On fields that will make, let's say, 50 to 60 bushels per acre and where in previous years lime and commercial fertilizers were applied at the time of seeding down, the application of 125 to 175 lbs. per acre of ammonium nitrate or its equivalent in other forms of nitrogen fertilizer, such as ammonium sulfate, cyanamid, nitrate of soda, or urea, will result in increases of from 15 to even 25 bushels more corn per acre.

Closer Planting Requires More Plant Food

In order to achieve these higher yields, we are finding it necessary to plant more corn per acre. This stepping-up of stands can be accomplished by narrowing our planter wheels to the 38″ or 40″ and then hill-dropping 2 to 3 kernels in spacings from 22″ to 28″ in the row. On sandy soils we must be careful not to plant corn too thick on account of moisture limitations. However, there is more corn "firing" for a lack of nitrogen than for a lack of water. But closer planting, more stalks per acre, calls for more plant food. This yellowing and "firing" of the lower leaves of corn in mid- or late summer are the telltale symptoms of the almost universal lack of nitrogen. Many farmers in the past have mistaken this drying-up of lower leaves for a lack of water.

What about attachments for tractor cultivators with which to apply fertilizer? Practically all the manufacturers of farm tractors are making these attachments. Prices range from $85 to $100 for the two-row attachments. The fertilizer is placed back of the inside shovels in bands on either side and at a distance of from 8″ to 12″ from the corn row.

The Best Time to Sidedress

Due to possible moisture limitations later on in the growing season in Wisconsin, we think it is best to apply nitrogen fertilizer in the early period of the growing season (late June or early July). It is true that excellent results have been secured where nitrogen fertilizer was applied even up to the first of August, even when corn had started to tassle. But in general it should be applied before the corn is knee-high. Bear in mind that sidedressing corn in late June or early July is not a substitute for the application of "starter" fertilizer at the time of planting. The practice of hill or drill fertilizing is still strongly recommended.

What about those low-fertility fields where manure is not available and where no clover or legume sod is being plowed under? I have already stated that the average yield of corn in Wisconsin is about 44 bushels per acre. In this average of 44 bushels per acre we include thousands and thousands of acres that made yields of 20, 25, 30, and 40 bushels per acre. There are thousands of acres of corn planted every year where manure is not available and where no commercial fertilizer has ever been applied in the rotation. Why not give such fields a complete balanced fertilizer as a substitute for stable manure? In my opinion 10-10-10 (or 8-8-8) is a well-balanced plant food and where plowed under at from 800 to 1,000 lbs. per acre with crop residues will supply approximately the same amount of plant food as is contained in 8 to 10 loads of "phosphated" manure. (By "phosphated" I mean manure to which 25 lbs. of 20% superphosphate have been added to each ton.)

It is true that the 10-10-10 or 8-8-8 grade of fertilizer does not meet the requirements of corn on all types of

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Fig. 5. Here, 800 lbs. of 8-8-8 applied on the furrow bottom plus "starter" fertilizer (2-12-6 in the hill) made 108.7 bushels per acre. "Starter" only made 76 bushels. This crop was planted thick (about 14,000 stalks per acre) and was grown on the Paul Bartels farm in Grant County, Wis. No manure was applied to this field.

Fig. 1. Nitrogen made this difference, but to realize the maximum benefit from nitrogen, it is necessary to follow a sound insect control program. Left—no nitrogen. Right—adequate nitrogen. Adequate quantities of phosphorus, potash, and lime were applied in both instances.

Increasing Cotton Yields in North Carolina

By C. D. Welch and W. L. Nelson

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COTTON is in the spotlight again, primarily because of the increased demand for this crop and its low production in 1950. Unfavorable weather conditions along with a severe insect infestation have been blamed for the low yields in North Carolina. However, it is interesting to note that many farmers obtained relatively good yields in 1950 by following recommended production practices.* These practices included the use of proper amounts of lime and fertilizer, the control of insects and diseases, the use of recommended cultural practices, and the planting of an adapted variety at the correct seeding date.

This article will deal primarily with recent research relating to nitrogen fertilization and spacing. Certain information on phosphorus, potash, and lime requirements will be mentioned.

Nitrogen Fertilization

An adequate supply of nitrogen throughout the growing season is an

* Kulash, Walter M., and Jones, George D. Cotton insect control in North Carolina, N. C. Extension Circular 312. March 1950 (revised).
Shanklin, J. A., et al. Seven steps to efficient cotton production, N. C. Extension Circular 345. January, 1950.

important factor in producing high cotton yields (Figure 1). A crop of cotton yielding two bales of seed cotton per acre will contain about 110 pounds of nitrogen, of which 60 pounds are in the seed cotton (Table I). Most soils in the cotton-producing areas of North Carolina are low in available nitrogen and nitrogen must be supplied if high yields are to be obtained.

Table I.—Pounds of Nitrogen, Phosphoric Acid, and Potash per Acre in a Two-Bale Crop of Cotton (Approximate Average Composition).

	N	P_2O_5	K_2O
	Lbs.	*Lbs.*	*Lbs.*
2 bales of seed cotton....	60	25	30
Plants (3000 lbs. air dry).	50	15	50
Total (per acre).....	110	40	80

There are certain hazards which must be recognized when applying high rates of nitrogen for cotton. Any condition that will cause the squares or young bolls to shed will allow the cotton plant to make greater vegetative growth provided the supply of nutrients and other conditions are favorable. Often excessively wet weather may cause square shedding. Early insect damage may also cause a poor "boll set." It is essential that good insect control practices be followed if maximum returns are to be realized from cotton fertilization, especially from sufficient nitrogen to produce 1½ to 2 bales per acre.

Nitrogen-deficiency symptoms: Nitrogen deficiency on cotton is shown by light green leaves, which later turn yellow, then red, and eventually shed. This is very common, particularly on sandy soils in early August. In some instances, premature leaf shedding is considered an advantage in order that opening will be hastened and picking made easier. However, the leaves are on the plant for the purpose of manufacturing carbohydrates, important constituents of the cotton lint. Hence, early leaf shedding may result in many partially developed bolls, poor quality lint, and low yields. The practice of artificial defoliation permits the grower to supply sufficient amounts of plant nutrients to keep the cotton leaves functioning until the desired time to remove them.

Time of nitrogen application: Experiments have shown that around 20 pounds of nitrogen (N) per acre should be applied for cotton at planting. This aids the plants in getting an early start and prevents early nitrogen deficiency which may "stunt" the plants. This "stunting" may reduce the yield potential even though the nitrogen supply is adequate during the period of boll formation.

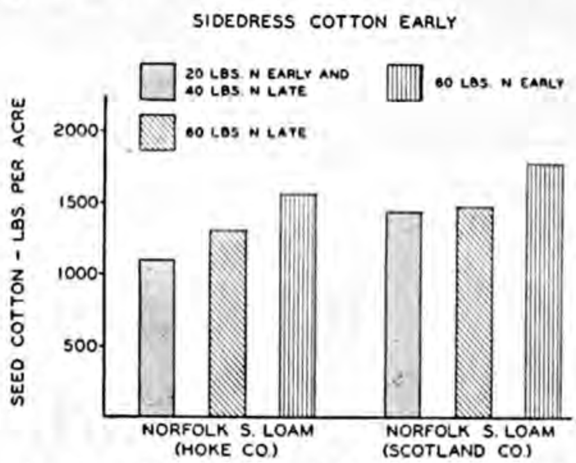

Fig. 2. Early nitrogen sidedressing is important in obtaining maximum benefit from the fertilizer applied. Twenty pounds of nitrogen, 80 pounds of P_2O_5, and 80 pounds of K_2O per acre were used at planting in all treatments. The early sidedressing was applied when the cotton was 6-8 inches tall. The late sidedressing was applied when the cotton was 20-24 inches tall.

The nitrogen sidedressing should be applied early so as to be effective before that applied at planting is exhausted. Experimental data shown in Figure 2 indicate that the best time to sidedress is when the plants are 6-8 inches tall. Results from two locations show that late applications of nitrogen were not effective in producing maximum yields. In these experiments, 20 pounds of nitrogen and adequate phosphorus and potash were applied in bands at planting.

Rate of nitrogen application: Studies conducted in North Carolina show increased cotton yields with increasing rates of nitrogen up to 80 pounds per acre. Some of the results obtained in 1948 and 1949 are given in Figure 3. Twenty pounds of nitrogen per acre were applied in bands at planting, along with adequate phosphorus and potash. The remainder of the nitrogen was sidedressed when the plants were 6-8 inches tall. The effect of nitrogen was similar both years except for the reduction from the 120-pound rate in 1949. Excessive rainfall, especially during July and August, provided less favorable conditions for the production of high cotton yields in 1949. Despite the lower yield level in 1949, the yields of seed cotton were increased with rates of nitrogen up to 80 pounds per acre.

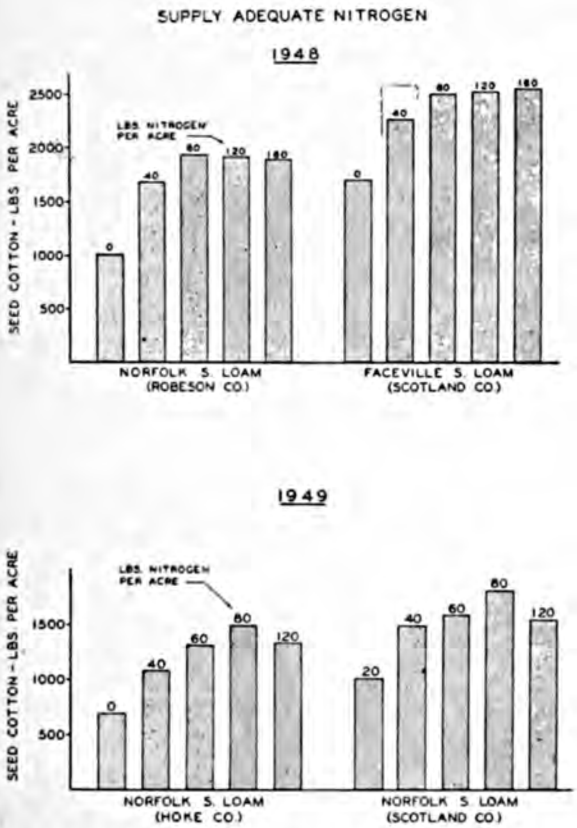

Fig. 3. Seed cotton yields were increased with rates of nitrogen up to 80 pounds per acre in experiments conducted in 1948 and 1949, (80 pounds of P_2O_5 and 80 pounds of K_2O were applied at planting in all treatments).

In general these and previous experiments show that from 40-80 pounds of fertilizer nitrogen are necessary to produce 1½ to 2 bales of cotton on average cotton soils. This is in general agreement with the results obtained in South Carolina at the Pee Dee Experiment Station. The results of a 16-year study have shown that approximately 60 pounds per acre of nitrogen are required for maximum yields of cotton.** The amount of nitrogen needed is of course greatly influenced by the soil and its previous treatment. On dark soils or where cotton is following legumes, the amount of sidedressing should be reduced or omitted entirely.

The nitrogen may come from several sources—the soil, cover crops, or commercial fertilizer. Unless the cotton is grown after legumes are turned under or on dark soils which will furnish some nitrogen, a high yield cannot be expected without an adequate application of nitrogen fertilizer.

As mentioned previously, an important factor in obtaining profitable returns from high amounts of nitrogen is to get an early set of bolls. A plant that is not setting many bolls tends to grow large. Early planting and early dusting greatly aid in early fruiting.

Effect of cover crops: The effect of cover crops on cotton yields was studied during the period from 1945-48 on a Marlboro fine sandy loam soil in Edgecombe County. Legume cover crops furnished adequate nitrogen for the yields obtained in this experiment (Figure 4). However, when sufficient fertilizer nitrogen (80 pounds per acre) was applied for the cotton grown on no-cover plots, the yields were as high as those obtained with cover crops. This indicates that the main effect of cover crops in this experiment was due to the nitrogen supplied.

Sidedressing 40 pounds of nitrogen after turning under vetch or Austrian winter peas reduced yields. This additional amount of nitrogen encouraged a greater vegetative growth and reduced fruiting. With oats, 40 pounds of nitrogen applied for the cotton were

** Hall, E. E., and Harrell, F. M., Fifty-seventh Annual Report of the South Carolina Experiment Station (1945), pp. 90.

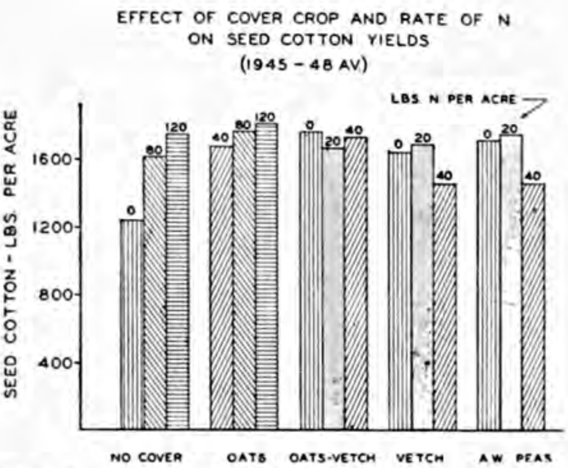

Fig. 4. A good growth of a legume cover crop or commercial fertilizer nitrogen will supply nitrogen for profitable cotton yields. (60 pounds of P_2O_5 and 120 pounds of K_2O per acre were applied at planting in all treatments).

adequate. It should be mentioned that the oats were topdressed with 18 pounds of nitrogen per acre each year.

Phosphorus, Potash, and Lime Requirements

The phosphorus, potash, and lime requirements of cotton have received considerable attention in experimental programs for a number of years.

Phosphorus: An adequate supply of phosphorus is important in rapid development of cotton. The response to phosphorus is of course related to the amount of this nutrient in the soil (Table II). On most Coastal Plain soils, 50 to 60 pounds of P_2O_5 per acre are adequate, while Piedmont soils may require from 75 to 100 pounds.

TABLE II.—EFFECT OF PHOSPHORUS APPLICATIONS ON YIELDS OF SEED COTTON (1948)*

P_2O_5 applied lbs./A	Yield of seed cotton—pounds per acre: Norfolk sandy loam 67 lbs./A of P_2O_5 in soil	Yield of seed cotton—pounds per acre: Norfolk sandy loam 288 lbs./A of P_2O_5 in soil
0	1439	2049
50	1929	2335
100	2048	2432

* 60 lbs. of N and 80 lbs. of K_2O applied per acre.

Potash: Cotton is considered to be a relatively weak feeder for potash, and "rust," or potash deficiency, is common on soils low in potash. The amount of potash needed in the fertilizer is related to the level of potash in the soil. Examples of the response of cotton to potash are shown in Table III. In general 30 to 40 pounds of K_2O are adequate on average soils while 60 to 80 pounds of K_2O are required on low potash soils or when cotton is grown in rotation with crops removing high amounts of potash.

TABLE III.—EFFECT OF POTASH APPLICATIONS ON YIELDS OF SEED COTTON (1944-6 AVERAGE)*

K_2O applied lbs./A	Yield of seed cotton—pounds per acre: Norfolk sandy loam low in potassium	Yield of seed cotton—pounds per acre: Cecil gravelly loam medium in potassium
0	863	1778
30	1411	1819
60	1734	1835
90	1710	1993

* 35 lbs. of N and 50 lbs. of P_2O_5 applied per acre.

Fertilizer placement: It is essential that the fertilizer used at planting be placed so as to avoid injury to the germinating seed and young seedlings. A vast amount of experimental work has been conducted for many years throughout the Cotton Belt to determine the proper placement of fertilizer. On the basis of this work, it is recommended that the fertilizer be placed in bands three inches to the side and two inches below the seed. Suitable equipment which distributes fertilizer and plants simultaneously is generally available.

Lime: Last, but not least, broadcast applications of dolomitic limestone are necessary on some soils to supply adequate calcium and magnesium. Cotton seedlings grown on acid sandy soils

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Fig. 1. Carrots—55, no treatment; 58, fertilizer only; 61, lime only; 65, 67, and 69, increasing amounts of lime with fertilizer.

Know Your Soil

VIII Penn Silt Loam

By J. B. Hester, F. A. Shelton, and R. L. Isaacs, Jr.

Department of Agricultural Research, Campbell Soup Co., Riverton, New Jersey

THE Piedmont Plateau lies slightly west of the Coastal Plain and extends from southeastern New York to Alabama. The soils on this plateau are derived primarily from ancient crystalline rock. Among the soils in this section is the Penn series. Better than one million acreas of land in New Jersey and Pennsylvania have been characterized as the Penn series, which makes it an important soil.

This soil in its native state of development is low in fertility. The soil reaction or pH value is below 5.5. The organic matter content is low and the plant nutrients, particularly calcium and magnesium, are insufficient to supply the crops that are valuable for animals. Since this acreage of soil is so tremendously important for the production of food for the cosmopolitan area of New Jersey and Pennsylvania, considerable research has been conducted upon it. Likewise, very outstanding accomplishments have been achieved by growers following the findings of this research.

Figure 1 points out some of the limiting factors of this soil in the production of carrots under controlled greenhouse conditions. Number 55 represents the maximum carrot-producing power of this soil without any treatment. Number 58 represents the same soil with an application of 1,000 pounds of 5-10-10 acid-forming fertilizer per acre. Number 61 represents this soil in which the calcium and mag-

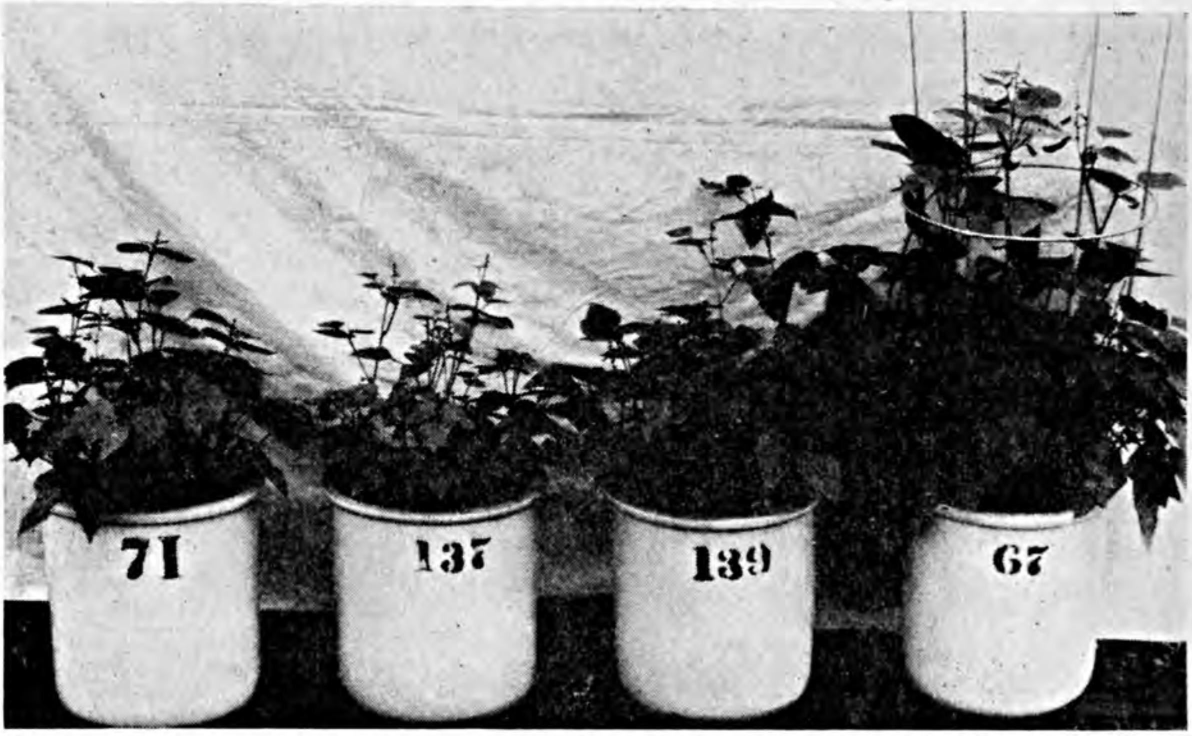

Fig. 2. Lima beans—Pot 71, no treatment; 137, fertilizer only; 139, lime only; 67, fertilizer, lime, borax.

nesium requirements have been satisfied. Numbers 65, 67, and 69 represent the fertilizer requirements of the soil being satisfied and the amounts of lime increased. From this experiment it is perfectly obvious that the first limiting factor of the native Penn silt loam is adjusting the pH factor and supplying sufficient calcium and magnesium for the crop concerned. Then the fertilizer and secondary elements can function properly.

To carry this point further, Figure 2 is given to show the production of lima beans. Pot 71 had no treatment, 137 received fertilizer only, 139 received lime only, and 67 received the proper application of fertilizer with the soil

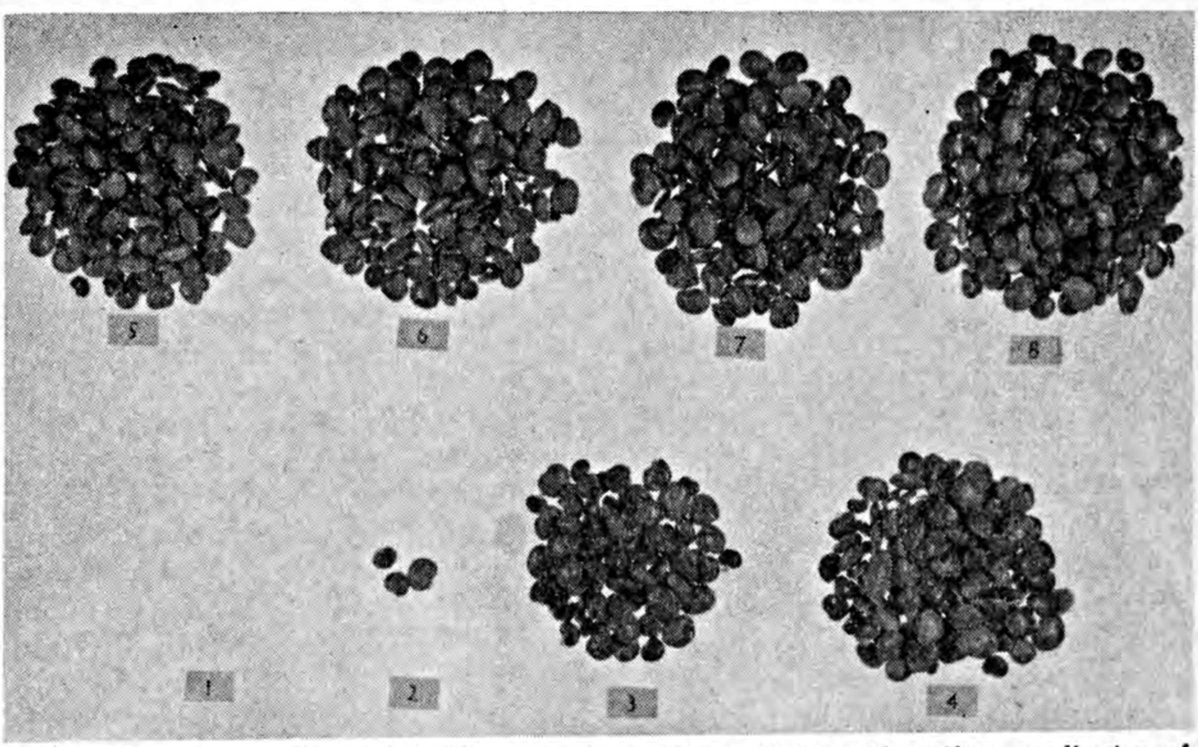

Fig. 3. Lima beans—No. 1, pH 4.9. Lime increased to pH 6.8 with uniform application of fertilizer.

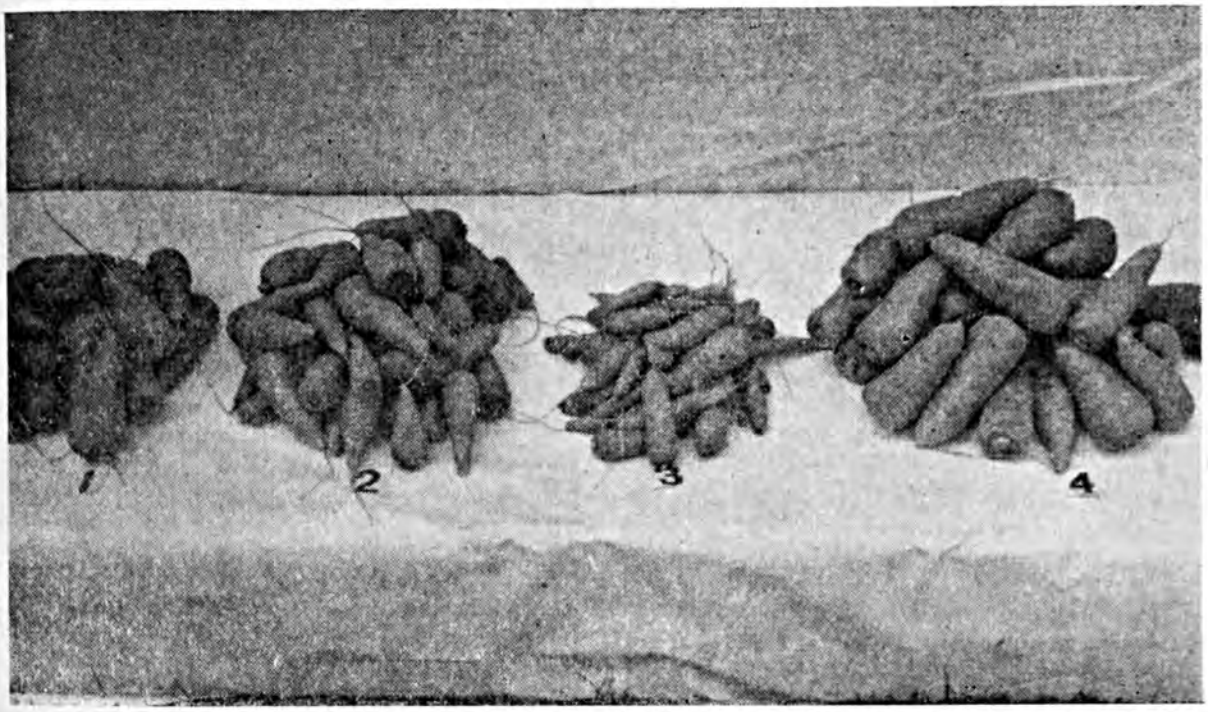

Fig. 4. Carrots—Optimum lime on all. No. 1, no nitrogen; 2, no phosphorus; 3, no potash; 4, complete mixture.

limed and borax added to produce maximum crop yields.

Since the most limiting factor in this soil was lime, it was decided to find out what the effect of the application of different amounts of lime or the change in pH value would be when a uniform application of fertilizer was used (in this particular case 1,000 pounds of 12-24-24 per acre). As shown in Figure 3, starting with Treatment 1, there was a pH value of 4.9 and no yield was produced. As the pH value of the soil progressed to 6.8, due to the application of liming materials, the yield of lima beans increased.

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Fig. 5. Five-year experiment. Pot 41, grower's treatment; 49, experimental area—both with no additional treatment. Pot 51, grower's treatment; 60, experimental area—both with additional fertilizer.

A Look at Alfalfa Production In the Northeast

By J. B. Washko

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

ALFALFA is the queen of our forage crops. It has been passed on to us as was our culture by ancient peoples. The Greeks, Romans, Russians, Arabians, and other early people grew this plant for its forage. Its very name "alfalfa" is from the Arabic and means "the best fodder." Today, it is still recognized as more nearly the perfect forage of any available. As hay, it is unsurpassed for livestock feeding. As pasture, it has a high carrying capacity and produces large gains when properly managed. It makes excellent silage when properly handled and makes good feed whether chopped or ground into meal. Its nutritive value is high since it is a valuable source of energy, carotene riboflavin (Vitamin G), protein, and calcium.

In addition to these virtues, there are other definite advantages in growing alfalfa. It assures hay in dry years. While it has a high water requirement, its deep tap root system can siphon water out of the soil that is beyond the reach of other forage species. This deep penetration of its roots system also enables alfalfa to recover from the subsoil plant nutrients which have leached there or are naturally present therein. The fact that two or more cuttings of alfalfa can be obtained per season spreads the risk of hay losses due to inclement weather. If properly managed and fertilized, it will endure 3 to 5 years or more.

Not only is alfalfa an excellent forage crop but when adequately fertilized with minerals, it can be regarded as a soil-improvement crop. It is one of the most vigorous fixers of atmospheric nitrogen that is available to the farmer. Experiments have indicated that under favorable conditions, alfalfa can fix up to 140 pounds of nitrogen per acre annually. But since two-thirds of this nitrogen is removed in the hay, only about 45 pounds of it are accumulated annually to enrich the soil. It would cost a minimum of $5.40 to purchase these 45 pounds of nitrogen if they were obtained from commercial sources. Indirectly, alfalfa culture can be credited with raising the general level of soil fertility on farms because large quantities of nutrients must be added in the form of calcium, phosphorus, and potassium for establishment and maintenance of stands.

Why the Small Acreage?

Putting all these reasons together, one wonders how any livestock farmer can get along without alfalfa in his farm program. The acreage of alfalfa in the 12 Northeastern States for the 10-year period of 1936-45 approximated 903,000 acres. During the two years of 1947 to 1948, it dropped to 852,000 acres. The total land area in the Northeast devoted to the production of hay approximates 8,156,000 acres. Thus, approximately 10% of this hay acreage is in alfalfa. This does not include the acreage in which alfalfa forms part of the grassland mixture since such acreage data are unavailable.

Why then, isn't more than 10% of our potential hay acreage in the production of alfalfa? What has limited its expansion? Historically, alfalfa, like most immigrants from Europe, landed on the East coast but it didn't stick except in the area near Syracuse, N. Y. The introduction that did make the United States the leading alfalfa-growing region in the world was that made on the West Coast. This would leave one to believe that the alfalfa plant was in harmony with such an environment as found in the West and conversely, that the Eastern environment is found lacking.

Examination of the facts indicates that such is the case. The soils in the East are generally acid, lacking in the basic materials, lime and mineral nutrients, whereas the soils in the West are high in basic mineral nutrients and are not leached out by the abundant rainfall so common to the East. Many Northeastern soils do not have proper drainage, and so subsoil moisture is often a problem. The soils in the West generally possess excellent drainage, especially in terms of the limited rainfall. The Northeast has less solar radiation whereas the West glories in its abundant sunshine. The alfalfa plant can make good use of abundant solar energy for the manufacture of large amounts of food reserves which are so essential for its survival. Northeastern winters are severe on large crowned herbaceous plants due to the high moisture content of soils and their alternate freezing and thawing. These and other unfavorable factors associated with abundant rainfall and inadequate surface drainage during the fall and spring are hard on alfalfa survival. Likewise, under humid Eastern conditions, disease and insect problems are more severe.

Since the Northeastern environment is so much less favorable than that of the West for alfalfa culture, greater attention must be given to the various factors associated with alfalfa production to overcome these environmental handicaps. What are the problems faced in alfalfa culture within the area and how can they be overcome?

Establishing Stands

There are still too many seeding failures with alfalfa in the Northeast. In this connection, the site chosen for

Fig. 1. Alfalfa is unsurpassed as a hay plant.

alfalfa production merits special consideration. Alfalfa culture should be confined to the better classes of soils. Deep soils are highly desirable. Good drainage is a "must" for alfalfa. It cannot stand wet feet, and unless internal soil drainage is satisfactory, stands will be short-lived.

It should follow a cultivated crop in the rotation to minimize competition from weeds. Such cultivated crops as potatoes, corn, canning tomatoes or peas, or tobacco are desirable preceding crops. The residual fertilizer from these heavily fertilized preceding crops can be utilized to advantage by the alfalfa plant.

Alfalfa requires a properly prepared, firm seedbed. Caution should be exercised, however, not to overwork the seedbed because then the surface crusts and packs. This reduces water intake and also increases the danger of runoff and erosion. The surface should be left with moderate amounts of small clods or lumps, being somewhat loose at the surface but firm below.

Time of Seeding

Time of seeding is another important consideration. In the warmer areas of the Northeast, a choice of either late summer or spring seeding can be made; in the colder portions of the area, only spring seedings are advocated. August seedings are highly successful if moisture is ample since the seedlings can become well established by winter. Late summer seedings, however, are subjected to severe competition from chickweed in areas where this pest abounds. August seedings are usually best from the standpoint of getting desirable hay yields the following season. Excessive moisture, inability to prepare a proper seedbed early, weed competition, and the pressure of other spring work are obstacles to spring seeding.

Should a nurse crop be used or is it better to seed alone? Oats are the most common nurse crop planted with alfalfa in the spring and yet they are one of the poorest from the standpoint of offering too much competition and shading. Spring barley is a better nurse crop where it can be grown. Competition from the nurse crop can be minimized by seeding at only one bushel per acre. If oats are to be used as a nurse crop, in addition to light seeding, an early maturing, short, stiff-strawed variety of the Clinton type should be used.

Seeding alfalfa in winter grains already established offers some possibilities. Alfalfa seeded in small grains in March or early in April on the surface of the soil is usually a waste of seed. The application of 400-500 pounds per acre of a 5-10-10 fertilizer in the spring on the small grains to be followed by breaking up of the soil crust with a weeder and seeding with a cultipacker seeder looks promising. The complete fertilizer also supplies nitrogen for the small grain crop.

High-quality seed of improved varieties such as Ranger, Buffalo, or Atlantic that have proven adapted to the region should be used. Certified seed is preferred. Inoculation of seed should be practiced even though alfalfa has appeared in the rotation previously. This is because too often soil conditions become unfavorable for multiplication of desirable bacteria. By re-inoculating, more efficient nitrogen fixation is assured.

Seeding Technique

Too many fields of alfalfa fail to become established because of improper seeding technique. Seed of alfalfa is frequently buried too deep; ¼ to ½ inch is sufficient. A combination cultipacker seeder is one of the best pieces of equipment available for getting this seeding job done properly. Cultipacking in one direction and then seeding and cultipacking in the other are desirable. If a cultipacker seeder is unavailable and the seeding attachment on the grain drill is to be used, the seeding tubes should be pulled out of the fertilizer and grain tubes to allow the seed to fall behind the shoe or disk to

Fig. 2. Alfalfa and bromegrass are a popular hay combination in the Northeast.

prevent deep coverage with cultipacking or rolling to follow.

Should alfalfa be seeded alone or in grass mixtures? If the alfalfa is to be grown for hay exclusively, then seeding alone is preferable. However, where silage and grazing are also desired, alfalfa-grass mixtures can be used to better advantage. When seeded alone, approximately 15 pounds of seed per acre are used; in grass mixtures 8 pounds of alfalfa seed seem adequate. Bromegrass teams well with alfalfa; timothy also has a place in short rotations with alfalfa. An orchardgrass-alfalfa mixture makes a desirable grass silage or grazing combination but is an undesirable hay mix. The advantages of alfalfa-grass mixtures merit attention. They are: (1) Soil conditions can be somewhat less favorable; (2) the alfalfa furnishes the grass with nitrogen; (3) on rolling lands, better erosion control is obtained; (4) the mixture helps cut down heaving damage; (5) it reduces hazard of bacterial wilt; (6) it minimizes chances of seeding failure; (7) herbage can be used either as hay or pasturage; (8) the mixture allows stands to stay longer—even after the alfalfa goes out, by the addition of nitrogen fertilizer, production can be maintained for an additional one or two years; and (9) hay yields are approximately as high as for alfalfa alone.

Meeting Fertility Requirements

Alfalfa is a heavy feeder on plant nutrients. Successful alfalfa culture, therefore, depends upon the maintenance of the soil at a high level of fertility. A three-ton alfalfa crop removes approximately the following amounts of nutrients from an acre of soil annually: 36 pounds of P_2O_5; 135 pounds of K_2O; 150 pounds of CaO; 50 pounds of MgO; 14 pounds of sulfur, as well as small amounts of boron, manganese, zinc, iron, copper, and molybdenum.

Fertilization of alfalfa should be considered in two phases: (1) Before seeding and (2) maintenance applications. For best alfalfa growth, the soil pH should be maintained at 6.5 to 7.0. On highly acid soils the lime should be applied to the preceding crop or several months before seeding; light applications can be applied at seedbed preparation. Caution should be exercised, however, to prevent overliming since this may lead to deficiencies of boron and manganese. On soils low in available nitrogen, 700-800 pounds of a 2-12-12 fertilizer or its equivalent can be used to good advantage at planting. The small amount of nitrogen helps the seedlings get off to a better start. On soils with ample nitrogen levels but low in boron, 400-500 pounds of an 0-19-19 fertilizer with 5% borax should be used; on soils not deficient in borax, the same amount of an 0-20-20 fertilizer would be satisfactory.

Such applications of 0-1-1 fertilizers are adequate for establishment, but indications are that they do not meet the needs of the alfalfa plant for maintenance because the plant requires greater amounts of potash. Recent work[1] at the New Jersey Agricultural Experiment Station suggests that a 0-1-3 ratio fertilizer for maintenance more nearly meets the mineral requirements of this plant. The highest yields and longest-lived stands were obtained where 60 pounds of P_2O_5 and 180 pounds of K_2O were applied annually. Early spring applications of P_2O_5 and K_2O were found to be more effective than applications after the first crop had been removed.

As regards the minor elements, boron is required by many Northeastern soils for successful alfalfa production. Annual applications of 20 pounds per acre of borax generally are sufficient. Molybdenum may also be deficient in many alfalfa soils as indicated by recent work by Dr. Firman Bear at New Jersey. Just which of the other minor elements need be added is unknown for most areas. The difficulty encountered in maintaining alfalfa stands on soils previously having grown alfalfa for long periods may be attributed in part to depletion of some of the minor elements now not considered critical in alfalfa culture.

1 Bear, F. E., and Wallace, A. N.J. Agr. Exp. Sta. Bul. 748, 1949.

Maintenance of Stands

The life expectancy of alfalfa stands in the Northeast varies from 2 to 5 years. Depletion of essential nutrients, mismanagement, winter-killing, weed competition, and incidence of diseases and insects all take their toll of plants. If alfalfa is cut for hay, cutting treatments should be practiced so as to allow replenishment of root reserves. This means taking the first cutting off at about 1/10 bloom, the second and third cuttings (where third cuttings are possible) when the alfalfa is approaching full bloom. The last cutting should be made from four to six weeks before the normal date for the first killing frost in order to permit ample time for storage of root reserves and to allow the plants to go into the winter with 6 to 8 inches of top growth. This vegetation acts as a mulch which not only protects against cold, but helps accumulate snow cover, and reduces heaving damage.

How should alfalfa and grass mixtures be managed when cut for silage and grazed? For silage, alfalfa-grass combinations should be cut when the alfalfa is in bloom. When the alfalfa is in bloom, orchardgrass growing with it is at full bloom at the first harvest. If the accompanying grass is brome, the bromegrass is just beginning to head. If the alfalfa is to be grazed, it is best to wait until the alfalfa begins to bloom irrespective of the stage of maturity of the grass, and then it should be grazed rotationally. Grazing should not be extended beyond the first week in September. Grazing is known to be hard on alfalfa but the plant has been kept in mixtures five years by this system of management in experiments conducted at State College, Pa.

Invasion of weeds into alfalfa fields can be minimized by promoting thrifty, vigorous growth in alfalfa and maintaining good stands. Keeping the competitive advantage in favor of the alfalfa gives weeds little chance for invasion. Chickweed, which is becoming

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Clinics for Sick Soil

By N. M. Coleman

Columbia, Missouri

FARMERS in Missouri can just about write their own ticket when it comes to building up and maintaining their soil fertility. Sixty-nine county soil-testing laboratories have been set up over the State by the Extension Service of the College of Agriculture.

No longer can a Missouri farmer blame the weather for poor crops, or excuse feeble yields because of having planted in the wrong time of the moon. Now he can be "in the know" regarding the plant-food needs of his different fields.

For a reasonable charge, usually less than 15 cents an acre, he can take soil samples to his county agent and have them tested for organic matter, soluble phosphate, exchangeable potassium, magnesium and calcium, and the pH or acidity. By these tests, and the information about recent crops and soil treatments, the county agent can more accurately determine the amounts of the different plant foods that will be released to certain crops grown on different kinds of soil. Once he knows this, and the amount of plant food added in the form of green or barnyard manure, he can determine what fertilizers should be applied to attain the desired yields.

Fig. 1. O. T. Coleman, Extension Specialist in Soils, demonstrates the proper methods of taking soil samples to represent the surface seven inches of each kind of soil in a field. Samples may be taken with a spade, a soil auger, or a sampling tube.

In the laboratories are technicians who carry out the soil-testing procedures, adjust, care for, and read the complicated instruments such as the photo-electric colorimeter and the limemeter. Strangely enough, they need know little of chemistry to do this. Like the bride baking her first cake, they work by the cookbook method—a recipe procedure based on steps 1, 2, and 3. The county agents, however, are responsible for the training of these technicians and checking their work. In every case the agents are responsible for interpreting the tests and making recommendations.

To take advantage of this service a farmer needs only to take a sample of soil to his county agent, give him the needed information of how it's been handled and treated, and tell him the crops or rotations he wishes to follow. The soil sample should represent the surface 7 inches of each different soil in the area on which a test is desired.

A composite sampling of about 10 borings 7 inches deep from each different kind of soil in the field to be tested should be taken. These borings should be thoroughly mixed, preferably in a bucket or small box, then about a teacupful of this mixture taken to the soil-testing laboratory. The mixture must be air-dry in order to get an accurate test. For this reason samples should be taken at least a week before testing. Artificial heat should not be used in drying samples. If the temperature is high enough to brown a white paper napkin, it may affect the test. Air circulated at room temperature by means of an electric fan is the best method for drying samples. Testing is best done when the soil is in good condition for plowing. A field need not be tested more often than every 4 or 5 years.

Figures prove that this soil-testing service is welcomed by the farmers. In 1946, the first year of operations, three laboratories were set up, and these centers handled approximately 9,000 tests. Last year, 69 laboratories took care of 67,000 tests.

Farm women are making use of these soil clinics by bringing samples from their gardens. Women's Clubs over the State are encouraging this practice because garden soil needs to be richer than other soil on the farm.

Oliver Miller of Davies County produced a record corn yield of 157.7 bushels per acre in 1950. "I've used fertilizers for years," he says, "but I notice a difference when I got it balanced. I found that applying fertilizers according to soil tests eliminates waste." He suggests five steps in getting higher yields.

1. Have soil tested.
2. Apply fertilizer as recommended by county agent.
3. Plow under a green manure crop with the fertilizer.
4. Vary planting rate according to fertility level.
5. Control weeds.

A farmer in Southeast Missouri says he had better cotton last year where he fertilized according to recommendations than he had ever grown. And this despite the wet and unfavorable growing season. His cotton was 10 days earlier on tested soil—an impor-

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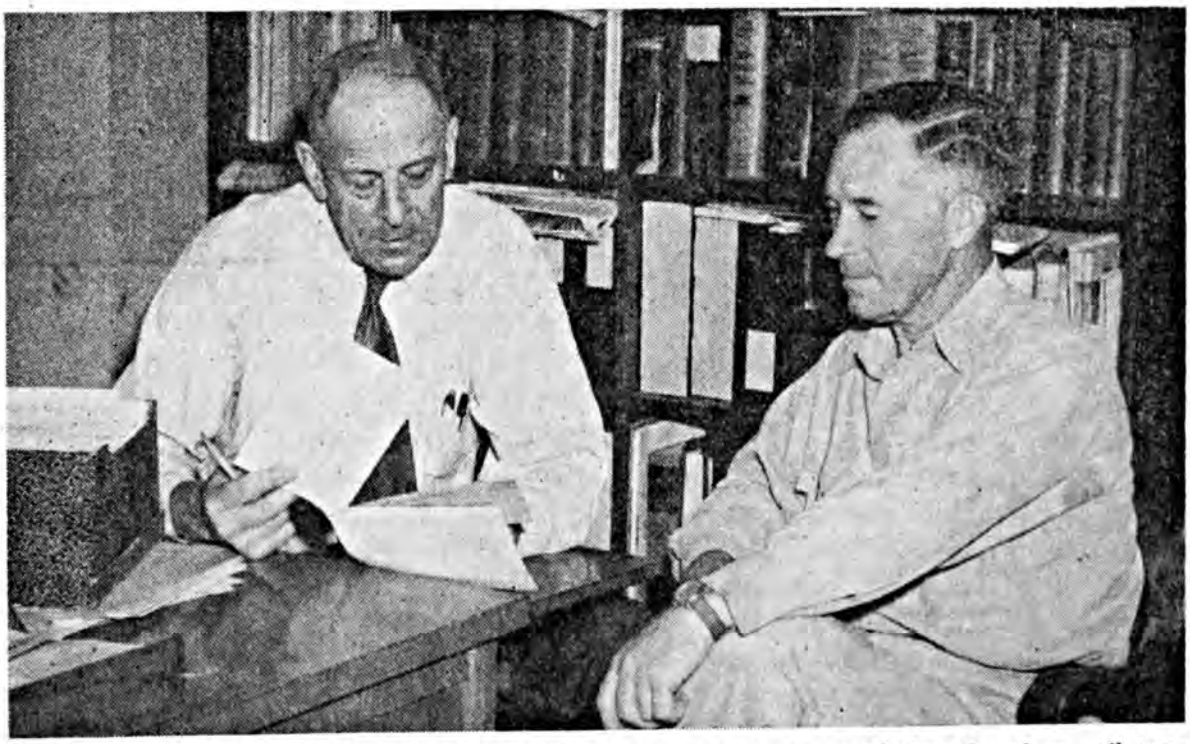

Fig. 2. In Boone County, T. A. Ewing, County Agent, makes recommendations based on soil tests made in the laboratory.

Meeting the Cotton Goal

By Claude L. Welch

National Cotton Council, Memphis 1, Tennessee

RECOGNIZING that this nation and its allies would need every pound of cotton that could be produced in 1951, the Secretary of Agriculture last fall announced a goal of at least 16 million bales for this season. Everyone concerned in this tremendous undertaking realizes it is a job that will demand the utmost in cooperation, hard work, and utilization of resources. Leaders in both industry and government, however, believe the American farmer will rise to the occasion. That conviction remains unshaken on the basis of a painstaking appraisal of the assets and liabilities in the production picture.

It is true that, in meeting their goal of 16 million bales, farmers will be confronted with the many shortages and restrictions imposed by a near wartime economy. On the other hand, from many standpoints, the Cotton Belt in 1951 is in better position to meet such a production goal than at any time in its history.

At the outset, in any analysis of our production possibilities for 1951, we all recognize that the weather which will prevail throughout the season will be one of the most important single factors. We can only hope and pray that it will favor the cotton farmer. There are, however, some tangible assets that will serve us in good stead as we strive to meet our goal.

Between 28 and 30 million acres of land suitable for cotton are available for planting this season. In 1949 a 16-million-bale crop was produced on 27.2 million acres.

Cotton production is more highly mechanized than ever before. There are more tractors and farm equipment on farms.

Cotton farmers are using more fertilizer and insecticides than ever before.

These, briefly then, are the big assets in the 1951 cotton production effort—available acreage, more machines, inclination of farmers to use more fertilizer, and to control insects more thoroughly.

It is foreseeable that the demands of industry, as mobilization for defense is stepped up, may result in shortages of the labor and materials cotton farmers will need for all-out production. In such an event they will not be able to get all the workers they will need and may not be able to obtain as much machinery, fertilizer, and insecticides as they would like to have.

Of these prospective shortages, that of labor looms as the most critical. In the South the number of farm workers in 1950 was half a million less than the 1935-39 average. Skilled labor is being offered enticing opportunities in nonfarm work. Young people are leaving the farms to enter the military services.

Farmers have been buying more equipment to offset insofar as possible the exodus of workers from the farm and to make the chores more attractive for those who remain. Producers, too, with more money available, have invested more heavily in machinery. Development of tractors and other equipment suited to farm enterprises of varying sizes also has been responsible for an increase in purchases of such machinery.

Another factor is the continuous educational program on the part of vocational agriculture, the extension services, equipment companies, and the Land Grant Colleges, in which producers have been taught how to operate and care for machinery. With more farmers learning how to operate modern equipment, more is being bought.

Use of Machinery

Demand for farm machinery has been increasing to such an extent that it is expected to exceed supply in 1951. This situation has developed not only because farmers want machines but also because of the stepped-up output of war materials. Although manufacturing capacity is adequate, steel and other metals are being diverted to the mobilization effort. Production for the first quarter of the farm equipment industry's fiscal year is only 75 per cent of the output for the same period last year.

On July 1, 1950, there were 992,000 tractors on Cotton Belt farms as compared with 335,000 in 1940. During the same 10-year period there has been a 220-per-cent increase in the number of moldboard plows and a 65-per-cent increase in manure spreaders.

In 1940 there were only a few mechanical cotton harvesters on Cotton Belt farms. Today there are more than 4,000 spindle-type pickers and 9,000 stripper harvesters available, and by the harvest season of 1951 the total is expected to be increased to around 6,500 pickers and more than 13,000 strippers.

This machinery not only will be a boon to cotton farmers sorely beset by labor shortages in 1951, it will be one of the most important assets in the effort to produce 16 million bales of cotton. It will be important because cotton farmers are using these machines, achieving greater efficiency in their production.

Today tractors are used for 60 per cent of the land breaking for cotton, as compared with 30 per cent in 1939. In Oklahoma, Texas, and New Mexico tractors are used for breaking more than four-fifths of the cotton land, while in California and Arizona the total is nearly 97 per cent.

Across the Cotton Belt, tractors are used for 54 per cent of the harrowing, 43 per cent of the planting, and 45 per cent of the cultivation.

In 1940 only a very small percentage of the cotton acreage was harvested with machines. In 1950 it was estimated that equipment was available for harvesting 16 per cent of the crop. With the pickers and strippers expected to be on hand in 1951, it will be possible to harvest an estimated 4,800,000 acres as compared with 3,000,000 last year.

Cotton production in California, Arizona, Texas, Oklahoma, and the Mississippi River Delta is relatively highly mechanized from seedbed preparation through harvest. Although tractor equipment is rapidly replacing animal-drawn machines in the Southeast for land breaking, seedbed preparation, and cultivation, most of the crop still is harvested by hand.

A spindle-type cotton picker, the harvester used most successfully in the rank, leafy cotton of the Southeast, represents an investment of several thousand dollars. A large part of the cotton in the Southeast is grown on small farms where the cotton grower does not feel the cost of such a picker would be justified. The machine, too, is better adapted to large, level fields

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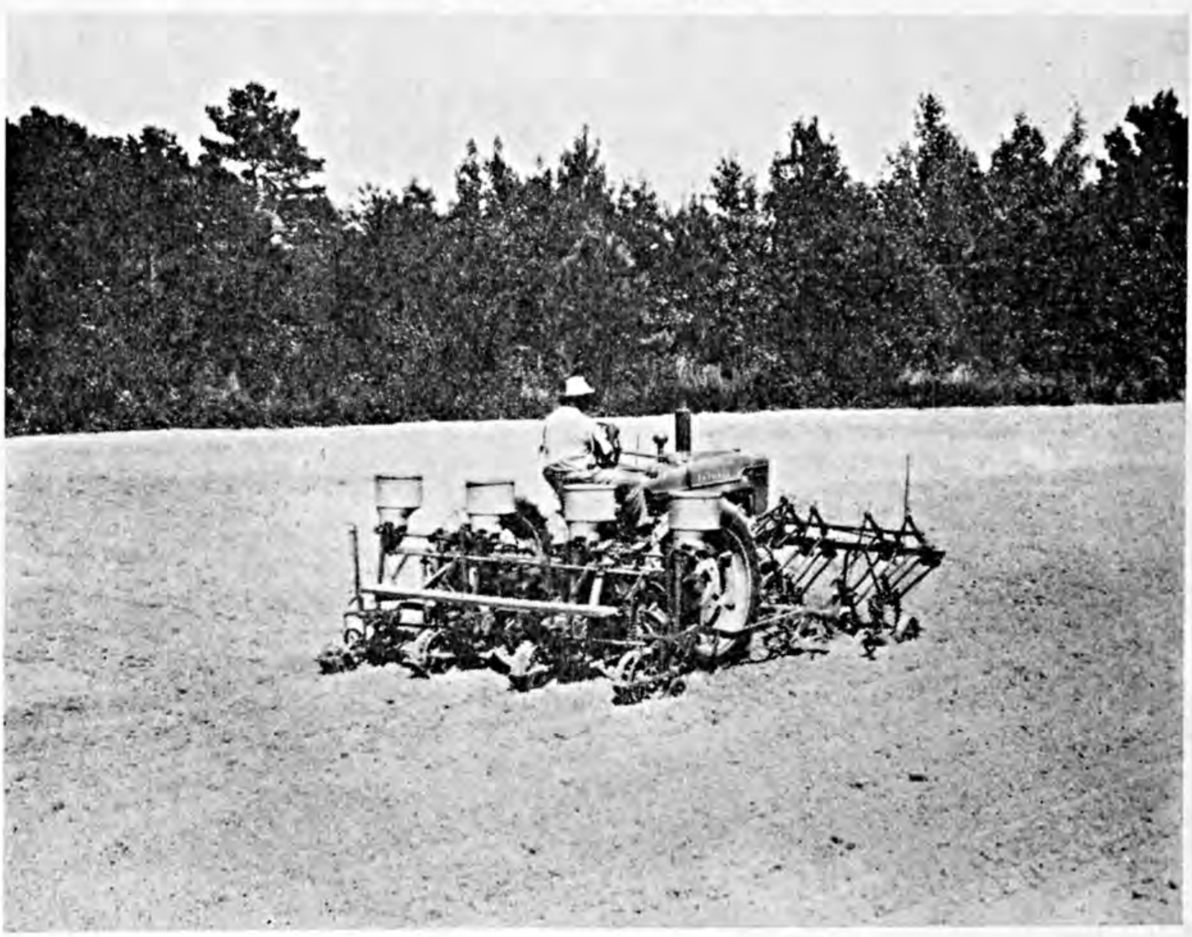
PICTORIAL

Picking cotton by hand is a slow and tedious job.

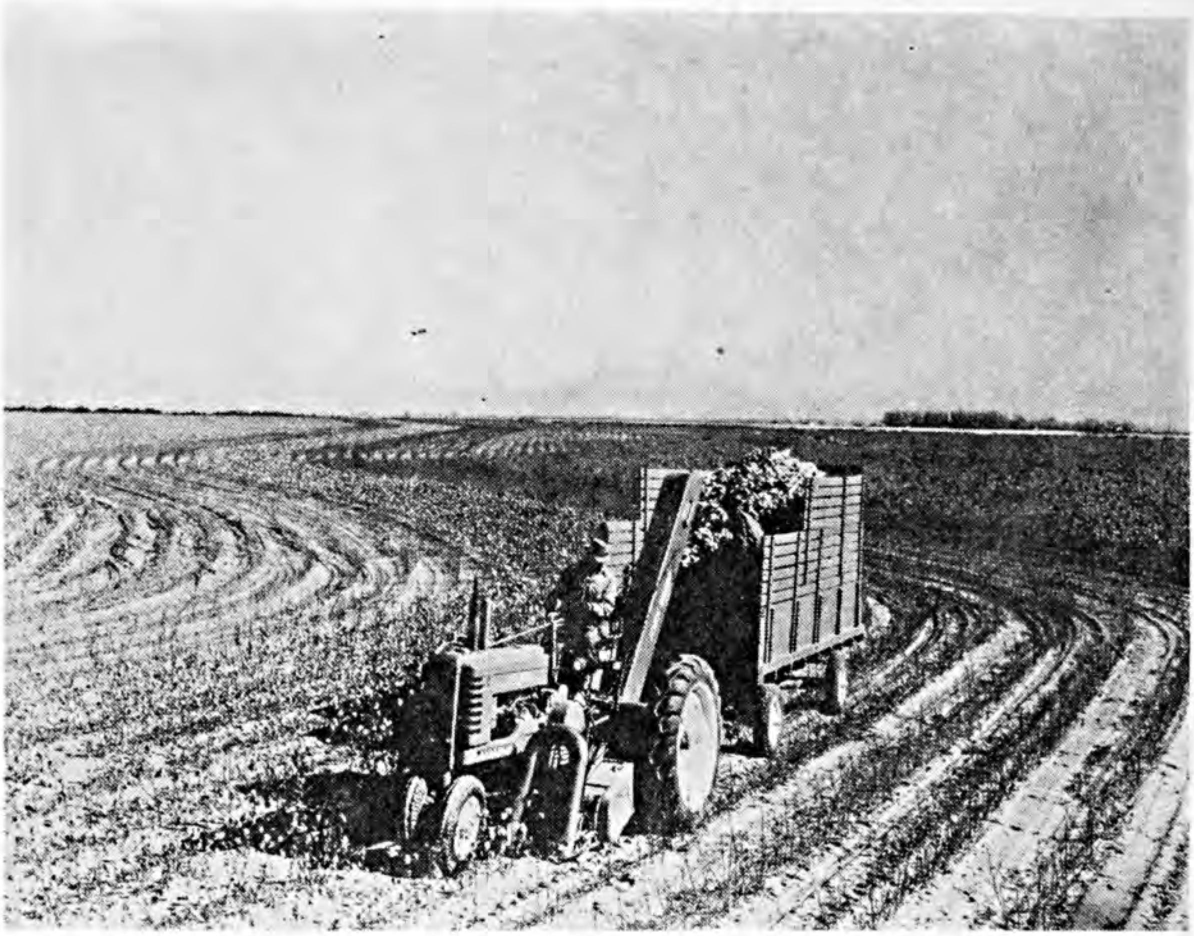
Above: **Four-row middle busters can cover as many as 30 acres per day in preparing land for planting cotton.**

Below: **This tractor-powered machine will plant from 50 to 60 acres per day and can be used as a power drill or corn planter.**



Above: **Searing jets of flame from this two-row flame cultivator kill weeds and grass but do not harm cotton.**

Below: **Tractor-mounted equipment can apply insecticides and defoliants to as many as 40 acres of cotton per day.**



Above: **The two-row stripper performs the same amount of work as 26 average hand strippers.**

Below: **Machines on parade at the annual Beltwide Cotton Mechanization Conference sponsored by the National Cotton Council.**

The Editors Talk

Mechanizing the Production of Cotton

With the current urgency and interest in meeting the goal of the production of 16 million bales of cotton this year, we are pleased to have two cotton articles to present to our readers in this issue. The one pertains to the role of fertilizers in increasing cotton production, whereas the other considers more particularly the other important factors. Among these factors, mechanization wherever possible is being emphasized. The good pictures obtained from the National Cotton Council and appearing in our pictorial section show much of the progress already made in this field.

That more progress is in store is assured as the results of the cooperative study being made by the U. S. Department of Agriculture and 12 Southern State Experiment Stations, in the Regional Cotton Mechanization project under the Research Marketing Act of 1946, are put into use. Current research embraces crop residue disposal, seedbed preparation, planting, grass and weed control, fertilization and cover crops, and harvesting. There also is work being done on insect control and cotton processing.

Some of the outstanding results already obtained are detailed in a recent publicity release by the U. S. Department of Agriculture. Work with deep-tillage equipment (moldboard plows and chisels) on some Alabama soils has resulted in improved weed and grass control, larger cotton yields, and deep-rooted cotton plants that better resist the pull of mechanical strippers. Mississippi planting studies have shown that mechanized operations are made easier and require less seed and hoeing if the cotton seeds are hill-dropped (planted in bunches rather than drilled) in leveled seedbeds. The machine developed to do this job quickly consists of a shallow-operating sweep-cultivator mounted in front of a tractor to clean out the weeds, and large runner wings on the rear-mounted planter to level the seedbeds after planting.

Chemical weed control to replace some early cultivation previously required in cotton production has been brought out in some recent research. Pre-emergence spray tests (applying spray before the cotton is above ground) in Georgia reduced hoeing as much as 40 per cent. Pre-emergence spraying controls weeds during the critical 4-6 weeks after planting. Because of cost, post-emergence weed spraying (spraying after the cotton is up) has not yet proved as practical as mechanical cultivation. However, the cost of hoe labor has been cut by as much as 55 per cent by post-emergence treatments. Widely used rotary weeders and sweep cultivators have been improved by Mississippi research so that they can be used behind high-speed, rubber-tired tractors. They give longer wear and better performance at no increase in cost.

Cotton fertilizer needs are being investigated in North Carolina with a machine developed to accurately place given amounts of radioactive granular fertilizers, which then can be scientifically traced as they are used by the plants.

Further research is going forward on the expanding use of anhydrous ammonia in Mississippi.

A modified grain drill has been successfully used in Georgia to seed cover crops in unharvested cotton. A brush-type cotton stripper, developed in Oklahoma, is showing promise of providing low-cost cotton harvesting, and tests of small, low-cost spindle-type harvesters in South Carolina this past season were encouraging.

All of this research is being counted upon to help in meeting this and future cotton goals on reduced acreages. That it will be employed wherever possible is guaranteed by the great eagerness with which Southern farmers are seeking and applying new and scientific production practices. The greatly increased diversification in Southern agriculture which has taken place during the past several years and from which so much benefit has been derived is further assurance our cotton needs can and will be met without re-employment of the acres which have been put into pastures and other crops that have been responsible for the terminology—"The New and Mechanized South."

Rising Farm Costs

Most farmers in planning their 1951 operations are deeply concerned over the inflationary spiral which is resulting in increased production costs. It is well, then, to reconsider the statement of Carl P. Heisig, Head, Division of Farm Management and Costs, Bureau of Agricultural Economics, at the Agricultural Outlook Conference held in Washington, D. C., last November. Granting that farm costs will be higher in 1951 than in 1950, Mr. Heisig believed that prices received will be up enough more so that in the over-all picture the net realized farm income should be considerably higher than last year. However, price-cost ratios will not be equally favorable for all types of farming and farmers may not be as prosperous as in the immediate postwar years.

Prices, of course, depend on supply and demand. In his outlook Mr. Heisig foresaw farmers probably being less concerned about prices of production goods and services in 1951 than about the availability of supplies. He believed that supplies of feed and most seed will be adequate, and fertilizer supplies larger, although demand could increase faster than supplies, particularly in some areas. Farm machinery and other equipment and supplies should be available well into 1951. The outlook for the last half of 1951 is less certain.

In more detailed reference to fertilizer, it was stated that the average price paid by farmers for fertilizer declined slightly in 1950 compared with 1949. In 1951 it probably will be higher, but prices received for farm products will increase at least as much. This continued favorable cost-price ratio will make it profitable for farmers to increase the use of fertilizers at a more rapid rate than they have during the last few years.

Farmers are now using about three times as much plant nutrients in fertilizer as they did in 1935-39. The use has increased at an average annual rate of about 10 per cent during recent years. With expected continued favorable price relationships, a similar or even greater increase can be expected for 1951 if supplies are available. Expansion of 10 per cent would mean a consumption of fertilizer in terms of plant nutrients of 4.6 million tons in 1951, compared with 4.2 million tons in 1950.

Mr. Heisig's concluding statement was that except for some temporary seasonal and local shortages, most production goods and services are expected to be adequate to meet farmers' needs for doing the larger production job of 1951. With a reasonable expectation of higher farm prices, there therefore should not be an unreasonable concern on the farmers' part about rising farm costs.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941...........	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942...........	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943...........	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945...........	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946...........	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947...........	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948...........	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949...........	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
March........	28.05	32.0	132.0	222.0	119.0	198.0	16.45	43.00	....
April.........	28.74	....	134.0	228.0	126.0	201.0	16.65	44.40	....
May.........	29.24	48.5	128.0	228.0	134.0	204.0	17.25	45.20	....
June.........	29.91	49.7	127.0	211.0	136.0	193.0	16.05	46.20	....
July..........	33.05	45.5	127.0	208.0	144.0	199.0	15.15	52.00	....
August.......	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September...	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October.......	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
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	89	81	109	74	87	110
1938...........	69	196	80	79	76	64	57	97	88
1939...........	73	154	100	84	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	105	117	107	82	211	129
1942...........	153	369	168	134	143	124	91	202	163
1943...........	160	405	188	235	174	154	125	231	245
1944...........	167	420	214	216	170	160	139	234	212
1945...........	181	366	205	232	198	170	127	227	207
1946...........	263	382	178	248	212	209	141	319	182
1947...........	257	380	232	248	336	259	148	381	226
1948...........	245	482	222	253	201	226	155	298	214
1949...........	231	463	184	244	210	210	139	192	201
1950									
March.......	226	320	189	253	185	224	139	191	168
April........	232	...	192	260	196	227	140	197	205
May.........	236	485	184	260	209	231	145	200	178
June.........	241	497	182	240	212	218	135	205	182
July.........	267	455	182	237	224	225	128	231	200
August......	298	531	175	248	224	223	130	314	164
September...	322	554	151	219	224	219	131	349	126
October......	314	551	123	175	213	216	134	361	138
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
March	3.00	2.32	9.70	13.01	10.17	9.34
April	3.00	2.32	10.34	12.58	10.39	8.19
May	3.00	2.05	10.74	11.97	10.14	7.59
June	3.00	1.71	10.55	10.79	9.41	7.36
July	3.00	1.71	11.53	10.71	9.35	8.74
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish scrap	Tankage	High grade ground blood
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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
March	112	81	277	369	302	265
April	112	81	295	356	308	233
May	112	72	307	339	301	216
June	112	60	301	306	279	209
July	112	60	329	303	277	248
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321

Wholesale Prices of Phosphates and Potash * *

	Super-phosphate, 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[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
March	.760	3.76	5.47	.375	.720	14.50	.200
April	.760	3.76	5.47	.375	.720	14.50	.200
May	.760	3.76	5.47	.375	.720	14.50	.200
June	.760	3.76	5.47	.336	.647	12.77	.176
July	.760	3.76	5.47	.368	.704	13.98	.193
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.75	5.47	.368	.704	13.98	.193
October	.760	3.73	5.47	.386	.704	13.98	.193
November	.760	3.73	5.47	.386	.732	14.72	.193
December	.798	3.73	5.47	.420	.796	16.00	.210
1951							
January	.810	3.73	5.47	.420	.796	16.00	.210
February	.810	3.73	5.47	.420	.796	16.00	.210

Index Numbers (1910-14 = 100)

	Super-phosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash in bags	Sulphate of potash magnesia	Manure salts
1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
March	142	104	112	68	76	60	83
April	142	104	112	68	76	60	83
May	142	104	112	68	76	60	83
June	142	104	112	63	68	53	80
July	142	104	112	67	74	58	82
August	142	104	112	67	74	58	82
September	142	104	112	67	74	58	82
October	142	103	112	70	74	58	82
November	142	103	112	70	77	61	82
December	149	103	112	75	84	66	85
1951							
January	151	103	112	75	84	66	85
February	151	103	112	75	84	66	85

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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
March	237	239	223	134	96	305	142	72
April	241	240	223	135	96	313	142	72
May	247	244	228	132	91	311	142	72
June	247	245	230	126	85	293	142	66
July	263	247	238	128	85	301	142	70
August	267	248	243	131	85	321	142	70
September	272	252	247	131	85	324	142	70
October	268	253	247	131	85	323	142	73
November	276	255	251	132	85	328	142	74
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78

* U. S. D. A. figures, revised January 1950. 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] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] 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 is 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

"Behavior of Nitrogenous Fertilizers in Alkaline Calcareous Soils: II. Field Experiments with Organic and Inorganic Nitrogenous Compounds," Agr. Exp. Sta., Univ. of Ariz., Tech. Bul. 121, Dec. 1950, W. H. Fuller, W. P. Martin, and W. T. McGeorge.

"Utilization of Phosphorus by Various Crops as Affected by Source of Material and Placement," Agr. Exp. Sta., Colo. A & M College, Fort Collins, Colo., Tech. Bul. 42, Dec. 1950, S. R. Olsen, W. R. Schmehl, F. S. Watanabe, C. O. Scott, W. H. Fuller, J. V. Jordan, and R. Kunkel.

"Recommended Fertilizer Practices for Field Crops in Colorado for 1951," Agr. Exp. Sta., Fort Collins, Colo.

"Fertilizer Recommendations for Idaho Soils for 1951," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, G. O. Baker, C. A. Simkins, A. S. Horn, and V. T. Smith.

"How and When to Use Chemical Fertilizers in Kansas," Kan. State College, Manhattan, Kan., F. W. Smith.

"Fertilizer Analyses—Fall 1950," Kan. State Board of Agr., Control Div., Topeka, Kan.

"Fertilizer Recommendations of the Louisiana Agricultural Experiment Station, 1950-51," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., M. B. Sturgis.

"Use of Fertilizer for Maine Blueberries," Agr. Exp. Sta., Orono, Me., Mimeo. Rpt. No. 8, Feb. 1950, M. F. Trevett.

"Inspection of Commercial Fertilizers and Agricultural Lime Products," Agr. Exp. Sta., Univ. of Mass., Amherst, Mass., Bul. No. 145, July 1950.

"Fertilizer Analysis and Registrations 1950," Dept. of Agr., Div. of Feed and Fert. Control, St. Paul, Minn. H. A. Halvorson.

"Crop and Fertilizer Recommendations for Mississippi 1951," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 156, Nov. 1950, F. J. Welch.

"Fertilizer Inspection and Analysis; Fall, 1949," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 543, Nov. 1950.

"Commercial Fertilizer Report for 1950," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Bul. 473, Dec. 1950.

"Commercial Fertilizers for Oats in Nebraska, Results for 1947, 1949, and 1950," Agr. Exp. Sta., Univ. of Neb., Lincoln, Neb., Outstate Testing Cir. 13, Dec. 1950, G. W. Lowrey, R. A. Olson, and A. F. Dreier.

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"Sodium as a Fertilizer for New Jersey Soils," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 752, Oct. 1950, C. D. Leonard and F. E. Bear.

"Fertilizers and Limes—1950," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Insp. Series 41, Dec. 1950, S. B. Randle.

"Facts and Findings about Fertilizers in North Dakota," Ext. Serv., N. D. Agr. College, Fargo, N. D., Dec. 1950, G. A. Johnsgard.

"Rotation Fertilization," Ext. Serv., Pa. State College, State College, Pa., Jan. 1951.

"Fertilizer Grades and Rates of Application—Rhode Island—1951," Ext. Service, R. I. State College, Kingston, R. I.

"Inspection and Analysis of Commercial Fertilizers," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 389, Nov. 1950, B. D. Cloaninger.

"Oat Fertilizer Tests in North-Central Texas," Agr. Exp. Sta., Texas A & M College, College Station, Tex., P. R. 1287, Nov. 6, 1950, J. H. Gardenhire, M. J. Norris, J. C. Smith, and D. I. Dudley.

"1951 Vermont Recommendations for Seed, Fertilizer, and Lime," Agronomy Dept., Univ. of Vt., Burlington, Vt.

"Virginia Agricultural Lime Law 1950," Dept. of Agr. and Immigration, Richmond, Va.

"The Fertilizer Situation for 1950-51," Prod. and Mkt. Adm., USDA, Wash., D. C., Feb. 1951.

Soils

"Soil Treatment Recommendations Based on Soil Tests," Ext. Serv., Univ. of Ill., Urbana, Ill., C. M. Linsley.

"Muck Soil Management for Head Lettuce Production," Ext. Bul. 303; "Muck Soil Management for Hay and Pasture Production,"

Ext. Bul. 304; Ext. Serv., Mich. State College, East Lansing, Mich., P. M. Harmer.

"Soil Diagnosis and Fertilizer Recommendations for Crops on Western Oregon Soils," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., R. E. Stephenson.

Crops

"Value of Irrigation with Different Fertility Treatments for Vegetable Crops," Bul. 276, June 1950, L. M. Ware and W. A. Johnson; "Experiments with Oil Crops," Bul. 277, Sept. 1950, D. G. Sturkie; Agr. Exp. Sta., Ala. Poly. Inst., Auburn, Ala.

"Small Grain Variety Tests in Alabama, 1950," Agr. Exp. Sta., Ala. Poly. Inst., Auburn, Ala., P. R. Series No. 11, Rev. Aug. 1950, E. F. Schultz, Jr.

"Cucamonga Brome—A New Grass for Covercropping," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Cir. 401, Nov. 1950, P. E. Lemmon, A. L. Hafenrichter, and B. A. Madson.

"Production, Harvesting and Curing of Burley Tobacco," Dom. Exp. Sta., Harrow, Ont., Can., Pub. 840, Farm. Bul. 163, Aug. 1950, R. J. Haslam and W. A. Scott.

"Annual Report 1949-1950," State Board of Agr., Dover, Del., Vol. 40, No. 3.

"Southland Oats—A New Variety," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Cir. S-18, Sept. 1950, W. H. Chapman.

"Winter Cover Crops for Nitrogen, Organic Matter, and Soil and Plant Food Conservation," Cir. 300, Rev. Sept. 1950; "Kudzu Culture and Uses in Georgia," Cir. 331, Rev. June 1950, E. D. Alexander, J. B. Preston, and J. R. Johnson; Ext. Serv., Univ. of Ga., Athens, Ga.

"Growing and Marketing Georgia Sweet Potatoes," Bul. 482, Rev. April 1950, W. C. Carter; "Plant Beds for Early Plants," Bul. 560, June 1950, W. C. Carter and E. Ragsdale; Ext. Serv., Univ. of Ga., Athens, Ga.

"Vegetative Propagation of Trees and Shrubs," Ext. Cir. No. 291, Aug. 1950, A. M. Hieronymus; "Cucumber Culture in Hawaii," Ext. Cir. No. 290, Aug. 1950, Y. Nakagawa; Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii.

"Soybean Yields in 1949 Variety Trials," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Cir. 669, Nov. 1950, R. F. Fuelleman, W. L. Burlison, C. H. Farnham, G. E. McKibben, and P. E. Johnson.

"Bromegrass in Indiana," Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Leaf. 310.

"Cooperative Oat Variety Tests, 1949," P. R. Series C.E. No. 20; "Cooperative Wheat Fertility Tests, 1950," P. R. Series C.E. No. 24; "Cooperative Oat Variety Tests, 1950," P. R. Series C.E. No. 25, A. L. Clapp, Agr. Exp. Sta., Kans. State College, Manhattan, Kans.

"Tobacco Production in Kentucky," Cir. 482, "It Pays to Prime and Cut Burley Tobacco Ripe," Cir. 483, G. B. Byers, C. E. Bortner, and W. B. Back; Ext. Serv., Univ. of Ky., Lexington, Ky.

"A Preliminary Report of Tests Conducted by the Red River Valley Agricultural Experiment Station, 1948-1949;" "A Preliminary Report on Experiments Conducted by the Crops and Soils Department of the Louisiana Agricultural Experiment Station, 1949;" "A Preliminary Report of Tests Conducted by the Red River Valley Agricultural Experiment Station, 1950," Agr. Exp. Sta., La. State Univ., Baton Rouge, La.

"Agricultural Research in Maine Sixty-sixth Annual Report of Progress, Year Ending June 30, 1950," Agr. Exp. Sta., Univ. of Me., Orono, Me., Bul. 483, June 1950.

"Annual Report of the Board of Control for the Fiscal Year Ending June 30, 1949," Agr. Exp. Sta., Univ. of Nev., Reno, Nev.

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"Poultry Ranges," Cir. 536, Apr. 1950; "Blueberries in the Garden," Cir. 538, Sept. 1950, C. A. Doehlert; Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J.

"A Guide to Forest Tree Planting in New Jersey," Ext. Serv., Rutgers Univ., New Brunswick, N. J., Leaf. 43, July 1950, A. N. Lentz.

"Sixty-second Annual Report," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., 1949.

"Responses of McIntosh Apple Orchards to Varying Nitrogen Fertilization and Weather," Memoir 290, Aug. 1950, D. Boynton, A. B. Burrell, R. M. Smock, O. C. Compton, J. C. Cain, and J. H. Beattie; "Stimulated Grazing Treatments Effect on Yield, Botanical Composition, and Chemical Composition of a Permanent Pasture," Memoir 295, Aug. 1950, W. K. Kennedy; Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y.

"Carolina Lawns," Ext. Serv., N. C. State College, Raleigh, N. C., Rev. Ext. Cir. 292, Aug. 1950, J. Harris and D. S. Chamblee.

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"Recommendations for Range Reseeding in Utah," Ext. Serv., Utah State College, Logan, Utah, Ext. Bul. 212.

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"What's New in Farm Science, Annual Report, Part I," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Bul. 491, Sept. 1950.

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"How About Grass Silage? Making It—Feeding It," Ext. Serv., Univ. of Wis., Madison, Wis., Sten. Cir. 277, Rev. Aug. 1950, N. N. Allen, G. Bohstedt, and F. W. Duffee.

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"Stubble-Mulch Farming on Wheatlands of the Southern High Plains," Cir. No. 860, Aug. 1950, W. C. Johnson; "Sericea and Other Perennial Lespedezas for Forage and Soil Conservation," Cir. 863, Nov. 1950; USDA, Wash., D. C.

Economics

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"Cigar Leaf Summer Statistics," Inf-18, Aug. 1950, A. W. Dewey; "Experimental Market Reporting for Connecticut Valley Binder Tobacco Markets to December 26, 1950," Inf-21, Jan. 1951, A. W. Dewey and A. J. Coutu; Agr. Exp. Sta., Univ. of Conn., Storrs, Conn.

"Tobacco, Production Practices and Costs, Lower Coastal Plain, Georgia," Mimeo. Series 17, Mar. 1950, B. J. Harrington; "Cotton Production Practices and Costs Limestone Valley, Georgia," Mimeo. Series 19, Mar. 1950, W. T. Fullilove and J. C. Elrod; "Wheat Production Practices and Costs, Piedmont, Georgia," Mimeo. Series 20, Mar. 1950, B. J. Harrington; "Marketing Okra and Other Vegetables, Grady County, Georgia, 1949," Mimeo. Series 21, May 1950, K. E. Ford and N. M. Penny; "Cotton Production Practices and Cost in the Piedmont Area of Georgia," Mimeo. Series 25, Aug. 1950, R. B. Glasgow and W. T. Fullilove; "Cotton Production Practices and Cost in the Upper Coastal Plain of Georgia," Mimeo. Series 32, Oct. 1950, W. T. Fullilove and J. C. Elrod; Agr. Exp. Sta., Univ. of Ga., Experiment, Ga.

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"Conservation and Use of Agricultural Land Resources," Pro. and Mkt. Adm., USDA, Wash., D. C., Jan. 1951.

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Hybrid Cotton Coming: But Probably Not Soon

INGENUITY, amounting to scientific trickery, is the hope of geneticists bent on putting hybrid vigor (hoterosis) into the cotton crop. Unlike corn—world's leading example of hybrid advantage among economic plants—cotton and most other crops have complete flowers. Corn has its male and female flowers widely separated and the pollen-bearing tassels are handy for removal. As a result, hybrid seed can be produced in quantity and economically.

According to geneticists Harold D. Leden of the University of Georgia and T. R. Richmond of the U. S. Department of Agriculture, there is evidence of significant increases in vigor, yield, and other characters in cotton as a result of various kinds of crosses in commercial varieties of four species. Those scientists are optimistic that some day hybrid vigor will give to the cotton grower somewhat the same sort of help it is now giving to the corn farmer. They say that large scale commercial utilization of natural crossing to produce hybrid cottonseed is not to be expected in the immediate future. However, some male-sterile plants have been found, opening the possibility for field crossing on a natural basis as worked out recently with onions.

When hybrid vigor can be captured, it builds up yields at a lower cost than almost any other factor, so both plant breeders and planters are determined to clear away difficulties and have this now familiar magic in the cotton fields.

Nature Tests the Seed

THE certified seed program sees to it that Nature is kept on the job in making climatic selections of hardy alfalfa. This is true even when the seed of the selected hardy alfalfa varieties are grown in the warm Southwest and are returned to the northern areas for field planting. There is a safety-first rule. The grower of certified seed can sell only from the first generation crop that grows from seed of northern origin and selection. Thus, says Dr. M. A. McCall of the U. S. Department of Agriculture, an Arizona grower of certified seed who wants to market his crop as suitable for planting in Montana, the Dakotas or in the East, must buy the seed he, himself, plants from an approved northern source. The rules do not permit him to plant even a second generation of his own seed, because the less rigorous climate and disease hazard might foster multiplication of the less hardy kinds of plants in the variety. But in a single generation there is little loss of hardiness.

Scientists, thus, have found the way to take a double advantage of Nature. For developing varieties resistant to cold or disease hazards, the plant breeder makes his selections where Nature imposes the most severe conditions. Then after Nature has aided in selection of a valuable variety, seed can be grown where Nature and man provide conditions most favorable for efficient seed production. This is in the hot and dry Southwest where rainfall during harvest is not a serious drawback and where moisture for growing can be supplied by irrigation.

Such superior varieties as Ranger, Buffalo, and Atlantic alfalfas have qualities of hardiness (resistance to cold and drought), and disease resistance, that have been developed by breeding and by generations of selection in fields where freezing and the disease organisms kill off individual plants that are not resistant. Seed from such plants transmit these good qualities. Such seed can be grown safely only for a single generation in the specialized seed-growing areas of the Southwest. But if successive generations were permitted, less hardy and less resistant variants might multiply unduly and Southwestern seed might again come to be regarded as unreliable for northern planting. Such protection is one of the features of the National Foundation Seed Project, says McCall.

Meeting the Cotton Goal

(*From page* 26)

than to small, hilly, or rolling plots which comprise a sizable part of the the cotton acreage in the Southeast. The stripper is a less expensive machine but the root system of the type cotton grown in the Southeast does not penetrate to a sufficient depth to hold the plant in the ground while cotton is being stripped from the plant.

Research to develop more versatile cotton production machinery is being pushed ahead aggresively by both government and industry. It is being spurred by an increasing demand on the part of cotton farmers who are not satisfied with a system in which more than half the production cost can be attributed to hand labor. It is being encouraged through necessity as farmers observe the drift of workers from the land. It is moving ahead as cotton farmers step in pace with a world where emphasis is constantly given to the fact that savings in labor and costs of production mean greater profits and a higher standard of living.

Cotton growers are moving to mechanization as they note the convincing achievements of experiment stations in effecting vast savings in man-hours through the use of fast-moving equipment to prepare the land, and through the employment of rotary hoes, flame cultivators, mechanical choppers, and pickers and strippers which can harvest more cotton in a day than the average hand laborer can gather in a month. They are encouraged by the progress of research in chemical weed control, which holds out the possibility that this last great barrier to full mechanization may soon be broken. They have seen that through mechanization the number of man-hours required to produce a bale of cotton can be reduced by more than three-fourths.

In the Coastal Plains of North Carolina, for example, these hours have been slashed from almost 146 to approximately 25. With yields of 423 pounds to the acre, under the old man-mule system, 15.3 hours were required for land preparation and planting, 33.6 for cultivation and hoeing and 97 for picking. When tractors, two-row mechanical choppers, flame cultivators, mechanical pickers, and other machines were substituted to do these jobs, only four hours were required for land preparation and planting, 15.3 hours for cultivating and hoeing, and 5.9 for harvesting.

On land producing 500 pounds of lint per acre in the Mississippi Delta, labor requirements were slashed from almost 140 man-hours to less than 32 hours when two-row tractor equipment, flame cultivators, and spindle-type cotton pickers replaced one-row mule farming and hand picking.

In California, researchers found that with a yield of 750 pounds of lint per acre, only 25.4 hours were required to produce a bale of cotton when four-row tractor equipment and mechanical pickers were used. This compares with 107.4 hours when mule equipment and hand picking were employed.

On the High Plains of Texas, fast-moving machines have greatly reduced labor requirements. In this area, with yields of 182 pounds of lint per acre, 66 hours of labor were required under old methods as compared with 15.4 hours with four-row equipment and machine strippers.

These savings through mechanization and their recognition by farmers are indeed encouraging as the cotton industry moves ahead toward its goal of 16 million bales in 1951. Fully as stimulating, however, are the results of research in the allied phases of cotton production—fertilization, insect control, seed treatment, chemical weed control, and defoliation. This knowledge, more and more, is being translated into action on Cotton Belt farms, resulting in spectacular increases in yield and quality of cotton.

Machines can prepare the land in less hours, but good stands come from good seed properly treated to withstand disease. Fertilization supplies the plant with food needed for higher yields. Protection of the crop comes through insect and weed control. Finally, quality is protected through defoliation and proper harvesting and handling of seed cotton.

With exception of harvesting, machinery and labor requirements for producing 500 pounds of lint per acre vary little from those for producing 300 pounds. Common sense dictates, then, that cotton farmers should strive to apply amounts of fertilizer and insecticide recommended to enable them to produce as much as possible on each acre they plant.

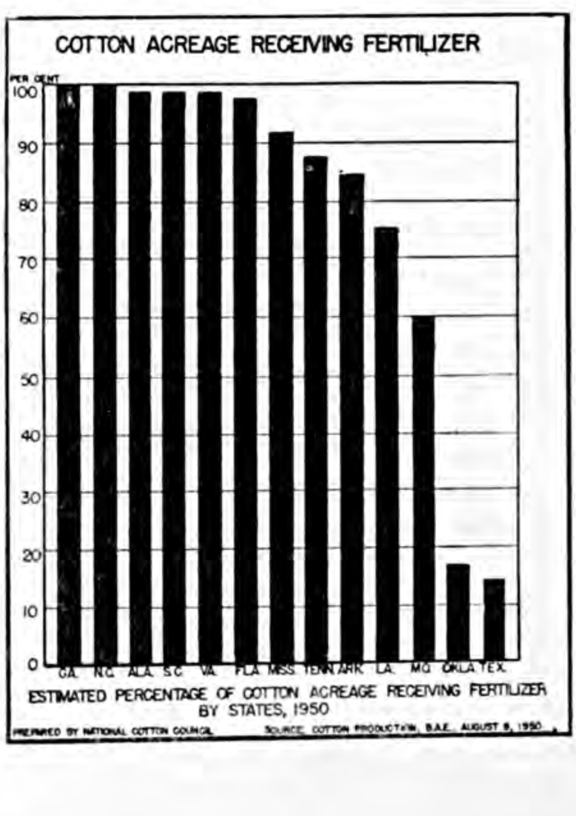
In many sections of the Cotton Belt, fertilizer is the key which opens the door to higher yields. Those farmers who doubt that the expenditure for these needed nutrients is justified, might well take a look at the results of experiments across the Cotton Belt. They prove conclusively that such an investment pays off handsomely—that more cotton and greater profits are the farmer's reward when he fertilizes as recommended.

At the South Carolina Experiment Station when 800 pounds of 4-8-4 fertilizer were applied, yields of lint cotton were increased an average of 177 pounds per acre, with a resultant increase of $49.43 per acre in net profits. In the Mississippi Delta net profits were hiked to $53.15 per acre when 250 pounds of nitrate of soda were used.

When fertilizer was applied in tests on different soil types during a four-year period in Texas, an average increase in yield of 175 pounds of seed cotton per acre was indicated.

The added expense of fertilization avails the farmer little, however, if insects destroy a substantial part of the crop before it reaches maturity. A thorough program of insect control, therefore, not only is necessary to protect his investment in fertilizer, but also to insure that his seed, labor, and time will not have been wasted.

Preliminary, unofficial estimates by the National Cotton Council indicate that cotton insect damage in 1950 amounted to nearly 600 million dollars. Although many cotton producers experienced a complete failure because of insect destruction, others who followed



recommended pest control programs made more cotton than ever before. In Mississippi, it is estimated that farmers saved more than a hundred million dollars through proper use of insecticides.

Insect control studies at College Station, Texas, indicated that 6 to 12 applications of insecticides as recommended resulted in yield increases ranging from 557 to 1,233 pounds of seed cotton per acre, and gains in net profits ranging from $88 to $133.

Defoliation, the use of chemicals to rid the plant of leaves, is associated closely with mechanization, fertilization, and insect and disease control. Where cotton is harvested mechanically, defoliation is almost a necessity since the chemicals remove the leaves, making the crop easier to harvest. Leaf stain and dry leaf trash are reduced, resulting in grade improvement and consequent better prices for the farmer's cotton in the market.

Where heavy applications of fertilizer are used, foliage of the plant is more dense and lower bolls sometimes rot. Defoliation, by ridding the plant of leaves, exposes more bolls to sunlight and air, thus reducing rot and allowing more bolls to mature. The exposed bolls open more rapidly and uniformly and a higher percentage of the cotton can be gathered at the first picking before it is greatly damaged by weather.

Defoliation is helpful in insect control late in the season. In many cases boll-weevils leave defoliated fields. In other instances defoliation may prevent late cotton leafworm infestation and heavy aphid population.

A combination of all these good cotton production practices—mechanization, fertilization, insect and disease control, control of weeds and grass, defoliation, and careful harvesting—will bring greater yields to farmers in 1951. Producers today, realize their value more than ever before. This knowledge, plus determination and hard work, will result in the attainment of their goal—production of the fiber and cottonseed this nation needs.

Increasing Cotton Yields in North Carolina

(*From page* 14)

start off slowly, and it has been observed that the seedling plants are less resistant to certain diseases. The soil reaction should be maintained at pH 6.0 to 6.5. The amount of lime needed varies depending upon the initial pH and the amount of clay and organic matter. The most satisfactory way to determine the amount of lime needed is to get a soil test. Where lime is needed, it should be applied and disked into the soil at least two months before planting.

Spacing

Much work has been done to determine the best plant spacing for cotton. The general practice is to plant a large number of seeds and then chop out the extra plants to the desired stand. However, many times good stands are ruined by improper chopping. It is necessary to have a sufficient number of plants present to utilize and return good profits from heavy fertilization and other approved practices.

Experiments conducted under conditions of adequate fertilization and good insect control practices show that three plants per foot of row (rows 3 to 3½ feet apart) gave the best yields (Figure 5). Plants spaced one foot apart may give larger plants and more bolls per plant but the final per-acre yield will be lower. A spacing of three plants per foot results in plants with less branching. In these studies, the desired stand was obtained by hand thinning after uniform drilling.

The use of a good quality treated seed, good planting methods, band placement of fertilizer at planting, and care in chopping are all factors that must be considered in establishing uniform stands. In some areas, chopping is being eliminated by hill-dropping only enough seed to provide a good stand.

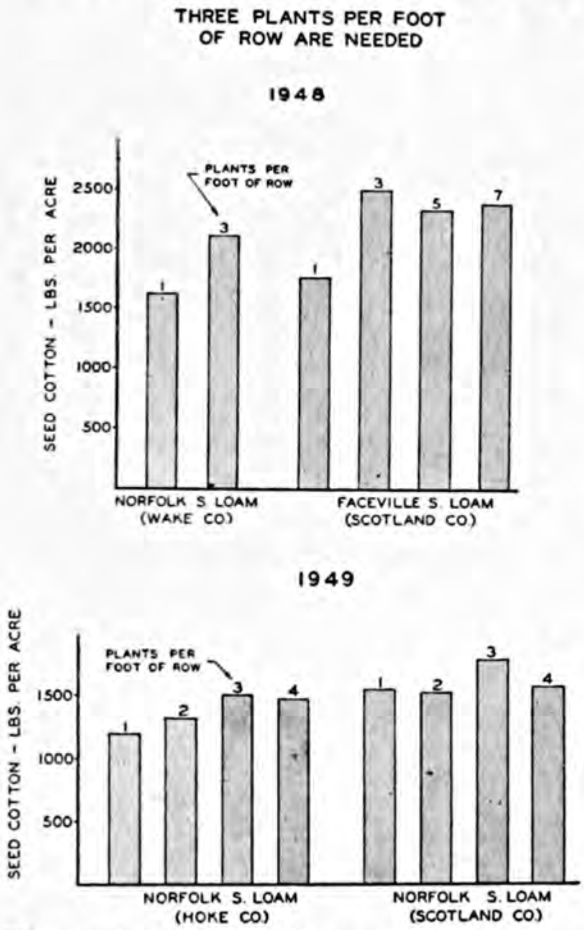


Fig. 5. Leave three plants per foot of row. Highest seed cotton yields were obtained from this spacing. These experiments were limed and fertilized at recommended rates and a good insect control program was followed.

Summary

Adequate quantities of nitrogen, phosphorus, potash, and lime must be supplied if high cotton yields are to be obtained. On average cotton soils in North Carolina, from 40-80 pounds of nitrogen per acre are needed to produce 1½ to 2 bales. Nitrogen applications should be reduced on dark soils. Following a good growth of a leguminous cover crop, cotton may require little if any nitrogen fertilizer. The response to nitrogen is complicated by insect injury and a good system of insect control is necessary in order to obtain greater returns from high fertilization. An early set of bolls is essential in obtaining profitable returns from the fertilizer, and early insect control is important.

From 50 to 100 pounds of P_2O_5 per acre and from 30 to 80 pounds of K_2O per acre are needed, the amounts needed depending upon the levels of these nutrients in the soil.

The soil reaction should be maintained at pH 6.0 to 6.5 by suitable applications of dolomitic limestone. Soil tests are helpful in determining the proper amounts of lime and fertilizer to apply.

Good stands are also important in obtaining high cotton yields. Under most North Carolina conditions, thinning to three plants per foot of row will give best results.

Fertilizing the Corn Crop in Wisconsin

(*From page* 10)

soil, but in general on these low-fertility fields this grade of fertilizer fits pretty well.

Summary

In summary then I'd say that the stepping-up of population to 12,000 or 16,000 stalks per acre is a prerequisite in the following program of fertilization for maximum yields of corn.

On a long-time soil fertility program we recommend the raising of the general level of fertility through liberal applications of phosphate, potash, and

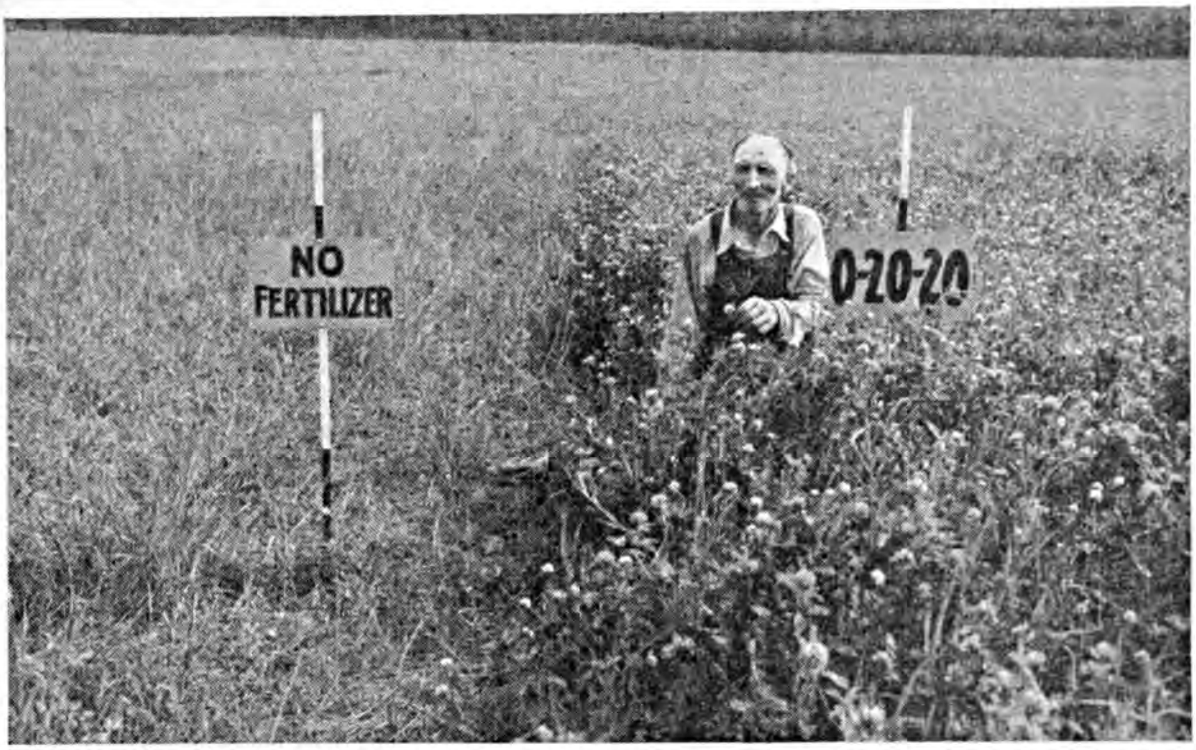


Fig. 6. Liberal application of phosphate-potash fertilizer in the rotation is necessary in any long-time program of corn growing in Wisconsin. Abundant crops of clover or other legumes enrich the soil in nitrogen and organic matter. Manure applied on good legume sod plus "starter" fertilizer will supply an abundance of plant-food nutrients, and in normal seasons make possible the production of 100-bushel crops of corn in southern Wisconsin.

lime. This should pay off in the growing of abundant crops of clover and alfalfa. Where all crops grown are fed to livestock and the manure carefully handled and applied to the corn crop and where a good legume sod or better yet a second crop of clover or alfalfa is plowed down for corn, "starter" fertilizer (3-12-12, 4-16-8, or 4-20-10) applied with attachment on cornplanter is all that is needed to bring yields up to the 100-bushel mark.

On fields where corn follows corn or grain and where no manure is available, the sidedressing of corn with nitrogen fertilizer at the time of the second or third cultivation is strongly recommended (hill or drill application of 4-16-8, 3-12-12, or 5-20-20 with planter attachment should be increased up to 200 or 300 lbs. per acre). When corn is knee-high the application as a sidedressing of from 125 to 175 lbs. per acre of ammonium nitrate or its equivalent in the form of other nitrogen fertilizer such as ammonium sulphate, cyanamid, nitrate of soda, or urea will frequently increase yields from 15 to even 25 bushels per acre.

As a short cut to good yields on fields where little or no manure or commercial fertilizer has been applied in recent years and where the general level of fertility is low, we recommend a liberal application of a balanced fertilizer such as 10-10-10 or 8-8-8 (from 800 to 1,000 lbs. per acre). The fertilizer should be applied broadcast and plowed under or applied in bands with an attachment on the plow or by other devices that will place the fertilizer at a depth of from 6″ to 8″. "Starter" fertilizer is recommended in addition to the broadcast plow-under 10-10-10 treatment.

Yields of corn in Wisconsin can be doubled and trebled if farmers will follow practices which have been suggested here. Let's grow more bushels of corn per acre on fewer acres. Let's seed down and maintain good stands of grasses and legumes on our more erodible land. If we follow this program we will conserve our soil, increase its organic matter content, and thus preserve its fertility.

Clinics for Sick Soil

(*From page* 24)

tant factor since early cotton is the goal of every farmer situated in the northern part of the Cotton Belt where the growing season is comparatively short.

The many laboratories which dot the State are indeed helping the farmer to help himself, and thereby increasing his income.

A Look at Alfalfa Production In the Northeast

(*From page* 22)

a serious pest in parts of the Northeast, seems to be an exception since it grows as a winter annual when alfalfa is dormant. Di-nitro sprays offer promise of control if the chickweed is not matted too thickly. Applications of 20 pounds of sodium chlorate per acre offer some hope but further research work is needed in order to find an effective chemical to control chickweed and not harm alfalfa under all conditions.

Winterkilling due to a lack of winter-hardiness sometimes occurs, but if alfalfa varieties which have proven adapted to the conditions under which they are to be utilized are grown, this need not be a problem in maintenance of stands. Where a maximum of winter-hardiness is required, such varieties as Grimm, Canadian Variegated, and Ranger are available. For those sections of the area not requiring the maximum degree of winter-hardiness, such varieties as Atlantic, Buffalo, Kansas Common, and Northern Common are recommended. Common alfalfa strains originating in Texas, Arizona, New Mexico, or in Argentina are to be avoided because they lack sufficient winter-hardiness for the Northeast.

Heaving caused by alternate freezing and thawing, particularly on wet soils, is a common cause of winterkilling of alfalfa. Heaving losses may be minimized by making sure that good surface and underdrainage prevail, by growing a grass in association with alfalfa, by permitting plants to go into the winter with high root reserves, and by having the protection of 6 to 8 inches of top-growth vegetation.

Disease weakened plants also winterkill easily. Bacterial wilt, a disease which plugs the vessels within the plant, roots, and crown, is one of the most severe diseases of alfalfa. It is apt to be most severe where alfalfa has been grown for several years. Plants weakened by this disease not only winterkill easily but they also may succumb any time during the growing season. Root rot or crown rot caused by the fungus *Sclerotinia* is another serious disease in the warmer areas of the Northeast that takes its toll during the winter and early spring months. This disease is especially harmful during mild or open winters. Alfalfa plants weakened by insect injury are also subject to winterkilling.

Alfalfa "Yellows"

During the growing season, yellowing of alfalfa is frequently noted. Alfalfa "yellows" may be caused by any one or combination of the following: (1) Drought, (2) boron deficiency, (3) potash deficiency, (4) magnesium deficiency, (5) Pseudopeziza and other leafspots, (6) downy mildew, (7) bacterial wilt, and (8) leafhopper injury. Each of these are characterized by different leaf symptoms and usually can be differentiated by the careful observer. It becomes apparent that the three types of yellows caused by deficiencies of nutrients can be remedied through proper fertilization. For those caused by pathogenic organisms, reliance must be placed upon resistant varieties since control is either unfeasible or uneconomical by the use of fungicides. That caused by leafhoppers can be eliminated by the use of insecticides. Nutritionally, the forage from yellowed alfalfa is lower in carotene than that of healthy green plants. Likewise, leaves affected by yellows generally drop and thus one of the most nutritious parts of the plant is lost.

Insects

An insect that has been building up in numbers during the past few years is the spittle bug. This insect is becoming a serious threat to alfalfa production in the Northeast. Leafhoppers also continue to be a problem, more serious in some years than others. Both insects can be controlled by insecticides but then there is the danger of poisonous residues being carried over to the hay. Some of the new organics offer considerable promise. J. O. Pepper, Pennsylvania State Extension Entomologist, has found chlordane and toxaphene effective in the control of spittle bug. These chemicals can be applied at the rate of 2 pounds of 50% wettable powder in 100 gallons of water per acre as a spray or as a 5% dust applied at 30 pounds per acre.

Application time for the control of this insect is critical since the application must be made just after the overwintering spittle bug eggs have hatched, which is when the plants are 3″ to 4″ tall in the spring. If the material is applied before the plants have reached a 5″ or 6″ height, residue does not carry over into the hay. Leafhoppers can be controlled effectively by the use of a dust containing 66% fine dusting sulfur, 10% pyrethrum powder, and 24% inert powder applied at the rate of 25 pounds per acre.

Disease and insect resistance bred into new alfalfa varieties offers the most feasible method of controlling many of the common pests of alfalfa. Plant breeders already have developed some promising new varieties with disease resistance. It is hoped that varieties with resistance to both the diseases and insects common to the Northeast can be developed now that plant breeders are at work on these problems in this region. Atlantic alfalfa from the New Jersey Station and Narragansett from the Rhode Island Station already have been developed specifically for Northeast conditions.

The New Varieties

The use of new alfalfa varieties offers some help in meeting production problems in the Northeast, particularly disease problems. These varieties and some of their characteristics are:

Ranger, originated by the Nebraska Agricultural Experiment Station and the U. S. Department of Agriculture, is highly resistant to bacterial wilt disease and is also relatively cold-resistant. It is therefore recommended for those areas in the Northeast where a high degree of cold tolerance and resistance to bacterial wilt are desired. There is a good supply of seed of this variety available.

Buffalo is also highly resistant to bacterial wilt. It was developed by the U. S. Department of Agriculture and the Kansas Agricultural Experiment Station from Kansas Common and is suited to those areas of the Northeast where a maximum of winter-hardiness is not required but resistance to bacterial wilt is needed. Seed of this variety is available commercially.

Atlantic, a high-yielding variegated variety from the New Jersey Agricultural Experiment Station, is one of the best adapted in the Eastern States. It is somewhat tolerant but not resistant to bacterial wilt and therefore should not be used where long-time stands are desired or where bacterial wilt is a serious problem. There is only a limited amount of seed available at present.

Williamsburg is a Virginia selection from Kansas Common. It maintains its stand under eastern Virginia conditions on account of high resistance to stem rot. It is being tested in many states, but there is no seed on the market at present.

Narragansett, a variegated strain developed by the Rhode Island Agricultural Experiment Station, is proving highly productive in the Northeast. This variety is relatively free of foliar diseases. As regards winter-hardiness, it falls in the same group as Ranger, Grimm, and Canadian Variegated. Narragansett, like Atlantic, is not resistant to bacterial wilt, hence should not be seeded in fields where this disease is a problem. Seed of this variety is now being increased commercially.

Despite the production problems encountered in growing alfalfa, it is a plant hard to beat for forage in the Northeast. Research workers are making progress in solving these problems and plant breeders are developing better varieties for this area. These developments promise a better future for alfalfa culture in the Northeast.

Know Your Soil

(*From page* 17)

This soil was limed to an optimum pH value of approximately 6.8 and the fertilizer ingredients varied. In Figure 4, Number 1 shows the results of carrots produced where nitrogen was the only limiting factor, Number 2 phosphorus was the only limiting factor, and Number 3 potassium. Number 4 shows the results where a complete fertilizer was applied. There is no doubt that after the pH value was corrected, potash became the most limiting factor for carrots.

For five years a ton of 5-10-10 fertilizer was applied annually to this soil in comparison with the normal fertilization program of the grower, which consisted of 300 to 400 pounds of fertilizer per acre annually. At the end of the five-year period, bulk samples were obtained from the field with a post-hole digger, thoroughly mixed, and brought to the greenhouse for further study.

In Figure 5, Pot 41 represents the grower's treatment and 49 represents the five-year fertilizer program, both without additional treatment. Pot 51 represents the grower's soil and 60 the fertilizer program, both with the same supplemental applications of fertilizer. It is believed that this clearly illustrates the importance of proper soil treatment in efficient and maximum crop production.

Practically all plants have different nutritional requirements. All soils differ in the physical and nutritional status. Millions of acres of Penn silt loam or related soils that are unproductive can be brought into efficient and maximum production by correcting the limiting factors.

Too Much Velvet?

(*From page* 5)

innovation of ready-to-eat alfalfa. Good old bacon and eggs and the pancake standby came as a second course.

Here you could interrupt my meditations and inquire if we ever heard of electric lighting and motor vehicles in our town and if maybe these didn't shake us out of a lethargy into a lather. That's quite easy to answer, my friend.

In distant parts there were whole

cities beginning to read and work by electric lamps, and in fact, to brag a little as well. A city in the central part of our state was really the first sizable community to put in and operate a municipal lighting plant. (Name on request accompanied with a bouquet and a stamped envelope.)—But except for a few dingy 20-watt carbon filament bulbs at the Methodist church, my memory doesn't swing back to the electric light as the first break we had with tradition and inertia. By the time we got them we were far gone on the "glory road to ruin."

And don't mention the auto car with the lever steering rod and the brass headlamps and linen dusters. For almost ten years after folks began talking about improved roads to promote motor travel, the only owner of one of those gas buggies was the retired banker. And he was so far removed from the hoi-polloi of average citizens that anything he had remained a luxury to be deplored for a long while.

I CAN remember clearly, of course, my first auto ride and the first horseless carriage to enter our bailiwick. The banker's son, a high school classmate, took me and my dinner bucket home from school one day; and Hi Henry's Minstrels used the first motor vehicle ever to traverse the streets of our home town, a shiny black carriage with bicycle wheels. I waited for three hours to see it, but it was just about as close to our humble lives then as atomic energy is to tractor fuel these days. Correspondents who recall that minstrel outfit are welcome to resign all pretentions to youth and write me about it.

But anyhow, barring the motor car and the electric light, the few simple innovations spoken about previously served to get us in a proper spirit to eschew and abjure and abandon all the sundry hard hand tasks and health-promoting inconveniences which served in reality as steady blood transfusions to a sturdy and self-reliant economy.

In due time it brought on a leisure class that didn't have the stamina, the ambition, the imagination, or the energy to utilize that new leisure well. Not for a moment would we return to the era that the new arrangements ushered out. We of the city are locked in the shackles of modernity, and the erstwhile independent farmer is also hog-tied and riveted to the mechanical-electrical age just as we all are. If it is a form of slavery, it's also the boon of freedom.

IN times of relative peace and tranquillity these new physical capacities we have become wedded to usually combine to push us into extreme levels of production, so that factories need super salesmen to hustle goods out on the partial payment plans; while farmers rely on the government to make a food surplus endurable—at least to them.

Here, of course, under normal circumstances we can extend our outlets and our services across the seas to not-so-distant lands of meager resources, helping them to absorb the surplus of our high-gear production line. That some of the cost of teaching them how to get something for nothing and to learn new ways and wants must come from our own pockets—that's natural for a few years in bringing these underprivileged consumers a taste of modernity. Of course, we are happy about it because they are entitled to it. Our main drawback seems to be that we rush them electronics and power plows before they are wise to hygiene or nutrition or what to do with a monkey wrench.

Those pioneer innovations of ours surely marked the vivid way to velvet living, all right, not only for us but for denizens of countless countries who are further behind than we were in the hoot-and-holler days.

The significant thing about all this change lies in the outstanding fact that no government dictum forced it on us. Here is one form of slavery and enforced dependence on each other which no debatable social reform laws foisted on our heads. No congressman in our district ever made the welkin jangle with proposals for new inventions. I admit after they were here and well into general use, the electioneering zealots whooped it up for stiffer terms and harsher regulations. That was the penalty we paid for getting tossed into a cycle of community relations to replace the haughty spirit of lonesome achievement.

When we ceased gradually to make the things we needed and used at home or in the village, and relied more and more upon the skill and steady effort of trained "specialists" to make our stoves run and our toilets flush and our telephones ring—that's when we shifted into high gear for the rock-strewn glory road. Even velvet can get badly mussed up and need patching, just like a pair of pioneer overalls.

Therefore, whenever we as a people trained to luxury run into some snags that trip up some of our suppliers and purveyors, it just means chaos and confusion. Even the good old government, which didn't start this curious cycle to glory, has a tough time as a referee. All this surge and struggle for bigger and better things to use and enjoy hinges so much on prices and wages that anybody who tries to solve it by putting his foot forward firmly usually mashes some very tender bunions.

OF course, there are still areas of this standardized land where the swift advance of science has not broken old spells of ancient mores. But thanks to the fast pace of our providers and inventors, such communities are becoming more rare. This is as it should be, if we as a nation are to conquer the vast crude world of primitive life with democracy and progress.

I applaud Point Four all right, being in favor of technical instruction to belated populations. But we ought to have a Point Five—on how to make it work abroad as well as at home.

You simply have to take the truth out there, but we must be sure that the truth will make us free.

Providing good and sensible teachers to extend the world's knowledge to hinterlands of hindered folks is always the first move to make. But let's be sure the pupils are ready to accept and make good use of the new-found science and improved methods. With us it took fourscore years of bewildered groping and testing to spread the velvet so snugly around us. Two generations of us now living have known nothing else but. We can hardly expect the dormant nations to suck at the Pierian Spring and come back blooming with the eternal spirit of youth and eager to wear the velvet like we do.

So let's cut and fit that velvet on foreign shoulders with great care and nicety. Our economy needs adoption by them of the good (and costly) things of life—maybe theirs does too, or will in a dozen years or more. The thing we've got to watch is not to fit that velvet on too fast in tailoring overseas programs—or it might drag in the muck or rip apart in the seams. We've got lots to spare here, but why waste the velvet when gingham or calico might do for awhile?

WELL, it's passing strange how we old-timers taught ourselves to do new tricks and accept new gadgets. Now we are trying to teach other folks the same benefits. Unfortunately, a majority of them are about where we were several centuries ago. The usages and articles we thought were in line for replacement forty years ago are just about what many of the submerged folks would think mighty fine and comfortable.

I'm not recommending foreign relief based on the oilstove, the telephone, and the water closet. Just plain old bacon and eggs, a roaring fire with ample fuel for the cook, a good, healthy pair of lungs, and a digestion that waits on appetite rather than equipment are the best signs of the dawn of tomorrow.

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

F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
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?
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—the Aristocrat
GG-6-45 Know Your Soil
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
H-2-46 Plow-Sole Placed Plant Food for Better Crop Production
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
AA-5-46 Efficient Fertilizers Needed for Profit in Cotton
WW-11-46 Soil Requirements for Red Clover
A-1-47 Fertilizing Vegetables by Applying Fertilizer to Preceding Cover Crop
I-2-47 Fertilizers and Human Health
P-3-47 Year-round Grazing
T-4-47 Fertilizer Practices for Profitable Tobacco
AA-5-47 The Potassium Content of Farm Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are You Pasture Conscious?
R-4-48 Needs of the Corn Crop
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
OO-11-48 The Use of Soil Sampling Tubes
TT-12-48 Season-long Pasture for New England
E-1-49 Establishing Bermuda-grass
F-2-49 Fertilizing Tomatoes for Earliness and Quality
J-2-49 Increasing Tung Profits with Potassium
CC-8-49 Efficient Vegetable Production Calls for Soil Improvement
EE-8-49 Why Use Potash on Pastures
GG-10-49 What Makes Big Yields
KK-10-49 An Approved Soybean Program for North Carolina
QQ-11-49 Some Fundamentals of Soil Building
RR-11-49 Alfalfa as a Money Crop in the South
SS-12-49 Fertilizing Vegetable Crops
A-1-50 Wheat Improvement in Southwestern Indiana
B-1-50 More Corn From Fewer Acres
F-1-50 A Simplified Field Test for Determining Potassium in Plant Tissue
I-2-50 Boron for Alfalfa
J-2-50 Use Crop Rotations to Improve Crop Yields and Income
K-3-50 Metering Dry Fertilizers and Soil Amendments into Irrigation Systems
L-3-50 Food For Thought About Food
N-3-50 Can We Afford Enough Fertilizer to Insure Maximum Yields?
O-4-50 Birdsfoot Trefoil—A Promising Forage Crop
P-4-50 Potash Production a Progress Report
S-4-50 Year-round Green
T-5-50 Physical Soil Factors Governing Crop Growth
U-5-50 Reseeding Crimson Clover Adds New Income for the South
V-5-50 Potassium Cures Cherry Curl Leaf
X-5-50 Fertilizers Help Make Humus
Z-6-50 Potash Tissue Test for Peach Leaves
AA-8-50 Alfalfa—Its Mineral Requirements and Chemical Composition
BB-8-50 Trends in Soil Management of Peach Orchards
CC-8-50 Bermuda Grass Can Be Used in Corn Rotations
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THE AMERICAN POTASH INSTITUTE

1155 16TH STREET, N. W. WASHINGTON 6, D. C.

A Few Whinnies

She was sweet but realistic. "When I crush you in my arms like this," he whispered, "what are you thinking of?"

Without hesitation she replied, "The manpower shortage."

* * *

A Scotchman was walking through a cow pasture one day when the wind blew his tam-o'-shanter to the ground. He tried on six of them before he found his own.

* * *

"Paw, long's yuh got yur carpenter's tools out, ah wisht y'd fix th' hinge on this kitchen door. Fly season's coming."

"Can't do it, Maw; too busy. Got to fix this garden gate so's the pigs can't git 'n th' garden. . . . Oh, hullo, Jim! Yuh fixin' to do a little fishin' with that there hook and line?"

"Yeah, thought mabbe y'd go along."

"Reckon I might. . . . Oh, Maw! Pick up muh tools, will yuh? I gotta go help Jim."

* * *

These days a farmer must be smart enough to understand all the advice the government gives him and select that which will do him the least harm.

* * *

"Children," said the teacher, "I want you to write an essay about King Alfred. But don't waste time writing about the burning of the cakes."

One essay read: "King Alfred went and knocked on the door of a lonely cottage in a forest and was admitted by a farmer's wife. What happened after that I'm not allowed to say."

Willie Johnson, a sawed-off, beaten-down little colored fellow, was arraigned in a Texas district court on a felony charge.

The clerk intoned: "The State of Texas versus Willie Johnson!"

Before he could read further, Willie almost broke up the meeting by solemnly declaring, "Lawdy! What a majority!"

* * *

The teacher was giving her students a lesson in geography, and was talking about Orientals and Occidentals.

"Orientals," she explained, "are those people who live in the Far East. The people who live in the West are called Occidentals. We are all Occidentals."

A bright boy of 11 piped up: "My mother says I'm an 'accidental'."

* * *

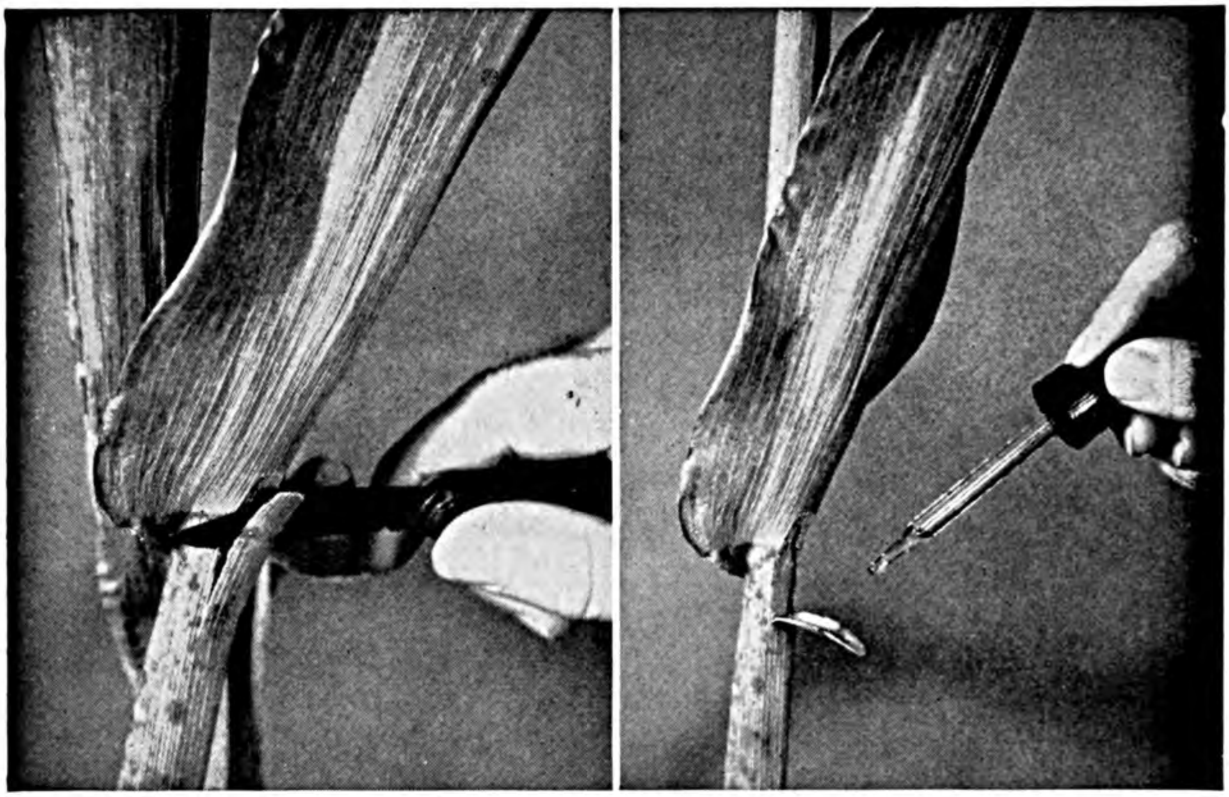
"Why does Geraldine let all the boys kiss her?"

"She once slapped a lad who was chewing tobacco."

* * *

A motorist and his wife traveling through the Blue Ridge Mountains stopped at a one-pump gas station before a mountaineer's cabin. After the man told the proprietor to fill the tank, his wife asked: "Is there a rest room here?"

"No, ma'am, there isn't," replied the gas man, "but you'll find a mighty comfortable rocker up there on the porch."



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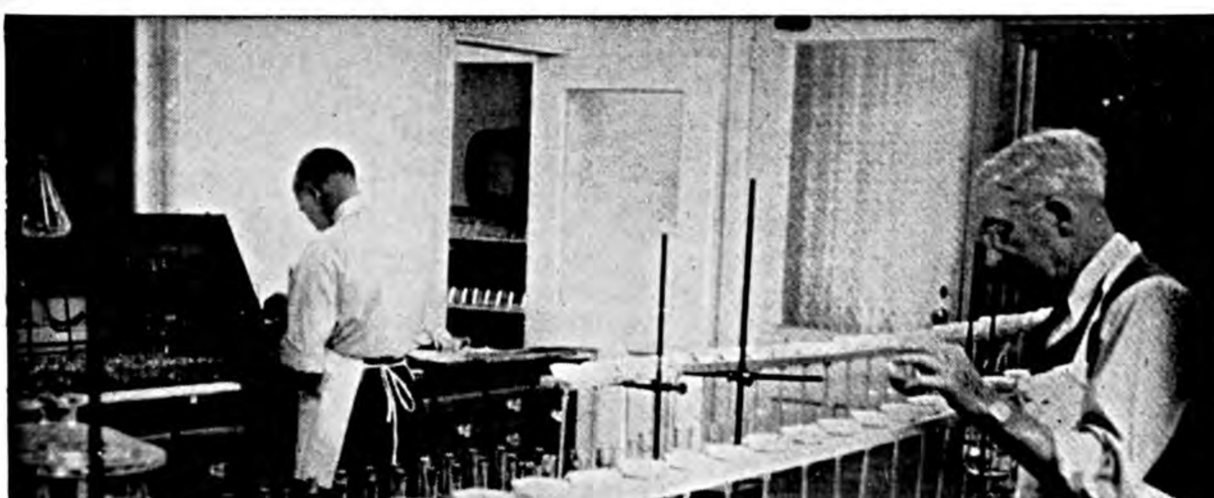

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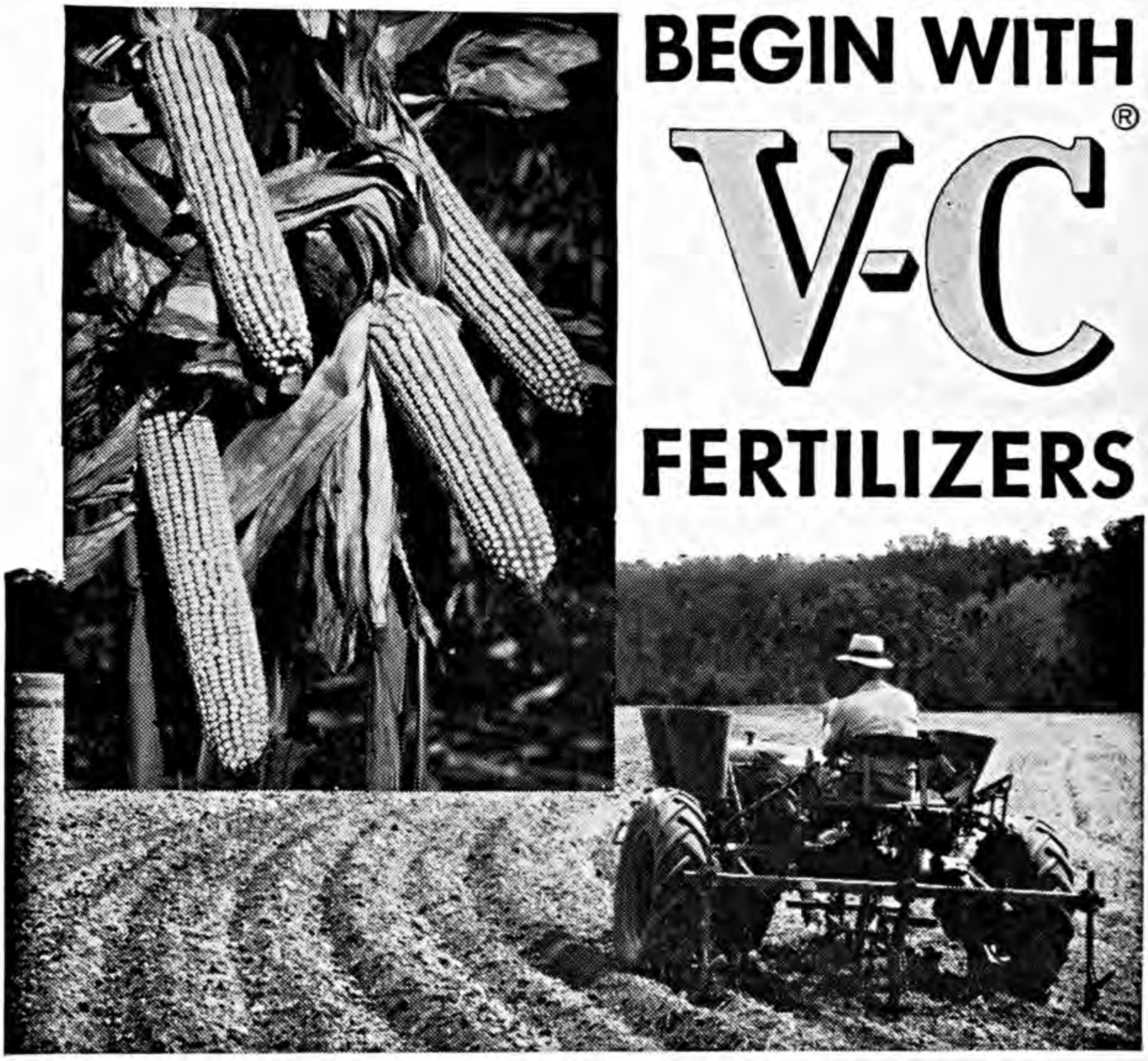

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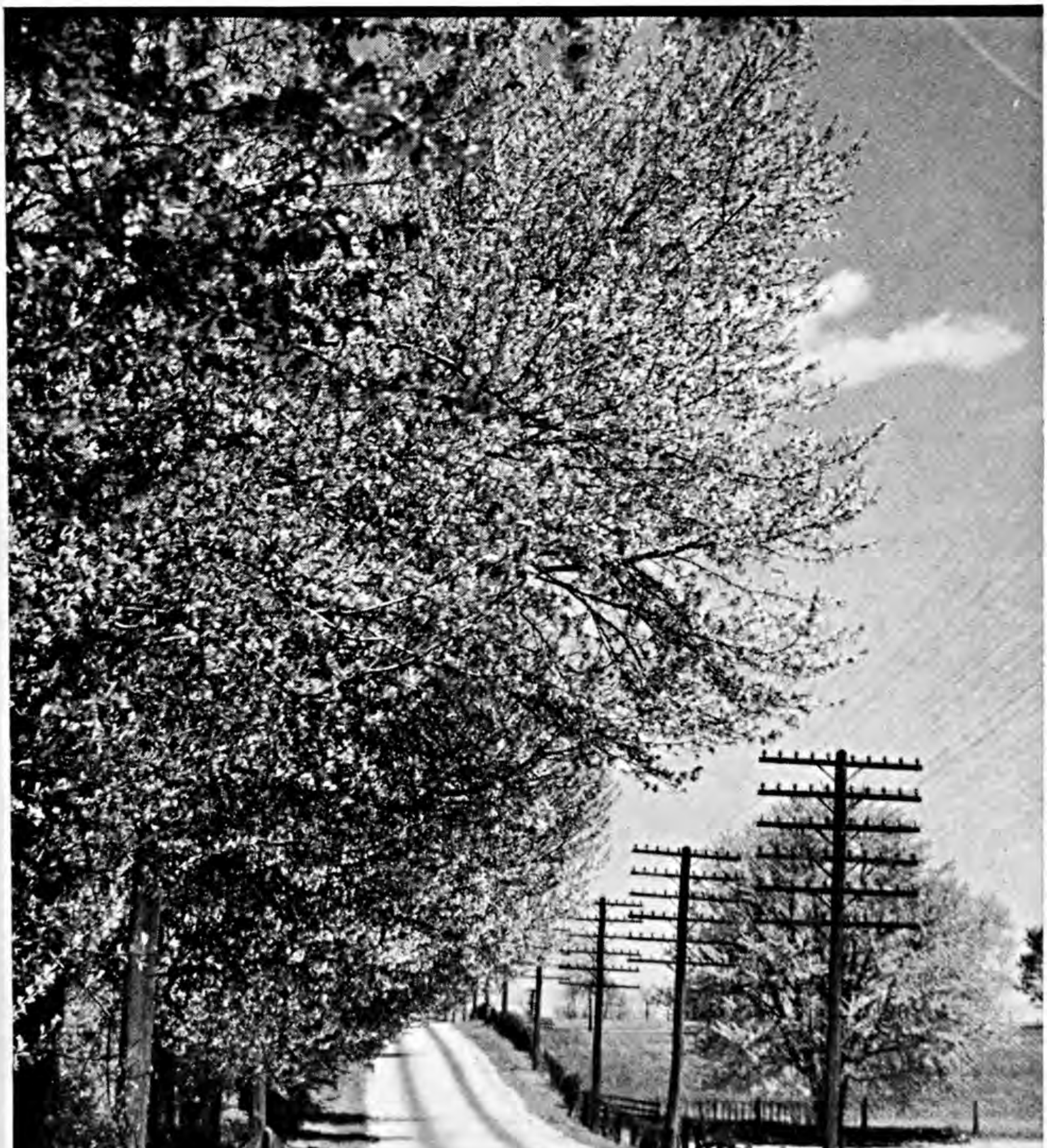

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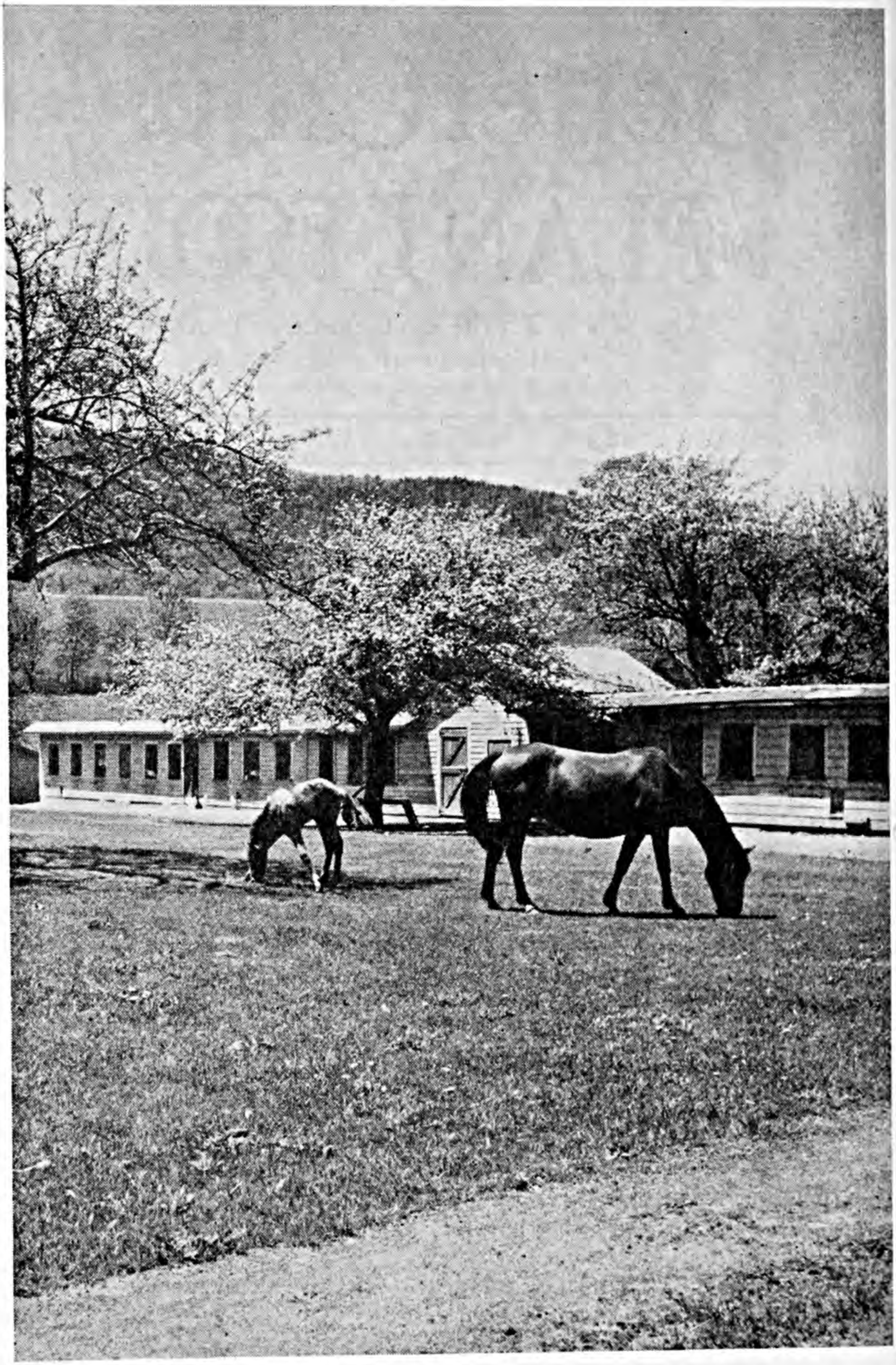

Springtime

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VOL. XXXV WASHINGTON, D. C., APRIL 1951 No. 4

Our Uncle Sam is . . .

Calling All Crops

Jeff McDermid

WHAT the book of tactics is to armed forces resembles those rather comprehensive production guides for farmers to use in 1951. The defense assignment handed to the soil gentry is simply to use discretion in conserving land resources at a time when the target set up to shoot at is a five per cent increase in agricultural output over 1950 and three per cent greater than the all-time record crops of 1949.

All this and much more were brought up with forceful resolve at the Iowa "corn-vention" early in April. Bawling calves and squealing pigs reinforced the clarion call for crops issued by state and federal farm leaders. Nothing irks a good all-around general farmer more than to hear his "critters" crying for sustenance without being able to fork out the provisions. To be "short on the shorts" is a real dilemma not only for the feeder himself, but for the distant and often misled food consumer who relishes juicy steaks and ample hamburger and bacon.

We who can look back with reminiscent mien to laissez-faire eras are able to see quite a difference in the way farmers take hold of the planting program. Possibly excepting a few feed crops, it was then customary for the shrewdest operators to sit back and size things up in the late fall prior to the spring seeding. They noted carefully what crops and livestock were being somewhat overdone in comparison to the local demands. If hogs were a sort of drug on a weak market, they made plans to increase their own farrowings for the coming season, in the firm belief that most farmers would drop out of hogs in considerable numbers, which might mean a pretty good market price the next year. On the contrary, if hogs were scarce and firmly priced, such wiseacres shook their sage heads and resolved to go easy on their litters for awhile. In the crop annals of those times the same method prevailed for cash crops like potatoes, flaxseed, sugar beets, and beans. It was each man for himself and the drought take the hindmost!

WE don't need to add that some farmers follow this practice quite generally still. Yet there really has been a decided drift to a more businesslike way of approaching the production problem in advance. This year there are 10 major crops listed in the so-called guide for plantings. The 1950 acreage to all these crops amounted to 212 million. This year the guide book and the organized leadership afield agree on trying to plant 224 million acres to the same crops.

If old methods and attitudes prevailed these days we could just fold our hands and deny that any power except weather and nature could either interfere or arrange for national and state acreages and goals of output. You'd say that no arguments or threats could drive the rugged individualist to open a furrow or breed a sow when he didn't think it would be sure to pay. In some aspects the same motive rules today, but it is obscured by history and a rather new "national concept" written into federal law. This new concept has taken deep roots and furnishes the financial incentive which greases the wheels of the united farm resolve.

All this ties right into the fact that every one of the 10 crops for which there is a call for increased production is definitely assured of a fairly profitable return to growers through the federal price-support program. Some of them will get this protection and assurance through indirect ways, but most of them receive guarantees of loans at storage time or outright government promises to purchase at some definite relation to parity.

So we see at once that the door to opportunity in agriculture is hinged to and swings with parity. You must go back to 1933 and 15-cent corn and 3-cent pork in order to be in at the genesis of parity. Now I am fully aware, just as you are, that we do not find all our good farmer friends amenable to and subscribers to this theory of the parity relationship. But the dissenters and unbelievers are almost as scarce as open-pollinated corn or walking cultivators.

NOT very long ago I got a letter from a native of my bailiwick who raved no end about the "cussed foolishness" of economists and farm statisticians in their monthly itemizing of hundreds of farm prices and parity ratios. He belonged to the old school which still "keeps" in red frame buildings dotting the back country. With him, all forms of change and adjustment in agriculture are signs of decadence and regimentation.

Not only have the majority accepted the new mathematical farming and mechanical tillage philosophy, but the whole fabric of our "life with consumers" hangs on the thread of parity —which has been under some pressure of late.

The concept of parity had to be upheld fiercely back in 1933-35. Few consumers at the time paid much attention to the drifting flow of this portentous move. They were busy with their own evictions for unpaid rent and creeping paralysis of incomes. Food prices then were low and farmers were forced to burn corn for fuel and let mountains of wheat decay on the ground. It was in that tough oven that the parity concept was baked to the queen's taste. In spite of that, parity had its loud critics, more especially aimed at the financial method of underwriting parity prices by means of the processing tax system. Farm defenders said in reply that benefit payments and parity formulas for agriculture were no different or no worse than the protective tariff—and they might have added the growing trend to hitch organized labor wages to the fluctuations of the living cost.

Anyhow, regardless of the arguments and the court decisions which threw dismay for awhile into the parity planning, the concept grew and expanded and blossomed. So today we have parity as the basic measure for what is deemed a fair share of the

national income for our farm workers. Of course, to be exact, prices and income for agriculture are not the same identical thing, but other things being equal, the price factor per unit of output still "shakes a mean leg" in the dance of destiny.

If some hopeful newcomers suggest that price control won't get very far unless you put parity away back in the deep freeze for a few years, the resulting heat wave is prodigious. Farmers who couldn't tell you how the federal figure foundry really digs up the parity figures each month are just as loud in support of the theory behind them as any "bureaucrat" whose days are spent behind a slide rule.

There will be a real debate on that issue. Many proposals will be made and many rejected. But there are some deeper considerations facing us at this juncture than a mere academic tussle over an economic theory. One great overpowering urge is uppermost—and that is production of a mammoth food and feed crop. Other angles of the situation diminish in importance before that one.

Neither the parity concept nor the escalator wage concept equals the national survival concept. Recent official statements warrant our feeling that our country is in grave danger. Families will be deprived of loved ones and communities will be insecure if that fate befalls us. Hence to squabble among ourselves about fifth-rate propositions and insist upon class and group privileges, no matter how just, or how well entrenched, are not true Americanism. I do not look to see either our labor or our farm leaders demanding adherence to slogans and traditions if we really must exert united power to survive.

IF that time has come, full energy must needs be used to conserve our resources and to channel equipment, facilities, services, and priorities to the loyal folks on our farms. So far, much of that effort has been feeble and at cross-purposes. Much of the Washington materials allocation business has been "business as usual." It was a kind of dream world, a make-believe effort without conviction or "guts." All this will change over night should the enemy knock at our gates.

Moreover, with a ruinous war on our hands the farmer's will to produce abundantly would be spiritual, personal, and overpowering. Prices would be plenty high enough, parity or none, so that given reasonable supplies and a broad interpretation of the essential industry idea in drafting manpower, his position would not be pathetic, hopeless, or discouraging.

As a matter of fact, this nation went through a few severe wars up to 1920 without any thought to farm parity. What hurt farmers worst was loss of their own kin and the depletion of their soils brought on by these wars.

(*Turn to page* 48)

Nutritional Problems of Peanuts in Southeastern Alabama

By Franklin L. Davis

Alabama Polytechnic Institute, Auburn, Alabama

THE results of cooperative field tests conducted during the last two years in southeastern Alabama on the effects of lime and gypsum on runner peanuts have disclosed some interesting facts concerning the nutritional needs of peanuts on the soils of that area. Chief among these are:

(1) Both the exchangeable calcium content of the soil and the shelling percentage are good indications of the need of calcium as lime or gypsum.

(2) Lime and gypsum treatments gave increases in the shelling percentage of peanuts on all soils on which they produced significant increases in yields.

(3) Responses in yield from lime and gypsum have been limited and sometimes prevented by insufficient potash supplied by the soil and fertilizer.

(4) The use of large amounts of potash in the fertilizer or sidedressings of additional potash resulted in decreased quality and yield of peanuts on the plots receiving no calcium.

Objectives of this work, in part, were to correlate the response of runner peanuts to lime with the calcium content of the soil and to determine the effect of lime and gypsum treatments on shelling percentage and kernel size. Specifically each test consisted of four replications of each of the following four treatments: (1) No lime or gypsum; (2) one ton per acre of lime; (3) 400 pounds per acre of gypsum dusted on the peanut foliage at early blooming stage; and (4) both lime and gypsum. Each test was fertilized according to the farm-cooperator's own practice.

The experiments are located on suitable experimental areas of selected farms. Soil samples were taken for soil analyses from each suitable site before the soil was limed. Soil reaction, lime requirement, exchange capacity, exchangeable calcium, and other analyses are made on the samples from each location. At harvest time, which is as near as possible to the date when the entire field is dug, the peanuts from a 100-square-foot area are dug, picked green, and weighed. A 500-gram sample from each plot is saved for drying, weighing, and shelling for determinations of yield of dry peanuts, shelling percentage, and percentage of sound mature kernels. Field data were obtained from 18 tests in 1949 and from 26 tests in 1950. Of the 26 tests harvested in 1950, 12 were begun in 1949 and 14 were new tests started in 1950.

Minimum Calcium Level

The statement that the exchangeable calcium content of the soil is a good indication of the need for lime or gypsum, since both these materials supply calcium, is almost axiomatic. Nevertheless, it is worthwhile to know the extent to which experimental data confirm this and to ascertain if there is a minimum level of calcium content below which peanuts would give a profitable response to lime and gypsum.

A summary of the 1950 data on yields and percentages of sound mature kernels in relation to exchangeable calcium content of the soil is given in Table I. The data in the table show that of the 26 soils tested, 12 had an exchangeable calcium content of less than 0.72 milliequivalents per 100 grams of soil and that the average increase in yield from lime and gypsum treatments on these soils ranged from 240 to 286 pounds per acre of dry peanuts. Of these 12 soils low in exchangeable calcium, only two failed to give an increase in yield of 200 pounds per acre or more to either lime or gypsum. Of the 14 soils containing more than 0.72 me. per 100 grams of exchangeable calcium, only one gave significant increases in yield (210 pounds per acre) to the lime and gypsum treatments. Thus the data indicate that exchangeable calcium content of soils is a good index of the need of peanuts for additional calcium as lime or gypsum.

The response in yield of peanuts to applications of lime and gypsum is somewhat better than that shown in Table I if no reference is made to the soil properties. Twelve of the 26, or 41 per cent of the tests harvested in 1950, gave increases of 200 pounds per acre or more of cured peanuts from 400 pounds per acre of gypsum (land plaster) dusted on the foliage. The average increase in yield of these 12 tests was 342 pounds per acre from gypsum and 300 pounds per acre from lime. Of the 32 different farm locations tested in the two years, four gave increases in yield from gypsum that exceeded 600 pounds per acre of peanuts.

The larger increases in yields were obtained from the soils that produced peanuts having lower shelling percentages. Thus, summarized in Table II are the data on yields and increases in percentage of sound mature kernels (SMK) in relation to the percentage of sound mature kernels produced on the plot receiving no calcium.

The data in Table II show that peanuts having a percentage of sound

TABLE I.—SUMMARY OF THE 1950 DATA ON YIELD AND PERCENTAGE OF SOUND MATURE KERNELS OF PEANUTS IN RELATION TO THE EXCHANGEABLE CALCIUM CONTENT OF SOILS.

Treatment	Exchangeable calcium content of soils expressed as $CaCO_3$					
	Less than 720 pounds per acre of lime (12 soils)		720 to 900 pounds per acre of lime (6 soils)		900 and more pounds per acre of lime (8 soils)	
	Average yield/A	Average increase/A	Average yield/A	Average increase/A	Average yield/A	Average increase/A
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
No treatment	1,361	check	1,515	check	1,497	check
Lime	1,601	240	1,537	22	1,517	20
Gypsum	1,644	283	1,605	90	1,571	74
Lime & gypsum	1,647	286	1,559	44	1,551	54
	SMK	Inc. SMK	SMK	Inc. SMK	SMK	Inc. SMK
	%	%	%	%	%	%
No treatment	58.9	check	63.3	check	62.0	check
Lime	64.2	5.3	66.0	2.7	62.2	0.2
Gypsum	63.9	5.0	66.1	2.8	63.3	1.3
Lime & gypsum	65.2	6.3	66.3	3.0	64.5	2.5

TABLE II.—SUMMARY OF THE 1950 DATA ON YIELD AND PERCENTAGE OF SOUND MATURE KERNELS OF PEANUTS IN RELATION TO THE PERCENTAGE OF SOUND MATURE KERNELS PRODUCED ON THE PLOT RECEIVING NO CALCIUM.

Treatment	Percentage of sound mature kernels on untreated plot					
	SMK less than 60% (10 soils)		SMK 60% to 65% (10 soils)		SMK 70% and over (6 soils)	
	Average yield/A	Average increase/A	Average yield/A	Average increase/A	Average yield/A	Average increase/A
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
No treatment......	1,331	check	1,442	check	1,610	check
Lime..............	1,589	258	1,504	62	1,607	−3
Gypsum...........	1,588	257	1,583	141	1,704	94
Lime & gypsum....	1,635	304	1,645	203	1,453	−147
	Average SMK	Average inc. SMK	Average SMK	Average inc. SMK	Average SMK	Average inc. SMK
	%	%	%	%	%	%
No treatment......	55.3	check	63.1	check	66.6	check
Lime..............	61.8	6.5	64.4	1.3	67.1	0.5
Gypsum...........	61.5	6.2	65.3	2.2	67.1	0.5
Lime & gypsum....	64.4	9.1	66.3	3.2	65.1	−1.3

mature kernels of less than 60 per cent were produced on the plots receiving no calcium on 10 of the 26 tests harvested in 1950. The average increase in yield from lime and gypsum treatments on these 10 soils ranged from 258 to 304 pounds per acre of peanuts. The average increase in percentage of SMK from the same treatments ranged from 6.5 per cent to 9.2 per cent. The increases in yield are about the same as those obtained from the group of 12 soils low in exchangeable calcium and shown in Table I. It is to be expected that the increases in percentage of SMK from lime and gypsum treatments are larger for the "low" group in Table II because in this case they were grouped on the basis of percentage of SMK.

Of the 18 tests harvested in 1949, three had a percentage of sound mature kernels on the untreated plot of less than 61 per cent and gave an average increase in yield from gypsum of 484 pounds per acre of peanuts. Seven fell within the limits of 61 to 69.9 per cent SMK on the untreated plots and gave an average increase in yield of 113 pounds per acre. The other 10 had percentages of SMK of above 70 per cent and produced an average increase in yield from gypsum of only 26 pounds per acre of peanuts. The data for the two years, 1949 and 1950, are not suitable for a combined grouping on this basis since the average grade, or percentage of SMK, of peanuts produced differed considerably with the two seasons.

These data show that both the exchangeable calcium content of the soil and the grade or percentage of sound mature kernels are good indications of the need of additional calcium applications in material such as lime and gypsum. The exchangeable calcium is a laboratory method of diagnosis and requires collecting representative soil samples. The percentage of sound mature kernels is given in the market grade and is associated with light peanuts having a high percentage of "pops" and "blow-outs." Practically

Fig. 1. Showing little or no response of peanuts to boron and manganese in addition to potash on an over-limed soil. Photographed September 18, 1950. Treatments: two center rows no-treatment check; two rows on left, 100 pounds muriate of potash plus 25 pounds manganese sulfate per acre; two rows on right, 100 pounds muriate of potash plus 5 pounds borax per acre.

all farmers know which fields and areas of their farms produce such peanuts.

The finding in this work that the yields of peanuts are limited by "available" potash indicates the best possibilities for future progress of investigations of the nutritional needs of runner peanuts on soils of southeastern Alabama. It was apparent in the data for 1949 that the yields of peanuts were

Fig. 2. Showing marked response of peanuts to zinc and an A-Z mixture in addition to potash on an over-limed soil. Photographed September 18, 1950. Treatments: two center rows, no treatment; two rows on left, 100 pounds muriate of potash plus 15 pounds zinc sulfate per acre; two rows on right, 100 pounds muriate of potash plus 5 pounds borax, 5 pounds copper sulfate, 15 pounds zinc sulfate, and 25 pounds manganese sulfate per acre.

TABLE III.—VALUES FOR CORRELATIONS EXISTING IN 1949 DATA

Relationship	Linear constants		Correlation	
	Intercept (a)	Slope (b)	Coefficient (r)	Significance
Yield of no-treatment plots to exchangeable calcium	1,404	0.27	0.247	N.S.
Yield of no-treatment plots to "available" potash*	860	9.27	.597	Sig.
Yield of gypsum-treated plots to "available" potash*	1,014	8.77	.680	Highly sig.

* "Available" potash = exchangeable soil potassium plus potash in fertilizer in pounds per acre of K_2O.

not closely related to the exchangeable calcium content of the soils. The calculation of the correlation coefficient (r) of only 0.247 for this relationship showed this to be true, although the yields ranged from 639 to 2,216 pounds per acre of peanuts and the exchangeable calcium contents from 0.44 to 1.60 me. per 100 grams of soil. The values for this relationship of yields to exchangeable calcium and for the relationships between yields and "available" potash are given in Table III. The term "available" potash refers to the sum of exchangeable soil potassium and that supplied in the peanut fertilizer.

The data in Table III show: (1) That the yield of peanuts was not significantly correlated to the exchangeable calcium content of the soils; (2) that the yield on the plots receiving no lime or gypsum was significantly correlated to the available potash; and (3) that the correlation between yield of peanuts on the gypsum-treated plots and available potash was highly significant. These facts and the knowledge that potassium is an essential plant-nutrient element commonly deficient in these soils show that potassium is more important than calcium as a factor limiting the yields of peanuts on these soils. This is further indicated by the fact that the eight soils that produced the largest yields on the gypsum-treated plots in 1949 included the seven tests that were largest in total available potash, i.e., exchangeable potash plus the potash applied in the fertilizer.

The data on a number of tests plainly showed that insufficient potash not only limited the yields of peanuts but on some of the tests completely prohibited any response to lime or gypsum. The pertinent data from two of such tests are given in Tables IV-A and IV-B. These two tests were located on different fields of the same farm in Houston County.

As shown by the data in Table IV-A, the soils were so similar that (with the

(*Turn to page* 45)

TABLE IV-A.—ANALYSES OF SOIL SAMPLES TAKEN ON JANUARY 2, 1949

Soil property	Location number 18	Location number 19
Soil reaction—pH	5.3	5.3
Cation exchange capacity me./100 gm.	3.88	3.22
Exchangeable calcium me./100 gm.	0.48	0.49
Exchangeable potassium p.p.m. K	19.6	21.7
NH_4F—soluble phosphorus p.p.m. P_2O_5	86.8	52.7

More Corn at No Extra Cost[1]

By A. C. Caldwell

Division of Soils, University of Minnesota, St. Paul, Minnesota

ON the Richard Clayton farm in Mower County, Minnesota, more than 15 bushels more corn per acre were obtained from the same amount of fertilizer simply by increasing the stand of corn. Doubling the plant population from two stalks per hill (7,840 plants per acre) to four stalks per hill (15,680 plants per acre) increased the yield from 100 pounds of fertilizer by 15.2 bushels. These are findings which, to a greater or less extent, would be true probably on many farms growing corn. Of the many factors which affect the growth of corn, two at least are pretty largely under the control of the operator, and these are the stand of corn and fertility of the soil. An examination of the effects of varying stand and fertilizer application to corn on a number of soil types over a period of several years in Minnesota has demonstrated that more attention to these two factors alone may affect appreciably the yield of corn obtained. Some of the details of how yield and ear characters may vary on different soil types with varying stand and fertilizer rate are presented here.

Sandy Soils

Sandy soils are apt to be drouthy and sometimes infertile, but will still produce fair yields of corn at times. Because of the risk of running out of moisture, too heavy a stand of corn should not be encouraged on soils of light texture. Figure 1 presents the yield of corn obtained from various rates of planting and two rates of application of fertilizer on a Hubbard sandy loam. The fertilizer applied was 8-16-16 at rates of 100 and 200 pounds per acre placed in the hill at planting time. This soil contained nearly 200 pounds per acre of available phosphorus (adsorbed and acid soluble), and 60 pounds of exchangeable potassium per acre six inches.

It can be seen that on this soil, a sandy loam, the best yield was produced with a stand of three stalks per hill on a 40-inch spacing, equivalent to 11,760 plants per acre. Four and five stalks per hill proved too many for the moisture available. The 100-pound-per-acre fertilizer rate slightly more than paid for itself when applied to two stalks per hill, but it was not until the stand was increased that substantial returns were obtained. The second 100 pounds of fertilizer were not economical at any planting rate.

A look at the relative ear size as shown in Figure 1 illustrates that the best yields were not obtained from the largest ears. The size of ear from a stalk in a 3-plant hill will be smaller than that from a 2-plant hill but not a third smaller, and since there are more ears, the yield is greater. Table I presents the actual average size of the ears from the various plantings on the sandy soil.

Slightly better than a half-pound ear was secured from a 2-stalk stand but

TABLE I.—THE EFFECT OF STALKS PER HILL AND FERTILIZER ON THE AVERAGE SIZE OF THE CORN EAR (HUBBARD SANDY LOAM).

Treatment	Stalks per hill (40" x 40") Average ear size (ounces)			
	2	3	4	5
None	7.5	6.1	5.1	3.5
8-16-16, 100#/A	8.2	7.1	5.0	4.0
8-16-16, 200#/A	8.5	7.2	5.1	4.0

[1] Paper No. 748 of the miscellaneous journal series, Minnesota Agricultural Experiment Station, St. Paul, Minnesota.

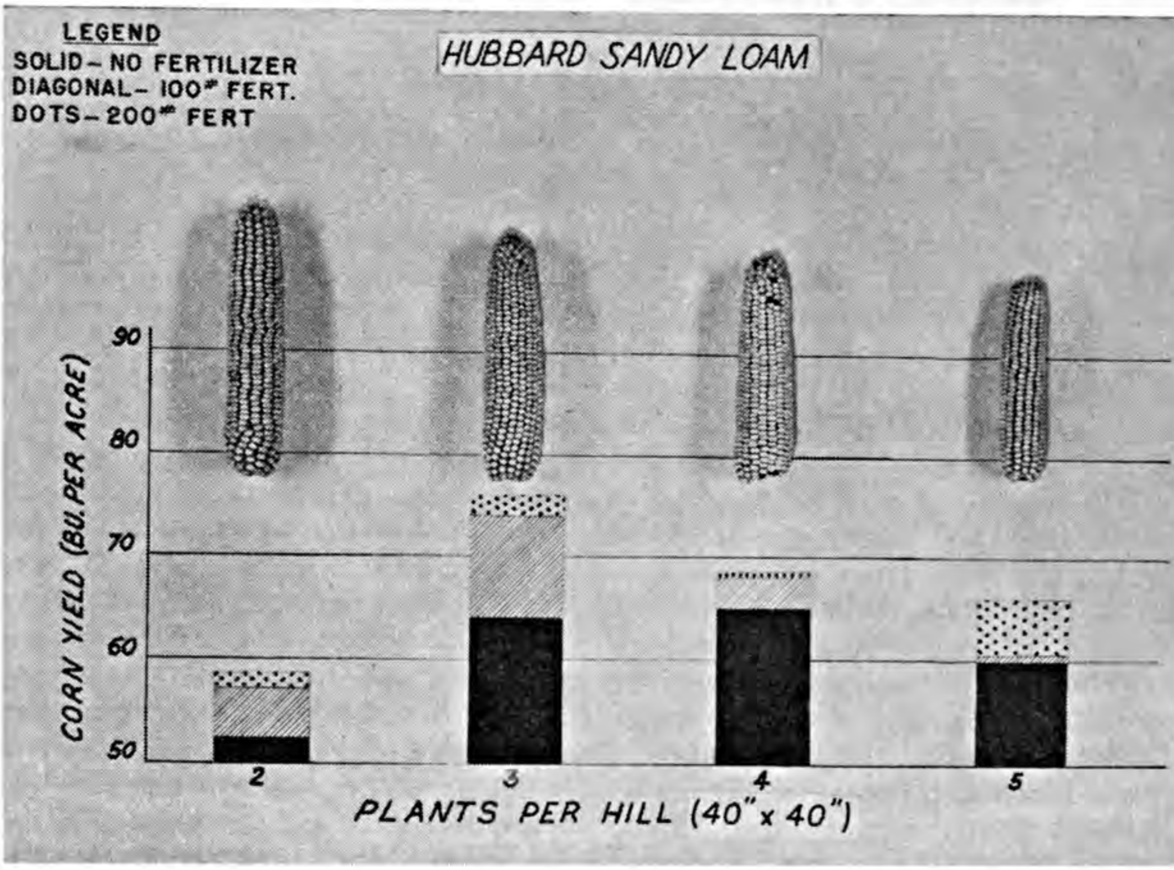

Fig. 1. Yields and relative ear sizes of corn from four rates of planting fertilized with 8-16-16 at two rates in the hill.

the best yields were obtained from ears that weighed about seven ounces.

Soil with Drouthy Subsoil

A stand and fertilizer trial was run on a soil called the Waukegan silt loam. This soil type is characterized by a variable depth of silt loam on the surface (30 inches or less) over gravel. This is a soil that does not produce too well when moisture is at all deficient. The surface soil on this field had just under 200 pounds of exchangeable potassium and 150 pounds of adsorbed and acid soluble phosphorus per acre six inches.

Figure 2 shows how yield and relative ear size were affected by varying stands and fertilization. Without fertilizer three plants per hill (just about 7,000 plants per acre) proved to be the optimum planting. When 100 pounds of fertilizer were applied, the stand could be increased by 3,500 plants and the best yield was realized. A stand of five plants per hill was too great, even with 200 pounds of fertilizer, because the yield was lower than from a 4-stalk stand which had been treated with 100 pounds of fertilizer. It is obvious that fertilizer was not worthwhile until the stand was increased sufficiently to use it.

The size of ear which gave best yields was the third smallest. The actual ear sizes obtained from the different stands and treatments can be seen in Table II.

TABLE II.—THE EFFECT OF STALKS PER HILL AND FERTILIZER ON THE AVERAGE SIZE OF THE CORN EAR (WAUKEGAN SILT LOAM).

Treatment	Stalks per hill (42" x 42") 2	3	4	5
	Average ear size (ounces)			
None	5.8	4.6	3.6	2.8
8-16-16, 100#/A	6.3	4.8	4.5	3.4
8-16-16, 200#/A	6.7	5.1	4.7	3.6

The ear size that gave maximum yields was a small one to be sure, about 4½ ounces. This is certainly not a robust ear, but with the variety used and under the conditions that prevailed on this field at the time of the

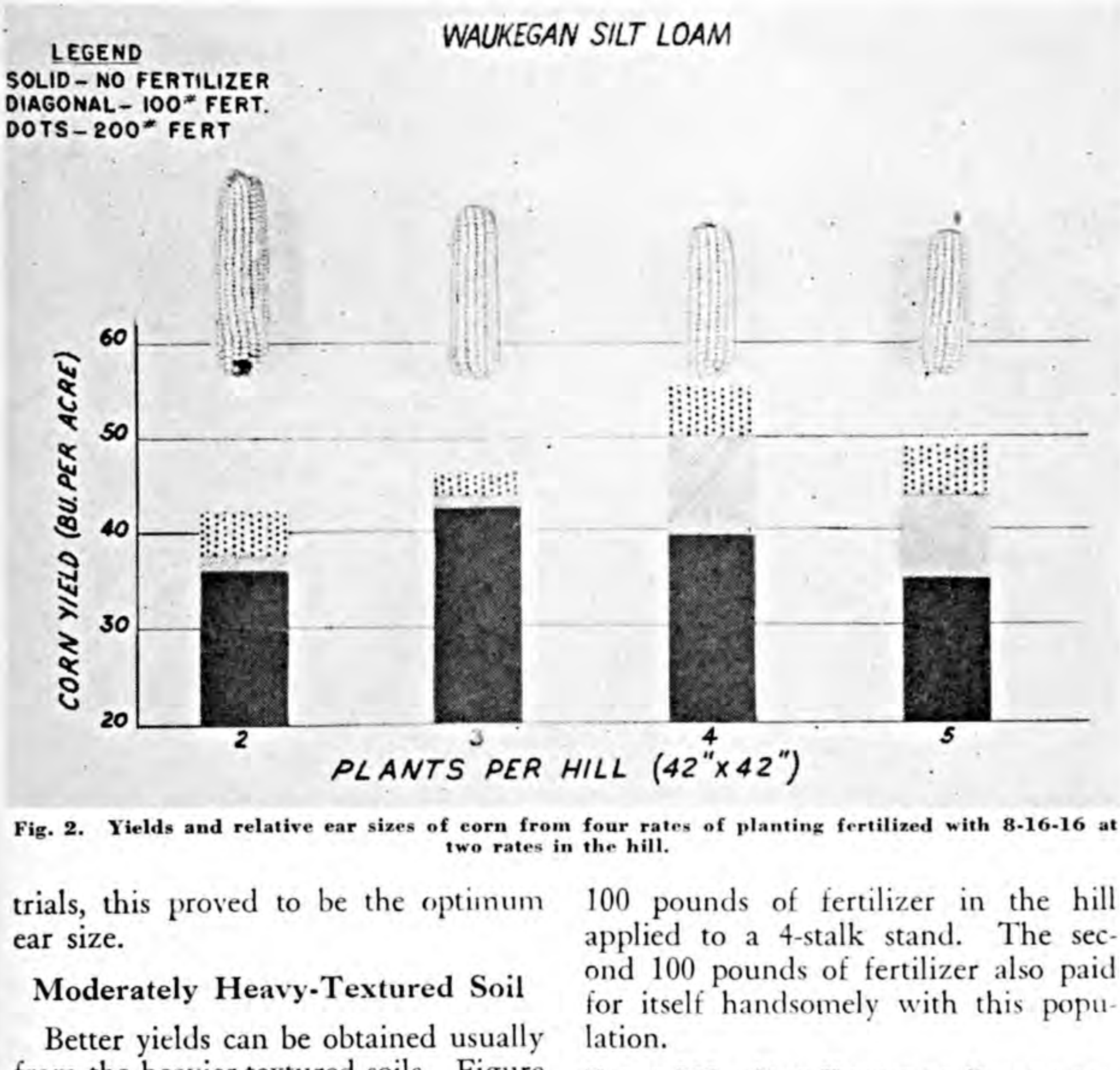

Fig. 2. Yields and relative ear sizes of corn from four rates of planting fertilized with 8-16-16 at two rates in the hill.

trials, this proved to be the optimum ear size.

Moderately Heavy-Textured Soil

Better yields can be obtained usually from the heavier-textured soils. Figure 3 presents the yields and relative ear sizes of corn grown on a Kenyon silty clay loam. This soil has a silty clay loam subsoil as well as surface which indicates a soil of good moisture-holding capacity. The acid soluble and adsorbed phosphorus was just under 150 pounds, and the exchangeable potassium 160 pounds per acre six inches.

Figure 3 shows that four and five stalks per hill fertilized with 200 pounds of fertilizer gave essentially the same yield. Since the 5-stalk stand was not superior to the 4-stalk in yield, the latter would be preferable because less moisture would be necessary to maintain the plants. This field is an example of one which had adequate moisture but was quite deficient in nutrients. An increase of more than 20 bushels of corn was secured from 100 pounds of fertilizer in the hill applied to a 4-stalk stand. The second 100 pounds of fertilizer also paid for itself handsomely with this population.

Table III.—The Effect of Stalks per Hill and Fertilizer on the Average Size of the Corn Ear (Kenyon Silty Clay Loam).

Treatment	Stalks per hill (40" x 40") 2	3	4	5
	Average ear size (ounces)			
None	8.6	5.7	4.8	3.9
8-16-16, 100# /A	9.1	7.4	6.1	4.7
8-16-16, 200# /A	9.1	7.9	6.6	5.5

The optimum sized ear for yield on this field was one that weighed 6.6 ounces (Table III). This was a considerably smaller ear than the 9-ounce one from the fertilized 2-stalk stand, but the ears were twice as numerous and consequently the yield was better by nearly 30 bushels.

Fertile Soil with Adequate Moisture

A stand and fertilizer trial was placed on a field of a type that is

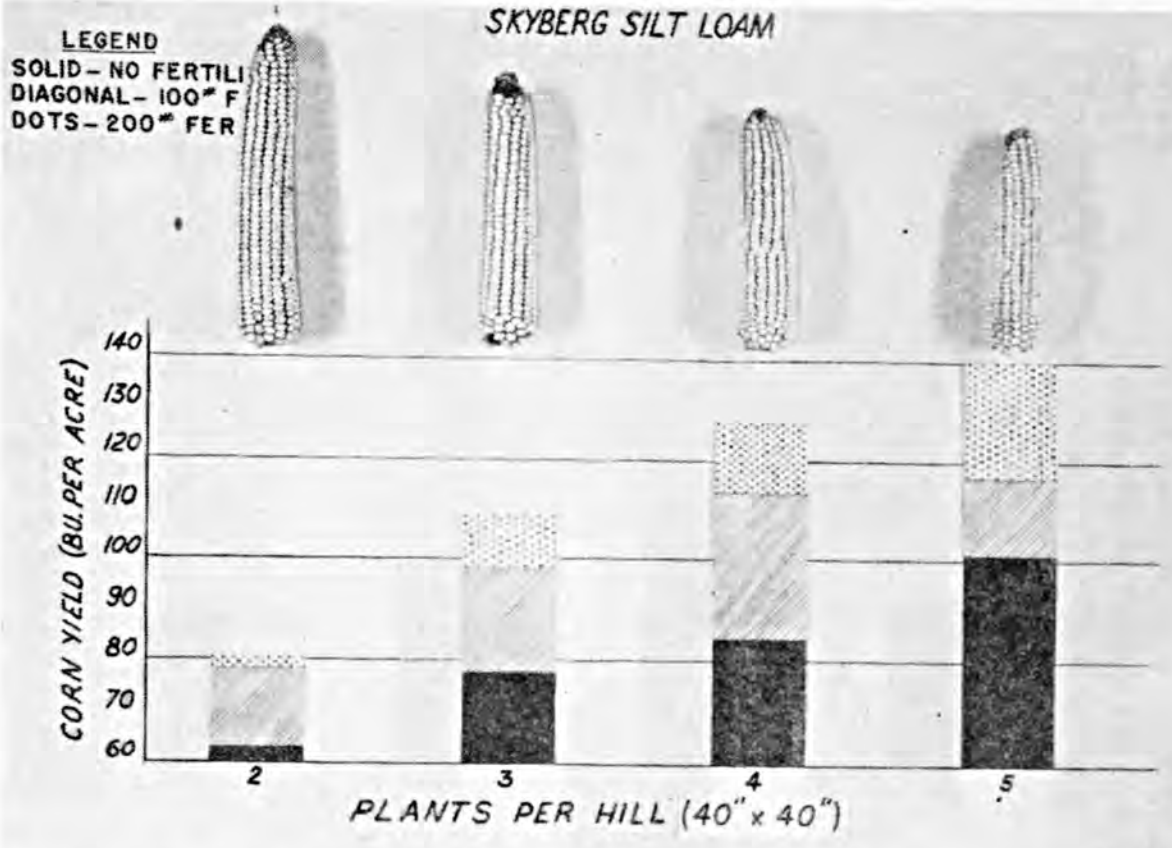

Fig. 3. Yields and relative ear sizes of corn from four rates of planting fertilized with 8-16-16 at two rates in the hill.

usually imperfectly drained (Skyberg silt loam). The year of these trials, however, the drainage proved no handicap but rather an aid, in that moisture supply was no limiting factor on the yields obtained. This soil had been well farmed and contained 200 pounds of available phosphorus (adsorbed and acid soluble) in the surface six inches, and just over 200 pounds of exchangeable potassium to the same depth. Figure 4 shows the tremendous yields that were obtained when stand and fertilization were at a fairly high level. An additional factor that contributed to these high yields was the use of a late-maturing, high-yielding hybrid, which, incidentally, was too late in maturing, for the region in which it was grown. The moisture content of the ears averaged over 50% at time of harvest, when the average should have been 25% or less in order to make cribbable corn. With this variety, 100 pounds of fertilizer proved profitable regardless of the stand. This fertilizer rate was not adequate on the 5-stalk stand, however. The second 100-pound application of fertilizer paid for itself at an increasing rate with an increase in plant population. There are no indications that 19,600 plants were the optimum planting on this field. It would appear that some stand greater than this would have proven the best.

Better than half-pound ears were obtained on the average from the 5-stalk stand even though the yield averaged 140 bushels of corn to the acre (Table IV).

It is obvious again that it is number of ears and not size alone that determines the yield.

TABLE IV.—THE EFFECT OF STALKS PER HILL AND FERTILIZER ON THE AVERAGE SIZE OF THE CORN EAR (SKYBERG SILT LOAM).

Treatment	Stalks per hill (40" x 40") — Average ear size (ounces) 2	3	4	5
None	9.0	7.5	6.3	6.4
8-16-16, 100# /A	11.2	9.4	8.1	6.9
8-16-16, 200# /A	11.6	10.4	9.2	8.1

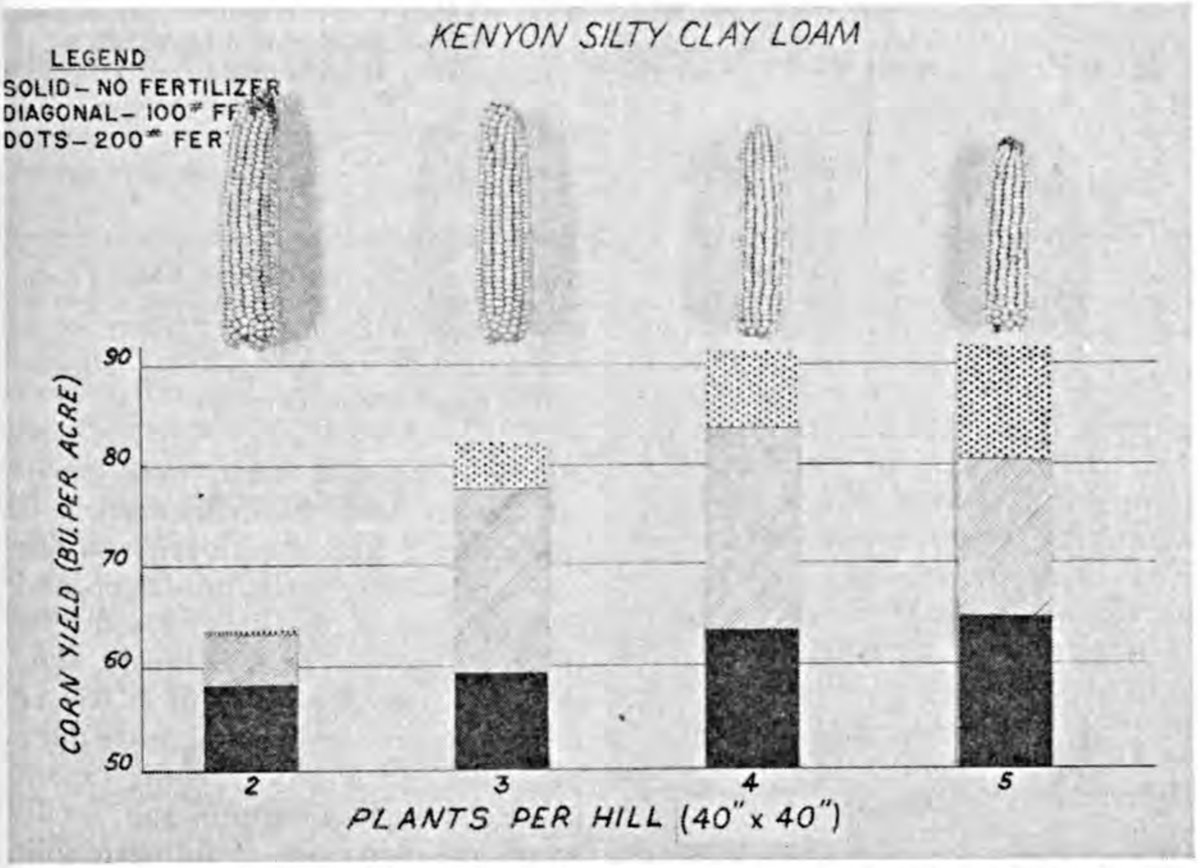

Fig. 4. Yields and relative ear sizes of corn from four rates of planting fertilized with 8-16-16 at two rates in the hill.

Shelling Percentage

It was thought worthwhile to determine the shelling percentage of the ears from a number of stands to see if one ear size had the advantage over any other. Corn from the plots on the Hubbard sandy loam field was run through a sheller and the shelling percentage determined. The results are given in Table V.

It is apparent that increasing the plant population *without* fertilization will result in corn of a lower shelling percentage. More importantly the figures show that with adequate fertilization there is no loss in shelling percentage with higher plantings. Just as much corn per bushel was shelled from corn from a fertilized 5-stalk hill as from a 2-stalk hill, even though the latter were larger, better-shaped ears.

Other Considerations

Heavier plantings had effects not only on ear size and yield, but also on number of good and poor or misshapen ears. A count of good and poor ears on each of the experimental fields was made and it was found the percentage of poor ears increased with stand.

As an example of the kind of results obtained, Table VI showing the percentage of good and poor ears on the Kenyon silty clay loam is presented.

The number of poor ears was considerably greater without fertilizer than when fertilized; 200 pounds of fertilizer gave better ears than were obtained from 100 pounds. The data show also that poor ears are more

TABLE V.—THE SHELLING PERCENTAGES OF CORN FROM VARIOUS STANDS AND RATES OF FERTILIZATION.

Treatment	Stalks per hill (40" x 40") 2	3	4	5
	Shelling percentage			
None	81.1	82.5	80.0	77.3
8-16-16, 100#/A	82.5	81.8	82.6	81.7
8-16-16, 200#/A	82.3	82.2	79.5	82.2

TABLE VI.—PER CENT POOR OR MISSHAPEN EARS FROM VARIOUS CORN STANDS (KENYON SILTY CLAY LOAM).

Treatment	Stalks per hill (40" x 40") 2	3	4	5
None	1.2	15.6	31.9	39.0
8-16-16, 100# /A	0.1	6.2	17.3	41.0
8-16-16, 200# /A	0.0	4.5	13.0	22.6

TABLE VII.—EAR-PRODUCING ABILITY OF THE CORNSTALK IN PER CENT.* (SKYBERG SILTY CLAY LOAM).

Treatment	Stalks per hill (40" x 40") 2	3	4	5
None	107.0	100.0	95.7	91.1
8-16-16, 100# /A	117.4	111.0	101.2	99.0
8-16-16, 200# /A	116.5	115.7	101.9	100.6

* One ear per stalk = 100 per cent.

numerous in the heavier plantings. This is an indication of deficiency in plant-growth factors, and it would be difficult to say just which one or ones were chiefly responsible. It was true for all experimental fields that increases in planting rate increased the number of poor ears. Rather surprisingly the poorer ears from heavier stands yielded as much shelled corn when fertilized as larger, better-shaped ears from lighter plantings. On the Hubbard sandy loam soil, the 5-stalk stand had up to 40% of poor, misshapen ears, yet the shelling percentage was as good as larger, well-shaped ears from a 2-stalk stand (Table V).

Ear and stalk counts were made in order to find out if all stalks carried at least one ear regardless of planting rate. It was found that at heavier plantings the ear count averaged less than one ear per stalk. Table VII contains the data from the Skyberg silty clay loam field, which is fairly typical of the other soils except the drouthier ones, in which the ear count was down to 75% of normal sometimes on the 5-stalk hills.

Plantings of two and three stalks per hill averaged better than one ear per stalk when fertilized. Without fertilization, heavier plantings such as the 5-stalk-per-hill rate did not average one ear per stalk, but with fertilization the 1-ear-per-stalk average was maintained.

Heavier Stands and Nitrogen

It was observed that sometimes the heavier stands showed nitrogen-deficiency symptoms to a greater or less degree. Five-stalk stands were especially apt to show the deficiency. It is likely that a lack of nitrogen was one of the reasons for small, misshapen, and missing ears on the heavy stands. If the moisture supply is adequate, sidedressing a stand of corn of 14,000 or more plants per acre should prove quite profitable. In one sidedressing experiment, the application to 4- and 5-stalk stands of 30 pounds of nitrogen split into two applications when the corn was kneehigh and hiphigh increased yields by 10 and 11 bushels, respectively.

Planting Rate an Individual Problem

There is no doubt that many farmers could plant and fertilize corn more heavily to very great advantage to themselves. Just what the optimum planting and fertilizer rate should be is nearly an individual problem. Stand should be fitted to the capacity of the soil to hold water for one thing. Fertilizer rate will vary with the fertility of the soil and with the stand. The use of ear size as a criterion of what the fertilizer rate should be is a doubtful one in Minnesota. In some areas the earlier-maturing (and consequently lower-producing) varieties must be planted to avoid the frost hazard. Ear size will vary with stand, fertility, and moisture available as the data have shown. It would seem that the thing to strive for is well-shaped ears, if necessary small ones, but plenty of them. That's what it takes to put corn in the crib.

Thirty Tons of Tomatoes Per Acre

By M. T. Vittum

Division of Vegetable Crops, N. Y. State Agricultural Experiment Station, Geneva, New York

FIFTEEN-YEAR-OLD Donald Britt of Elba, New York, can be justly proud of the 1950 4-H tomato-growing project in which he produced 30.0 tons of tomatoes on each acre of a 5.8-acre field. Many growers two, three, four, or even five times his age might well afford to study some of the techniques he used to produce this large crop.

For his project, Donald selected a field of Honeoye silt loam which is a moderately well-drained soil formed from highly alkaline, unassorted glacial drift composed of limestones, sandstones, shales, and crystallines. In 1949 this field produced 37 bushels of wheat per acre. Sweet clover had been seeded in the wheat and all wheat straw, after combining, was left on the ground.

Fertilizing

In early May of 1950, Donald disked the straw and sweet clover, and broadcast 1,500 pounds per acre of 5-10-10 fertilizer plus 500 pounds per acre of 18% superphosphate. Thus, before plowing he applied a total of 75 pounds of nitrogen (N), 240 pounds of phosphate (P_2O_5), and 150 pounds of potash (K_2O) on each acre. The fertilizer and organic matter were plowed under on May 6.

After plowing, the field was disked and "planked" or "floated" twice, and Red Jacket tomatoes were transplanted May 27. Red Jacket is a new potato-leaved variety recently developed by Professor W. T. Tapley of the Geneva Experiment Station. This variety has become so popular with New York canners and growers that it is estimated that in 1951, only three years after it was released, 50% of the cannery tomato acreage in the State will be planted to this variety.

Donald Britt (right) receives a plaque from D. F. Tobin, President of the Association of New York State Canners, in recognition of the 30-ton-per-acre yield he obtained in a 4-H tomato-growing project in 1950.

At transplanting, Donald applied to each plant approximately one-half cup of a starter solution which was made by dissolving three pounds of completely soluble 15-30-14 fertilizer in 50 gallons of water. Use of starter solutions with transplanted crops reduces loss of plants, stimulates earlier maturity, and increases total yields provided adequate reserves of plant nutrients are available to carry the crop through to maturity.

Spacing

Donald spaced his plants 28 inches apart in rows 68 inches wide, which gave 13.2 square feet per plant or 3,290 plants per acre. This spacing is somewhat closer than that used by most New York growers who usually aver-

(*Turn to page 42*)

LIME REMOVALS by—
Erosion, Leaching, Crops, Fertilizers, Sprays, and Dust[1]

By C. L. W. Swanson

Department of Soils, Connecticut Agricultural Experiment Station, New Haven, Connecticut

THE amount of lime lost from the soil annually has been the subject of study and speculation for many years. Lysimeter studies, runoff investigations, and chemical analyses of plants, soils, and fertilizers have been made on an extensive scale. We may ascribe this loss to two major factors—the removal by natural causes (erosion and leaching) and the removal in the complicated process of growing and harvesting crops (crops, fertilizers, sprays, and dusts).

Intensity and amount of rainfall, seasonal temperature, chemical and physical nature of the soil, kind of crop grown, and tillage operations are all factors which influence lime removals. Lipman estimated in 1927 that cultivated crops removed 13 pounds of lime per acre from the soils of the United States. In 1930, he estimated losses from harvesting crops, grazing, erosion, and leaching amounted to 170,464,325 tons of $CaCO_3$. Additions by fertilizer and liming materials, manure and bedding, rainfall, irrigation waters, and seeds were 31,404,183 tons. This left a net annual loss of 139,060,142 tons.

Principal mineral sources of calcium in soil are calcite, dolomite, oligoclase, labradorite, anorthite, augite, hornblende, and gypsum. Some calcium is held in organic combinations and in an exchangeable form in the colloidal complex. In surface soils calcium varies from less than 0.1 to more than 5 per cent. In some soils lime is most abundant in the lower horizons. Soils in regions of low rainfall contain larger supplies than soils in humid regions. Organic acids produced by the decomposition of forest litter leach soils of bases although in some cases the leaves are high in calcium, and lime in the surface soil is built up. Grass vegetation and roots on decomposing add lime to the surface layer of the soil.

The several processes of lime removal may be considered as follows:

1. Erosion

In removal of the soil by erosion, the finer soil particles, including humus, are sorted out and carried away. These losses are likely to be greater than one might expect since the finer material is much higher in fertility than the whole soil. The annual loss by erosion of calcium from row crops in the Tennessee river system was reported in 1945 to be 151 pounds per acre of $CaCO_3$. The erosion experiments at Columbia, Missouri, showed that 552 lbs. of $CaCO_3$ per acre were lost when corn was grown continuously, and 300 lbs. per acre for corn, wheat, clover rotation.

2. Leaching

General. It has been estimated that from 100 to 500 lbs. of lime per acre

[1] Presented at the Twelfth Annual Meeting of Agronomists with the Eastern States Farmers' Exchange, West Springfield, Mass., March 9-10, 1950.

are leached out of the soils of the North Central States each year. Leaching losses are directly related to weather conditions and time of fertilizer application. In lysimeter experiments in Connecticut using a Merrimac sandy loam soil, more than 90 per cent of the calcium loss occurred during the May-November period (fertilizers applied May 26). The rainfall was 55 per cent greater during this period and the daily temperatures were higher.

More calcium was removed in Connecticut from a Merrimac sandy loam soil by tobacco during dry summers than during wetter periods. Of basic fertilizers used, calcium was usually higher in the crop in the wetter seasons but was less for strongly acid sulfate of ammonia and ammophos treatments.

Most of the calcium in plants remains in the leaves and stalks in contrast to movement of N, P, Mg, and S to the seed. Calcium in plants is rather soluble, e.g., 34 per cent in wheat and 40 per cent in oats. Much of the calcium is leached out by rains. Of the cations, Ca is removed in largest amounts by leaching under cropped conditions (Mg from ⅓ to ½ as much, K usually less than 10-15 lbs/A).

Soils vary in Ca losses. Dunkirk silty clay loam lost 575 pounds of $CaCO_3$ per acre annually; Tama silt loam 117.5; Merrimac sandy loam 180-610; Volusia silt loam 877.5; and Ontario loam 740 pounds $CaCO_3$.

River water (drainage). The Tennessee River carries annually calcium in solution equal to 348 pounds of lime per acre of watershed. Clarke reports that the percentage of calcium in the Mississippi River varies from 17 to 23 per cent. Magnesium is next in abundance but is about one-fifth that of calcium. It has been estimated that 2,201,299 tons of $CaCO_3$ were removed in the drainage system of New England in 1942. Ross and Beeson estimate that in the United States each year 213,519 tons of $CaCO_3$ are lost by drainage into sewers.

3. Crops

Effect of leguminous green manures. Using legumes to supply nitrogen results in the production of nitrates. Nitrate nitrogen not used by plants leaches calcium out of the soil with it as $CaNO_3$. The lime needed to neutralize the acidity of a soil in Rhode Island was 2,861 lbs/A without green manure, 3,027 after rye, and 4,405 pounds after clover. The green manures were planted each year when the corn was laid by (15 years). On a Norfolk coarse sandy loam soil where leguminous green manures were used, 3.74 pounds of lime were leached from the soil for every pound of nitrogen.

Losses from bare and cropped soil. Crops markedly reduce the removal of calcium in drainage. Removal of bases through cropping also tends to leave the soil more acid. For the Dunkirk silty clay loam soil, losses of $CaCO_3$ per acre annually were 995 pounds $CaCO_3$ for bare soil, 575 for rotation, and 650 for grass; for the Volusia silt loam losses were 809 pounds of $CaCO_3$ for bare soil, and 627 pounds for rotation.

Removal through cropping. Bear gives data on the amount of $CaCO_3$ removed by harvested crops on an acre basis as follows: 100 bu. corn—1.78 pounds; 100 bu. oats—8.90 pounds; 50 bu. wheat—3.56 pounds; 3 tons clover hay—171 pounds; 3 tons timothy hay—25 pounds; 400 bu. apples—1.78 pounds; and for 400 bu. potatoes—3.56 pounds.

The amount of calcium removed by crops is dependent on the fertilizer and cultural treatment used and the crop yield. Annual removal of lime by tobacco and grass from a Merrimac sandy loam soil in Connecticut is shown in Table I.

According to Brown of Connecticut, in mixed pasture grasses and legumes the more the clover, the greater the Ca content because clover contains more lime than grasses. In 1929 he found that with mixed grasses fertilized with phosphate and lime, or phosphate, lime,

TABLE I

Crop	Treatment [1]	Annual average dry weight lbs/A	Ca % dry weight	Annual average lbs/A (dry wt. $CaCO_3$ removed)
Tobacco	No N, no cover crop	1,787	0.86	38.4
"	No cover crop	4,545	1.43	162.5
"	Oats cover crop	4,710	1.54	181.3
"	No cover crop [2]	4,179	0.99	103.4
"	Oats cover crop [2]	4,197	1.04	109.1
"	Rye cover crop [2]	4,352	1.05	114.3
"	Timothy cover crop [2]	4,285	1.01	108.2
"	No cover crop [3]	4,184	1.30	136.0
Grass [4]	No nitrogen	1,113	0.49	13.6
"		3,935	0.45	44.3

[1] 100 lbs. P_2O_5, 200 lbs. K_2O, 50 lbs. MgO, 200 lbs. N/A (Calurea—80% urea, 20% $CaNO_3$).
[2] 120 lbs. N as cottonseed meal, 40 lbs. as castor pomace, 40 lbs. as nitrate of soda.
[3] Same except 167 lbs. N (117 lbs. of N sidedressed).
[4] Timothy, fescue, bluegrass.

and potash, nearly 50 per cent more Ca was obtained in the dry matter for these treatments than for untreated, phosphate, or nitrogen, phosphate, and potash treated plots. Nitrogenous fertilizers depressed the uptake of Ca. Omission of superphosphate to sweet vernal, Kentucky bluegrass, and white clover resulted in very low contents of Ca. Probably some of the Ca was obtained from the Ca in the superphosphate. Eighty-six samples of grass collected from pastures throughout Vermont averaged 0.825 per cent calcium.

Unpublished data of Mehring state that 85,003 tons of $CaCO_3$ are removed in harvested crops alone in New England.

Removal by trees. Chandler found that the calcium content of the foliage of five forest tree species increased progressively throughout the growing season. Mature foliage of trees like red cedar, basswood, and black locust averaged more than 2 per cent calcium; shagbark hickory, American elm, red oak, and white pine averaged from 1 to 2 per cent; and red maple, hemlock, and Scotch pine averaged less than 1 per cent calcium. Mixed leaves in Massachusetts have been found to contain 2.29 per cent $CaCO_3$. Work in Illinois shows that trees growing on poor soils have lower contents of Ca than those in good soils. On an average, about 165 lbs/A of $CaCO_3$ are returned annually to the soil by hardwood forest trees and 67.5 pounds by conifers.

4. Fertilizer Applications

Work based on the lysimeters of the Connecticut Station show that in the absence of growing plants, soils having a good supply of lime lose approximately 3.57 per cent of lime for each pound of N applied. The Ca is leached out as calcium nitrate. Work in England showed that when crops are grown, the N not taken up by the crop but which is leached out of the soil carries 3.57 pounds of lime with it. This compares with 3.74 lbs. given for a Norfolk coarse sandy loam where leguminous green manures were used.

The effect of nitrogenous fertilizers in removing Ca from the soil by leaching is shown in Connecticut lysimeter experiments using a Merrimac sandy loam soil. Where the soil was fallowed and P and K were applied, 208 lbs/A of $CaCO_3$ were recovered in the leachate. Addition of N (200 lbs/A of Calurea) to the fertilizer increased the $CaCO_3$ to 542 lbs/A. Adding N to soils planted to tobacco increased the $CaCO_3$ in the leachate

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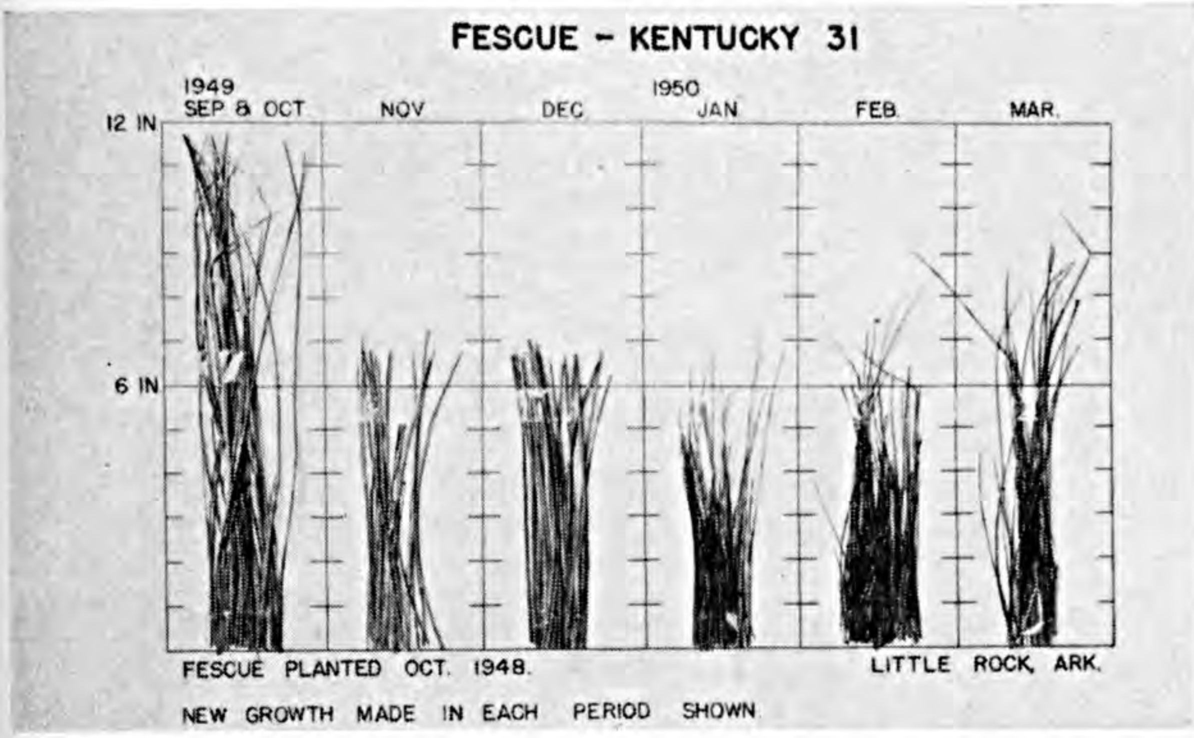

Fig. 1. New growth made from September 1, 1949, through March 1950 by months. Base leaves predominate September through December.

Field Observations on Tall Fescue

By Edgar A. Hodson

Agronomist, Soil Conservation Service, Little Rock, Arkansas

SELDOM has a new crop had the attention that has been given to tall fescue the past few years. Farmers are making extensive plantings of this grass and are asking numerous questions about establishing and managing it.

Field observations give convincing proof that fescue has a very definite place in the permanent pasture phase of the soil conservation work in Arkansas. But because of the claims that have been made for it, some growers have expected too much. It is, however, better than any other perennial cool season grass that has been widely grown here.

Soil Conservation district cooperators in Arkansas planted 84 acres in 1946, 688 acres in 1948, and 3,610 acres in 1949. This represents plantings made by 503 farmers, and as evidence of its popularity the acreage is being increased this year by 22,000.

When and how much to graze fescue has been a question without a complete answer. An observation plot was clipped in September 1949 and then clipped on the first of each month from November on through 1950.

A chemical analysis of these clippings of both the new growth and the total growth made up to the date of sampling was made at Soil Conservation

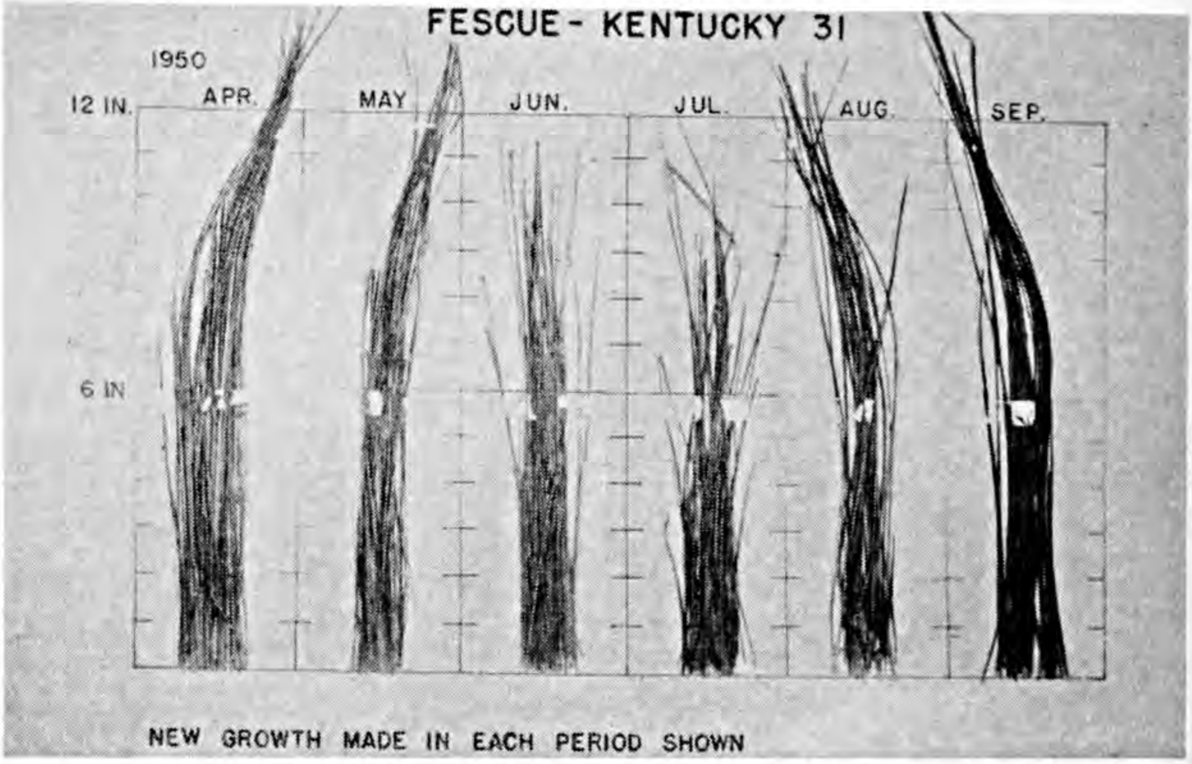

Fig. 2. New growth made from April 1, 1950, through September 1950. Seed stalks predominate through April and May. Base leaves make up all of the June, July, and August growth. Stem leaves are present in the September growth. Because of the good growing season in 1950, the stem leaves began to emerge much earlier than in 1949.

Service Operations Laboratory, Fort Worth. Similar samples were taken from oats and ryegrass for comparison. The results of the analysis are interesting and should help to answer the question on grazing.

The vegetative growth of fescue the first year after planting closely resembles that of ryegrass, and remains highly palatable for the entire growing season until seed matures in the early summer. The mild 1949-50 winter followed by unusually favorable rainfall distribution in the summer of 1950, which in turn was followed by very severe winter weather, afforded an unusual opportunity to observe the development and use of fescue pasture under extreme growing conditions.

The normal growth cycle from seed crop to seed crop requires 12 months. A new crop of crown buds develops in the early spring, and from it a crop of base leaves develops. The normal summer and fall growth is made up entirely of base leaves. About the time the base leaves have made their full growth, stem leaves begin to emerge and continue to grow until the seed crop develops. The base leaves are considerably coarser and a little less palatable than the stem leaves. It appears that a limited amount of summer grazing should be obtained if there is sufficient moisture to allow continuous new growth. Continuous new growth was available for grazing all through the 1949-50 winter season.

From mid-November 1950, the temperature was too low to allow much, if any, new growth. Winter grazing can be insured by either allowing very light fall grazing or by delaying use until early winter. Tables I and II, show the relative protein and crude fiber content from clipped and unclipped samples for the winter months of 1949-50. Where the fall growth was reserved for winter grazing the protein content varied from 12 to 20 per cent compared with 17 to 30 per cent for the clipped plot.

Bill Lewis, a cooperator with the Sebastian County Soil Conservation District, Greenwood, Arkansas, planted 10 acres of fescue in the fall of 1949.

This pasture was held in reserve for winter grazing last winter and in spite of the severe cold gave good grazing from the first of December.

Tables I and II show the protein and crude fiber content for fescue, ryegrass, and oats at various stages of development and for the total growth to the date of sampling. The palatability of fescue in the summer and fall is determined by the stage of development of the basal leaves at the time of use. The analyses indicate that the grazing period having the highest palatability and feed value is from the time the stem leaves begin to emerge until late spring when seed stems begin to develop.

White clover or ladino clover grown along with fescue will be available in the fall months and again in the late spring when the quality of the fescue falls off. The combination will yield a high quality of forage. Heavy summer grazing will greatly retard and reduce the fall and winter growth and should be limited to a moderate use to keep any excess growth out of the way. To provide the necessary forage for winter use, the pasture plan should include oats or other supplementary pasture for late fall or early winter grazing or enough fescue to defer the grazing on a sufficient acreage to be held in reserve until needed during the mid-winter months.

Plantings have been made on a wide variety of soil types but, as would be expected, the best growth was obtained on the most fertile, well-drained soils. Fescue has done well on soils very low in fertility where liberal applications of complete fertilizer were made. It thrives equally well on the wetter soils. Growth is retarded during periods when the water table is at or near the surface, but it withstands being submerged for considerable periods with relatively little injury. With deep sandy soils and light sandy loams as possible exceptions, fescue can be grown successfully on almost any soil type if the necessary fertilizer is added. Fescue fits perfectly into a cropping system for year-round grazing because of its season of usefulness, and because it is adapted to the wetter soils it can be used there

Fig. 3. The plant on the right is from a plot that was clipped on the first day of each month from January 1, 1950, to November 1, 1950; that on the left from a plot that was clipped June 1, 1950, and then again November 1, 1950. The picture was made April 1, 1951, and shows the total winter growth from November 1, 1950, to April 1, 1951. It emphasizes the importance of letting fescue "rest" during the summer months in order to get maximum cool season growth.

to better advantage than any other pasture crop.

Early fall planting has been far more satisfactory than any other. When fescue is planted on land where competition from weeds and other grasses may be a factor the first year, it may be better to use from two to five pounds more seed to the acre than would be necessary on clean-cultivated land.

Fescue-legume pastures will require careful management to maintain a good stand of both types of forage. How best to accomplish this must be learned from additional experience. Many growers who have been accustomed to grazing Bermuda grass are tempted to graze fescue before it makes sufficient growth and then graze it too closely. The plant needs to develop an extensive root system before grazing is started, which means that the top growth should be half kneehigh. To maintain plant vigor, a top growth of from four to five inches should be left at all times. Some of the near failures are the result of too close grazing or grazing before the plants have reached full root development.

Soil conservation district cooperators are finding that increased yields of forage more than pay for the fertilizer applied to fescue. Heavy applications of nitrogen fertilizers are necessary for maximum production; however, a good part of the needed nitrogen can be supplied by growing white or ladino clover with the grass.

Soil conservation district cooperators

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TABLE I.—CRUDE PROTEIN.

Date Sampled	Fescue (Little Rock, Ark.)	Ryegrass (Jonesboro, Ark.)	Oats (Jonesboro, Ark.)
(New growth made during the preceding month)			
Nov. 1, 1949..	17.38[1]	21.00	21.63
Dec. 1.......	19.19[1]	22.31	23.13
Jan. 1, 1950..	26.63	30.56	28.38
Feb. 1.......	30.94[2]	29.25	27.50
Mar. 1.......	30.00[2]	22.31	22.44
Apr. 1.......	22.94	16.63	14.50
May 1.......	15.44	13.81	14.94
June 1.......	17.88	4.63	....
July 1.......	16.63	....	....
Aug. 1.......	19.25	....	....
Sep. 1.......	18.75	....	....
Oct. 1.......	21.69	....	....
(Total growth made to date of sampling)			
Nov. 1, 1949..	12.62	....	....
Dec. 1.......	14.44	18.68	20.31
Jan. 1, 1950..	20.31	24.36	23.44
Feb. 1.......	20.31	25.81	26.19
Mar. 1.......	19.94	18.38	18.00
Apr. 1.......	24.25	25.13	11.19
May 1.......	15.94	11.38	19.44
June 1.......	....	5.69	....
July 1.......	....	....	....
Aug. 1.......	....	....	....
Sep. 1.......	15.69	....	....
Oct. 1.......	13.63	....	....

[1] Base leaves.
[2] Young stem leaves.

TABLE II.—CRUDE FIBER.

Date Sampled	Fescue	Ryegrass	Oats
(New growth made during the preceding month)			
Dec. 1, 1949..	21.8	13.3	12.7
Jan. 1, 1950..	19.4	17.8	14.8
Feb. 1.......	19.2	15.5	19.0
Mar. 1.......	18.3	15.3	14.5
Apr. 1.......	20.3	15.8	14.8
May 1.......	32.8	25.5	27.6
June 1.......	28.5	33.5	....
July 1.......	25.15	....	....
Aug. 1.......	25.87	....	....
Sep. 1.......	26.5	....	....
Oct. 1.......	25.5	....	....
(Total growth made to date of sampling)			
Dec. 1, 1949..	25.3	14.16	13.2
Jan. 1, 1950..	26.5	17.8	16.4
Feb. 1.......	24.7	19.1	15.9
Mar. 1.......	25.4	19.0	16.1
Apr. 1.......	24.2	19.7	14.8
May 1.......	32.3	28.5	28.5
June 1.......	....	34.6	....
July 1.......	....	....	....
Aug. 1.......	....	....	....
Sep. 1.......	28.9	....	....
Oct. 1.......	30.5	....	....

Can Soil Organic Matter Be Accumulated?

By Joel Giddens, J. H. Perkins, and W. O. Collins

Department of Agronomy, University of Georgia, Athens, Georgia

IN the past, agricultural workers in Georgia and other Southern States have preached the use of green manure crops to "build up the organic matter of the soils." The value of these crops in a rotation is unquestionable. There is little evidence, however, to indicate that organic matter is increased except only temporarily in soils of this area by these crops when kept in continuous cultivation. In connection with a soil organic matter survey in Georgia, it was observed that content of organic matter in the soil was not closely related to cropping practices. The purpose of this paper is to (a) relate certain physical factors of some of the leading soil series to organic matter content and (b) to examine the effect of several so-called "land-building" practices on soil organic matter.

Methods

For the organic matter survey, only soil samples submitted by soil surveyors and others experienced in soil classification were used. Composite samples taken from cultivated fields to a depth of 5-6 inches were included. The cropping practices varied from continuous row crops to the better rotation systems.

To study the effect of different soil-building practices on organic matter, soil samples were taken from 13 so-called "land-building" plots on a Cecil soil varying in texture from a sandy loam to a sandy clay loam at Whitehall, Georgia, in 1940 and 1948. From each plot a composite sample of 12 to 15 borings made to a depth of 5 to 6 inches was taken. The fertilizer and cropping practices used are outlined in Table II.

Organic matter determinations were made by the modified Walkley-Black method (3). Results were calculated to 100 per cent oxidation, assuming 66 per cent oxidation by the method.

Results and Discussion

Organic Matter by Soil Types

Soils on which organic matter determinations were made represent some of the leading series of the geographic soil areas of Georgia.

Results reported in Table I indicate that organic matter content of the well-drained cultivated soils is higher for the heavier-textured soils. There is some organic matter variation in different soil series of close association of the same textural type, but in general it is related to soil texture. Cecil sandy loam with $1.278 \pm .028$ per cent organic matter is in general a heavier soil than Appling sandy loam with $1.062 \pm .043$ per cent. Tifton sandy loam of the Coastal Plain with $1.312 \pm .031$ per cent organic matter is a heavier soil than Norfolk sandy loam with $1.051 \pm .019$ per cent organic matter. In fact, many of the Norfolk soils classified as sandy loam are actually loamy sands as shown by mechanical analysis.

The less well-drained soils, as would be expected, contain a higher organic matter content. Drainage affects the rate of oxidation in a soil. Some of these soil series, especially lowland soils, vary considerably in degree of drainage and also in organic content.

TABLE I.—ORGANIC MATTER CONTENT OF CULTIVATED GEORGIA SOILS BY SERIES, TOPOGRAPHY, AND AREAS.

Soil	No. Samples	Mean Per Cent
Appalachian Mountain Area		
Upland		
Fannin loam	73	*2.069±.076
Hayesville clay loam or loam	57	1.907±.087
Lowland		
State silt loam	39	2.717±.145
Transylvania silt loam	46	2.922±.123
Limestone Valley Area		
Upland		
Clarkesville silt loam	37	1.930±.080
Dewey silt loam	26	1.600±.094
Fullerton silt loam	15	1.660±.221
Piedmont Plateau Area		
Upland		
Cecil sandy loam	273	1.278±.028
Appling sandy loam	95	1.062±.043
Lloyd sandy loam	98	1.222±.039
Madison sandy loam	124	1.338±.037
Lowland		
Congaree sandy loam	45	1.904±.112
Upper Coastal Plain Area		
Upland		
Greenville fine sandy loam	21	1.330±.076
Orangeburg sandy loam	16	0.950±.050
Magnolia fine sandy loam	16	0.780±.046
Middle Coastal Plain		
Upland		
Norfolk sandy loam	227	1.051±.019
Tifton sandy loam	116	1.312±.031
Lowland		
Plummer sandy loam	41	2.076±.106
Lower Coastal Plain		
Upland		
Scranton fine sandy loam	230	1.480±.030
Less well-drained		
Lynchburg loamy sand	20	1.580±.080
Portsmouth loamy sand	20	5.410±.415

* Standard Error.

Jenny (2) has shown that soil organic matter is greatly influenced by temperature, the amount being approximately doubled for a decrease in mean annual temperature of 10 degrees C. It is recognized that lower mean annual temperature accounts for part of the higher organic matter in the Appalachian Mountain and Limestone Valley soils of North Georgia. Apparently, part of the higher organic content of these soils can be attributed to the heavier soil texture.

Soil Organic Matter on Different Land Uses

Organic matter content of the "land-building" plots is reported in Table II for the years 1940 and 1948. Except for the plot with manure applied, there was a tendency for the cultivated soils to approach a constant organic level, low ones to increase and higher ones to decrease. This seems to be irrespective of treatment. The area being badly eroded in spots accounts for the variable organic matter of the 1940 samples.

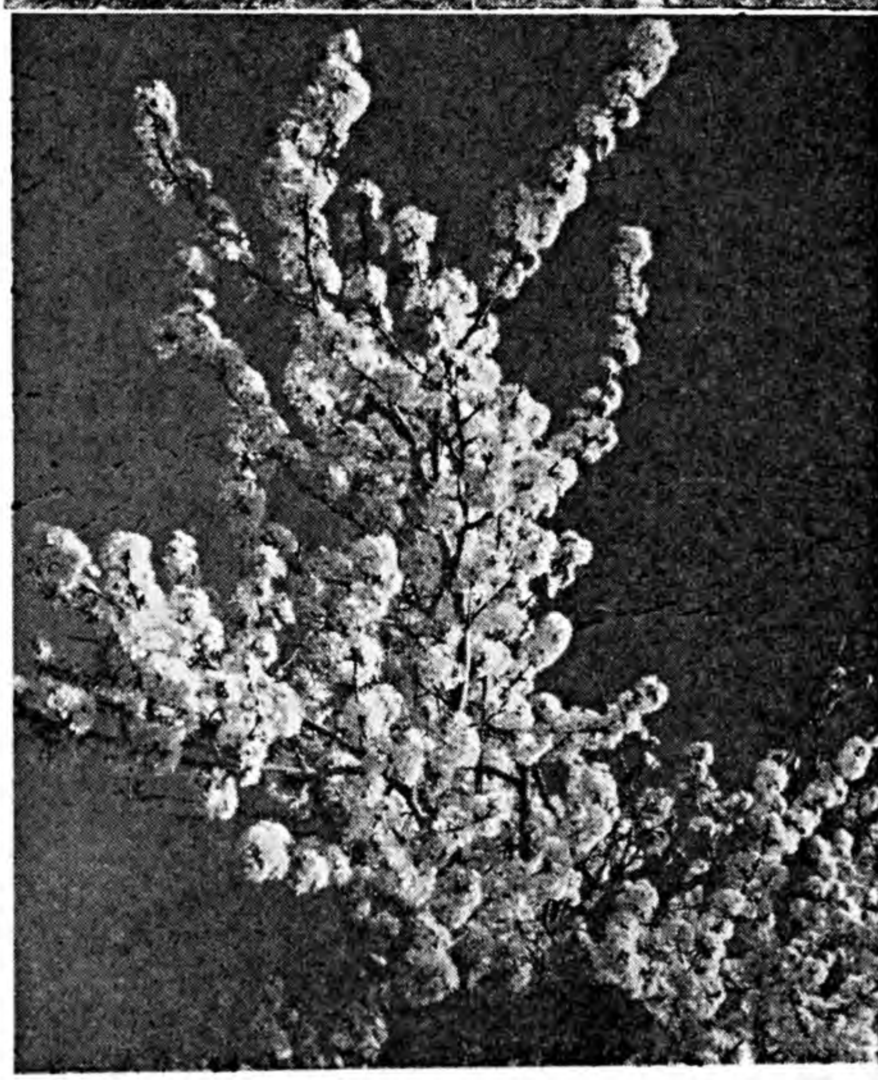
From a study of organic matter as influenced by different cropping systems on Land Classes II, III, and IV of the Southern Piedmont, Gosdin, Stelly, and Adams (1) reported that after a six-year period there was a tendency towards approximately the same level of organic matter in all the soils studied.

The mild, humid climate of Georgia results in rapid decomposition of organic residues in soils. It does not appear practical to attempt to raise the organic matter above a certain level in well-drained soils in the State and still keep them in cultivation. For well-drained soils, texture appears to be a predominant factor affecting organic matter, and for lowland soils it is drainage. Erosion, of course, is an important factor in the level of organic matter reached and should not be overlooked in any cropping system. Ero-

(*Turn to page* 42)

PICTORIAL

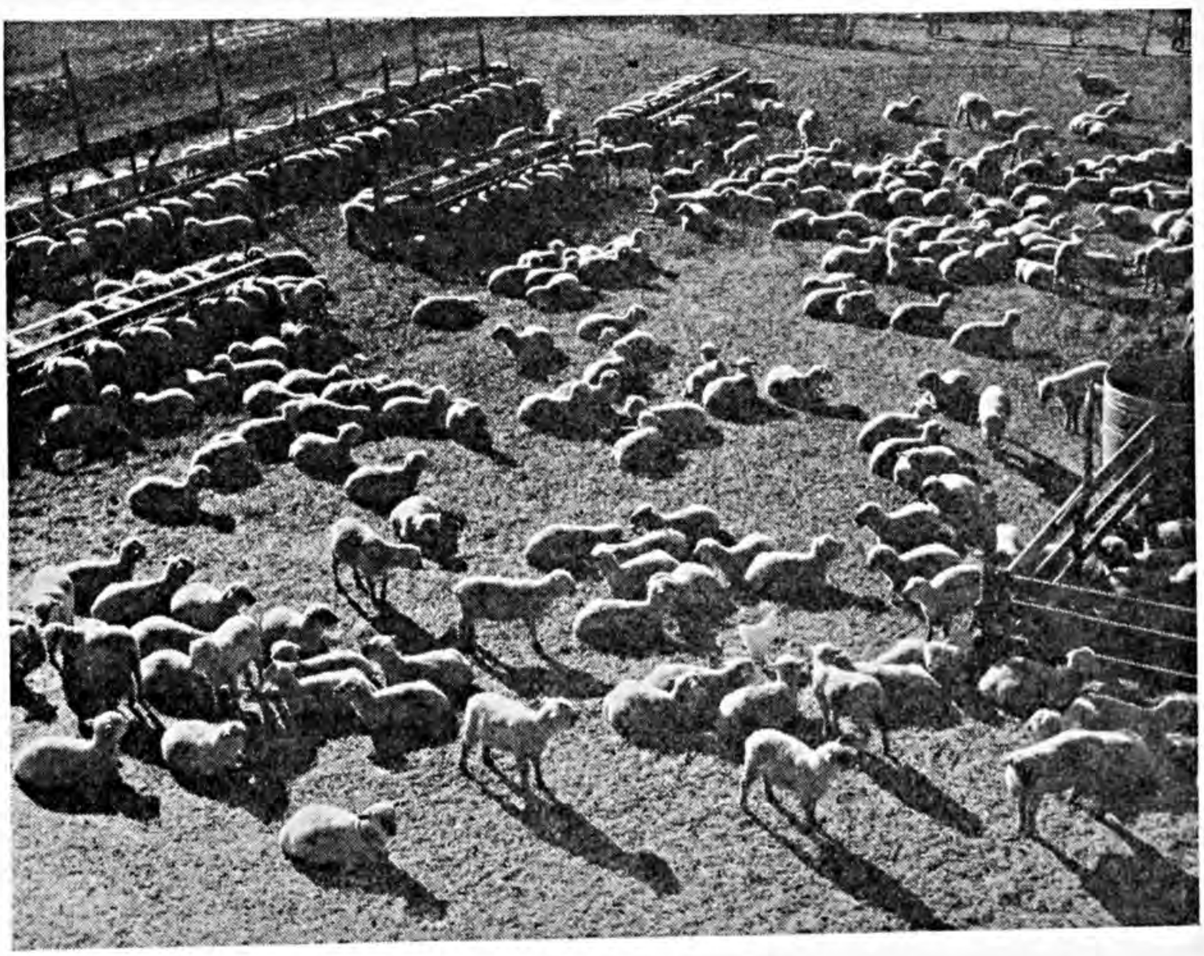
According to Directions!



Spring Blossoms

Spring Odors

Keeping up the meat supplies is currently one of our Nation's chief agricultural concerns.



The Editors Talk

Soil Management

Everyone uses the term "soil management," yet how many know just what it involves. Dr. F. W. Parker, soils authority of the U. S. Department of Agriculture, defines it as follows: Soil management is the efficient production of quality crops along with continued improvement in soil productivity.

Going into the considerations involved, Dr. Parker says that the fundamental requirements of a productive soil include the most favorable combination of soil moisture and air, an ample supply of needed nutrients, root room, and the absence of harmful factors.

Soil structure is the key to ideal soil moisture and air condition, he points out. Soil with good structure retains an ample supply of moisture and enough air to allow the roots to breathe. Maintenance of soil structure is becoming a big problem on many of the predominantly clay soil farms in the Great Plains, the Corn Belt, and the Black Belt of Texas, Mississippi, and Alabama. In most of these areas, structure is associated with the loss of from 25 to 50 per cent or more of the soil organic matter. Correcting this condition largely means protecting the soil from further breakdown and giving it a chance to rebuild. Dr. Parker recommends the growth of sod crops with good root systems, plus the use of green manure crops, crop residues, composts, mulches, and farm manures. Fertilizers have little direct effect on soil structure, but when used to promote the growth of the sod and green manure crops and deep-rooted legumes, fertilizers indirectly rebuild the soil. Fertilization, by increasing crop yields, often doubles or trebles the amount of organic matter returned to the soil as crop residue or farm manure.

"Fertilizers also play an important role in the number and quantity of needed soil nutrients," he says. "Since a 100-bushel corn crop takes 400 pounds of mineral nutrients from the soil in from 120 to 160 days, it is easy to see that continually repeating such a process without resupplying the soil with nutrients will soon devastate it. Even virgin soils are not necessarily stocked with nutrients. Most virgin soils lack some important mineral; many lack several of them. The parent material of the soil, the vegetation that grows on it, the rainfall, temperature, time, and topography all play a part in soil nutrient content. Fertility tends to be greater where temperatures and rainfall are moderate. Soils in the South are relatively low in soil nutrients because of warm temperatures and heavy rainfall. In the cooler North and drier West, soils are generally more fertile. However, when rainfall is too low to support good grass growth, some nutrients are again lacking. Organic soils formed from the accumulation of plant residues are just as likely to lack nutrients as more common mineral soils. Crops grown on organic soils have no source of vital minerals, and so cannot supply them to the soil. The use of commercial fertilizers furnishes the primary method of rebuilding the supply of nutrients in soil. Liming materials and nitrogen-supplying legumes are also important."

Enough room for root growth is Dr. Parker's final essential soil-management consideration. Lack of room may be caused by a high water table, hardpan, poor soil structure or the presence of salts. In turn, extending root room may require drainage, the removal of salts, and the addition of organic matter, lime, and nutrients below plow depth. The use of deep-rooted legumes is probably the best way to extend root room, although this end can often be achieved by applying lime and nutrients with attachments to chisels or other deep-tillage implements. The extensive root systems of alfalfa and kudzu make these two legume crops ideal for the job of extending the rooting zone for subsequent crops. These crops add root residues and, as a result, a larger rooting zone is gradually developed and improved.

With such a diversity of soil types and conditions in the United States, Dr. Parker emphasizes that there is no one best way to maintain soil quality . . . . to achieve good soil management. It is first necessary to understand the needs of the soil and then to use the various management methods that will cause the soil to produce good crop yields while retaining its own vitality.

Farm Labor Shortages

Every day in the approach to the heavy-work season on the farm is increasing the concern over farm labor shortages. With the draft and the lure of higher wages in factories making their inroads on young workers, many a farm operator is viewing his future with a deep feeling of helplessness. To him, the calls for increased production may seem like "so much talk," yet a word of encouragement may be found in a talk by Under Secretary of Agriculture Clarence J. McCormick at the Ninth Annual Rural Life Conference in Wilmington, Ohio, on March 30.

"The best hope of meeting the labor shortage, of producing up to the very high goals we have set, is through the increased production of folks on family farms," Mr. McCormick said. "Some family farmers may wonder what I am talking about when they already get up before the east has begun to lighten and work till it's too dark to see at night. Yet on some family farms, people are underemployed. Their land is not used to best advantage, their operations are less efficient than they should be, and they are not able to help either themselves or the Nation as well as they might. Through increasing the productivity of these less productive farms, we can help solve the labor problem, we can assure production of more of the things the Nation needs, and we can provide a much better standard of living on many of these underdeveloped farms. Perhaps the best way to say it is that we want to see that underdeveloped farms become true family farms—farms that fully use the family labor and provide a good family living. The Nation must see to it that the operators of such farms can get sound credit, the equipment they need, fertilizer, and the other things it takes to run a successful farm today."

Here, again, is another challenge to add to the already overchallenged agricultural advisory forces. That they will find the time to aid the farm operators needing such help is assured by the long and high record of the efficiency and effectiveness of these extension groups.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938..........	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939..........	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940..........	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941..........	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942..........	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943..........	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944..........	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945..........	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946..........	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947..........	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948..........	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949..........	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
April........	28.74	....	134.0	228.0	126.0	201.0	16.65	44.40	....
May........	29.24	48.5	128.0	228.0	134.0	204.0	17.25	45.20	....
June........	29.91	49.7	127.0	211.0	136.0	193.0	16.05	46.20	....
July.........	33.05	45.5	127.0	208.0	144.0	199.0	15.15	52.00	....
August......	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September...	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October......	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.......	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
Index Numbers (Aug. 1909—July 1914 = 100)									
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	89	81	109	74	87	110
1938..........	69	196	80	79	76	64	57	97	88
1939..........	73	154	100	84	88	78	67	94	91
1940..........	80	160	78	97	96	77	64	96	111
1941..........	137	264	116	105	117	107	82	211	129
1942..........	153	369	168	134	143	124	91	202	163
1943..........	160	405	188	235	174	154	125	231	245
1944..........	167	420	214	216	170	160	139	234	212
1945..........	181	366	205	232	198	170	127	227	207
1946..........	263	382	178	248	212	209	141	319	182
1947..........	257	380	232	248	336	259	148	381	226
1948..........	245	482	222	253	201	226	155	298	214
1949..........	231	463	184	244	210	210	139	192	201
1950									
April........	232	...	192	260	196	227	140	197	205
May........	236	485	184	260	209	231	145	200	178
June........	241	497	182	240	212	218	135	205	182
July.........	267	455	182	237	224	225	128	231	200
August......	298	531	175	248	224	223	130	314	164
September...	322	554	151	219	224	219	131	349	126
October......	314	551	123	175	213	216	134	361	138
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.......	345	266	154	236	249	240	155	457	265

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
April	3.00	2.32	10.34	12.58	10.39	8.19
May	3.00	2.05	10.74	11.97	10.14	7.59
June	3.00	1.71	10.55	10.79	9.41	7.36
July	3.00	1.71	11.53	10.71	9.35	8.74
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53

Index Numbers (1910-14 = 100)

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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
April	112	81	295	356	308	233
May	112	72	307	339	301	216
June	112	60	301	306	279	209
July	112	60	329	303	277	248
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328

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[3]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[3]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[3]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[3]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
April	.760	3.76	5.47	.375	.720	14.50	.200
May	.760	3.76	5.47	.375	.720	14.50	.200
June	.760	3.76	5.47	.336	.647	12.77	.176
July	.760	3.76	5.47	.368	.704	13.98	.193
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.75	5.47	.368	.704	13.98	.193
October	.760	3.73	5.47	.386	.704	13.98	.193
November	.760	3.73	5.47	.386	.732	14.72	.193
December	.798	3.73	5.47	.420	.796	16.00	.210
1951							
January	.810	3.73	5.47	.420	.796	16.00	.210
February	.810	3.73	5.47	.420	.796	16.00	.210
March	.810	3.73	5.47	.420	.796	16.00	.210

Index Numbers (1910-14 = 100)

1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
April	142	104	112	68	76	60	83
May	142	104	112	68	76	60	83
June	142	104	112	63	68	53	80
July	142	104	112	67	74	58	82
August	142	104	112	67	74	58	82
September	142	104	112	67	74	58	82
October	142	103	112	70	74	58	82
November	142	103	112	70	77	61	82
December	149	103	112	75	84	66	85
1951							
January	151	103	112	75	84	66	85
February	151	103	112	75	84	66	85
March	151	103	112	75	84	66	85

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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
April	241	240	223	135	96	313	142	72
May	247	244	228	132	91	311	142	72
June	247	245	230	126	85	293	142	66
July	263	247	238	128	85	301	142	70
August	267	248	243	131	85	321	142	70
September	272	252	247	131	85	324	142	70
October	268	253	247	131	85	323	142	73
November	276	255	251	132	85	328	142	74
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78
March	311	271	268	141	91	357	151	78

* U. S. D. A. figures, revised January 1950. 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] **Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.**

[2] **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 is 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

"Fertilizers for Alaska 1950," Agr. Exp. Sta., Univ. of Alaska, Palmer, Alaska, Cir. 10, Feb. 1950.

"Sales of Commercial Fertilizers and of Agricultural Minerals Reported to Date for Quarter Ended December 31, 1950," Dept. of Agr., Sacramento, Calif., Bur. of Chem. Announcement No. FM-207, Feb. 20, 1951.

"Fertilizer Guide—Maritime Provinces of Canada 1951," Maritime Fert. Council, Moncton, N. B., Can., J. E. McIntyre.

"Commercial Fertilizers 1949 and 1950," Dept. of Agr., Atlanta, Ga., Serials Nos. 134 and 135, Jan. 1951.

"Tonnage of Commercial Fertilizer Reported by Manufacturers as Shipped to Kansas in the Fall of 1950, By Counties," State Brd. of Agr., Control Div., Topeka, Kans., July 1, 1950 to Dec. 31, 1950.

"Maryland Fertilizer Facts for 1950," Insp. and Reg. Serv., College Park, Md.

"General Fertilizer Recommendations for Central Nebraska," CC 106, 1951, M. D. Weldon and W. E. Ringler; "General Fertilizer Recommendations for Western Nebraska," CC 107, 1950; "General Fertilizer Recommendations on Irrigated Land in Nebraska," CC 108, 1951, M. D. Weldon and W. R. Ringler; Ext. Serv., Univ. of Neb., Lincoln, Neb.

"Facts and Findings about Fertilizers in North Dakota," Dept. of Agron., N. D. Agr. College, Fargo, N. D., Dec. 6, 1950.

"Summary of Fertilizer and Fertilizer Materials Sold in South Carolina, July 1 through December 31, 1950," Clemson Agr. College, Clemson, S. C., Mar. 1, 1951.

Soils

"Irrigating the Prairie Home Garden," Pub. 851, Dec. 1950, H. C. Korven; "Organic Soil Management for Vegetables," Pub. 853, Dec. 1950, F. S. Browne; Dept. of Agr., Ottawa, Ont., Can.

"Protecting Your Soil," Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 667, Sept. 1950, C. A. Van Doren and L. E. Gard.

"Christian County Soils," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Soil Rpt. 73, Aug. 1950, J. B. Fehrenbacher, R. S. Smith, and R. T. Odell.

"Phosphate Facts," Ext. Serv., Univ. of Minn., St. Paul, Minn., Soil Series No. 34, Misc. Paper No. 741.

"Effects of Diverting Sediment-Laden Runoff From Arroyos to Range and Crop Lands," USDA, Wash., D. C., Tech. Bul. No. 1012, Aug. 1950, D. S. Hubbell and J. L. Gardner.

Crops

"Arkansas Farmers Stand Ready," Ext. Serv., Univ. of Ark., Fayetteville, Ark., Cir. No. 470, 1950 A. R.

"Arkot 2-1—The New Arkansas Cotton," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Series 19, Aug. 1950.

"Report of the Minister of Agriculture for Canada for the Year Ended March 31, 1950," Ottawa, Ont., Can.

"Experimental Substation for Mucklands, Ste. Clothilde, Quebec," P. R. 1936-1948, Ste. Clothilde, Que., Can.

"Apple Growing in Eastern Canada," Pub. 847; "Plum Culture," Pub. 849; Dept. of Agr., Ottawa, Ont., Can., Dec. 1950, D. S. Blair.

"The Value of Pasture for Milk Production," Agr. Exp. Sta., Univ. of Del., Newark, Del., Bul. No. 286, June 1950, C. E. Phillips and T. A. Baker.

"First-Year Yields from Louisiana White Clover-Dallis Grass Pasture Plots on Carnegie and Tifton Fine Sandy Loams," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Cir. S-19, Sept. 1950, N. Gammon, Jr., H. W. Lundy, J. R. Neller, and R. A. Carrigan.

"Home Garden for the Coastal Plain of Georgia," Mimeo. Paper No. 12, Rev. Dec. 1950; "Truck Crops for the Coastal Plain of Georgia," Mimeo. Paper No. 72, Jan. 1951; "Planting and Care of Muscadine Grapes," Mimeo. Paper No. 75, Mar. 1951, O. Woodard and W. T. Brightwell; Ga. Coastal Plain Exp. Sta., Tifton, Ga.

"Progress Report on the Utilization of Perennial Grazing Ladino Clover and Tall Fescue," Ga. Mt. Exp. Sta., Blairsville, Ga., Mimeo. Series No. 26, Aug. 1950, O. L. Brooks and W. H. McKinney.

"Agricultural Research in Idaho, Fifty-Seventh Annual Report, Year Ending June 30,

1950," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Bul. No. 280, July, 1950.

"Progress of Agricultural Research in Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sixty-Third A. R., June 30, 1950.

"Farm Ponds for Iowa," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Bul. P109, July 1950, D. O. Hull, R. A. Wilcox, and E. B. Speaker.

"Kansas Corn," Cir. 219, L. E. Willoughby and E. A. Cleavinger; "Sorghums in Kansas," Cir. 220, L. E. Willoughby and F. G. Bieberly; Ext. Serv., Kans. State College, Manhattan, Kans., May 1950.

"Pecan Production in Louisiana," La. State Univ., Baton Rouge, La., Ext. Pub. 1057, Reprinted July 1950, J. A. Cox, R. S. Woodward, and A. O. Alben.

"Ten Suggestions for Growing Tomatoes in the Home Garden," Ext. Serv., Univ. of Md., College Park, Md., Misc. Pub. 117, May 1950, E. K. Bender.

"Dahlias in the Garden," Ext. Fldr. F-144, Mar. 1950; "Garden Roses," Ext. Fldr. F-145, Apr. 1950; "Gladiolus Culture," Ext. Fldr. F-146, Apr. 1950; "Feeding Potatoes to Livestock," Ext. Fldr. F-147, Apr. 1950; "African Violets," Ext. Fldr. F-148; "The Home Fruit Garden," Ext. Fldr. F-149, May 1950; "Peony Culture," Ext. Fldr. F-150, May 1950; "Hay and Pasture Crops for Emergency Use," Ext. Fldr. F-151, May 1950; "Grass Silage," Ext. Fldr. F-153, June 1950; Ext. Serv., Mich. State College, East Lansing, Mich.

"Improved Varieties of Farm Crops," Ext. Fldr. 22, Rev. Feb. 1951; "Tips on Tree Planting," Ext. Fldr. 85, Rev. Mar. 1951, P. Anderson; "Vegetable Varieties for Minnesota," Ext. Fldr. 154, Feb. 1951, O. C. Turnquist; Ext. Serv., Univ. of Minn., St. Paul, Minn.

"Red Rustproof Oats Lead in Winter Grazing Small Grain Variety Tests at South Mississippi Experiment Station," Inf. Sheet 452, Aug. 1950, H. A. Johnson and J. B. Gill; "Oat Varieties Compared for Grain Yields," Inf. Sheet 453, Sept. 1950, S. S. Ivanoff, D. Bowman, B. L. Arnold, B. C. Hurt, Jr., S. L. Wedgeworth, C. L. Blount, and H. A. Johnson; Agr. Exp. Sta., Miss. State College, State College, Miss.

"Success with Strawberries," Bul. 542, Nov. 1950, A. D. Hibbard and D. D. Hamphill; "1950 Yield Trials with Corn Hybrids in Missouri," Bul. 544, Dec. 1950, M. S. Zuber, C. O. Grogan, and W. E. Aslin; Agr. Exp. Sta., Univ. of Mo., Columbia, Mo.

"Better Pastures, An Important Part of Balanced Farming," Ext. Serv., Univ. of Mo., Columbia, Mo.

"Breeding Improved Horticultural Plants, II. Fruits, Nuts, and Ornamentals," Agr. Exp. Sta., Univ. of N. H., Durham, N. H., Sta. Bul. 383, June 1950, A. F. Yeager.

"Pasture Management Investigations," Agr. Exp. Sta., Univ. of N. H., Durham, N. H., Sta. Cir. 81, June 1950, F. S. Prince and P. T. Blood.

"The New Jersey Green Pasture Program, Reporting for 1950," Ext. Serv., Rutgers Univ., New Brunswick, N. J., Ext. Bul. 257, Jan. 1951, J. E. Baylor.

"Bromegrass Strain Performance Trials," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 753, Dec. 1950, G. H. Ahlgren and L. Dotzenko.

"Field Crop Recommendations 1951," Ext. Serv., Rutgers Univ., New Brunswick, N. J., Leaf. 47, Dec. 1950, J. E. Baylor.

"Cornell Recommends for Field Crops," Cornell Univ., Ithaca, N. Y., 1951.

"Good Pasture Is a Bargain!" Ext. Serv., Cornell Univ., Ithaca, N. Y., Hay and Pasture Ltr. No. 3.

"North Dakota's Agricultural Progress Through Research," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Annual Report, Sta. Bul. 365, Jan. 1951.

"Cotton Production Insect and Disease Control South Carolina 1951," Ext. Serv., Clemson College, Clemson, S. C., Cir. 358, Jan. 1951.

"Progress Report, 1950 Oklahoma Vegetable Research Station at Bixby, Oklahoma," Agr. Exp. Sta., Stillwater, Okla., Mimeo. Cir. M-202, June 28, 1950.

. . "Agricultural Research in Texas, 1947-49," Agr. Exp. Sta., College Station, Texas.

"Mustang Oats," Agr. Exp. Sta., College Station, Tex., Bul. 728, Oct. 1950, I. M. Atkins.

"Building a Better Utah," Ext. Serv., Utah State Agr. College, Logan, Utah, 1948-50 Biennial Report.

"Agricultural Research," Agr. Exp. Sta., Va. Poly. Institute, Blacksburg, Va., Rpt. for Yr. Ending June 30, 1950.

"Safflower, Agronomic, Processing, and Economic Data," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. 521 and No. 210, Jan. 1951, S. Kellenbarger, R. L. Albrook, and A. H. Harrington.

"Science Serves Your Farm," Agr. Exp. Sta., W. Va. Univ., Morgantown, W. Va., Bul. 342, Sept. 1950.

"Cody—A New Oat for Wyoming," Bul. 301, Sept. 1950, D. W. Bohmont; "Dryland Pastures for the Great Plains, Bul. 302, Oct. 1950, O. K. Barnes and A. L. Nelson; Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo.

"Improving Native Hay Meadows in Wyoming," Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo., Cir. 38, Oct. 1950, T. J. Dunnewald.

"Report of the Chief of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration 1950," USDA, Wash., D. C.

"1950 Report of the Chief of the Forest Service, Cooperation in Forestry," USDA, Wash., D. C.

"Our Forests: What They Are and What They Mean to Us," Misc. Pub. No. 162, Rev. Oct. 1950, USDA, Wash., D. C.

Economics

"The Agricultural Outlook for Canada 1951," Dept. of Agr., Ottawa, Ont., Can.

"A Retirement Guide for Connecticut Farmers," Ext. Serv., Univ. of Conn., Storrs, Conn., Fldr. 43, Aug. 1950, P. L. Putnam and W. C. McKain, Jr.

"Pimiento Peppers," Mimeo. Series 12, Jan. 1950, B. J. Harrington; "Cotton Production Practices and Cost in the Lower Coastal Plain of Georgia," Mimeo. Series 27, Sept. 1950, W. T. Fullilove and J. C. Elrod; "Spanish Peanut Production Practices and Costs, in the Coastal Plain of Georgia," Mimeo. Series 28, Sept. 1950, W. T. Fullilove and J. C. Elrod; "Oat Production Practices and Costs, in the Piedmont of Georgia," Mimeo. Series 29, Oct. 1950; "Okra Production Practices and Costs in the Lower Coastal Plain of Georgia," Mimeo. Series 30, Oct. 1950, B. J. Harrington; Agr. Exp. Sta., Univ. of Ga., Experiment, Ga.

"Agricultural Statistics for Louisiana 1909-1949," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., La. Bul. No. 444, June 1950, J. P. Montgomery and S. L. Bryan.

"Maine Snap Beans, Sweet Corn, and Green Peas for Processing," Agr. Exp. Sta., Univ. of Me., Orono, Me., Mimeo. Rpt. No. 11, Mar. 1950, W. E. Schrumpf.

"Farm Business Inventory and Net Worth Statement," Ext. Fldr. F-154, Dec. 1950, J. C. Doneth and B. R. Bookhout; "Social Security for Farm Workers," Ext. Fldr. F-155, Jan. 1951, E. B. Hill; Ext. Serv., Mich. State College, East Lansing, Mich.

Field Observations on Tall Fescue . . .

(*From page* 24)

have applied various amounts of fertilizers and fertilizer mixtures. In general they are all in agreement that the best plan is to determine the lime, phosphorus, and potash needed to get the companion clover established. Numerous soil analyses show that the average site that will be used for the fescue-clover combination will require about one ton of lime, 400 pounds of 20-per-cent phosphate, and from 80 to 120 pounds of muriate of potash. In addition and to supply the nitrogen needed by the fescue, 100 pounds of ammonium nitrate should be applied in the fall and the same amount again in the early spring.

Ben Block Meyer, a cooperator in Cross County Soil Conservation District at Wynne, Arkansas, planted 10

Fig. 4. Fescue planted September 2, 1949, on the Arkansas State College Farm, Jonesboro, Ark. Growth shows benefit from fertilizer. Four hundred pounds of 5-10-5 were applied at time of planting. This picture shows where one round made by the fertilizer distributor was partly clogged up.

Fig. 5. This picture was made November 9, 1949, of fescue and ladino clover planted September 2, 1949, Arkansas State College Farm, Jonesboro, Ark. The 24-acre block carried an average of 35 head of dairy cows and 20 sheep from March 1, 1950, until November 10. The dairy cows had two hours per day supplementary grazing on sweet sudan during the summer months, and the unusually good growing season made continuous grazing available, which could not be expected with average rainfall. Four hundred pounds of 5-10-5 were applied at time of planting and the soil was typical Crowley's Ridge soil, having a low fertility level.

acres of fescue and ladino clover on loessial terrace soil of only medium fertility in the fall of 1949. He applied two tons of lime, 300 pounds of 20-percent phosphate, and 500 pounds of 5-10-5 per acre at the time of planting, and a topdressing of 150 pounds of ammonium nitrate in March 1950. Included in the same pasture are 13 acres of common lespedeza, with a light sod of Dallis grass and some redtop, which supplied a moderate amount of summer grazing only. This pasture furnished grazing as follows:

October and November 1949	120 days
February and March 1950	4,140 days
No grazing in April and May to allow a seed crop to mature.	
June 1 to 15, 1950	450 days
July 1 to 15, 1950	665 days
August 1 to 10, 1950	450 days
September 1 to October 15, 1950	3,105 days
Total for 7 months	8,930 days

Rainfall at Little Rock, Arkansas

By Months from September 1949 to October 1950

Sept. 1949	2.75 inches
Oct.	9.68 "
Nov.	0.28 "
Dec.	4.78 "
Jan. 1950	12.53 "
Feb.	9.27 "
Mar.	4.90 "
Apr.	2.75 "
May	8.37 "
June	2.07 "
July	1.87 "
Aug.	7.59 "
Sept.	6.77 "
Oct.	1.29 "

Number of Days When the Temperature Fell to Freezing and Below During the Winter Months 1949-50

Dec. 1949	9 days
Jan. 1950	11 days
Feb. 1950	10 days
Mar. 1950	5 days

Green From the Grass Roots

MANY kinds of grass start growth in spring before the soil has warmed up enough for the roots to become active in collecting and supplying the plant with nutrients from the soil. In these early weeks of growth, the plant draws on reserve materials stored in the roots. This results in relatively slow early growth, but the plant does progress in developing green leaves and top growth ready to go to work as soon as the roots become active. The leaves are the factory part of the plant. As soon as the roots send up raw plant nutrients, the leaves in sunlight are ready to convert this into plant material. Growth is then rapid, and pastures and ranges supply the lush forage associated with spring. If the first leaves that develop from root reserves are grazed off, it is like destroying part of the machinery in a factory. The factory cannot do its full job of production.

This is the elementary explanation which E. William Anderson of the Soil Conservation Service of the U. S. Department of Agriculture offers, in discouraging grazing of the first growth of the range grasses. Grazing too early will limit the supply later in the season.

Grazing too close late in the season is also undesirable. The grass plants need an opportunity to restore the food reserves in the roots that will be carried over winter and will get the plants off to a good start the following spring.

Grass in Shade

WHAT bothers lawn makers most is to get a good green turf in the shade. According to Dr. Fred V. Grau, who carries on research for the U. S. Golf Association, in cooperation with the U. S. Department of Agriculture, the public asks more questions about this shade problem than about any other matter related to grass growing on home grounds. "This sounds reasonable," he says, "when we consider that nearly everyone likes shade trees and a good lawn, and that in 99.44 per cent of the cases you can't have both. The shade is above the grass and the roots of the trees are underneath, leaving the grass in a pinch—and the loser."

But Grau gives out some helpful suggestions to people in the various regions: In the South, St. Augustine grass will grow to the bases of shade trees if the trees are high and open. In the North, the fescues (Chewing's fescue and sheep's fescue) do pretty well under shade trees when soil is well drained. Boughstalk bluegrass (Poa trivialis) is good if it gets plenty of water. But under the Norway maples it is practically impossible to have a good turf because shade is so very dense and the feeder roots are so shallow.

A common mistake in attempting to grass shady places is to sow in the spring so that the seed sprouts about the time the trees become strong competitors for moisture and light.

Fall is the best time for two reasons—the special reason that trees are about to drop their leaves, and the second and general reason (for lawns in shade or sun) that weeds and trees are not such vigorous competitors then.

Thirty Tons of Tomatoes Per Acre

(*From page* 17)

age 15 or 16 square feet per plant, or about 2,800 plants per acre.

The field was cultivated five times between June 1 and July 10, and the tomatoes were sprayed according to the alternating schedule of Zerlate and copper recommended by Professor W. T. Schroeder, Canning Crops Plant Pathologist at the Geneva Experiment Station (Table I).

TABLE I.—SPRAY SCHEDULE USED TO CONTROL EARLY BLIGHT, LATE BLIGHT, AND ANTHRACNOSE.

Date of application	Material
July 20	Zerlate
Aug. 5	Zerlate
Aug. 18	Copper
Sept. 3	Zerlate
Sept. 15	Copper

In addition to the sprays, a 7% metallic copper dust was applied by plane on August 30.

The field was picked four times, and the total yield for the season was 30.0 tons per acre (Table II). Most of the tomatoes were delivered to the Haxton Foods, Inc., canning factory at LeRoy where they graded 72.7% No. 1's, 25.1% No. 2's and 2.2% culls.

Gross returns for the crop totaled

TABLE II.—YIELD SUMMARY.

Date of harvest	Tons per acre
Sept. 1–6	4.2
Sept. 12–15	10.1
Sept. 25–27	11.6
Oct. 8	4.1
Total	30.0

$4,560, while total costs for everything except Donald's own time totaled $2,349. Thus, the net profit for the project was $2,211, or $381 per acre. Donald, a freshman at South Byron High School, has deposited the money in the bank to help pay expenses when he enrolls in the College of Agriculture at Cornell University in September 1954.

Good tomato-growing practices which are demonstrated by Donald's success include the following: (1) Plow under plenty of organic matter, preferably including a deep-rooted legume such as sweet clover or alfalfa; (2) Use large amounts of fertilizer; (3) Use varieties which are adapted to the area; (4) Use starter solutions at transplanting; (5) Control weeds by adequate cultivation; (6) Control diseases and insects.

Can Soil Organic Matter . . .

(*From page* 26)

sion is likely the main cause for the same or lower organic content of upland Piedmont soils as compared with the lighter-textured, well-drained Coastal Plain soils.

Summary and Conclusions

Organic matter determinations were made on a large number of cultivated Georgia soils and on soils with different land-use practices. The results in-

TABLE II.—ORGANIC MATTER CONTENT OF SOILS OF "LAND-BUILDING" PROJECT—WHITEHALL, GEORGIA.*

Plot No.	Treatment	% Organic Matter	
		1940	1948
1	Pines	1.17	1.11
2	Black locust 300 lbs. 5-7-5 fertilizer at start	1.25	1.36
3	Cowpeas in summer. Crimson clover turned in spring. 100 lbs. KC1	1.00	1.13
4	Cowpeas in summer. Crimson clover turned in spring. No fertilizer	0.87	1.41
5	White sweet clover. 4,000 lbs. limestone, 600 lbs. superphosphate, 100 lbs. KC1 each 2 years	1.06	1.50
6	Cowpeas in summer. Crimson clover turned in spring. No fertilizer	1.21	1.31
7	Cowpeas in summer. Crimson clover turned in spring. 500 lbs. basic slag annually. 100 lbs. KC1	0.78	1.31
8	Pines—Included in No. 1	....	....
9	Vetch and lespedeza sericea. 600 lbs. basic slag and 100 lbs. muriate each 5 years	1.13	1.34
10	Cowpeas in summer. Crimson clover turned in spring. 2,000 lbs. limestone. 100 lbs. KC1	1.70	1.21
11	Cowpeas in summer. Crimson clover turned in spring. 600 lbs. superphosphate, 2,000 lbs. limestone, 100 lbs. KC1	1.70	1.45
12	Cowpeas in summer. Crimson clover turned in spring. 200 lbs. 4-7-4, 100 lbs. KC1, 4 tons stable manure annually	1.70	2.04
13	Cowpeas in summer. Crimson clover turned in spring. 300 lbs. superphosphate, 100 lbs. KC1	1.13	1.16
14	Cowpeas in summer. Rye turned in spring with 200 lbs. Ca cyanamide. 600 lbs. basic slag, 100 lbs. KC1 to each crop	0.87	0.97

* Started 1938 on Cecil soil of sandy loam to sandy clay texture. Corn planted each 5 years and fertilized uniformly except for plots 1, 2, and 8. KC1 added to plots only after first 5 years. Plots with cowpeas in summer and crimson clover in winter have fertilizer applied to each crop at rates listed.

dicate that for a given area the organic matter content of cultivated Georgia soils is more closely related to factors such as soil texture and drainage that affect decomposition rates than to the ordinary cropping practices. Apparently the organic content of some Southern soils that are below the level governed by environmental factors can be increased slightly, for example, severely eroded soils. For most soils it is not practical to raise the organic level. More emphasis should be placed on use of green manure and cover crops for immediate supply of nitrogen and to reduce leaching and erosion losses rather than to build up organic matter. During active decomposition, organic matter continuously releases plant nutrients and possibly exerts other benefits. The objective should be to maintain a continuous supply of actively decomposing organic materials in the soil at all times.

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Lime Removals . . .

(*From page* 20)

134 pounds and in the tobacco 125 pounds; for grass the respective increases were 31 and 30 pounds. Least $CaCO_3$ was leached from the grass plots with PK fertilizer only and the largest amount from the fallow soil with NPK fertilizer. Soils cropped to tobacco were intermediate. Associated with losses of $CaCO_3$ were corresponding increases in acidity.

Ammonium sulfate, urea, and cottonseed meal, with and without neutralization, were added to a strongly acid and a nearly neutral Merrimac sandy loam soil under uncropped conditions. Neutralizing the soil produced greater amounts of Ca in the leachate for all conditions, but to a lesser extent in the nearly neutral than in the acid soil. On neutralizing the fertilizers applied to the acid soil, losses of Ca and increases in acidity (pH) corresponded to the net acidity of the fertilizer; greatest for ammonium sulfate, next for urea, and least for cottonseed meal.

Each pound of nitrogen in ammonium sulfate would require about 7¼ pounds of agricultural limestone to neutralize the acidity produced. Urea requires about 3.6 pounds and cottonseed meal 3.2 pounds of lime per pound of nitrogen. Basic fertilizers like cyanamid and tobacco stems add about 1.2 and 2.5 pounds of lime, respectively, to soils.

Further evidence of the efficiency of ammonium sulfate in leaching Ca from the soil is shown by the results from an experiment using sodium nitrate, ammonium sulfate, urea, and cottonseed meal as nitrogenous carriers. Enfield very fine sandy loam, Merrimac loamy sand, Wethersfield loam, and Merrimac sandy loam were the soils used in the Connecticut lysimeters. For every soil the largest $CaCO_3$ losses were obtained from the ammonium sulfate fertilizers. Next in lime removal was urea, cottonseed meal, and sodium nitrate. Omitting N from the fertilizer produced an intermediate loss of lime. In all cases the least lime was lost from the soil of lightest texture (Merrimac loamy sand, 120 lbs/A) and the largest from the heaviest texture (Wethersfield loam, 746 lbs/A). The soil with the greatest exchangeable Ca (Wethersfield) lost the most lime, followed in order of exchangeable Ca (Merrimac sandy loam, Enfield very fine sandy loam, and Merrimac loamy sand least).

In a Connecticut lysimeter experiment using Merrimac sandy loam soil the interaction of various fertilizer cations (Ca, Mg, K, Na) and anions (CO_3, SO_4, Cl, PO_4) in relation to the nitrification of urea, to soil reaction, and to leaching of the various constituents from an uncropped soil were compared. In every case exchangeable Ca was less at the end of the experiment than in the beginning. Calcium was removed from the soil in the largest amounts by the chloride treatments ($CaCl_2$, $CaSO_4$, etc.), followed in order by the sulfate, carbonate, and phosphate (in order of solubilities). Fifty-two per cent of the total cations leached was Ca. In every case, the use of Uramon decreased the pH from that of the original soil.

In another experiment using the same soil to which equivalent rates of fertilizers (NPK) were added, information was obtained on the amount of Ca removed from the soil by leaching and in crops in relation to the amount added in the fertilizers. Two hundred pounds of nitrogen per acre were applied; 15 sources of N were studied. In general, the organic (castor pomace, linseed meal, fish meal, cottonseed meal) lost somewhat less lime in the crop and leachate than did the inorganic fertilizers (ammonium sulfate, ammophos, potassium nitrate). Exceptions are cyanamid, Ca nitrate, and no nitrogen fertilizer which ended the experiment on an annual basis of 646, 162, and 28 pounds of lime, respectively, in excess of the amount of lime leached from the soil. This follows in general the acidity-basicity relationships of these fertilizers.

5. Sprays and Dusts

Use of sulfur fungicides for spraying orchards acidifies soils. Elemental sulfur sprays and dusts have largely taken the place of lime-sulfur sprays because of their better eradicative action. Boynton states that the average annual uncompensated sulfur applied to some apple orchards ranges from 10 to 12 pounds per tree (270 to 324 lbs/A). Since 1 pound of sulfur will leach approximately 3 pounds of lime out of the soil, about 30 to 36 pounds of lime per tree (810 to 972 lbs/A) would be required to counteract the potential acidity of the sulfur. The greatest acidity has been found to occur in the branch-spread area of the tree or about 10-12 feet from the trunk. In one apple orchard, planted on a Dunkirk silty clay loam, the soil was below pH 5 to about an 18-inch depth and increased to above pH 5 at greater depths.

Nutritional Problems of Peanuts . . .

(*From page* 10)

exception of their phosphorus content) they might have been two soil samples from the same field. The chemical analyses indicate the soils in both fields to be critically low in content of both calcium and potassium.

The data in Table IV-B show that in 1949 the response to lime and gypsum on these two soils was quite different. The essential difference in the treatment of the two soils was the amount of potash applied to the fertilizer. Test No. 18 gave no increase in yield from either lime or gypsum. This test was fertilized with 400 pounds per acre of 4-10-7 and had a total available potash (i.e., exchangeable soil potassium plus 28 pounds of potash applied in the fertilizer) of 65 pounds per acre-plow-depth. Test No. 19, which had a total of 133 pounds per acre of available potash, approximately one-half of which was supplied by the extra 100 pounds per acre of muriate of potash, gave yield increases of approximately 50 per cent from the gypsum-treated plots. The difference in response of the two soils was due to the difference in the amount of potash applied to the peanuts. Lime was applied to both tests on February 8, 1949. This was apparently too short a time previous to planting peanuts for the lime to have given its full effect. The somewhat smaller values for both yield and percentage of SMK for the no-treatment plot of test No. 19 should be noted.

Peanuts were grown on location No. 18 again in 1950. They followed lupines, which were heavily fertilized with an 0-14-10 fertilizer, and the fertilizer to peanuts was higher in potash than that used in 1949. Large increases in yield were obtained from all three lime and gypsum treatments in 1950. In fact, the yield of sound mature kernels was more than doubled by all lime and gypsum treatments, whereas no response whatever was obtained the previous year. The test was on the same plots but with only the gypsum treatments of 400 pounds per acre being repeated in 1950. These results provide one explanation for the statement, "No two peanut experiments give the same response and the same experiment will not give the same response two years in succession!"

TABLE IV-B.—RESPONSES OF RUNNER PEANUTS TO LIME AND GYPSUM AS AFFECTED BY THE POTASH AND FERTILIZER USED.

Test no.	Fertilizers used	Soil treatments			
		No treatment	1 ton per acre lime	400 lb. per acre gypsum	Lime and gypsum
19	300 lb./A 4-10-7 plus 100 lb./A 60% KCl				
	Yield in 1949—lb./A	1,186	1,257	1,834**	1,750**
	Increase in yield—lb./A	check	71	648	565
	Percentage of sound mature kernels	60.9	67.7	68.8	68.8
18	400 lb./A 4-10-7				
	Yield in 1949—lb./A	1,322	1,289	1,328	1,235
	Increase in yield—lb./A	check	−33	6	−89
	Percentage of sound mature kernels	67.8	68.8	67.1	71.4
18	820 lb./A 0-14-10 to lupines 200 lb./A 0-14-10+100 lb. 4-10-7 to peanuts				
	Yield in 1950—lb./A	868	1,567**	1,385**	1,528**
	Increase in yield—lb/A	check	699	517	660
	Percentage of sound mature kernels	51.5	66.1	68.7	72.1

** Highly significant increase in yield over no-treatment plot yield.

A comparison of the yields and percentages of sound mature kernels for the no-treatment plots shown in Table IV-B indicates that potash applied to soils low in calcium decreases the yield and lowers the quality of peanuts. In 1949, the average weights of green peanuts on the untreated check plots of tests Nos. 18 and 19 were identical. The green peanuts from test No. 19, which received 53 pounds per acre more potash, lost 156 pounds per acre more upon drying. Thus the yield of dry peanuts was decreased by larger amounts of potash. In addition, the peanuts from the higher rate of potash had a percentage of sound mature kernels 6.9 less than those from the lower rate of potash. On the other hand, the additional potash increased the yields on the plots to which adequate calcium was supplied in the form of gypsum. The comparison between yields and percentage of SMK for the two years' data on test No. 18 shows the same relationship. Pronounced visible differences in the number and size of peanuts on the vines of the untreated plots as compared to those that received lime or gypsum existed at the time the peanuts were dug in 1950. While plants from the no-calcium check plots had set more peanut pods, most of them were small, undeveloped, or empty.

Similar effects of increasing the potassium supply by sidedressings of potash or by larger applications of fertilizer were evident in the data from three other tests located on soils low in calcium. The results of all these tests indicate the necessity of supplying both calcium and potassium to soils low in these elements in order to obtain the expected increases in yield of peanuts, as well as to avoid actual decreases in yield when the use of potash or of mixed fertilizer is increased. It appears probable that the yield of runner peanuts on low-calcium soils can be considerably increased by the use of optimum amounts of potash in conjunction with applications of lime or gypsum on such soils. Low levels of both calcium and potassium in the soil are undoubtedly the major nutritional reason for low peanut yields on many of the soils of that area.

It is doubtful, however, that the use of satisfactorily balanced amounts of calcium and the major fertilizer elements will produce maximum peanut yields on all soils. Of the soils tested in this work, two have given negative responses to lime and gypsum even when additional potash was applied. The magnitude of this negative response approached statistical significance. It is not at present known what other, if any, nutritional element was deficient. Whichever it may be, its need by the plant appears to be intensified by liming and by increasing the calcium supply in the soil.

Information obtained on over-limed soils may possibly be related to these soil conditions. A number of small, seriously over-limed areas have been encountered in this section. They have usually resulted from lime having been bought in bulk and piled in the field before being spread. Two such areas were selected for study and treatment in June 1949. One was in peanuts and the other in corn. The overliming effect was so severe that both crops were complete failures on the affected areas. No response to treatments applied in June was noted for either corn or peanuts in 1949. In

Fig. 3. Showing typical set of peanuts by representative plants from plots receiving muriate of potash alone and muriate of potash plus zinc sulfate on an over-limed area (soil pH values 7.85 and 7.35, respectively). Photographed September 18, 1950.

TABLE V.—TREATMENT AND RESPONSE OF RUNNER PEANUTS ON AN OVERLIMED SOIL AREA.

Treatment		Yield of dry peanuts		Percentage SMK	Soil reaction 9/28/50
Materials applied June 7, 1949	Rate per acre	Yield per acre	Increase per acre		
	Lb.	Lb.	Lb.	Pct.	pH
Muriate of potash only	100	714	651	64.9	7.35
Muriate of potash	100				
and borax	5	544	481	62.5	
Muriate of potash	100				
and manganese sulfate	25	194	131	59.4	
Muriate of potash	100				
and A-Z mixture*	*	1,804	1,741	70.5	7.85
No treatment—check	—	63	check	49.9	
Muriate of potash	100				
and zinc sulfate	15	1,390	1,327	68.1	

* The A-Z mixture consisted of 5 lb. borax, 5 lb. copper sulfate, 15 lb. zinc sulfate, and 25 lb. manganese sulfate per acre.

1950, corn and peanuts were rotated on each field. The corn in 1950 showed marked improvement in the rows on which muriate of potash and four minor elements had been applied in 1949. The deficiency symptoms of corn on adjoining untreated rows were corrected by a foliar spray of zinc sulfate.

Peanuts growing on the other area in 1950 showed almost complete recovery from the over-liming effect on rows to which 100 pounds per acre of muriate of potash and 15 pounds per acre of zinc sulfate had been applied in June 1949. The treatments had been applied to two rows in the middle between the treated rows and every alternate two rows left as untreated checks. A hundred-square-foot plot from each treated row was dug for yields. The yields from the different treatments are given in Table V in the order in which they occurred in the field. Photographs showing the responses to the different treatments are reproduced in Figures 1, 2, and 3.

Calling All Crops . . .

(*From page* 5)

Parity cannot restore soils by itself nor can it ever take the place of lost relatives. Like prices and markets, good or bad, parity is not the same to all farmers. But bountiful crops usually pay out in both purse and pride, if and when coupled with practical application of long-known ways to maintain fertility.

Besides, a bumper harvest and a full storage of well-balanced food and feed crops are equally beneficial to city consumers. They are far better off on good wages to pay a slight premium to the farmer than to let prices be driven down and have the reservoirs of production dried up.

I think it is clearly such a basis of preparedness-for-the-worst in agricultural planning which is going to benefit us much, even if we do not founder on the rocks of a world struggle. We do not vision any surplus pile to defeat our efforts anyhow, either in war or in peace. As long as our industries remain geared to full-steam-ahead, the market place is going to render to Caesar the things which belong to Caesar. And we won't need a parity formula to make production worthwhile.

In making known the 1951 production guides, the farm planners consulted the state leaders and then laid out certain targets for several basic crops. No guides were suggested for any class of livestock or in terms of meats, eggs, wool, and milk. Everyone took it for granted that keen consumer eating habits would dictate a good high level of animal products as desirable.

Hence instead of outlining livestock and poultry guides, the easy but indirect method was used. Emphasis was laid on corn, barley, oats, and other cereals and on hay and pasture improvement. One couldn't forget the end-use of the bulk of our cereals, headed direct to the feed lots. Neither could one overlook the necessity for keeping a sound balance, so that livestock and poultry production should not deliberately run far ahead of the available harvests of grain or the abundance of seasonal pastures.

Right along with the current crop enhancement drive there is also a look-ahead notion. Rash and wasteful practices of land treatment and bad tillage methods in a mad effort to get high yields and big returns for 1951 could easily catch up with us and blacken the outlook for making succeeding seasons bountiful ones. Thanks to our earnest, experienced farmers and the extension educators and commercial representatives in the field, this hint to protect the future is widely and wisely accepted and applied. No more repetition of the scavenger farming and cream-skimming exploitation systems that hurt us so in World War I is likely to prevail. Would, however, that we had legal power to halt the gambling instincts of some city plungers, who avidly seek such pretext to ravish and destroy the topsoil and sell our land legacy for a shady farthing.

Such stay-at-home wastrels who skulk and scheme to skin the soil are as much subversive characters as are the atom bomb traitors. A minority of our land wreckers are just ignorant, and unworthy of a chance to farm.

If perchance we fall a trifle below the guidebook in acreage planted to soil-depleting cereals, let's not look back too hard to the old AAA specifications right after the processing tax was ruled out. They then began to put emphasis through benefit payments on balanced conservation farming—grass husbandry.

This logic has gained ground because it is sound. Grassland improvement means better fertility at cheaper costs and it spells easier and less expensive rations for livestock. It also saves hard and costly labor, if modern curing, hay-chopping, and hay-keeping ways are utilized.

SO I can't get terribly upset or feel down in the gizzard if it develops that some missing corn or oats acreage bobs up as good pasture, meadow, or hay land which was too well established to plow. In these times of high farm expenditures and big wage outlay it may seem the best and wisest and most logical plan to adhere to a high degree of forage crops, other things being equal.

I surely do not partake of the anxiety or misplaced fears expressed by some newspaper scribes in my territory, who when writing about the campaign for more crops stated flatly that a drop of a couple of million acres in corn might influence the next national election. I'm afraid that's not worth a puffing comment from a Missouri corncob pipe. It'll be the pork-hungry consumers of 1952 who might nurse a grievance—but their memories are too short to last in a world so fraught with other disturbances.

Nevertheless, farmers figure that we can't take any too many chances betting against weather and borers, so I look to a firm upward push in their late winter corn-planting intentions. Even with a couple of stray million acres below the 90-million-acre goal, we can bet that the use of adapted hybrids and tons of mixed plant food plus power cultivators and chemical weed-killing agents will pretty nigh fill the cribs and silos.

OAT seeding and early land preparation were badly delayed in many Midwest sections this spring, so some of the land which misses the oats will be planted to corn and soybeans—maybe some barley here and there. The April farm-storage reserves of oats were almost a top record, so if we slight them a little it won't make as bad a dent in livestock rations as a corn failure would.

Soybeans are another "must" crop. Three-fourths of the 1951 soybean acreage will be planted to eight new improved varieties which yield highly and do not lodge much. Fully three bushels an acre extra harvest is almost a guarantee through use of any of the better soybean sorts. Their oil and protein content both exceed some of the older varieties.

When the April crop report hit the newsstands one could believe by some of the scare stories that we might have to import some breadgrains. It's queer how easy the reporters can find a horror yarn in agriculture. And they surely make the most of it when Kefauver is taking a vacation and things get dull in urban crime waves.

What about wheat anyhow? Well, with no further serious setbacks, the total wheat production and supply outlook for 1951 is by no means a source of alarm. Because of an adequate over-all reserve and the chance that we will grow another billion-bushel crop, barring natural hazards, there is apt to be enough wheat for our normal domestic needs, plus a reasonable volume left for exports.

The production guidebook asked for a safe top goal of about 1,150,000,000 bushels. This won't quite be reached, based on present field estimates. The crop of last season was 1,027,000,000 bushels.

The April 1 estimate of winter wheat production this year amounts to 727 million bushels. This was shy about 170 million bushels of the total estimated last December, before the drought, bugs, and abandonment took toll. To this prediction we can add about 309 million bushels likely to come from spring seedings. This is based on the March 1 planting intentions.

If this guess which is figured on average yields for five years turns out right, it would stack up to 1,036,000,000 bushels of new wheat for 1951. The July carryover last year was 423 million bushels, which is about twice the carryover volume before the last war. Now they forecast a carryover for next July amounting to 420 million bushels. If we tack that onto the expected production of new wheat, we would get somewhere near 1,400,000,000 bushels, more or less.

Against the estimated supply we figure out the requirements. Food, feed, and seed wheat for home use foots up to 750 million bushels. Exports are an unknown quantity, but just to make things fairly safe, the outbound wheat for next season is placed at 300 million bushels. This takes care of the international agreement quotas too. If this turns out right, the total 1951 supply as estimated in a conservative way would cover the disappearance of 1,050,000,000 bushels, with a little to spare. So far it's hope rather than certainty.

Yet the present dilemma revolves around the extent to which we may be called upon to relieve hunger abroad by wheat and other food cereals. India is knocking hard on our door, and Congress seems apt to grant them extra supplies from our pile—maybe nearly 70 million bushels. Already for the March through May period, India has bought and paid for about 35 million bushels of all food grains combined. Our exports of good grains in that period totaled 200 million bushels.

Down Dixie way the fiber farmers are all set to grow bumper bales to beat the weevil. Bolstered by an unusual "scarcity of surplus" and price-protected both by government supports and a soaring market demand, the term "planter" will surely fit the Southern farmer as never before. That goal of 16 million bales will probably be more than attained, unless unforeseen disaster occurs. More fertilizer will be pumped and soaked into the soil to make the cotton crop than history has ever recorded.

AND so the plot thickens all along the farm front. By virtue of a year of positive programs reinforced by able leadership and the world's most intelligent and resourceful land army, we shall see agriculture hit the high spots from April to November. There is even some dim hope that even the astounding achievements of the late war years will be surpassed.

What farmers can do in a year of destiny will soon be proven. But what they will do meanwhile to preserve their own health and the health and vigor of their land is subject to careful thought and purposeful resolve.

There will be mistakes, overwrought and wasted zeal, old men forced to resume where young men left off, some discouragement and plenty of backaches and brain storms. But above the typical griping and the sarcastic comments of an embattled Americanism there will surely emerge many deep layers of the fat of the land, heaved up and distributed to the hungry in a time of pressure and peril.

A Few Whinnies

Two small-towners were sitting on the front porch of a general store when a city slicker drove up in a flashy convertible. "Hey, you," yelled the driver, "how long has this town been dead?"

"Can't be long," drawled one of the natives, "You're the first buzzard we've seen!"

* * *

Seaman: "Shall I leave the dim lights on?"

Wave: "No. Turn the dim things off."

* * *

Major: "You were absent from the parade, any explanation?"

Private: "Yes, sir, a mule kicked the Sergeant in the head and I had to fix it."

Major: "Fix what?"

Private: "The mule's leg, sir."

* * *

"Which would you rather give up—wine or women?"

"It depends on the vintage."

* * *

They were most anxious not to be recognized as newlyweds so before they went in to the hotel to register, they shook off the last of the rice and the bride took off her corsage.

Then sure that no one would know they had been married just that morning, the groom said casually to the desk-clerk:

"I'd like a double bed with a room, please."

A beginner at golf, when asked how he came out on the first day on the links, replied that he made it in eighty.

"Eighty," ejaculated his friend; "that's really remarkable. Most old-timers would envy you with that score. You'll surely be an enthusiast from now on."

"Yes," said the novice condescendingly. "I'm going back tomorrow to try the second hole."

* * *

Missus Mandy Johnsing, surrounded by her brood of eleven or thirteen pickaninnies, was talking to the spinster settlement worker. "Yes 'em, birth control am all right fo' you all, but me, ah's married and don' need it."

* * *

Have you ever stopped to think what a wonderful thing the human brain is? It never ceases working for you from the time you are born until the moment you stand up to make a speech.

* * *

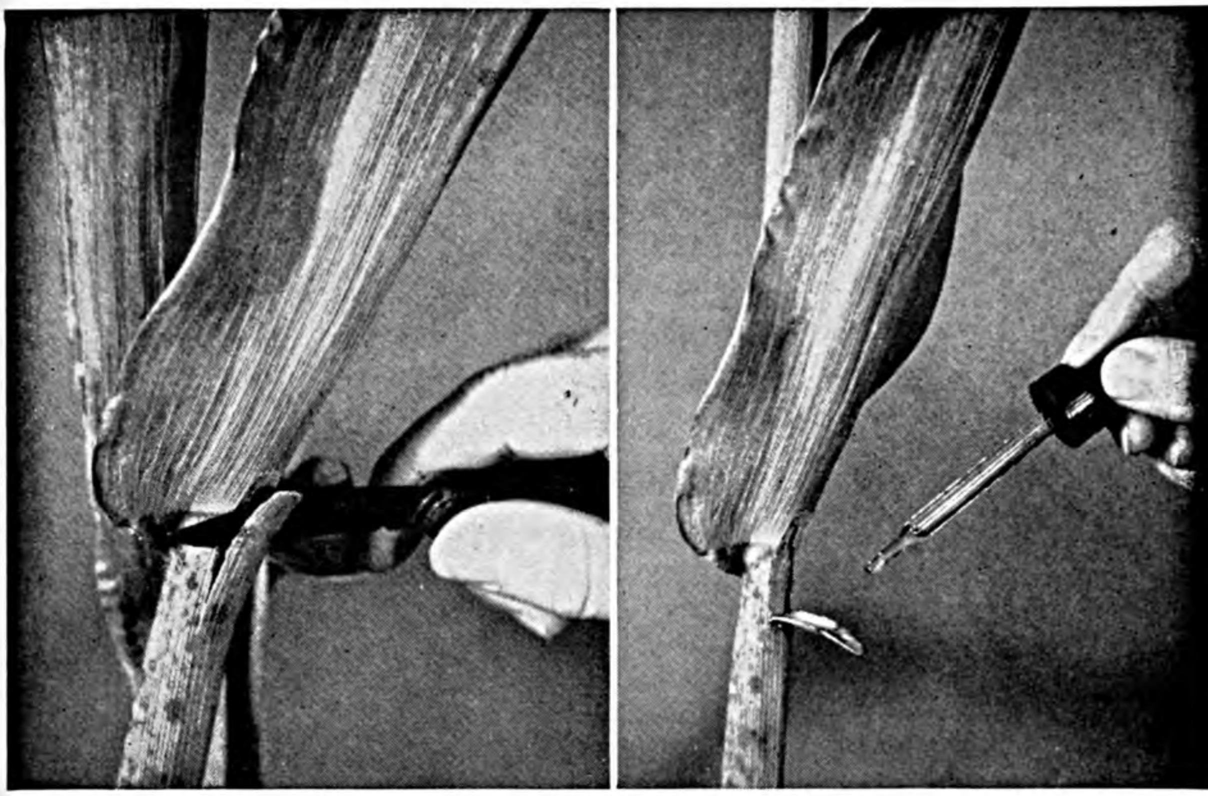
"I'm a bit worried about my wife," said Brown. "She was talking in her sleep, and saying: 'No, Frank, no, Frank!' "

"Well, what are you worrying about?" demanded his friend. "She said, 'No,' didn't she?"

* * *

Old Lady: "My word! Doesn't that Little Jones boy swear terribly?"

Little Joe: "Yes'm he sure does. He knows the words all right but he don't put no expression in 'em."



Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.

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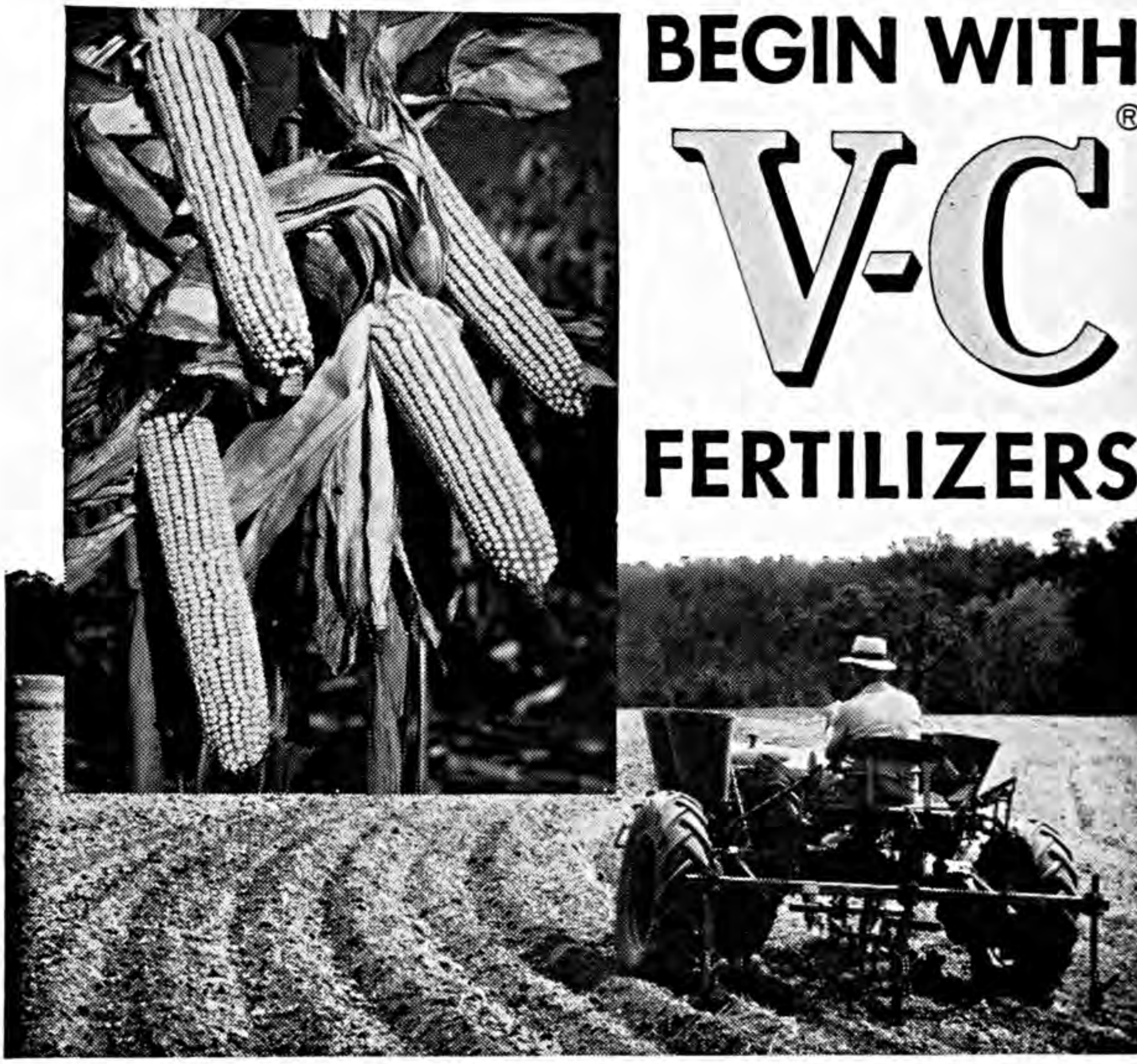

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R. H. STINCHFIELD, *Editor*

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

VOLUME XXXV NO. 5

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

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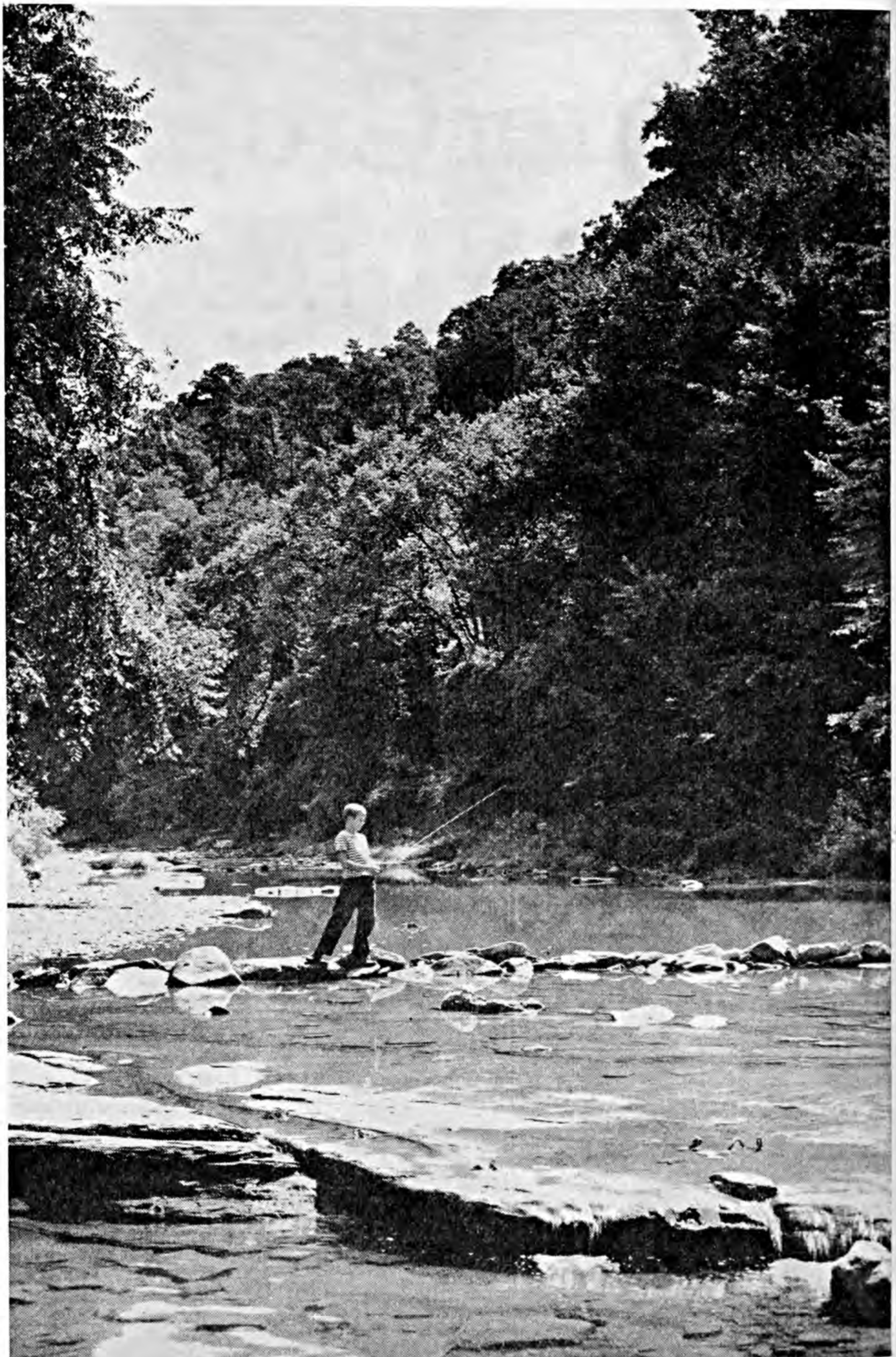
United States Potash Company
Potash Company of America



Waiting for the Strike

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Let's Not Think . . .

The Candy's All Gone

Jeff McDermid

AS one gets along toward the time when he begins to show signs of becoming "childish," it's nice to remember that a majority of human beings act sort of childish, more or less, right along. Grown folks can act angelic and sweet, and many of them are that way most of the time. But plenty of hell-raising and bickering, mad looks and tongue-sticking, dead-cat tossing and knuckle-dusting goes on every day in places high and low.

It often works out in both adult and juvenile life that a lot of ruction and mean behavior can be halted and side-tracked with a generous reserve supply of stick candy or all-day suckers. Sometimes it's ice-cream cones instead, to the joy of the dairy industry, but the end objective is always the same—peace and quiet and brotherly love for a period of unknown length.

Like all amateur philosophers who have attained the age of supposed discretion and judgment, I have wondered why mature persons with education and some stock of religion and sanity could indulge so often in narrow outbursts as the years draw nigh in which they might say, "I have no pleasure in them." It might be reasonably deduced that elderly citizens of a country as good as ours could attain a high degree of calm and forbearance to match the retrospective years. But it doesn't seem to work that way.

Maybe, therefore, it rests with the fact that the "candy's all gone." Maybe there is little left to such folks to serve as a bribe or something to divert their attention from irritating things, and because the candy is absent or completely gone from the future, they see no cause to be agreeable or be willing to compromise. All of which as a preamble to a ramble brings me to consider some people of my past who lost their candy early, or never had any, and what happened to them.

I GUESS my parents and their closest blood relatives never had much of a stock of good-behavior candy hidden away by their own parents or left around handy for soothing syrup. Probably if you peer back a little among family memories to the times when this country was growing up, you'll also be aware that *your* relations were also shy of the sweet meats and tidbits which are so common now.

As a matter of fact, candy of any sort was mighty scarce to bribe kids with back in the beginning of the settlements which have since been built up and trimmed with gingerbread, lollipops, and sugar ice. Lots of our forerunners were as much deprived of decent comforts and bereft of wholesome diets and pleasures as the poor underprivileged foreigners we worry about so much now.

Of course, a lot of these early settlers were prejudiced and mean in their attitudes, just as some of us are today, but believe me they had far less to make them behave otherwise than seems to be the case now. We had a whole western migration based on the same "have-not" urges that stifle and anger the coolies and peasants and serfs of far-off dark continents, and make them envious and suspicious of American prosperity and progress.

So while I am heartily favorable to extending largesse and constructive help to make these backward people independent and prosperous and well-fed, I can't help looking back to the "lost tribes" in my own era and beyond who fell far short of realizing the fruits and harvests of a contented nation, and who often gave their whole substance for the sake of a dream—a dream and a vision that they could not live to enjoy. I go over to the old, country graveyard and look across the river valley, now resplendent with well-tilled farms, fine roads and modern structures, shiny implements and push-button labor-savers, and I ponder deeply on the relative possessions and prospects that faced the loved ones now departed beyond the confectioner's beguiling.

They were poor, sometimes so poor that the makings of the meals a month ahead were just a wishful hope. As for banks and savings accounts and government bonds, these sturdy citizens went their meager way minus a vestige of marginal reserves. They accepted this situation in a wistful, trustful, ever-cheerful way for the most part. No golden opportunities, no havens of security, no anchors to the windward, no sinecures, no boondoggling snaps, no rainbows after the deluge. Just acceptance of the present as duty and maybe even as a glorious living privilege, beside which the blatant vaporings and jealousies of this age are silly and incomprehensible.

IF you say, "It was only their own fault," I disagree. Theirs was to be born and reared in a slowly emerging society which gave grudgingly of the chances to reach full security in old age. For did they not as a rule follow as best they could all the wise saws and churchly precepts, having learned many mottoes and admonitions from old McGuffy readers and prayer books?

Invention and science and marvels of progress never came their way in their day. Of this it cannot be said, "It is their fault," any more than we who reap the fancy results of electricity and power and progress today may look into ourselves and say, "This is our own reward." To what have most of us contributed that earns us all this candy? I dare say very little indeed—as we just happened to be here when all the sweet things were abundant.

I recall how old-time certain thoughtful men told me with bated breath about the wondrous achievements which would surely come, but which would never be vouchsafed to them. I seldom detected any note of bitterness in these remarks of prophecy, only glowing pride at the strides which science and the will of men would one day bring to pass.

When my father was a youth he swung the old-style open scythe, and the first new invention he enjoyed

was the "cradle" attachment thereto. He stood all day on one of the early reaper models and bound by hand. Water for the livestock had to be pumped laboriously by hand and often carried in bucketfuls to their winter stalls. Dim lanterns bobbed around on nights of late chores, and only the murky kerosene lamp or, earlier, the tallow candle provided uncertain light for what little "book larnin" came his way at the tiny, ill-equipped, and poorly taught country school.

Mother was raised in the fireplace and primitive cookstove era. Balanced meals as modern home economists see them were narrowed to any eatables that home resources and native climates could supply. Imported fruits and salad delicacies or vitamins to correct things lacking in the normal diets were unknown and unrealized. Home sewing was largely done with deft fingers and the needle until the first designs of sewing machines arrived—and they had to be pumped by weary feet on heavy iron treadles. A few of her aunts still spun and dyed the native fleece for fabrics.

It is true that the widespread reliance on homespun crafts and individual production cut down almost to zero the need for cash money and made that item of less significance in measuring a family's economic standing. But it was the poverty of progress and the dearth of incentive that clogged the way and made visions and dreams seem as silly and romantically impossible as the ambition of Darius Green with his poor flying machine. It was natural for folks to be skeptical and critical about schemes to emancipate the farmer and the mill-hand from drudgery, tired bodies, and a short expectancy of life. The main comfort and solace for that deprived form of living were in the promised rewards and leisures of the world to come. To carp and fret and rave over minor ailments, misfortunes, and abuses seldom occurred to them.

This patience and generally hopeful attitude were bred into them from their surroundings and the painstaking skill and time required to do the necessary tasks which actually kept them going and producing. The sweets and delicacies of life were few and far between and therefore had to be treasured, rationed, and conserved. Thanks to their acceptance of the inevitable in a broad way, they took the fate allotted to them with a cheerful demeanor and made the very most of rare opportunities to partake of the candy and the condiments. Hence what joys and triumphs and recreations there were had that much more vitality and were remembered longer.

I HAVE an acquaintance living away up in the rolling hills near a pleasant river. Recently he communicated with a large cooperative company of which he is an officer, stating the case as follows:

"As president of our company, it seems to me I should make myself better known to many of you, as you

(*Continued on page* 49)

The Development of the

American Potash Industry

By J. W. Turrentine

Washington, D. C.

IN tracing the development of the American potash industry, the logical place to start would seem to be the beginning even though the story has often been told; and the beginning may be described as that point in our agricultural history when we first realized our state of utter dependence on a single foreign source for our supplies of potash salts which we had been taught to use and which we had learned were essential in scientific crop nutrition.

The date was 1910 and the single source of commercial potash salts was Germany. There the potash industry had been over-expanded to the point where surplus production and competitive selling were reducing to near bankruptcy many of the factors except the lowest cost producers, with resulting chaos. To save the industry the German government organized a trust, closed down the less profitable mines, assigned production to the more profitable mines and fixed the prices at which potash salts could be sold.

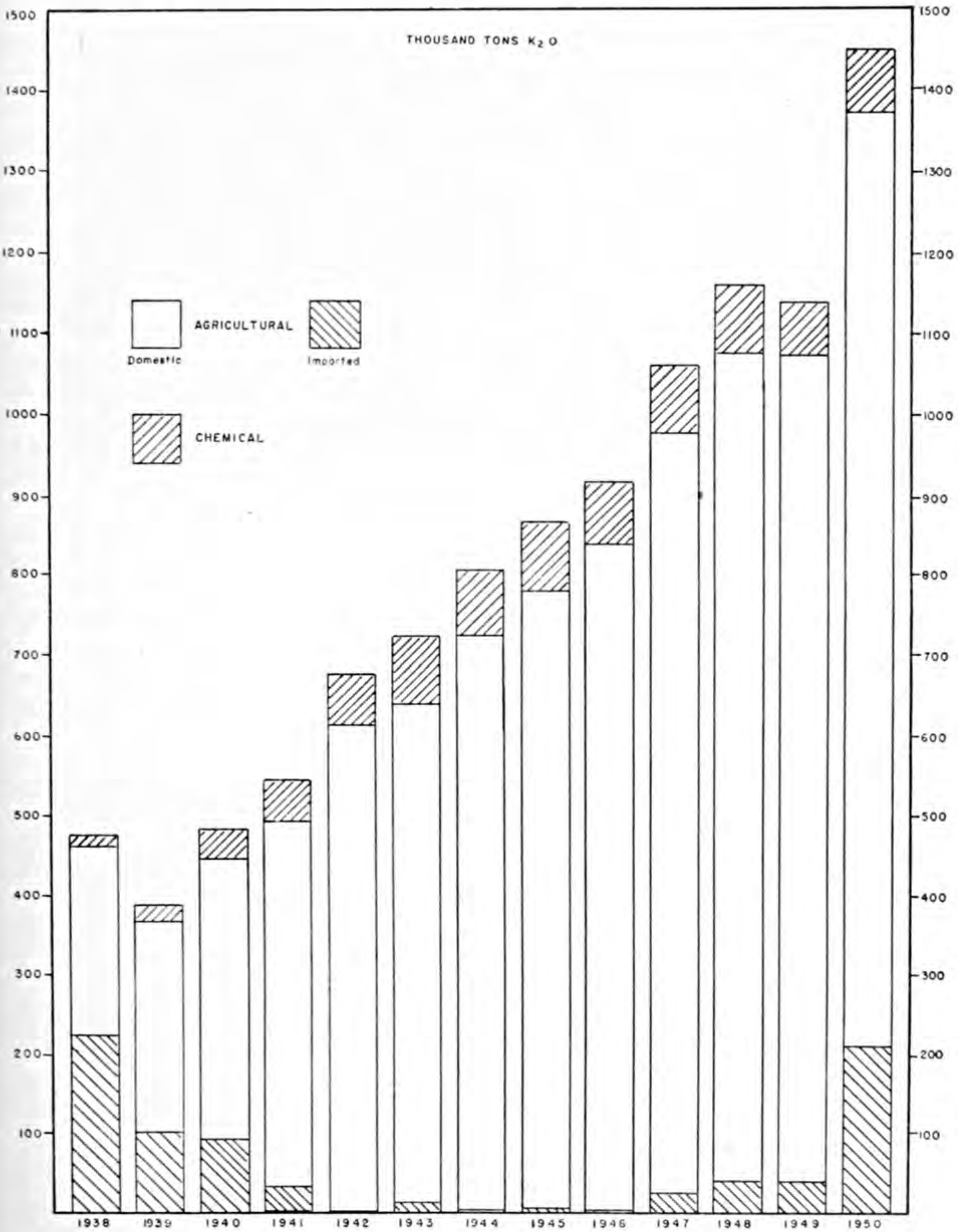
This resulted in the cancellation of favorable contracts with the American buyers, who brought their troubles to Washington after the good, old, traditional manner and were told that the proper solution of the problem was the severance of dependence on Germany through the establishment of domestic sources of potash—if such could be found and developed. Subsequently a Congressional appropriation became available in 1911 for exploration in the United States for occurrences of minerals, salines, brines, and seaweeds from which potash could be produced.

Those explorations and surveys were most opportune, for in 1914, with the outbreak of World War I, German importations were abruptly terminated and we were left deprived of all potash supplies. Thereupon, under the impetus of a price increase from $35 to $500 per ton of 50% muriate, practically all of the potash-bearing raw materials (and industrial wastes) listed as the result of Federal surveys were placed under industrial development, resulting in the construction of 128 production units, with an output of 209,000 tons of salts containing 54,800 tons K_2O by 1918, and a rated but unrealized capacity considerably in excess of that.

The critical nature of the emergency did not admit of technological research. On the contrary, potash was being extracted in many instances "by main force and awkwardness." As a result, with the reappearance of German potash on the American market at a carefully regulated descending scale of prices, the wartime domestic industry faded away with only three units surviving to recent years.

But potash research continued and one of the enterprises that survived the post-war deflation in potash interest developed its processes to the competitive basis and became a major factor in potash production—the American Potash and Chemical Corporation, the American Trona Corporation of World War I. Since that time, beginning with the extraction of potassium chloride from the complex brines of Searles Lake, California, through dint of continuous and persistent research it has undergone de-

POTASH DELIVERIES – AGRICULTURAL & CHEMICAL
NORTH AMERICA



velopment after development, added product after product from the raw material processed, to reach its present state of constituting one of the outstanding chemical achievements of this country. Here is to be found phase-rule chemistry in its most intricate form applied on the plantwide scale and mechanized with the greatest precision.

It was in this plant that occurred the first large-scale application of the vacuum-cooling crystallization of potassium chloride yielding a product of 97% purity which established the now well-known "60% muriate" as the standard potash grade.

Prior to 1926, surveys for the search for potash resources had been restricted to what might be called surface aspects of the problem, outcroppings of potash minerals, the less pure strata of sodium chloride in salt mines already opened, and subterranean brines from salt springs and oil wells. No funds had been provided for the exploration otherwise of the Nation's great saline deposits with which it was well known from German explorations that potash deposits were associated. Conspicuous and least explored among these salt deposits was that of the vast Permian Basin underlying parts of Texas, New Mexico, and the states to the north.

It was in this area of Texas that in the examination of the natural brines from oil-well drillings potash salts were found in solution. Then followed the discovery of fragments of crystalline potash minerals, indicating the occurrence of potash segregations in the saline strata penetrated by the borings.

On the basis of such evidence, meager at best, a bill was introduced in the Congress in 1924, "Authorizing Investigation by the United States Geological Survey to Determine Location and Extent of Potash Deposits in the United States," which by dint of much perseverance on the part of its proponents and after drastic amendments including the designation of the U. S. Bureau of Mines as a participating agency, became law in 1926.

Under this authorization between 1926 and 1931, 24 core tests were drilled, 10 in Texas, 13 in New Mexico, and 1 in Utah. Beds of potash salts described as "of possible commercial interest" were encountered at depths of from 373 to 2,737 feet, varying in thickness from 1 ft. 6 in. to 8 ft. 10 in. and in potash content of from 9.12 to 13.94 per cent K_2O.

The drilling procedure made use of the plunger type of drill through the overlying rock strata until the saline strata were encountered, whereupon the diamond core drill was substituted. With the use of saturated saline solutions as lubricants, complete cores of

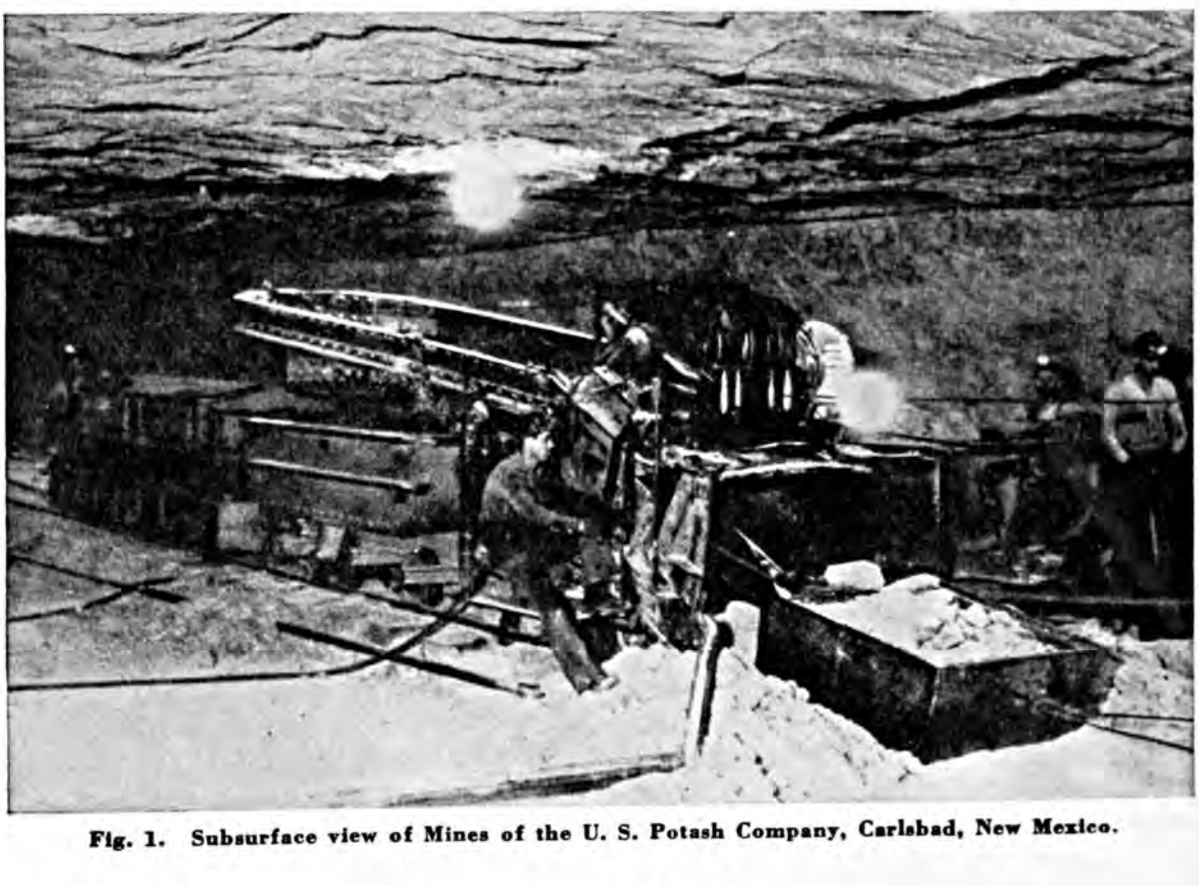


Fig. 1. Subsurface view of Mines of the U. S. Potash Company, Carlsbad, New Mexico.

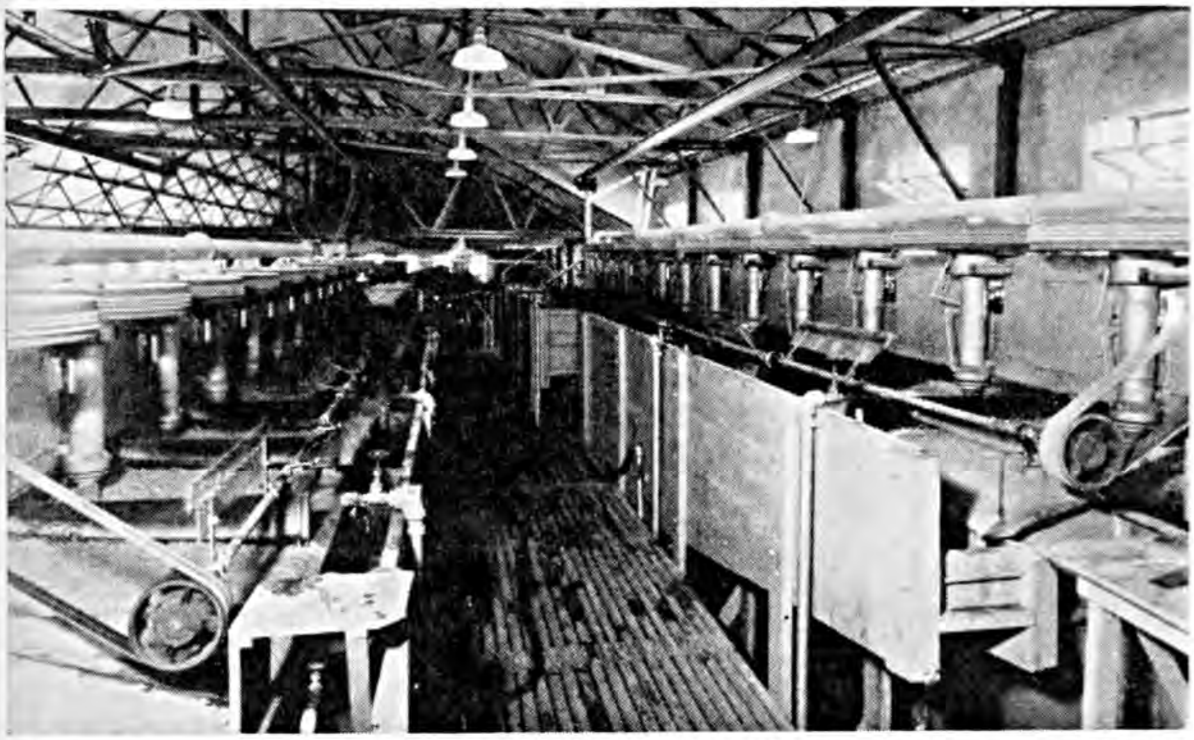


Fig. 2. Concentrating raw potash by flotation process in Potash Company of America plant, Carlsbad, New Mexico.

the saline strata were recovered and their content of potash minerals identified and analyzed. This activity and the related publicity which preceded it alerted the oil-drillers exploring for oil in the Permian Basin to the possibility of discovering potash deposits and taught the technique of identifying such deposits if encountered.

Accordingly and concurrently the Snowden and McSweeney Oil Company exploring for oil in the neighborhood of Carlsbad in Eddy County of southeast New Mexico discovered a potash deposit as the result of the first core test for potash beginning April 14, 1926. This deposit proved of such richness and thickness and at a depth of only 1,000 feet as to leave no doubt as to its entire commercial value—a deposit which with further exploration to determine its lateral dimensions was recognized as equal to the best of the European deposits. Among the several strata of water-soluble potash minerals penetrated was the bed of sylvinite (a natural mixture of sylvite, potassium chloride, and halite, sodium chloride) containing 21% K_2O, which was destined to become the major source of potash for American agriculture.

In the development of a potash industry based on this deposit, the United States Potash Company organized by the aforementioned oil company was the first to enter this field and with production beginning in 1931 became the American pioneer in the mining and refining of a raw material from such a source. Its mine was equipped with the latest mechanical devices and its refinery in accordance with the best technology then developed. Thus was realized for the first time the dream of an American potash industry similar to that of Europe, long recognized as the ideal.

Then followed in the same field the Potash Company of America (organized in 1936) with a mine thoroughly mechanized and a refinery built to apply the flotation process, the first industrial application of the familiar flotation principles to a water-soluble ore. This was followed in turn by the mine and refinery of the former Union Potash and Chemical Corporation, subsequently to be amalgamated with the International Minerals and Chemical Corporation, again with a mechanized mine and a refinery employing flotation methods in part at least. Including the aforementioned American Potash and Chemical Corporation, these four companies are the major factors of the American potash industry.

Intermediate in scale of production is the plant of Bonneville, Ltd., near Wendover, Utah, where the raw material is a brine found in the clay stratum underlying the salt crust covering the Bonneville Flats or Salduro Marsh of the Salt Lake Basin. Here solar evaporation is employed to yield a mixture of crystalline potassium and sodium chlorides, subsequently separated by flotation.*

In more recent years, the Dow Chemical Company of Midland, Michigan, has become a minor producer of high-grade potassium chloride as a by-product of its processes employing the natural brines of that State as the raw material.

Further expansion in potash production is under way in the Carlsbad area of New Mexico. The Duval Sulphur and Potash Company and the Southwest Potash Corporation, a subsidiary of the American Metal Company, Ltd., are proceeding with the sinking of mining shafts and the construction of refineries for the exploitation of deposits of sylvinite in close proximity to the existing potash mines. With these two new enterprises in production there will be five companies operating in the Carlsbad potash field.

While steadily increasing their capacities, the major producers have added other chemicals to their list of products and thus have effected a diversification and full utilization of the constituents of their raw materials. Outstanding in this respect is the American Potash and Chemical Corporation with a list of products that includes potassium chloride of some 98% purity designed for the fertilizer trade and a product further refined for the chemical trade, as well as potassium sulfate, sodium sulfate, sodium carbonate, sodium borate decahydrate, sodium metaborate, boric acid, bromine, potassium, sodium, and ammonium bromides, and lithium salts.

The potash ores of the Carlsbad area are too free from impurities to admit of such an array of products; yet under production are potassium chloride of several degrees of purity and crystal size, 60% muriate, 50% muriate, and 22% run-of-mine salts, potassium sulfate, sulfate of potash-magnesia, and potassium chlorate.

In tracing the development of the American potash industry, mention of an occurrence of 1935 may be warranted. The industry by then had reached those production levels where it felt itself justified in participating in the scientific research and educational activities long supported by the potash importers with enviable success. Accordingly, in that year the American Potash Institute was organized with an experienced staff designed to conduct the agronomic, editorial, chemical, and economic purposes and activities in the agricultural field for which it was organized,—namely, consumer service in the scientific and therefore profitable use of potash in crop production. To this end, supported by the American Potash and Chemical Corporation, the Potash Company of America, and the United States Potash Company, there are maintained research fellowships in the leading agricultural research centers of the Continent, and headed by the Agronomic Journal, "Better Crops With Plant Food," there is disseminated a large volume and diversity of educational literature dealing with the many aspects of the profitable use of potash in agriculture.

With these developments, the advent of World War II in 1939 found the Nation in a radically different situation with respect to potash supplies as compared to that former situation of critical and near-disastrous dearth of supplies in 1914. On the later occasion the interested public greeted with considerable skepticism the announcement that

* The operations of these five potash production units including their processes are described in detail in the book, "Potash In North America" (Reinhold Publishing Company, 330 West 42nd Street, New York 18, N. Y.).

the American potash industry was then prepared to take care of the Nation's potash requirements, for it was known that up to September of that year we still had been importing a considerable percentage of our potash requirements. What was not so generally known was that we had been exporting a substantial proportion of our production, which could and would be diverted back immediately into the domestic market; that we had large expansions in production capacity underway; that we had great reserves of unrefined run-of-mine salts readily available to equal any deficit in the refined salts that might develop; and that production of potassium sulfate, formerly largely imported, could and would be promptly expanded.

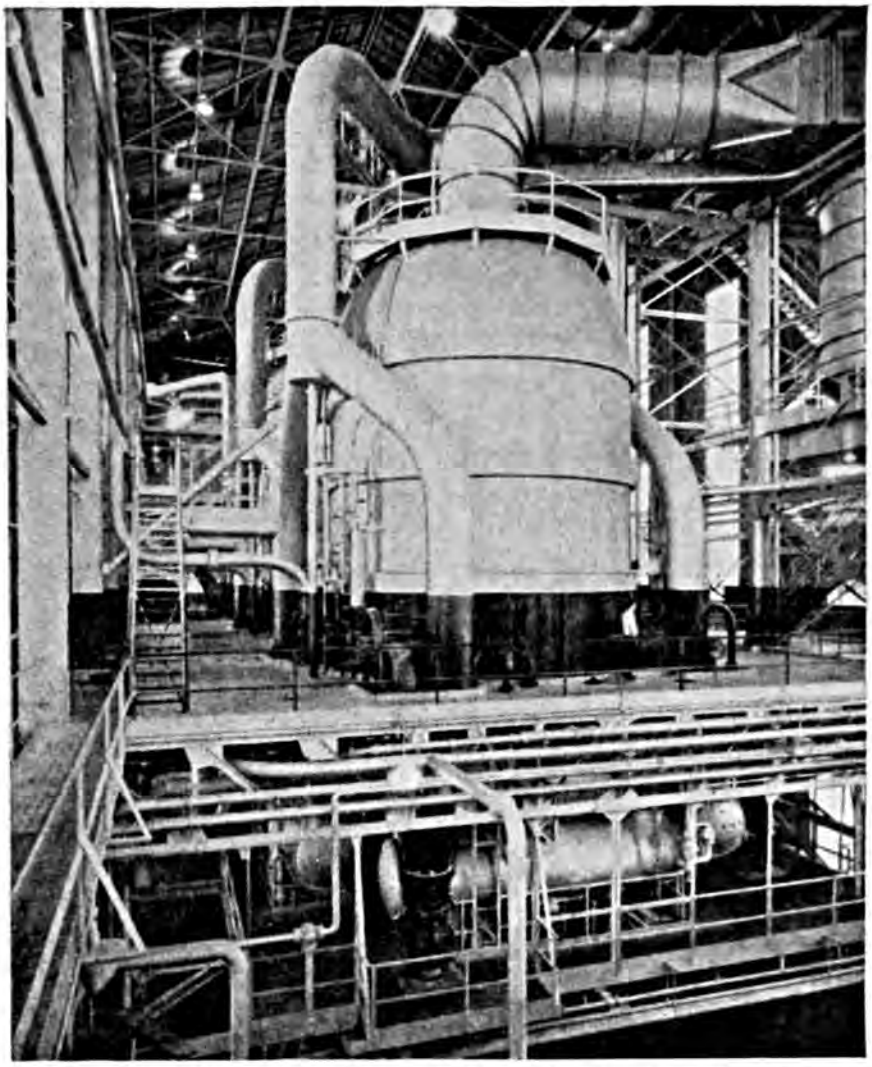


Fig. 3. Evaporator unit in the plant of the American Potash and Chemical Corporation's plant on Searles Lake, California.

As recently as 1938 we still imported 65,000 long tons of potassium sulfate from Europe. At that time we already had some production from the interaction of potassium chloride and sulfuric acid. This conversion was promoted by the Potash Company of America in collaboration with producers of salt cake, potassium chloride being substituted for sodium chloride in that process. Later the American Potash and Chemical Corporation entered upon this production through the interaction of potassium chloride and burkeite, another practical application of the phase rule. In 1939 this company announced its willingness to expand initial production to provide the essential requirements of agriculture, and proceeded to do so. This was followed in short order by the completion of the refinery of the International Minerals and Chemical Corporation with the production of potassium sulfate from langbeinite (a natural potassium-magnesium sulfate) by interaction with potassium chloride. As the result of these activities, keen apprehension as to the adequacy of wartime supplies of this form of potash so essential in the growing of quality tobacco promptly subsided.

Likewise, the interruption of European exports deprived us of our accustomed source of agricultural water-soluble "magnesia" and magnesium sulfate and sulfate of potash-magnesia, both of German origin. This situation was adjusted by the last-named company in production of "washed langbeinite," an acceptable substitute for the formerly popular sulfate of potash-magnesia.

As the war progressed, drew to a victorious close, and the Nation entered upon its reconstruction period of ever-increasing demand for agricultural products, calling for more and more potash wherewith to grow them, there was no let-up in the potash industry's efforts to meet the requirements. Thus from an output of 535,000 tons of potash salts, equivalent to 317,000 tons K_2O in 1938, the last normal prewar year, production has increased, now reaching a volume allowing a total of North American deliveries during the calendar year of 1950 of 2,579,100 tons of salts, containing an equivalent of 1,465,600 tons K_2O. (See Chart.) This potash was produced on an ever-expanding scale under the many wartime handicaps that confronted the production industries in general but without the special Federal dispensations of capital and other aids so liberally provided other industries whose products were regarded as more intimately tied in with the war effort. The chart, therefore, presents a picture of performance and of voluntary response to a national demand.

Superimposed was the task, voluntarily assumed by the producers, of supplying Canada with its requirements on terms of exact equality with our own. Added thereto were the requirements of Puerto Rico and Hawaii, of course, Cuba and the "good neighbors" to the south of us. Even "lend-lease" came to us for its quota.

Then the chemical industries, in 1938 consuming some 14,903 tons K_2O in their numerous manufactures, under the impetus of wartime demands had increased their estimated requirements to 100,000 tons K_2O by the war's end, dropping back to a peace-time requirement of 80,347 tons K_2O in 1950.

This record of performance was achieved without a price increase for the major grade, 60% muriate, making up some 90% of the total. In fact, during the period covered in this outline of the development of the American potash industry, prices decreased. Prior to 1947 potash prices were quoted C.I.F. Atlantic and Gulf ports. Since that date, they have been quoted F.O.B. point of origin. Applied is a maximum seasonal discount of 16% from the list

TABLE I. NORTH AMERICAN DELIVERIES OF DOMESTIC POTASH SALTS FOR THE CALENDAR YEARS, 1949 AND 1950

Destination	1949		1950	
	Short Tons K_2O			
Agricultural				
United States	954,943		1,077,943	
Canada	42,113		38,971	
Cuba	5,151		5,371	
Puerto Rico	14,320		22,843	
Hawaii	11,535		13,430	
Other Exports	11,040		16,313	
Total Agricultural		1,039,102		1,174,871
Chemical				
United States	66,251		79,970	
Canada	314		377	
Total Chemical		66,565		80,347
Grand Total		1,105,667		1,255,218

Fig. 4. Storage facilities and refinery of U. S. Potash Company, Carlsbad, New Mexico.

price under which most sales are made. On the old C.I.F. basis, the per-unit price of 1910-14 was 71.4 cents for muriate. By 1946 this price had been reduced to 47.1 cents (with a 12% discount applied), a reduction of 24.3 cents per unit. The 1914 price of $35 per ton for 50% muriate is comparable to the 1946 price of $28.26 per ton for 60% muriate. The increase in concentration from 50% to 60% represents a corresponding decrease in transportation charges per unit K_2O. With an average primary freight charge of $13 per ton from the potash refineries to the fertilizer mixing plants, from which it is distributed on the retail basis to the farm, the 60% grade of muriate represents a saving in freight of some five cents per unit K_2O as compared to the 50% grade. The current F.O.B. price under the 16% discount is 35.3 cents per unit for the 60% grade of muriate. As compared to the former C.I.F. price this is a further reduction at many points of delivery.

Thus, on the basis of the production and price records, it would appear that the claim is justified that the American potash industry has shown its entire competence to meet all of the Nation's more essential needs for potash salts for the agricultural and chemical industries, during not only the critical period of World War II but also subsequent years.

The distribution of the 1950 output of potash salts is shown in the tabulation of Table I together with that of 1949 introduced for the sake of comparison.

With reference to potash importations from Europe, it was expected that they would reappear with the progress of reconstruction in the European areas of production. For the total of North American potash supplies shown in Table I there should be added imports of 40,126 tons K_2O in 1949 and 210,381 tons of K_2O in 1950. The item "Other Exports" relates to shipments to countries other than those mentioned in the title of the above tabulation. Since potash prices in the United States are the lowest of all world markets, it is apparent that only unsold surpluses abroad, which do not exist, or the quest of dollar credits here would be a sufficient incentive for exports to this country in any great volume.

As to the distribution of the American output within the Continental

United States, during 1950 potash salts were distributed by the primary producers to 46 states and the District of Columbia, which may be taken as the prevailing pattern. In that year Illinois and Ohio led with receipts of 114,300 and 104,900 tons K_2O respectively, followed in order by Georgia, Virginia, Florida, Maryland, North Carolina, and Indiana, each exceeding 70,000 tons K_2O in receipts. State deliveries, however, cannot be taken as synonymous with state consumption, for the following reasons: Currently, potash salts are sold wholesale and in car lots to the fertilizer mixing industry which functions as the retail agency distributing the potash to the ultimate consumer, the farmer, principally as a constituent of mixed goods, some 95% of the total being so distributed. From the larger mixing plants, the products frequently are shipped across state borders into neighboring and sometimes quite distant states where the potash contained therein finds its ultimate consumption in the fertilization of crops. In such situations, therefore, state consumption may vary widely from state deliveries.

These mixtures, commercial fertilizers, as is well known, are carriers principally of the major crop nutrients, compounds of nitrogen, phosphorus, and potassium, to which frequently are added the minor, but still essential, nutrients such as magnesium, boron, and others. These mixtures are compounded in various ratios as determined by such factors as crop requirements as indicated by official state recommendations, the nutritive status of the soils on which grown (as determined by soil tests), the availability of supplies, and in too many situations habit and tradition. Under this system the potash content may vary from 0 to 30% K_2O.

Yet, despite the record of production and distribution, as herein related, there are potash demands that remain unfilled, articulate from those who want more and silence from those who have enough, providing no basis whatever for gauging the dimensions of the deficit in supply. Surprise that the market has increased as it has in view of the increased production that has taken place is frequently expressed.

Several factors are responsible. Foremost is the phenomenal increase in gross farm income, in 1948 reaching the record total of $31 billion. To provide contrast, this is to be compared to the gross farm income of $9.4 billion in 1938. It is a matter of statistical record that the farmer's expenditures for fertilizers rise and fall with his income and in a close ratio thereto, which is to say that he habitually spends for fertilizers so many cents out of each dollar of income, varying widely be-

(*Turn to p.* 41)

Fig. 5. Heavy equipment for removing potash salts from large stock piles in storage, American Potash and Chemical Corporation's plant on Searles Lake, California.

Know Your Soil

IX The Cecil Series

By J. B. Hester

Soil Technologist

Campbell Soup Co., Riverton, New Jersey

THE Cecil series is an important soil occupying the lower Piedmont section and is very extensive in scope. It is developed mainly from ancient crystalline rocks. Three predominating factors influence the type of soil developed, namely, parent material, climatic conditions, and age. Some rocks decompose into soil structural material faster than others. The igneous rock material is made up of feldspar, quartz, amphiboles, pyroxenes, mica, and accessory materials and are developed into soil comparatively slowly.

In a former article the Penn series was discussed. This series is also developed from crystalline rock material but mainly from red shale and sandstone which are more easily and readily decomposed. The two soil types, however, are comparable in many ways. In the first place, both soils are extremely acid, carrying a pH value below 5.5 and frequently below 5.0. Either soil can be comparatively deep, depending upon the extent of erosion and degree of weathering.

The surface soil of a Cecil sandy loam in cultivated fields is light grayish-brown or yellowish-brown, loose, friable, light sandy loam from 4 to 6 inches thick. In forested areas one will find a thin covering of partly decomposed organic debris on the surface, and the topmost 2 or 3 inches of the surface soil are dark grayish-brown, mellow sandy loam that contains a fair quantity of organic matter and is well matted with roots.

The upper part of the subsoil is stiff

Fig. 1. Typical granulated, weathered profile of the Cecil series.

Fig. 2. Possible one-season erosion.

but brittle red clay containing a small quantity of sharp quartz grains. It is sticky when wet, but when dry it is hard and breaks into irregular clods that are easily crushed to a friable, crumbly mass. It is permeable to air and water, and roots readily penetrate it. At a depth of 24 to 30 inches this soil becomes a light red and yellowish-red, friable clay or clay loam. At a depth of 36 to 40 inches it is underlain by light red, soft, disintegrated, and partly decomposed gneiss and other crystalline rock materials that are mottled or streaked with yellow, brown, and gray. This material rests on bedrock at a varying depth. The mica content of these soils varies, but one can usually find a noticeable quantity of mica flakes in the lower part of the subsoil.

It has always been interesting to the author to observe the softness and purity of the water obtained from underneath these soils. In 1925 the author made an analysis of well and spring water found on the Cecil series. This water contained 28 parts per million (ppm) of silica, 1 ppm of iron and aluminum sesquioxide, 14 ppm of sodium chloride, 15 ppm of potassium sulfate, 4 ppm of calcium carbonate, 7 ppm of magnesium carbonate, and 31 ppm of calcium sulfate. It might be interesting to know that it was necessary to evaporate several liters of this water for analysis as compared with a few hundred milliliters for most water analysis. The total hardness of this water was less than 0.04 parts per liter, meaning that the water is extremely soft. In fact it is very difficiult to remove the soap from one's body while bathing in this water.

The total analysis of some of the soils of the Cecil series reported by the U. S. Department of Agriculture indicates that the total calcium is extremely low, it being reported in many cases as a "trace" or less than 0.1 per cent. The magnesium is also low, but the potassium, sodium, iron, aluminum, and silica are high. These soils carry considerable titanium and manganese, but small amounts of phosphorus and sulfur.

These soils weather into a granular, fine, clay material which is terrifically subject to erosion. The granular nature of the soil is shown in Figure 1. The possible erosion within a single year is shown in Figure 2, and the terrific susceptibility to erosion over a period of time is shown in Figure 3.

The principal methods of holding this soil in place are by the use of sod crops, terraces, and the interplanting of pine, kudzu, and other deep-rooted plants. When there were a large num-

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Fig. 3. Possible gully erosion resulting from improper control of run-off water.

Fig. 1. Chlorotic field of sorghum—arrow indicates plants sidedressed with sulfur-manure-iron sulfate mix.

Lime-induced Chlorosis on Western Crops

By W. T. McGeorge

Arizona Agricultural Experiment Station, Tucson, Arizona

IN Western lands a large percentage of the soils are calcareous—that is, they contain rather large amounts of $CaCO_3$. Calcium carbonate is mildly alkaline of itself and therefore these soils usually exhibit pH values of 7.5 to 8.2 and higher when sodium salts are present, which they usually are.

Many crops show a definite preference for a limited pH range in soils and thus it follows that some will show a dislike for the calcareous Western soils. They show nutritional troubles which are manifested by variable plant behavior. Prominent among these is one in which there is a loss of chlorophyll and it is usually associated with a micro-nutrient element deficiency. The most common of these deficiencies are iron, zinc and manganese and each, when deficient, is supposed to show a definite chlorotic pattern which is used to identify the deficiency.

Deficiencies of these elements have frequently been found in non-calcareous soils but rarely in alkaline-calcareous types. In the latter soils it has been shown that $CaCO_3$ and the accompanying alkalinity contribute to the display of deficiency symptoms. Thus the prevalence of chlorosis on plants

Fig. 2. Close-up of sorghum leaves: left, mildly chlorotic; center, leaf from plant sidedressed with sulfur-manure-iron sulfate mix; right, severely chlorotic.

growing in calcareous soils has become known as limestone or lime-induced chlorosis. Obviously the problem is different from the simple soil deficiency in non-calcareous soils and probably more complex.

Lime-induced chlorosis in Arizona is typical of the problem as it occurs in the West. Agriculture is largely confined to irrigated valleys and practically all the soils in these valleys are calcareous. Chlorosis is present in varying degrees from mild chlorotic patterns to "dieback". The complex nature of the problem is illustrated by the variable tolerance within plant varieties. This is true for both orchard and field crops.

Approaching the Problem

The usual approach to the study of any nutritional problem is by a chemical analysis of the plant despite the fact that this only adds to the confusion unless the deficiency is great. Too little is known about what represents a nutrient deficiency in the marginal range. The analyses of several hundred leaf samples—green, slightly chlorotic, and severely chlorotic—representing many crops in Arizona have shown no difference between iron and zinc in green and chlorotic leaves. Strange to say there is evidence of less manganese in chlorotic than green leaves but this is for the iron and zinc deficiency patterns.

All the evidence from this phase of the study pointed to the deficiency as being physiological rather than actual. There is no evidence of a deficiency in the soil and likewise none that $CaCO_3$ and the accompanying alkalinity reduce the uptake to the point where it is inadequate. The problem appeared to be one of determining why certain plants exhibit micro-nutrient element deficiency symptoms when grown in calcareous soils.

A seedling technique, similar to the Neubauer nutrient deficiency test for soils, was selected for such a study. It has the advantage of being rapid, quantitative, and a method by which ion transport can be studied by separate analyses of roots and tops. Briefly the method involves growing 100 rye or barley seedlings in 100 grams of soil for 17 days. The plants are then

TABLE I. SEEDLING EXPERIMENT—FE, MN, ZN MGMS. PER 200 SEEDLINGS

	Roots	Tops	Root: top ratio
		Iron (Fe)	
Severely chlorotic soils	4.22	0.27	15.6
Slightly chlorotic soils	2.49	0.18	13.8
Non-chlorotic soils	2.46	0.24	10.2
		Manganese (Mn)	
Severely chlorotic soils	0.42	0.16	2.6
Slightly chlorotic soils	0.32	0.16	1.4
Non-chlorotic soils	0.32	0.18	1.7
		Zinc (Zn)	
Severely chlorotic soils	0.21	0.19	1.1
Slightly chlorotic soils	0.18	0.16	1.1
Non-chlorotic soils	0.20	0.16	1.3

washed free of soil and ashed for analysis, roots and tops separately.

The Cause

First this technique was used to determine the comparative availability of iron, manganese, and zinc in calcareous and non-calcareous soils. The tests were quite informative, for the seedlings indicated that there is no evidence to support the belief that plants cannot obtain a supply of micro-nutrient elements, from calcareous soils, which is adequate if other conditions are normal. The uptake of iron, zinc, and copper was just as much or more from calcareous soils as from non-calcareous soils. Manganese uptake was only slightly less.

To put the technique to a further test it was applied to soils from severely chlorotic, slightly chlorotic, and non-chlorotic citrus orchards. Here again the results obtained were quite illuminating. This is shown by the figures given in Table I. Iron, manganese, and zinc values are given as mgms, per 200 barley seedlings.

The seedling experiment from which the data given in the table are taken shows that the average iron content is highest for the seedlings grown in soils from the severely chlorotic orchards. The data show that the major part of the iron is held in the roots and that this is in proportion to the severity of chlorosis exhibited by the citrus trees growing in these soils. Further evidence of this is shown by the root: top ratios given in the last column of the Table. The manganese and zinc values also show a greater uptake of these two elements from the severely chlorotic soils. The root: top ratios for manganese and zinc show little or no fixation of these in the roots. In this way they differ from iron and this explains why the iron deficiency pattern is the dominant pattern in lime-induced chlorosis. The calcareous soil does not materially disturb the transport of manganese and zinc within the plant as it does the iron transport.

This experiment gave further proof that there is no evidence of failure of plants to obtain iron, manganese, and zinc from these calcareous soils. If a micro-nutrient deficiency is a true deficiency for plants growing on these soils, the data suggest that it is one of inactivity or failure to function within the plant itself. Obviously it is an inherent characteristic of some calcareous soils to cause an accumulation of residual or inactive iron at the expense of the active iron fraction.

The investigations presented up to this point show quite definitely that iron is the element which is primarily concerned with lime-induced chlorosis. In an attempt to obtain further information on this, the solubility of iron in dilute HCl, as proposed by Oserkowsky, was determined. In a study of chlorosis of pear leaves he found no relation between total iron content and chlorophyll but a definite relation between chlorophyll and the iron fraction soluble in dilute HCl. He designated this soluble iron as the iron active in chlorophyll formation. Using the Oserkowsky method, our investigation began to crystallize. A very definite correlation was found between the HCl soluble iron in seedlings grown in chlorosis-producing and non-chlorosis-producing soils. There was more active iron in the latter. The highly calcareous soil and its accompanying alkalinity caused a build-up of inactive iron in the roots and to a lesser extent in the tops. All the seedlings showed an active and an inactive iron fraction, but only in the seedlings grown in the severely chlorotic soils does the inactive fraction become dominant.

The seedling technique showed that lime-induced chlorosis is caused by a reduction in the active iron fraction within the plant. It is not a true iron deficiency but a physiological deficiency in which the high calcium carbonate content of the soil and its accompanying alkalinity make a major contribution. It is of interest that iron is the only micro-nutrient which accumulates, in excess, in residual or inactive form.

Calcium: Potassium Balance

The question naturally arises regarding the part that the excess of calcium carbonate plays in lime-induced chlorosis. The chemical analyses of plants growing in highly calcareous soils show quite consistently a disturbed calcium: potassium balance. This is especially true for the leaf analyses of orchard crops. The Ca:K balance was studied, using the seedling technique, and rather informative data were obtained.

The barley seedlings grown in chlorotic soils absorbed an excess of calcium and this greatly reduced the uptake and reserve supply of potassium in the roots, increasing the Ca:K ratio. Normally the roots of seedlings contain more potassium than calcium but for

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Fig. 3. Left, control tree—chlorotic; right, treated tree—plugged with iron citrate in trunk.

Fig. 1. The speaker at the microphone is giving instructions and a lecture on soil conservation and improvement to about 750 vocational agriculture students and teachers as this contest got under way.

Oklahoma's Contests in Soil Conservation [1]

By Harley A. Daniel

Soil Conservation Service, Guthrie, Oklahoma

RECOGNIZING experience as the best teacher, soil conservationists of the U. S. Soil Conservation Service and the Oklahoma A. and M. College have worked out a contest system of teaching soil conservation. It is designed to give farm people a new approach to farming the soil-conservation and land-improvement way. And, although 4-H Clubs, Future Farmers of America, and Veterans Agricultural Trainees are taking part in most of these courses and exercises, here and there are groups of adult farmers who are getting much useful information from similar activities.

[1] Contribution from U. S. Soil Conservation Service and the Oklahoma A. and M. College.

The purpose of the schools and contests is to teach the student to put each piece of land to the use for which it is best suited and treat it according to its needs for controlling erosion and improving fertility. In fact, all the practices and treatments necessary for developing and maintaining a permanent agriculture are stressed, says Louis E. Derr, State Soil Scientist of the U. S. Soil Conservation Service.

Contests of this nature have grown out of the 4-H Club and Future Farmers of America soil-conservation schools that have been held annually at the Red Plains Conservation Experiment Station, Guthrie, Oklahoma, since 1941. However, the contest held recently was

TABLE I.—LAND JUDGING PLACING SHEET

1. (Name or No.)........................	Score Part 1 ....
2. (Address)........................	Score Part 2 ....
3. (County or)........................	
4. (Group No.)........................	
5. ( )........................	TOTAL SCORE ....

Part 1—Soil.

Field No.	Surface texture	Subsoil permeability	Depth of surface soil and subsoil	Slope
	......Coarse ......Medium ......Fine	......Very slowly permeable ......Slowly permeable ......Permeable ......Freely permeable	......Deep ......Shallow ......Very shallow	......Nearly level ......Gently sloping ......Rolling ......Steep ......Very steep

Erosion		Drainage	Land capability Class No.
Wind	Water		
......None ......Slight ......Moderate ......Severe ......Very severe	......None ......Slight ......Moderate ......Severe ......Very severe	......Good ......Poor	I II III IV V VI VII VIII

Part 2—Recommended treatment.

□ □ □ □ □ □ □ □ □ □ □ □ □ □

nothing like the event we held nine years ago. Up to that time we held field days which were more in the nature of a school, identifying plants and studying soil profiles. But, we recognized the need for some simple and practical method of teaching soil conservation. We observed the fact that youths who were winners in livestock contests emerged somewhat in the role of heroes. A thought occurred that something should be done to glamorize our soils in the same manner. We worked at it—many people were responsible for the development of our present contest, and a large part of the credit goes to Edd Roberts, Extension Soil Conservationist, Oklahoma A. and M. College, and Sam Lowe, District Conservationist, U. S. Soil Conservation Service.

In 1949, contests of this nature were held for the first time at the Wheatland Conservation Experiment Station, Cherokee, Oklahoma. During the 4-H Club and FFA soil-conservation contests that were held at these two stations, more than 1,200 youths participated and learned about soil conservation. Roberts says that during the last year and a half he has taught soil conservation by this method to over 15,000 FFA and 4-H Club members and adult farmers in Oklahoma.

Schools and contests usually take all day. Mornings are devoted to study of soil conservation and improvement; afternoons are set aside for the contest. The participants are divided into small groups and taught to identify soils, classify land, and to recommend the treatments necessary for a soil-conservation and land-improvement program.

Depth of Soil

Four fields, numbered 1, 2, 3 and 4, with different land-capability classes, are generally used in the contest. They are selected by soil scientists in accordance with the land-capability classification developed by the Soil Conservation Service. In each of these fields a hole is dug through the topsoil and into the subsoil to enable contestants to observe the depth. Samples of topsoil and subsoil are piled close by for the contestants to observe.

In the case of cultivated land or that being retired from cultivation, the original depth and other soil conditions are given each contestant as he visits the field. From observation he then decides whether the soil is deep, shallow, or very shallow. By feeling the soil he determines whether texture is sandy, loamy, or clayey. Permeability is determined by feeling and observing whether the soil is loose or tight. In this way he classifies it as being very slowly permeable, slowly permeable, moderately permeable, or rapidly permeable. He then observes the topography of the land and decides if it is nearly level, gently sloping, moderately sloping, steep, or very steep. Then he examines the topsoil that is left to determine the amount of damage from wind and water and decides if erosion is very severe, severe, moderate, slight, or none. The last factor he considers is whether the land has good or poor drainage. From all these factors he places the land in its proper capability class (Table I).

Land Treatment

Land treatment for these four fields is next in the soil-conservation and improvement program. Some land needs fertilizers. Therefore, a sign showing results of a previous soil test is set up in each field indicating whether or not it needs lime or mineral fertilizers.

Contestants have a sheet listing pos-

Fig. 2. A trophy given by the Southwestern Livestock Conservation and Production Clinic of the Oklahoma City Chamber of Commerce is being presented to Ralph Dreesen, Vocational Agriculture Teacher, Guthrie, Oklahoma (left), and his team of FFA boys who won the contest in competition with teams from 41 other schools.

TABLE II.—LEGEND FOR LAND TREATMENT

Treatment: (Cropland)

1. Terrace and farm on contour
2. Farm on contour
3. Construct a diversion terrace
4. Maintain terraces each year
5. Crop rotation including legumes every fourth or fifth year
6. Crop rotation including sowed crops and legumes every third or fourth year
7. Crop rotation of sod-like crops of small grains and legumes and grasses for hay or pasture
8. Apply mineral fertilizers
9. Apply lime
10. Use mixed fertilizer
11. Apply available barnyard manure
12. Do not burn crop residue
13. Return to vegetative cover (grasses or clovers)
14. Stripcropping for wind erosion
15. Mulch tillage to conserve soil and water
16. Install drainage system
17. ....
18. ....
19. ....

Treatment: (Land to be retired from cultivation)

20. Plant to tall grasses
21. Plant to Bermuda and adapted clover combination
22. Plant to adapted clovers only
23. Plant to tall and medium tall grass mixtures
24. Plant to short grasses
25. Apply phosphate
26. Apply lime
27. Mow pasture to control annual weeds
28. Spray pasture to control perennial weeds
29. Construct diversion terraces
30. Install drainage system
31. Apply deferred grazing
32. Apply gully-control work
33. Protect from burning
34. Control grazing
35. Provide noncompetitive cover for wind-erosion control
36. Soil-conditioning crop (legume)
37. ....

Treatment: (Native pasture land)

38. Overplant adapted clovers
39. Apply mineral fertilizers
40. Apply lime
41. Mow pasture to control annual weeds
42. Spray pasture to control perennial weeds
43. Construct diversion terraces
44. Apply deferred grazing
45. Prevent burning of vegetation
46. Overplant with native grass seed
47. Apply brush eradication
48. Control grazing
49. ....
50. ....

sible treatments for cultivated land, for land retired from cultivation, and for pasture land (Table II). Each recommended treatment is numbered on the test sheet. For each field the contestant marks the number indicating the specific treatment beside the number of the field. For example, the cropland lists 14 practices which may apply to the various fields, and the contestant selects the number of these practices which apply to this particular field. In all, there are 46 practices listed for the different types of land. This procedure continues until each of the fields in the contest is classified and the land treatment necessary to conserve the soil and keep it productive is determined.

After the contest is over, scores are added and the winners determined from the tabulating card (Table III). Winners may be teams or individuals. A perfect score for each field is 50 points. When four fields are used, a perfect score is 200.

Soil-saving and land-use training of this type will bring about a greater appreciation of the land and thereby will expedite the conservation program on the land.

TABLE III.—TABULATING CARD FOR LAND-JUDGING CONTEST

....
Contestant's No. Group No.

Name..............................

Address..............................

County..............................

	Sheet No. 1	Sheet No. 2
Field No. 1		
Field No. 2		
Field No. 3		
Field No. 4		

TOTAL SCORE..............................

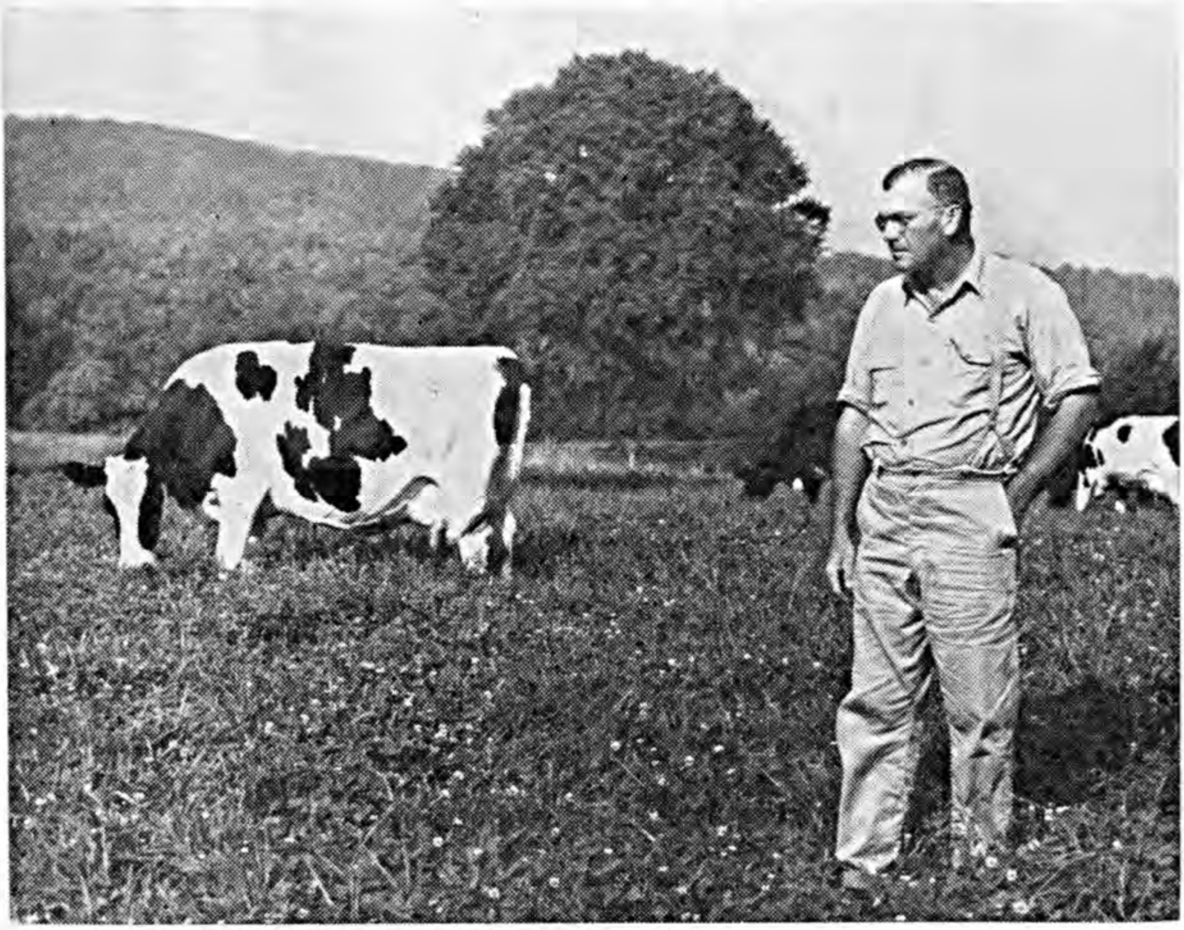

Fig. 1. Walter Hurlburt watches his 12,000-pound Holsteins on his prize-winning pasture.

Home-bred Holsteins Make the Grassland Champion[1]

By Ben Brown

Brattleboro, Vermont

NO matter how greatly you improve your pastures, you can't sell grass in the public market. Before that grass, regardless of its verdure, turns to cash, it must be transformed into human food. Walter Hurlburt of Ashley Falls, Berkshire Co., Mass., westward near the Housatonic River and near the Connecticut line, like the Dutch dairymen of old, has found Holstein dairy cows to be the best "converters" of grass to dollars.

Last year, 1950, Mr. Hurlburt was named winner of the New England Green Pastures Contest. The honor is no small achievement. Competition is stiff and his winning pastures represent many hours of hard work, constant study, and careful management.

Walter has been a "pasture man" for 15 years. Even so, it took him until last year to cop top honors. When

[1] Reprinted from Breeder's Gazette.

the contest began three years ago, under direction of Lewis Zehner of the Federal Land Bank in Springfield, Mass., the best Walt could do was to get "mention" in his county. He's had "mention" of some sort ever since, but this year he not only topped his county, but his state as well, and finally took the hard-sought regional crown. Since the contest has grown into friendly rivalry between the six state governors of the region, the honor makes Walt top man in the eyes of Gov. Paul A. Dever, and the whole Bay State is proud of him.

A Professional Farmer

To Walter Hurlburt, however, the honor plays second fiddle to the main benefit his pastures represent:

He is a professional farmer and Holstein breeder.

His whole livelihood is wrapped up in his milk production and seed-stock sales.

If the contest were staged for glory alone, Walter Hurlburt would have neither the time nor the required investment to compete. It just so happens that the goal of the contest is also the goal that Walt would strive for, contest or no. For he has long since recognized that the production of his herd (and his net profit at year's end) depends directly on the amount and quality of the roughage he produces.

To you cornbelt farmers, Walt's 300-odd acres may sound pretty spacious. But in Ashley Falls, under the shadow of Mt. Everett, second highest point in the State, a good share of those acres would challenge a mountain goat. Timber, rocky ledges, and mountains take up all but 135 acres of Hurlwood Farm, leaving Walt very little land to support his hungry 100 head of Holsteins. His problems are resolved under two main headings:

(1) Taking 135 acres in small, odd-shaped plots and making them produce the maximum of pasture, hay, and silage.

(2) Seeing to it that every cow in the barn is a top producer, and that she makes the best possible use of the roughage he can raise.

Excellent pasture management has solved the first of these.

Registered Holsteins and a superb homebred breeding program have solved the second.

First of all, then, let's see how Walter Hurlburt makes those pastures grow.

Plans Ahead

Mapping the farm is first. Each and every little plot is tested and studied. Then the proper "crops" are sown and the all-important rotation begins.

Walt starts his cows out on rye in the early spring. Then they go onto young wheat. By this time the early ladino acres are ready. These fields are rotated until silo-filling time when the cows go onto the oats. While they're munching these, out go the field choppers and the silos are filled with grass silage from the early fields. Walt believes in taking grass silage while it's very young, and last year he had all his grass silage in by the first of June.

Next the cows are rotated according to the feed available. What's left makes 2nd and 3rd cutting hay—baled and stowed away.

Fields are clipped every time they're pastured . . . clipped down close to control natural grass and weeds. This makes a thicker stand.

A couple of fields (on mountain tops and otherwise unsuited to pasture) are planted to alfalfa and used for hay. Both the ladino and alfalfa stands are seeded with brome mixture. The very wettest land goes into reed canary grass with some of this in ladino as well. Walt says ladino will grow in wetter spots than most folks realize.

When the silos settle later on in the year, they are filled with sudan. Walt needs every inch of silo space and in this way he fills all silos right up to

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PICTORIAL

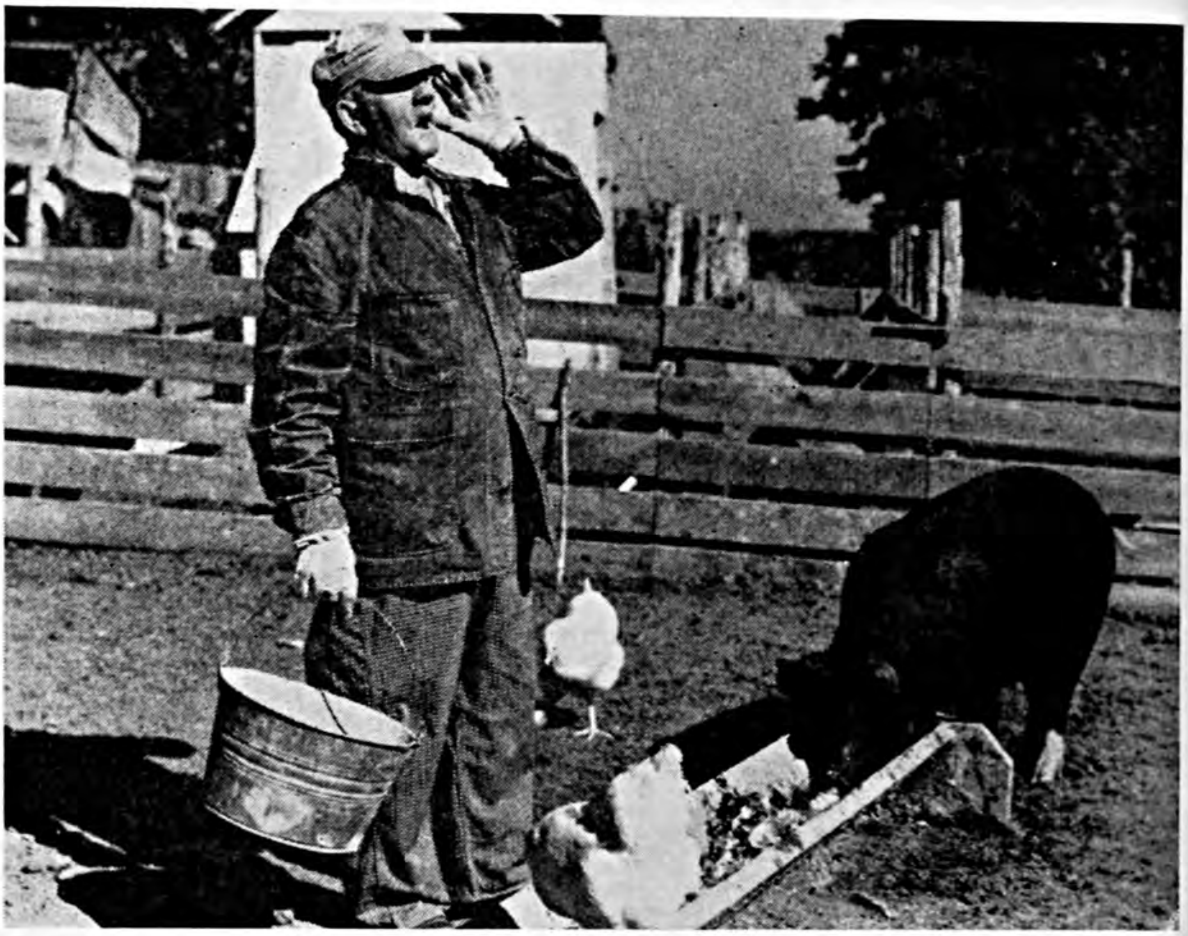
Pals!

Above: So soft to handle.

Left: Follow the leader.

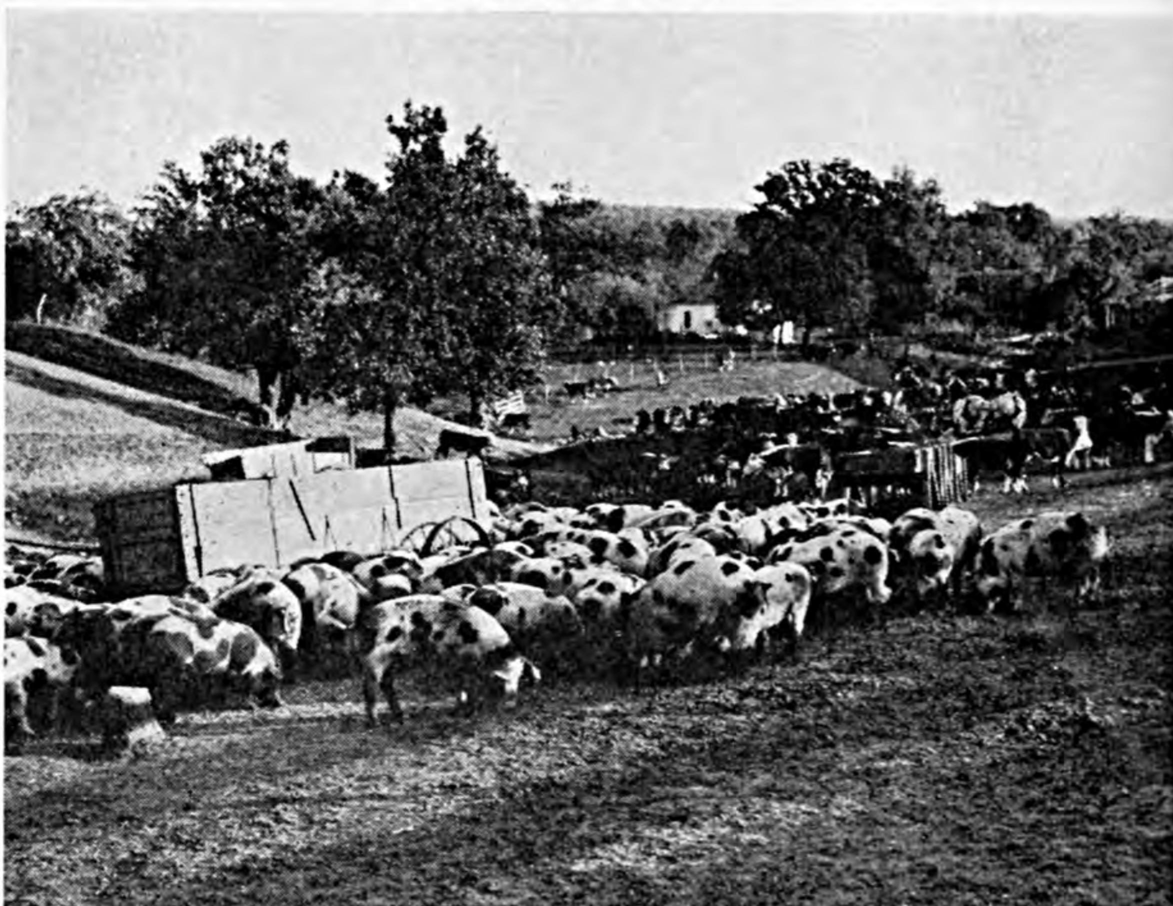
Right: Chores never cease.

Below: Home with the groceries.



Above: First come, first served.

Below: More pork and beef.



The Editors Talk

Fertilizing Corn 100 Years Ago

The spring issues of our agricultural journals have contained many excellent articles on recommended practices for the growing of corn, our most important feed crop. Here is a little item that appeared in "The Cultivator" Vol. 1, No. 2, p. 79, Feb. 1844, in which the editor reported a good yield and then added a few editorial comments:

"Another example of a good crop of corn is that of Mr. Bugbee of Palmer, Mass., who raised from five acres of land 540 bushels, or 108 bushels per acre. The following is the account given by Mr. B. of his mode of culture:—'Last spring I plowed up a piece of green sward, measuring about five acres, and prepared it for corn as well as my means would permit. After plowing, 30 loads of manure to the acre were spread over the ground, and thoroughly mixed with the earth by means of the harrow, without turning up or breaking the sod. The ground being now prepared, on the 30th of May I planted my corn. A small quantity of ashes, lime, and plaster of paris, mixed together and prepared for the purpose, was used at the time of planting, or put in each hill. Of this mixture, there were 2½ bushels of lime, 2½ bushels of plaster, and 25 bushels of ashes for the 5 acres. The corn was hoed but twice, a third hoeing being unnecessary.'

"This crop affords another of the many proofs already existing of the excellent effect of such a compost of lime, plaster and ashes, especially on inverted sward, as that prepared by Mr. B. Those farmers who sell off their ashes, and harvest corn crops of only 30 or 40 bushels per acre, would do well to imitate Mr. B. in the use made of his."

Defense Work

American agriculture's big defense is on again—defense of the Nation's supply of food and fiber against the hoards of insects which appear each year to threaten the anticipated yields of crops for which so much planning, time, effort, and money for seed and fertilizer already have been spent. In addition there are the diseases and weeds to combat. It has been estimated that the annual toll taken by insects is around 25 per cent of the total crop values; by diseases, around 15 per cent. No reliable estimate is available for the losses from weeds, but it is known that they are great. In terms of dollar income, it is estimated that the annual loss from insects is 4 billion dollars and from diseases 2½ billion. Income losses due to lack of weed control would add another several billions.

Thanks to constant research in effective "ammunition" and the means of projecting this "ammunition in combat," there has been a resulting decrease in costs, time, and labor involved in crop protection. According to the Farm Equipment Institute, many new improvements in agricultural chemicals for controlling crop pests have occurred since World War II and the accompanying changes in spraying and dusting equipment have made pest control measures cheaper and easier to apply. Any crop yields obtained by the extensive use of spraying and dusting equipment to control pests will take less time, labor, and materials to produce than additions from extra acres, and the quality of the harvested crops can also be materially improved.

That there is still much to be done in the mobilization for this defense is seen in the opinion of Dr. Robert M. Salter of the USDA's Agricultural Research Administration to the effect that the potentialities of chemicals in agriculture at this time are comparable to those typified by hybrid corn 12 years ago. Our teachers and extension forces are playing an important role in keeping up with the new procedures and seeing that they are adopted wherever practicable. On these hard-working advisers is resting a big share of the responsibility for the success of this year's agricultural defense work. Everyone should help them in every way possible.

What a Farmer Does

Recent concern over the drafting of young men from farms for the military services has brought new insight into the complexities of farming and the skills involved. As set down by the Labor Department for the guidance of Selective Service Boards, a farmer—

> "Performs without supervision a wide variety of the following skilled tasks in commercial agricultural production where applicable to the particular type of farm on which he works; or supervises workers of lesser skill; prepares soil for planting by plowing, harrowing, and fertilizing; seeds, cultivates, and harvests crops. Irrigates arid lands and practices erosion control. Plants, sprays, and prunes fruit trees. Cares for livestock. Operates, repairs, and maintains farm implements and mechanical equipment, such as tractors and electric motors, combines, gang plows, ensilage cutters, corn and cotton pickers, milking machines, and hay balers, used in the production of crops, such as grain, vegetables, hay, fruit, cotton, and/or livestock, poultry, and their products. Repairs farm buildings, fences, and other structures. On specialized farms, such as dairy or livestock farms, performs such tasks as scientific feeding and selective breeding, rotating pastures, operating and maintaining dairying equipment, sterilizing containers and equipment, and maintaining sanitary conditions in barns. Knows over-all operations including when, where, and how crops should be planted, cultivated, sprayed, and harvested. May determine when and where products will be marketed. Trains and supervises casual and seasonal workers during planting and harvesting."

This looks like, and is, a formidable fund of knowledge to accord young men of draft age. However, it must be remembered that these farm boys have grown up in it, gaining their experience as they go along. They are not like their city friends who from the ages of 18 to 25 are just completing their educations or beginning to learn their trades and professions.

It would take many seasons in an "agricultural boot camp" to train replacements in what a farmer does.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay[1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941...........	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942...........	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943...........	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945...........	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946...........	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947...........	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948...........	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949...........	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
May.........	29.24	48.5	128.0	228.0	134.0	204.0	17.25	45.20	....
June.........	29.91	49.7	127.0	211.0	136.0	193.0	16.05	46.20	....
July.........	33.05	45.5	127.0	208.0	144.0	199.0	15.15	52.00	....
August.......	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September....	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October......	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January......	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February.....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March........	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April........	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
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	89	81	109	74	87	110
1938...........	69	196	80	79	76	64	57	97	88
1939...........	73	154	100	84	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	105	117	107	82	211	129
1942...........	153	369	168	134	143	124	91	202	163
1943...........	160	405	188	235	174	154	125	231	245
1944...........	167	420	214	216	170	160	139	234	212
1945...........	181	366	205	232	198	170	127	227	207
1946...........	263	382	178	248	212	209	141	319	182
1947...........	257	380	232	248	336	259	148	381	226
1948...........	245	482	222	253	201	226	155	298	214
1949...........	231	463	184	244	210	210	139	192	201
1950									
May.........	236	485	184	260	209	231	145	200	178
June.........	241	497	182	240	212	218	135	205	182
July.........	267	455	182	237	224	225	128	231	200
August.......	298	531	175	248	224	223	130	314	164
September....	322	554	151	219	224	219	131	349	126
October......	314	551	123	175	213	216	134	361	138
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January......	333	459	141	221	240	236	150	448	324
February.....	337	325	148	233	249	250	155	443	333
March........	345	266	154	236	249	240	155	457	265
April........	348	253	161	231	252	242	155	457	225

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
May	3.00	2.05	10.74	11.97	10.14	7.59
June	3.00	1.71	10.55	10.79	9.41	7.36
July	3.00	1.71	11.53	10.71	9.35	8.74
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35

Index Numbers (1910-14 = 100)

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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
May	112	72	307	339	301	216
June	112	60	301	306	279	209
July	112	60	329	303	277	248
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322

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
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
May	.760	3.76	5.47	.375	.720	14.50	.200
June	.760	3.76	5.47	.336	.647	12.77	.176
July	.760	3.76	5.47	.368	.704	13.98	.193
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.75	5.47	.368	.704	13.98	.193
October	.760	3.73	5.47	.386	.704	13.98	.193
November	.760	3.73	5.47	.386	.732	14.72	.193
December	.798	3.73	5.47	.420	.796	16.00	.210
1951							
January	.810	3.73	5.47	.420	.796	16.00	.210
February	.810	3.73	5.47	.420	.796	16.00	.210
March	.810	3.73	5.47	.420	.796	16.00	.210
April	.810	3.73	5.47	.420	.796	16.00	.210

Index Numbers (1910-14 = 100)

1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
May	142	104	112	68	76	60	83
June	142	104	112	63	68	53	80
July	142	104	112	67	74	58	82
August	142	104	112	67	74	58	82
September	142	104	112	67	74	58	82
October	142	103	112	70	74	58	82
November	142	103	112	70	77	61	82
December	149	103	112	75	84	66	85
1951							
January	151	103	112	75	84	66	85
February	151	103	112	75	84	66	85
March	151	103	112	75	84	66	85
April	151	103	112	75	84	66	85

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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
May	247	244	228	132	91	311	142	72
June	247	245	230	126	85	293	142	66
July	263	247	238	128	85	301	142	70
August	267	248	243	131	85	321	142	70
September	272	252	247	131	85	324	142	70
October	268	253	247	131	85	323	142	73
November	276	255	251	132	85	328	142	74
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78
March	311	272	269	142	91	357	151	78
April	309	273	267	141	91	353	151	78

* U. S. D. A. figures, revised January 1950. 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] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] 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 is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 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

"Thirteenth Annual Report of the Arizona Fertilizer Control Office Fertilizers and Agricultural Minerals Year Ending December 31, 1950," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Spec. Bul., Feb. 1951.

"The Fertilizer Manufacturing Industry 1949," Dom. Bur. of Stat., Dept. of Trade and Commerce, Ottawa, Ont., Can., Vol. 2—Part XVIII-C-1.

"Fertilization of Red McClure Potatoes in the San Luis Valley of Colorado," Agr. Exp. Sta., Colo. A & M College, Fort Collins, Colo., Tech. Bul. 43, Jan. 1951, R. Kunkel, R. Gardner, and A. M. Binkley.

"Chemical Fertilizers vs. Organic Matter For Maximum Production of Nutritious Crops," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Jan. 1950, R. H. Bray.

"Nitrogen Top Dressing of Wheat in the Pocket Area," Ext. Serv., Purdue Univ., Lafayette, Ind., AY-47a, H. R. Lathrope.

"Commercial Fertilizers in Kentucky, 1950," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Reg. Bul. 87, Feb. 1951.

"Official Report Maryland Inspection and Regulatory Service," Insp. & Reg. Serv., College Park, Md., Issue No. 217, Jan. 1951.

"Soil Fertility Practices," Ext. Serv., Univ. of Neb., Lincoln, Neb., Ext. Cir. 175 (Rev.), May 1949, R. A. Olson and J. W. Fitts.

"Summary of 1950 Fertilizer Tonnage Reports," Agr. Exp. Sta., New Brunswick, N. J., Mar. 29, 1951, S. B. Randle.

"The Use of Fertilizer in Oklahoma," Ext. Div., Okla. A. & M. College, Stillwater, Okla., Cir. 553, W. Chaffin and R. O. Woodward.

"Fertilizer Summary for South Carolina, July 1 through December 31, 1950," Clemson Agr. College, Clemson, S. C., Mar. 1, 1951, B. D. Cloaninger.

"Fertilizers for Cotton Near College Station," Agr. Exp. Sta., Texas A & M College, College Station, Texas, Prog. Rpt. 1303, Dec. 1950, J. C. Smith, J. F. Fudge, and J. E. Roberts.

"Nitrogen Fertilizers for Wheat Production," Sta. Cir. No. 85, Mar. 1950, H. W. Smith; "Nitrogen Fertilizers for Wheat Eastern Washington," Sta. Cir. No. 86, Mar. 1950, G. M. Horner and S. C. Vandecaveye; Agr. Exp. Sta., State College of Wash., Pullman, Wash.

"Commercial Fertilizers . . . . What They Are and How to Use Them in Western Washington," W. Wash. Exp. Sta., Puyallup, Wash., Sta. Cir. No. 129, Feb. 1951, K. Baur and F. T. Tremblay.

Soils

"Soil Acidity and Its Importance in the Growth of Azaleas, Camellias and Other Ornamentals," Agr. Exp. Sta., Univ. of Ga., Experiment, Ga., Press Bul. 630, Mar. 6, 1951, L. C. Olson and D. Brogan.

"Soil Conservation in Indiana," Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Bul. 228, 1950, R. O. Cole.

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. . . . Know Your Soil

(*From page* 16)

ber of animals used on the farm for cultivation and drayage, as shown in Figure 4, it was essential to keep this land covered with a certain amount of sod and forage crops for feed. With the advent of the use of tractors, all the land could be tilled, Figure 5, and it was thus exposed to the ravages of soil erosion.

The composition of the water of the streams flowing from the soil is very interesting. The chemical equivalents are as follows: silica—70, iron—1, calcium—21, and magnesium—5. This of course means that with the comparatively low calcium content of the native rock and the leaching of calcium and magnesium from the soil, the soil is left with a high silica-sesquioxide content.

Liming materials are often used very sparingly on these soils. This should not be the case because, as similar to the Penn series, liming materials are the first limiting factor in a stable agricultural program. Terracing, strip-cropping, liming, fertilization, and a crop-rotation system fitted to the terrain are very important for success.

The introduction of commercial fertilizer into the picture on an economical basis has completely changed the situation as far as farming the Cecil series is concerned. The production of such crops as okra, pimento peppers, tomatoes, and other vegetable crops is economically feasible if proper methods of liming and fertilization are followed. Timber production on the steeper phases and sod crops with some of the more recently introduced grasses and legumes are suited to this soil. General farming is very profitable under the present conditions.

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Fig. 4. Animals used in early agricultural development on the Cecil series.

Fig. 5. Modern agricultural development on the Cecil series.

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. . . American Potash Industry

(*From page* 14)

tween agricultural areas such as for example, 16 cents in the Southeast and 3 cents in the Midwest. With an income of such dimensions resulting from the increasing demands and sustained high prices for farm products since the beginning of World War II, the farmer has had funds wherewith to purchase plant-food material more nearly in the quantities and of the grades he has been taught to use by his agronomic advisers.

In recognition of this economic rule other segments of the fertilizer industry, notably the phosphate producers, have greatly expanded their output and have applied an increased percentage of that output to the preparation of mixed goods for which, of course, potash is needed.

Thus education has become a further important factor accounting for this phenomenal increase in potash consumption—education based on research and field demonstration imparted to the farmer by many zealous Federal and state agricultural agencies.

Among the most effective educational devices has been the widespread adoption of diagnostic techniques for determining the fertility status of soils and the nutritional status of the crops growing thereon. Principal among these are the soil tests provided largely by state laboratories to which farmers can send their soil samples for analysis. These reveal the presence, or more frequently the absence, of potash in adequate supply in forms available for crop nutrition, thus providing authentic information for the farmer's guidance.

Related thereto is our growing knowledge of what constitutes the balanced nutrition of the major crops. In applying this knowledge as a diagnostic technique, the crop is "sampled" by the collection of leaves or other parts which are analyzed for their plant-food content. This procedure is resulting, with respect to potash, in the establishment of the so-called "critical levels" of potash content characteristic of the respective crops below which potash deficiency is indicated as determined by crop yields.

Contributing also to this increase in potash consumption has been the changing pattern of American agriculture. The great expansion of interest in soil conservation and in the adoption of the various practices that enter into that fundamentally important program have been conspicuous in this respect. Somewhat related thereto is the fertilized pasture, a revolutionary new development, particularly in the South where the potentialities of a livestock industry are being so widely demonstrated through actual practice. In addition, this program is being promoted there as an important phase of diversification to relieve dependence on cotton and the one-crop system which its growing so extensively represents. For the fertilized pasture, legume-grass mixtures are prescribed, with liberal applications of high-potash fertilizer grades. For grazing and hay the legumes are being increasingly grown with emphasis in the South on alfalfa where its successful growing has now been made possible with adequate high-potash fertilization, provided borax is included. High-potash mixtures are in great demand and when unobtainable create the impression of inadequate potash supplies.

Among the changing patterns mention should be made of the radical new practices in the growing of the corn crop, it now having been demonstrated that with greatly increased fertilization applied to the adaptable hybrids, closely planted, yields can be more than doubled over the averages obtained by the old practices.

In this new development increased applications of compounds of nitrogen are the major feature, although the balanced ratio of potash is likewise essential. With the prevailing high wages for farm labor, yields per acre take on added importance in determining farm profits, the adequate use of fertilizers to this end having been demonstrated as yielding a handsome profit on the money so invested.

Mention should be made likewise of the sensational new results in the development of chemical pesticides, enabling the farmer more effectively to resist the inroads of the multifarious organisms that infest his crops, reduce his yields, and thereby his profits. As a striking illustration of this changing pattern, mention need be made only of the phenomenal increase in cotton yields recently reported as resulting solely from the complete elimination of the boll-weevil. With the repetition and verification of these results, the conclusion is being drawn that once the boll-weevil hazard is eliminated, the cotton farmer can greatly increase his fertilizer applications on that crop with assurance of a profitable return on the investment.

All these and other phases of the changing pattern, while currently increasing his income, enhance the economic stability of the American farmer as a lasting result, rendering him less vulnerable to unfavorable changes in the economic pattern and by that route lending stability to the industries dependent upon him as the ultimate consumer of their products.

Witnessing the rapid strides being made in potash production, the question arose among conservationists as to the dimensions of the Nation's potash reserves and their life expectancy at the current rate of production—a pertinent question worthy of mature consideration. Estimates of reserves had been made earlier by competent Federal agencies, but were based on earlier surveys predating the later and more detailed surveys conducted by the potash industry itself whose data had not been made public. To make these data available for the information of the interested public, a survey of reserves was financed by the four major producers, it being conducted by the eminent consulting mining engineer and geologist, Samuel H. Dolbear, whose findings were presented in the report, "Potash Reserves of the United States," issued by the American Potash Institute in 1945.

Summarizing in part, this report states:

"Known resources of potash in brines and in highly soluble salts of deposits now under production amount to 107 million tons of actual potash (K_2O) of which 73 million tons are estimated to be recoverable.

"Possible reserves of sylvite yet undeveloped in the New Mexico field may add as much as 400 million tons to these reserves.

"Polyhalite, a mineral containing soluble potash, has been encountered in the Permian Basin over an area of 40,000 square miles. Beds explored by drilling and underground work in the Carlsbad area of New Mexico contain huge proved reserves. Proved reserves are estimated at 140 million tons of K_2O and there is in addition over 100 million tons of K_2O in probable reserves, with possible reserves several times these figures. The total gross potash (K_2O) content of proved and probable polyhalite is therefore over 240 million tons in and adjacent to the present potash operations in the Carlsbad area. The degree of probability in this case is of such character that the proved and probable figures have been combined in estimating reserves."

Lime-induced Chlorosis . . .

(*From page* 20)

the seedlings grown in the chlorotic soils this relation was completely reversed, calcium greater than potassium. It is significant that a large percentage of the calcium in the roots is insoluble in dilute HCl. In this way it is similar to the iron in that there is an active and inactive fraction. The calcium in the roots of seedlings grown in non-chlorosis-producing soils is completely soluble in dilute HCl.

Continuing the study of the accumulation of calcium in the roots, it was learned that this is not necessarily always correlated with chlorosis-inactive iron. When an adequate supply of active iron was maintained in the plant, the accumulation of calcium was not accompanied by loss of chlorophyll. The active iron percentage is definitely the major factor contributing to lime-induced chlorosis. In this connection it is of interest that Milad found an accumulation of iron in the roots of chlorotic pear trees growing in calcareous soils and the amount was greater than for non-chlorotic trees.

Active Iron in Field Samples

A large number of chlorotic and green plant samples have been analyzed in the study of chlorosis in Arizona. The plants represented are sorghum, Sudan grass, several varieties of citrus and deciduous fruits, peanuts, beans, and others. Despite the fact the chlorotic leaf patterns are predominantly zinc and iron deficiency patterns, the only evidence of a deficiency was for manganese. In general, chlorotic leaves contain less manganese. The total iron determinations showed no relation and no evidence that the supply was inadequate. Using dilute HCl to determine

Fig. 4. Foreground, left, control chlorotic tree. Background, trees plugged with iron citrate.

the solubility of iron in leaves, the green leaves were consistently higher in active iron than the chlorotic leaves.

Lime-induced chlorosis is caused by an excessive uptake of iron and calcium which, when the roots are surrounded by an excess of $CaCO_3$ and its accompanying alkalinity, is converted into an inactive form. This creates a need for more active iron, and the major seat of the disturbance is in the roots.

Corrective Measures

Obviously, in order to cure lime-induced chlorosis, iron uptake or iron activity must be increased. Using the seedling technique of growing 100 barley seedlings in 100 grams of soil, it was found that increasing the iron uptake was not easily accomplished even by heavy applications of iron sulfate to the soil. This is in direct contrast to manganese, zinc, and copper, the uptake of which was easily increased by adding the salts of these elements to the soil. This again emphasizes the specific iron relationship in lime-induced chlorosis. When an iron salt or an acidifying agent was added to the soil in the seedling experiments, the uptake of iron was not increased but the active iron percentage was. This showed that the seedlings were able to obtain ample iron from the calcareous soils but need some help in maintaining the iron in an active form.

A major problem in connection with the control of lime-induced chlorosis is that of maintaining a supply of soluble iron in the soil as well as active iron in the plant. Iron salts are insoluble in calcareous soils and are therefore quickly precipitated when added to the soil as a corrective measure. This procedure is unsatisfactory although there is sometimes a temporary benefit. In the presence of organic matter, especially when sulfur is also used to produce a low pH, iron salts are more effective. The seedling technique was useful in studying corrective measures.

Manure has cation-absorbing properties and when hydrogen-saturated it is strongly acid—has a low pH value. It can be easily saturated with hydrogen by mixing with acid or composting with sulfur. If iron sulfate is mixed with this acidified manure an efficient mixture is obtained. This mixture is ideal because it will reduce the alkalinity of the soil and it is the alkalinity that builds up the residual iron in the roots. It also maintains a more available form of iron in the soil and thus possesses the two properties which are effective in the cure of chlorosis, low pH and active iron.

Field Crops

Field crops which are frequently chlorotic when grown in calcareous soils are sorghum, Sudan grass, pinto beans, and peanuts. The comparative chemical analyses of green and chlorotic leaves showed less active iron in the latter. By sidedressing chlorotic plants with sulfur-manure-iron sulfate mixture the chlorosis was cured and the leaf analysis showed that the major change was an increase in active iron in the greened leaves. The prime essential is that the sidedressing be applied deep enough to reach the roots. It was surprising to find that this mixture was residually effective the second year on a field replanted to sorghum.

Lime-induced chlorosis on orchard crops is much more of a problem than it is on field crops where the roots are more easily reached with a sidedressing. In orchard crops the roots are not easily reached and lack of contact with the roots places a limitation on the application of correctives to the soil. Some trees respond to dusts or sprays but others do not, and the same may be said for injections in the trunk. Either operation is only temporary as dusts and sprays must be repeated for each new growth. Tree injections will last several years and are quickly effective in some cases, those in which the wood is porous and absorption is rapid. For orchard crops there seems to be no general recommendation that will suit all cases.

There are three significant characters about lime-induced chlorosis of fruit trees. These are the lesser active iron content of leaves and roots, the disturbed Ca:K balance, and an upset in organic acids with increased citric and reduced oxalic acid. Excessive uptake of calcium does not cause chlorosis except under alkaline soil conditions; that is, if sufficient active iron can be maintained in the plant, largely by reducing the pH of the soil, then the excess of calcium does no harm. Also if sufficient active iron is present in the plant

Fig. 5. A novel cure for chlorosis: On observation this tree was solidly chlorotic except for two branches. Close examination disclosed a horseshoe had been hooked in the crotch of these two branches and the bark had grown around it.

there will be no upset in organic acids.

For example when citrus seedlings were grown in calcareous soils and fertilized with the sulfur-manure-iron sulfate mixture the uptake of calcium, both roots and tops, was increased. There was no chlorosis because the active iron percentage was increased and was no longer a limiting factor. In this both the citrus seedlings and the grain seedlings were in agreement.

When the sulfur-manure-iron sulfate mixture was added to the soil the uptake of zinc, manganese, and copper by the plant was increased. Contrariwise, uptake of iron was not increased but active iron percentage was significantly increased. This is additional evidence that lime-induced chlorosis is entirely a matter of active iron percentage. If this can be controlled, then the other accompanying troubles are automatically erased. Apparently if active iron can be maintained in the plant the total iron uptake is less, showing that the accumulation of inactive iron creates a need for more active iron.

Chlorotic citrus trees did not give satisfactory response to plugging, dusting, or spraying. The deciduous fruit trees gave a rapid response and complete recovery when the trunk or branch was "plugged" with iron sulfate or citrate. This offered an opportunity to determine, by leaf analysis, the effect of iron injections on active iron percentage and on the organic acid balance. The analyses of leaves from trees which had been plugged with iron salts, but which had recovered a normal green color, showed an increase in active iron and a readjustment in the organic acid balance. Citric acid was reduced and oxalic acid increased. The fundamental importance of active iron to the plant is thus again demonstrated.

Conclusion

Research has shown that a highly calcareous soil, its alkalinity, and the excess uptake of calcium contribute to a reduced iron activity in the root and aerial part of the plant, primarily the root. It is shown that if ample active iron can be maintained in the plant the excess of calcium does not cause chlorosis. This may be accomplished by reducing the pH, the alkalinity, of the zone of contact between the root and the soil. The soils in which lime-induced chlorosis occurs contain too much $CaCO_3$ to attain a pH reduction throughout the entire soil mass. The obvious procedure then is to apply a sulfur-manure-iron sulfate mixture in bands where a zone of low pH can be maintained. There is no assurance that the treatment will be successful unless a sufficient root population can be contacted with the banded material.

In the suggested corrective measures it is assumed that all the rules of proper cultural practice will be observed, for failure to observe some of these definitely contributes to chlorosis. Such soil conditions as poor aeration, poor drainage, or any soil condition which will restrict root respiration may predispose the plant to chlorosis. In orchards, when the subsoil is kept too continuously wet, chlorosis is frequently observed and the same is true for poorly drained spots in sorghum fields.

Two men were discussing their crops in the general store of a small Vermont town when joined by a third.

"Hiram," one of the men said to the other, "You know Abel Brown, don't you?"

"Wal," replied Hiram, extending his hand, "We've howdied but we ain't shook."

MacTavish and his girl were walking down the street past a cafe. In the front window, a big turkey was being roasted. They stood and watched.

"My goodness," she said, "just seeing that turkey makes my mouth water."

"Go ahead and spit," replied MacTavish, "nobody's looking."

. . . . Home-bred Holsteins

(*From page* 26)

the top. He doesn't wilt his grass silage, but does add 80 pounds of molasses to the ton for extra feed value later on.

Walt's fields are all fertilized, most of them receiving 500 pounds of 0-14-14 per acre twice a year. This schedule is skipped once when manure is used. He uses no extra nitrogen (beyond manure) since the legume crops provide this element. He does use a little nitrogen at seeding time, however.

To start his stand, he plows the old sod twice, seeding sudan or wheat between plowings. This gets rid of natural grass and weeds. The land is then seeded according to the following schedule:

Ladino—3 lbs. to the acre. (Walt feels this can be increased profitably to insure thick stands.) Brome—8 lbs. to the acre. Alfalfa—10 lbs. to the acre.

Mr. Hurlburt raises no mature grain crops at all. No corn. No threshing.

That then, in a nutshell, is his farming program.

How does he utilize his wealth of roughage? His feeding ration tells the story.

In summertime, the Hurlwood cows (between 40 and 50 head in the milking string) get 100 pounds of 12% dairy ration in the morning and 100 pounds of citrus pulp at night. This is 100 pounds for the whole herd, around 2 lbs. per cow.

They also get hay in their mangers at milking time and, of course, all the pasture they can use.

Just the other day the local tester arrived and they weighed 1,600 lbs. of milk from the herd (39 cows that day) representing one ordinary day's production on the feed enumerated above.

In winter Walter feeds 100 lbs. of grass silage per cow, along with 5 lbs. of hay, and grain fed on ratio of 1 lb. grain to 6 lbs. milk.

On this diet (starvation, according to grain-feeding dairymen) the herd strikes a herd test average of over 12,000 lbs. of milk and 454 lbs. fat per cow, with an over-all average 3.8% test. This is made on strictly practical twice-daily milking.

Now, 454 pounds of fat is not a world-record herd average. One look at the cows in Walt's barn tells anyone with an eye for cattle that this average could be raised considerably if the cows were "pushed." But today's costs of dairying do not allow much "pushing." What the modern dairyman strives for is not only production but economical production, and there's where our Pasture Champion shines.

He gets this average with very little purchased feed. He also has the kind of herd average that spells efficiency. His top cows are in the 600-700-lb. fat production bracket. This simply means that his "average" is a true average; his barn just doesn't have any shirkers. Each and every cow is doing a full day's work, and doing it at lowest possible cost.

This brings us up to the cow story which has been overlooked in much of Walt's pasture publicity. It's a story, however, that means much to the real farmers who visit Walt's place . . . and to Walt it means just about everything.

Walt's herd is remarkable in many ways. First of all, its a home-bred herd. The story goes back to 1889 when Walter Hurlburt's grandfather and father took possession of the place. For many years, it was a better-than-average grade dairy farm. After Walt came back from service in the first World War, he finished college at the University of Massachusetts. After working out a bit, he came back to the home farm. In 1923 Walt and his father, Ralph Hurlburt, started a purebred herd . . . just a few animals at first.

They liked the purebreds, these Hurlburts, and before long, the herd was 100% registered.

Ever since they have studied bloodlines and have built a herd that's well-respected within the breed. They showed at Eastern States Exposition from the very beginning and still are represented at Springfield each year.

The Hurlburts' first herd sire, Nutmeg Walter Colantha, combined with their foundation cow, Veeman Pietje Ormsby, established for them a family which has been outstanding for type and production. From these they built the herd of today.

Fig. 2. Daughter Ann proves girls can help, too. Here she puts the milker on one of Dad's 6,000-quart home-bred Holstein cows.

The original sire is the sire of Hurlwood Sir Segis Walker, named All-American Bull Calf and later All-American Senior Yearling, and Hurlwood Sir Segis Walker 2nd, Reserve All-American Calf in 1929. From this sire also came Hurlwood Sir Canary Walker, Reserve All-American 2-year-old in 1929 and Reserve All-American 3-year-old in 1930. A grandson of Veeman Pietje Ormsby, Hurlwood Sir Veeman, also was named All-American Bull Calf. He is the sire of the present herd bull, Hurlwood Sir Walker Veeman ("Excellent" Silver Medal Type).

From Veeman Pietje Ormsby came many fine cows, including one "Excellent" daughter with 684 lbs. fat, one "Excellent" granddaughter with 651 lbs. fat, 4.2% and two "Excellent" cows, both over 500 lbs. fat, from the granddaughter.

Now the whole herd is from that line.

The foundation cow made a record of 711 lbs. fat and had a 3-lactation average of over 600 lbs. fat herself.

Another family (still related) is the Hurlwood Buttergirl chain, exemplified by Hurlwood Buttergirl Fez, now in the herd with a 709-lb. fat record behind her. Four sisters from the Buttergirl cow average 626 lbs. fat.

Considering that these are farm-barn records, they speak very well indeed for the Hurlwood breeding. It's no wonder the Hurlwood Holsteins are popular with other breeders.

Hurlwood Farms is a family affair. Walt and his father worked together until the senior Hurlburt passed away in 1948. Walt recalls wistfully how his father stayed with the cattle at the Springfield show two months before he died, and worked on the farm until 3 weeks before his passing, at the age of 80 years.

Today, Walt's daughter Ann, 15, helps with the milking. His son Joseph, 13, is an active 4-H dairy club member; has been showing cattle since he was 9. (He topped the 4-H junior yearling class at this year's Eastern States Exposition.) Ann is also a 4-H winner in home economics.

Mrs. Hurlburt (Alice), also a graduate of University of Massachusetts, takes an active interest in the farming program and has a lifetime farm background.

Tradition plays a major role in New England farming. Every New Englander is proud of the past. But, Walter Hurlburt typifies the New England farmer who uses the past to map out the future.

Cycle of Soybean Improvement

RESEARCH and plant breeding are directly responsible for last year's record soybean crop. Soybean acreage in 1950 was about 14½ million acres. This puts this relatively new farm crop in fifth position in U. S. Agriculture. Only wheat, corn, cotton, and oats are ahead. In acreage it is about on a par with barley, and is well ahead of such important crops as grain sorghum, rye, and rice, says the U. S. Department of Agriculture.

Heavy planting in 1950 accounts for the record total yield which resulted in spite of unfavorable weather in the main production area in the North Central States.

High production totals are traceable directly to the fact that breeders have developed new varieties that yield 20 per cent more than the varieties grown 10 years ago, which the new varieties have supplanted. Dr. M. C. Weiss of the Bureau of Plant Industry, Soils, and Agricultural Engineering, in charge of soybean research, says this increase in yield amounts to about three bushels an acre. This means an added return to the farmers of about $6 an acre. This helps account for the rapid rise in popularity of the soybean as a crop. In the last 10 years, production has tripled, increasing from an average of 87 million bushels in the late 30's to 270 million bushels in 1949.

The cooperative soybean improvement program in which 24 States are working with the U. S. Department of Agriculture is now in its 15th year. The first of the new varieties was introduced in 1942. Others have followed. They now account for most of the acreage.

Heavy yield and improved oil content have been principal aims of breeders to date. Disease has not been serious in soybean culture. Breeders, however, are not relying on continued freedom from disease. They have already located effective resistance to several diseases that might become serious, and are breeding these resistant qualities into new and better soybean varieties that are now on their way toward growers. "The superior varieties now being grown," says Weiss, "represent only the first cycle of improvement."

The Candy's All Gone

(*From page* 5)

only know my name and little else besides. I was born and reared on a farm which I now own and operate. The farm was occupied and cleared by my ancestors almost a century ago. The farm has passed from father to son for several generations, and I am proud that no one but a Groves has ever owned or tilled a foot of the soil which I now call mine. This farm is a heritage and a sacred trust.

"I live in an old-fashioned, red brick house which was built by my grandfather. It is the only home I have ever known. I was born in the very room in which I am now writing this letter. Edgar Guest once said, 'It takes a heap of living in a house to make it a home.' There has been a heap of living in this old house of mine, down through the years. Every crack and cranny bring happy memories to mind of happy days gone by.

"You can see from what I have written that I am a sentimentalist and a philosopher. I have never been accused of being a hard-headed businessman. Retrospection and contemplation have been the dominant factors in my life."

I presume this man has modern conveniences in that old homestead now, and saves his eyesight by using bright and numerous electric bulbs, and does not bathe in the wash-tub filled by hand in the kitchen. He has radio and telephone communication with the world beyond his plantation. But these great innovations and privileges have come gradually over the years, and they have been accepted with the same calm philosophy which his forebears deemed to be necessary to any turn that change might bring.

The danger we face lies in the fact that so few of these country gentlemen of the old school are left to look back and measure what we possess and often take lightly as our due, compared with the stern and rigorous conditions that former generations experienced. Those who do look backward or examine the plight of foreign farmers still in a primitive state too often do so with a complacent and critical view. They attribute any "yen" for those fundamental virtues to a lack of business acumen and strident support of the latest gadgets and policies. And sometimes I feel sorry for the generation which has had no anchor of tradition to keep them from drifting. In many ways it is not their fault. They were born "too late," not as the cartoonist says, "too soon."

IN saying this I am aware that our society still has some deprived people in it. They are not confined to crowded city tenements either, many of these disadvantaged folks having residence in the farming zones. Yet somehow it seems to me that the "candy" they miss from life has been filched from them by a few others who store pails of sweetmeats away in secret places to get moldy and tainted with the "gimme germs."

However, leaders high in the councils of business and capital also see this threat to a balanced American way of life. I quote a leader in the U. S. Chamber of Commerce, from a speech made in April 1951. Referring to too many evidences of lowered moral standards, he said:

"When grabbing for the fast dollar becomes standard procedure in high places through the formative years of a whole generation, something happens to the moral tone, to the ethical sensibilities of a people."

It is not true to believe that all rich men, all powerful men, all civic leaders are willing to accept this letdown of standards and goals. On the contrary, I think that any gains we make in restoration of solid values depend mostly on just these prominent leaders and educators, financiers and policy-makers. Either that must happen, or unrest will come.

IN all likelihood it's more pleasurable to eat candy in company with other celebrants and sweet-toothed people than it is to hide away in a dark personal corner and lick hard at a nut bar. They say that the same holds true for certain liquid refreshments too. Happiness, like misery, loves company.

But the nub of this debate actually rests on our definition of candy. And on our definition of what is sweet and comforting. That is, we sometimes *think* that the candy is all gone, when really it isn't. Too often we also mistake ourselves and bite into some of that bitter April Fool candy, outwardly bland and appetizing, but inwardly full of bile and pepper sauce.

Moreover, we seldom start the fires of good will and aspirations with which we can cook up plenty of home-made candy—easy enough to make cheaply so that we can pass it around a little. We rely too blamed much on store candy. The louder the radio vocality and the bigger the type face, the more we depend on commercial tidbits.

We say that all the simple homespun arts and crafts are gone, and accepting this apparent fact we make no preparations for manufacturing some of the wholesome things of the spirit and the heart. We let the professional preachers and entertainers and hired educators pump that molasses for us. If we have cash to buy it, O. K. Otherwise we can't find it anywhere.

But, thank goodness, not always. Last week in my town a young man died and was widely mourned by old and young. Not because he was brilliant or rich. But because he spent so much of his brief span of years aiding and educating and encouraging boys in their teens—in sports and books and craftsmanship. His bag of home-made candy was also full and always open. I hear that the parents of the boys he helped and took on scouting trips intend to keep his memory green by carrying on in the same way, thanks to his example. Remember those old-style "candy hearts"? Well, he had a full store of them with him always, and the bottom of the "bag" was never reached, figuratively.

SO all of you hard-working, obscure, and unheralded men who are making home-made candy every day for someone you teach or inspire, this old world is sweeter and warmer-hearted by virtue of your work and devotion. For you and the kids growing up in your bailiwick, it may well be said that the candy is *not* all gone.

Need I proceed further than this, just to eat up the allotted white space? Paper is expensive—much more so than the real candy we still have available. So we have thought it through and found that the past is prologue to the present and the years ahead. We have reached the conclusion that false values and temporary delights are tasteless and brittle candy, but that tucked away among our fund of opportunities under a modern civilization we possess the best raw materials for life's enjoyment that America has ever known.

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THE AMERICAN POTASH INSTITUTE

1155 16TH STREET, N. W. WASHINGTON 6, D. C.

A Few Whinnies

An elderly Negro had a hen that contributed an egg now and then for her keep. One day she became broody and started to set. The old man tried every device he could think of to discourage the maternal instinct and finally appealed to an experienced poultryman. "Dat ol' hen," he said, "she sot an' sot. I done ever'thin' I knows of, but hit ain' do no good." The poultryman suggested putting some thorns in the nest.

"I done dat," said Mose, "I put thorns an' briars under her—an' doggone if she don't stood up an' sot!"

* * *

Cop: "No parking; you can't loaf along this road."

Voice within car: "Who's loafing?"

* * *

Mrs. Dick (sighing)—"Do you remember our honeymoon, dear?"

Dick—"Yeah. I wish we had the money I spent on it."

* * *

"I don't like your heart action," the doctor said, applying the stethoscope again. "You have had some trouble with angina pectoris, haven't you?"

"You're right in a way, Doctor," said the young man sheepishly, "only that isn't her name."

* * *

Advice to fathers: Don't worry if your young daughter is boy crazy. She'll outgrow it. After a few years she'll be man-crazy.

The beautiful young girl shook her head decidedly.

"No, Mr. Gotrox, I cannot marry you," she said. "You are over 70 and I am only 16."

The old man shrugged his shoulders. "All right, sweet," he sighed, "I'll wait."

* * *

"Gee, I feel terrible. It must-a been them clams I et."

"What's the matter; weren't they fresh?"

"I don't know."

"Well, what did they look like when you opened 'em?"

"Gee whiz! Are you supposed to open 'em?"

* * *

Concerned: "What do you do when a girl faints?"

Conceited: "I stop kissing her."

* * *

Company Officer: "You are charged with using insulting language to your sergeant."

Private: "Sir, I was only answering a question."

"What question?"

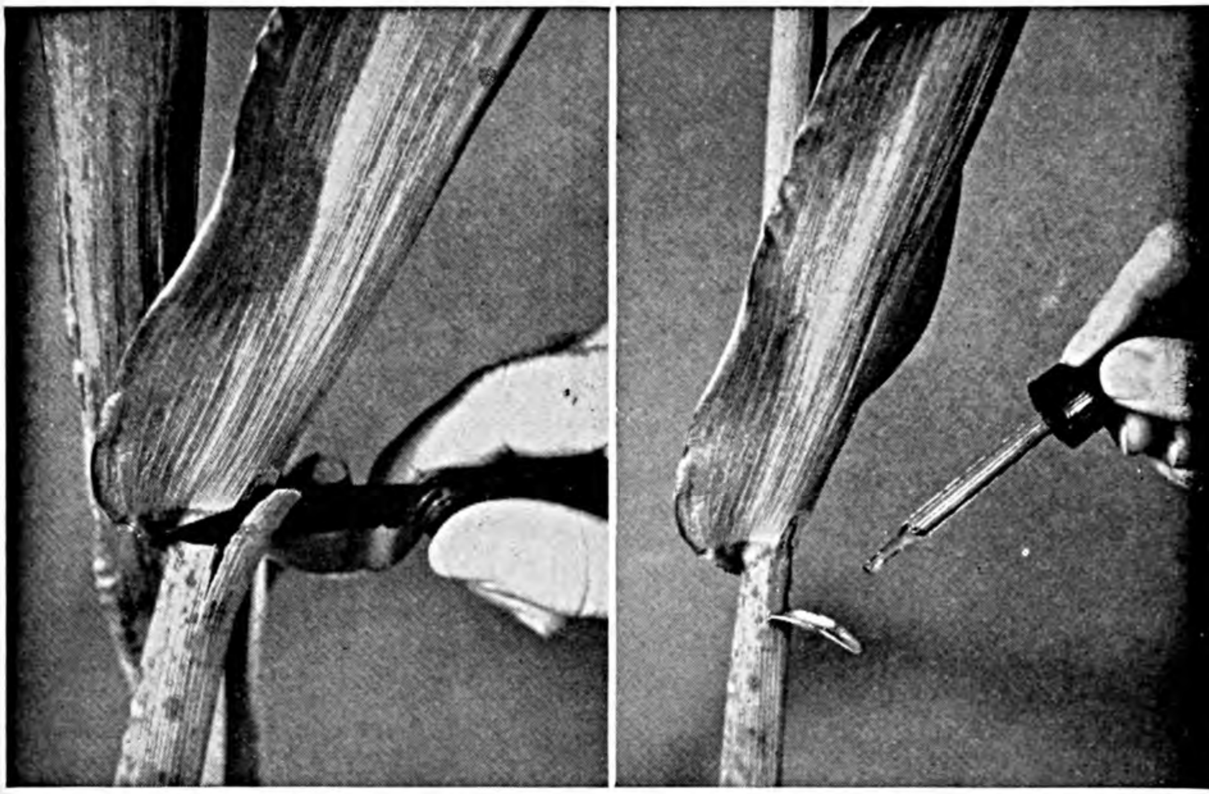
"He said, 'What do you take me for?' and I told him."

* * *

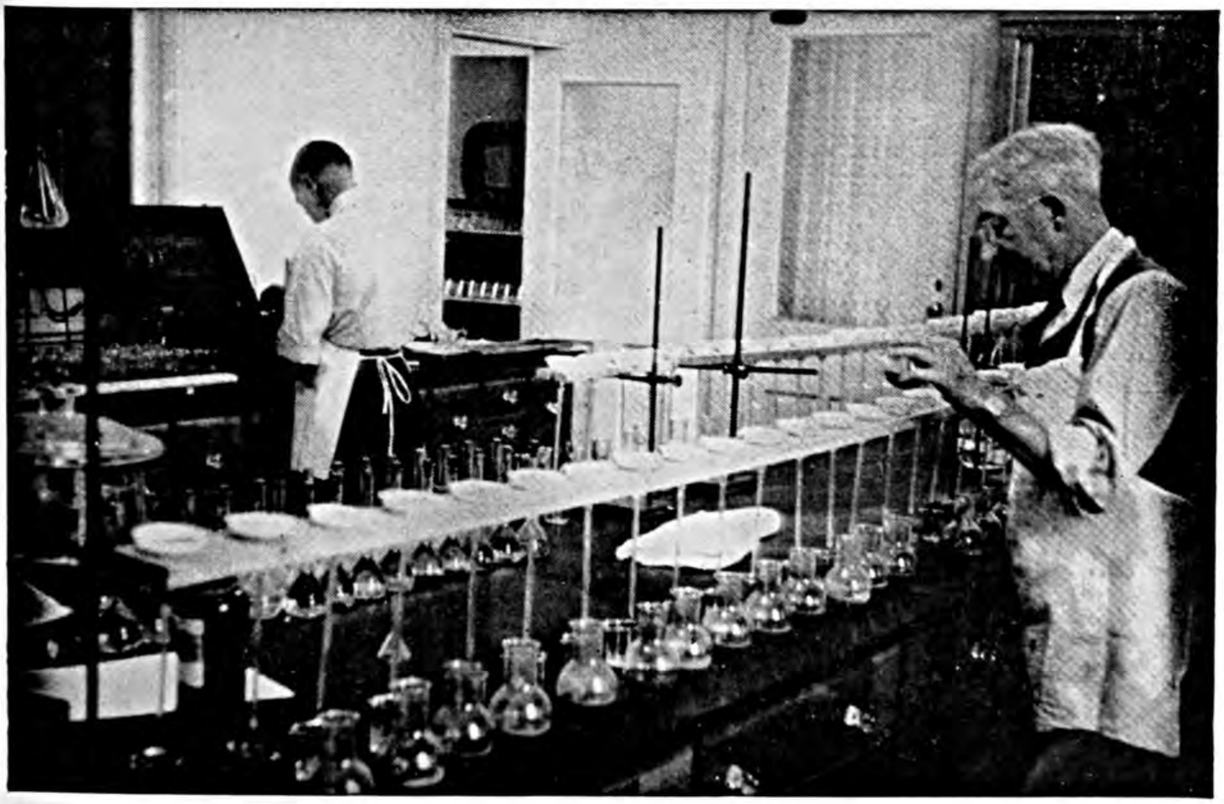
A small boy, with a penny clutched tightly in his hand, entered a toy shop. After a few minutes the proprietor, driven to distraction after showing him most of the stock said:

Shopkeeper—"Look here, my boy, what do you want to buy for a penny, the world with a fence around it?"

Boy—"Let's see it."



Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



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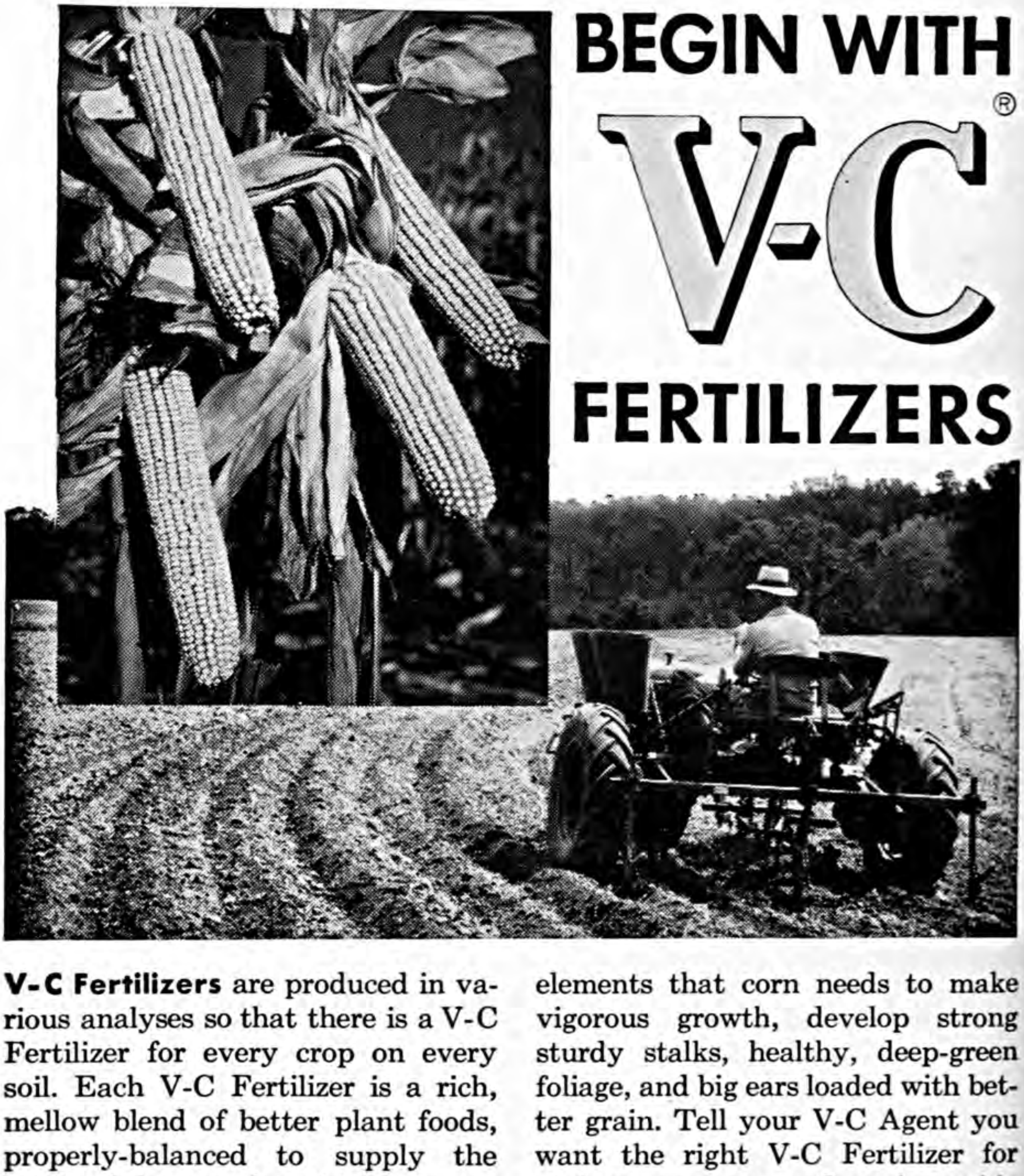

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VOLUME XXXV NO. 6

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Full-headed and Heavy

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Experience Brings Forth . . .

Lines by a Landscraper

Jeff McDermid

YOU might infer that a chap with the soil of centuries of farming bred in his bones and under his fingernails ought to produce a superabundance of herbiferous garlands and succulent edibles from a plot of rich alluvia, not too replete with broken bottles and scrap iron. Whether he strives to get a good garden for little money or spends good money for a little garden, the experiment is worth the gamble. It is truly a primal urge that causes a sedentary scholar to awaken with the woodpecker's rap on the roof to grab his breeches and seize the spade for a foray in the realms of botany and entomology.

Not being a born fisherman, I detest the fellow who abandons the rowboat and the reel for a measly purchase at the nearest fishmonger's. Being a gardener, however, I see no harm in eking out my laudable vegetative ambitions with a budget of beans or a head of cabbage produced by a professional muckland artist, or in relying upon the florist for enough sweet peas to make good the ones that did not grow for me.

In this regard I renounce all cheap excuses which might be advanced for my shortcomings gardenwise. There are no careless boys to tramp the daylights out of my dahlias. Nary a neighbor keeps a dog to blast my choice evergreens. The ordinance under which I pay taxes abolishes the nuisance of the home gardener—the clawing, sharp-toed hen.

On the contrary, I live in a community where the best of advice can be had without asking for it, and where several renowned doctors of plant structure and deans of landscape carpentry are almost chummy with me at times. Moreover, my long list of erudite acquaintances includes men of rare discernment in matters of manure, as well as experts in soil-saving dams and damn-saving soils. To each and all of them I dedicate my noble efforts, sans regret and sans reproach.

What I forget to ask them or they disdain to tell me I usually seek avidly in magazines and bulletins. Yet I have two neighbors who never systematically studied the arboreal arts, but whose ardent toil is rewarded by a veritable rainbow of gorgeous bloom and a surfeit of salubrious saladry and kale. Not that I have the slightest tinge of envy in my make-up, but I do feel hurt about the unfailing success of those who have seldom courted the counsel of my wise professional friends. I often wonder why nature flouts the men of learning and caters to those with more sweat than sense.

I OWE these savants of the horticultural world more than mere personal coaching or neighborly garden guiding. For a brief time I was the editor of a suburban almanac and garden-lore book, in the absence of the real expert. Leaning chiefly on the accomplished specialists aforesaid, I was able to relay answers to perplexed readers at no apparent cost to our periodical's reputation. In doing this I ventured to add only a few instructions of my own vintage to the tested formulas prescribed by this neighborhood faculty. I shall point to a sample or two of these for what they are worth.

Planning the side and back hedges depends considerably on the kind of adjoining neighbors you possess. For the really congenial ones, no hedge is indicated. For the ones who too often toss over mean remarks, old cans, and dead cats, you need a combination of shrubs that afford permanent barriers. I suggest using blackcap brambles set two feet apart, with a generous spring combination of beggar lice, poison ivy, nettles, or anything that blocks both vision and visits.

"From the first of June to the middle of September, the wise gardener will undertake only what he can do in *half* his leisure time," is another common rule. The trouble here lies in figuring out exactly what half of your leisure time is equal to. One is so often tempted to spend more than half of this allowance of leisure on the links, or over at the neighbor's sampling mint julep, or showing him how to prune his potatoes. It is far wiser to leave this calculation to the wife. She keeps better track of the leisure of her spouse than any other person in the universe. And she can also cut it in half much quicker than others.

"You may rely upon receiving gifts of plants from neighbors and old friends, who are deeply touched by your earnestness and industry." This is also subject to reservations. I have a neighbor lady with an expansive and expensive garden, and each time we go there to admire it she finds some exotic specimen to load me down with. At the insistence of my frugal wife and with a certain inbred Scotch instinct to boot, I totter homeward with bushel baskets of *Nepeta mussini, Thalictrum,* or *Henchera,* and then work beneath a waning moon and amid a bevy of mosquitoes trying to give these precious plants a decent burial.

Then there cometh that dowager who mothers my wife, bringing us some cute flowering weeds she located on one of her dizzy rambles, telling us to use them in our wild-flower nook. Luckily, none of us have hay fever or asthma, because the stock she unloaded on us accounts later for the highest pollen record ever wafted on the suburban breeze.

"Avoid all ugly flower-holding contrivances for your gardens and lawns." After years of fertile invention and original design, I endorse this rule completely. The list of bizarre effects successively tried on my premises have caused some doctors to drive in with patients for the asylum, through natural mistake of location. The contraptions include old cart wheels and auto tires discreetly laid down in sod and seeded to moss roses, Uncle Ike's steamer trunk filled with fertility and sown to phlox, an abandoned wire bedspring used to train sweet peas

and morning-glories, and a clump of golden glow burgeoning in a length of salvaged sewer pipe.

I have had to quash this imaginative instinct for "different" floral accessories. The junk dealers woke me up too early and often, outbidding each other for the right to remove these articles at the end of the season.

NORTHERN gardening on old soils amid the breeding grounds of all the voracious insects known to your state entomologist is a great aid to stamina and honestly applied sunburn. Despite lice on my turnips and slugs on my tomatoes, despite long winters and short asparagus, I would not trade my honest hours with the hoe for all the automatic bounty of the tropics.

I thoroughly enjoy attending conventions of landscrapers and horticultural wizards. I try to appear discerning and appreciative while strolling down the bosky aisles of a flower show with the lady secretary of the Nineteenth Ward Home Grounds Circle, in technical conversation with the herb specialist from the State Society.

"Notice that exquisite blend of color in that fine *Aquilegia,*" remarks the plant physiologist, and I hastily stop to admire the geraniums, when I should have nodded with deep conviction at the columbines instead. Or the learned lady finally catches me off base by naively asking whether I prefer *Lilium candidum* or *Lilium superbum,* and all I can stutter back is that I usually admired the lily of the valley most of all.

Why the dickens so many folks insist on calling "baby's breath" by the cognomen, *Gypsophila,* or mother's old back-yard favorite, the bleeding heart, as *Dicentra,* or little old forget-me-nots as *Myosotis* just makes it tougher for the roughnecks like myself to get imbued with culture and good influences.

It's rather risky that way too. If a tyro gets verbal orders to whack off *Polygonum aviculare* and he mows down *Polygonatum giganteum* through mistaken identity, his cultured frau will be the first one to horrify his harassed soul with the awful news that he doesn't know knot-weed from Solomon's Seal.

But regardless of such notions and complexities, the improvement of our domestic landscape by the devoted labor of so many amateurs gets my lasting support and commendation. As I observe the trend outward from narrow apartments and tiny city lots to wider and greener spaces, it strikes me that we are bound to raise a generation of youth with finer sensibilities toward the lasting values—which some folks of our own generation may have lost in the rush for profits.

Thanks to such ambitious and stalwart gardeners as myself, I need not pull down the parlor car window shades when riding into the cheaper suburbs of our big cities, for fear of seeing so many ash piles and junk

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Fig. 1. Fertilizer for grass was almost unheard of by cotton, corn, and tobacco farmers until soil conservation became their objective.

The March of Progress in Soil Conservation

By J. W. Sargent

Soil Conservation Service, Spartanburg, South Carolina

THE march of progress in Southeastern agriculture is almost fantastic. Advances in production of food and fiber are being made along a broad front including research, understanding, marketing, processing, transportation, machinery and equipment, land use and treatment, seed, fertilizer, etc.

Whatever the advances along the whole front, they are due largely to the development and use of scientific knowledge to meet the problems of our day. We might do a little bragging about progress, but there is danger in complacency. There is no reason for leaning on our oars. The job of adequately clothing and feeding all of our people and helping clothe and feed people of the world is a tremendous task. We now know it is unwise to exploit and abuse our resources to meet current needs.

Let's narrow our field of thinking and review progress made during recent years in a few phases of agriculture in which most of us are vitally interested. I believe they are good indications of progress on the whole front:

The upward trend in the production of seed of grasses and legumes needed for land improvement and forage is noteworthy. In the early '40's only a few thousand pounds of Suiter's grass (Kentucky 31), tall fescue, seed were

Fig. 2. Heavy equipment, privately owned, furnishes power to build terraces, dig the canals, make farm ponds, and convert handicapped or idle land into useful, working acres.

available. In 1949 more than 10 million pounds of this valuable grass seed were harvested in soil conservation district activity. These 10 million pounds of available seed plus much more of which we have no record had already been exhausted by early March 1950.

Take another example. In 1935 there was one packet of two pounds of blue lupine in the United States. Although lupine had been grown in the Orient for 2,000 years, no progress had been made in the use of this crop in our country. Largely through soil conservation district activity, more than 50 million pounds of blue lupine seed were harvested in the spring of 1949. This may mean an end to the ever-increasing dust storms in the peanut belt of the Southeast.

Increase in the use of Caley peas, sometimes called wild winter peas or Singletary peas, is impressive. Alabama and Mississippi alone now produce several million pounds of this seed annually. In at least two of the soil conservation districts of Alabama, farmers harvested about a million pounds in 1949. It is a valuable grazing and soil-improving plant, which with proper management is self-perpetuating.

Sericea, sometimes referred to as poor-land alfalfa, was scarcely known 15 years ago. Last year, farmers in soil conservation districts in Georgia, Alabama, and the Carolinas harvested nearly 15 million pounds of sericea seed. Not only does sericea provide good grazing, but with good management is a valuable hay crop well-suited to rough land conditions.

Crimson clover is not a new crop, but it has recently increased and spread into new territory. Alabama conservation farmers harvested more than 10 million pounds of seed last year. Georgia farmers produced even more. One county in Alabama—Autauga—produced almost one million pounds last year—mostly the reseeding strain.

Annual lespedeza, for all practical purposes, was introduced in the Piedmont section of the Carolinas by the Soil Conservation Service. A surplus of seed was harvested last year in the Carolinas, Virginia, and Tennessee.

There has been a substantial increase in the amount of all the white clovers, particularly ladino, and in button clover.

Fig. 3. Crimson clover is no longer confined to isolated areas. It can be found almost anywhere soil conservation is practiced in the Southeast.

We have had a lot to do with a more extended use of some 20 previously unused crops in this region. Others include bicolor lespedeza, hairy indigo, Pensacola Bahia, Pangola, kudzu, crotalaria, Coastal Bermuda, rye grass, and we have been instrumental in a far more extensive use of Dallis grass, orchard grass, alfalfa, and pine trees.

Let's take a look at the soil amendment materials—fertilizer and lime. During 1948, the soil amendment industry produced some 40 million tons of fertilizer material for use on the land. Forty million tons will load a string of freight cars—30 tons to the car—reaching three times across the continent from New York to San Francisco. But the most significant thing in this connection is not the amount produced or consumed, but how it was used.

Ten years ago, most material of this kind was used on row crops. Now more than 50 per cent of it is used on grasses and legumes to improve grazing and soil conditions. We have actually begun to exchange fertilizers and minerals with the soil for grasses and legumes in a better agriculture.

As to farm equipment, forty years ago there were about 2,000 farm tractors in the United States. Thirty years ago the number had increased to about 200,000. In 1949, it exceeded 2½ million. In that same year there were 14,000 contractors in the nine Southeastern States using improved types of farm equipment to assist soil conservation districts in getting conservation measures applied to the land. Ninety-five per cent of this type of work that was "hired" was done by farmer-contractors. The replacement value of this equipment alone was $220,000,000.

But some will ask, "What is the value of all this?" "What is it worth to have an abundance of planting seed and fertilizers and farm equipment?" The answer is: There is no value in these things without soil and soil fertility.

One thing to which we point with pride is the scientific use and treatment of the land. Where the Soil Conservation Service has made its big contribution is in determining the capability of various lands and building a soil conservation program on them, not only

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Neglected Plant-food Elements

By Benjamin Wolf

Bridgeton, New Jersey

THE failure of certain soils to provide sufficient quantities of all the elements necessary for crop growth has already cost the American farmer considerable money. There is a good possibility that in the future there will be even greater losses due to these shortages unless prompt and effective means are taken to make up the deficiencies.

There are at least 12 chemical elements necessary for plant growth taken up from the soil. These are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, boron, copper, zinc, and molybdenum. Considerable emphasis has been placed on the first three or "major" elements, guaranteed in mixed fertilizers as percentages of nitrogen, phosphoric acid, and potash. The remainder of the group have been generally neglected and usually have been applied, if at all, with lime or as impurities in fertilizers, manures, bone, and other sources of organic matter. Because of the general lack of attention to all but the first three elements (primary or major) and also due to relatively smaller needs of the latter group, they have been labeled "minor," "trace," or "secondary" elements.

Importance of Trace Elements

In no way should we consider this latter group to be of minor importance in the needs of the plant. On the contrary, every essential element is of equal importance. This is as true for molybdenum as it is for nitrogen, even though a few ounces per acre of the former will satisfy crop needs and in some cases more than 100 lbs. per acre of nitrogen are needed.

Shortages of the trace elements affect plants in different ways. Some of the specific effects of shortages will be discussed later under each element. Generally, a shortage of trace elements, as in case of the primary elements, markedly affects yields of crops and in many cases quality as well. There is some evidence that at least some of the trace elements are important in keeping plants healthy. It is not yet known whether these elements actually prevent diseases or discourage insect attack or whether they help plants recover more quickly from such attacks. Perhaps it is a combination of both. The story on this phase has not been fully revealed but when it is, it promises to be an exciting chapter in man's fight against certain plant diseases and perhaps some insect attacks as well.

Another importance of at least some of the trace elements seems to be in making plants hardier to lower temperatures. This can be very important in such crops as peaches, apples, strawberries, and other plants that bloom or have fruit in cold weather.

Why Deficiencies Are Increasing

There are several reasons for the increasing number of deficiencies of these neglected elements. Many of these reasons have to do with the intensification of agriculture. The growing of several crops per year on the same land has greatly increased the removal of these elements from the soil. This is especially serious with some elements which were never too plentiful in the light soils. The very intensification speeded up the destruction of organic matter which for centuries had been a storehouse of available supplies of these and the major elements as well. Not to be overlooked is the fact that with better fertilization with the major elements, plus the use of more powerful strains of seeds and better cultivation practices, greater yields were obtained. A trace-element supply satisfactory for 5 tons of tomatoes per acre is totally inadequate for 10 tons. In many cases, lack of the trace elements has become a limiting factor in obtaining higher yields.

Coupled with the intensification of agriculture, there have been the purification of agricultural chemicals used as fertilizers and the almost complete lack of organic materials applied to the soil. Formally, crude materials made up much of our fertilizers. As a result, the fertilizer analysis was low but it did carry considerable amounts of iron, magnesium, copper, etc. Likewise, manure, bones, blood, and other organics added liberal amounts of these elements. At the same time the additions of organic matter helped to keep some of these elements in an available state and also reduced the loss of them from the soil by helping to control both erosion and leaching.

Today this has been changed. Chemical salts of high analysis with low impurities (trace elements) make up our fertilizers. In most fertilizers, the organic materials are completely or almost completely eliminated. As a result, the trace-element content is low —often too low for crop needs.

Where Deficiencies Are Generally Found

There are certain areas in the United States where a preponderance of these deficiencies occurs although no soil area is immune to deficiencies of all the elements. One of the worst areas as far as number and variety of deficiencies is the Coastal Plain extending from Long Island through Florida. The soils in this area are derived from relatively new marine deposits and as a rule have little holding capacity for nutrients. They are light, open soils that have been subject to heavy leaching. Also many of these soils have been intensively cultivated.

Muck soils also have shown some trace-element shortages. Despite the high content of organic matter, reports of response of additions of boron, manganese, and copper have been noted.

Effect of Certain Soil Treatments Upon Trace-element Deficiencies

Effect of Lime: Lime, because it influences pH (acidity or alkalinity) of a soil, has a marked effect upon the solubility of the trace elements. As an acid soil is limed so that the pH approaches 7.0 (neutral point, i.e., neither acid or alkaline), the amounts of available iron, manganese, zinc, copper, and boron are greatly reduced. Many a soil has been made deficient in boron by large additions of lime.* This has also been true for iron, manganese, copper, and zinc. It is the amount of available nutrients present and not the total amount which may be locked up in the soil that decides whether a plant will suffer from deficiencies. The author has seen plants completely stopped because they lacked a few ounces of available iron per acre although the soil had tons of iron. When less than ½ lb. of iron sulfate per acre was sprayed on the leaves, these plants resumed healthy, normal growth.

Application of lime to an acid soil increases rather than decreases the supply of available molydenum. Also, applications of lime supply calcium and if dolomitic materials are used will provide magnesium as well.

* In fact, for many years farmers in Southern States refused to use lime, fearing crop reduction. Much of the adverse effect on crops grown on these poor Coastal Plain soils was due to immobilization of boron. When the true cause of poor results with lime was determined, sufficient boron in the form of borax was added. Today, greater crop yields are being produced by use of both lime and borax.

Effects of Phosphates and Arsenates: Large applications of phosphate and arsenates help reduce the available supply of elements such as iron, manganese, and zinc which form insoluble phosphates or arsenates. The "locking-up" of these trace elements is not very serious except on the light soils which already contain relatively small amounts of the elements. This process is also more severe when it takes place on soils that have been limed. Again this affects the farmers who are intensively cultivating these soils.

Sulfur: This element is provided in fairly large quantities as part of ordinary superphosphate or sulfate of ammonia. Near industrial areas or large cities, fairly large amounts of sulfur are present in the air as sulfur dioxide. This is brought down into the soil with rain and snow. Most sulfur deficiencies have been reported on western soils, sulfur being particularly useful in alkali soils. Here it is used to depress pH as well as supply elemental sulfur for crops. There have been no verified reports in recent times of the deficiencies of this element in heavily fertilized areas in the East and probably there will not be as long as phosphorus in the mixed fertilizer is provided by ordinary superphosphate.

Not too long ago, there was made available the double or triple superphosphate. If there is ever a considerable reduction in price of this type of phosphate, we may expect more of it to show up in mixed fertilizer. If it becomes the source of phosphate most generally used, we can expect deficiencies of sulfur in our lighter soils that are cropped to vegetables such as cabbage, broccoli, radishes, and beans, and to the legumes such as alfalfa. Sulfur-deficient plants have a pale sickly color much like nitrogen-deficient plants.

Calcium: In the field it is difficult to distinguish between the effects of calcium deficiency and low pH values, since the two go hand in hand. However, it is believed that some of the ill effects of low pH are due to shortages of calcium. Since application of lime corrects the low pH and also provides calcium, usually there is no difficulty with calcium deficiencies on limed land.

There are some exceptions. On very light soils with low organic matter content, only a small amount of calcium will be present even at pH values of 7.0. The author has obtained increased yields of lima beans and peas at such pH values by use of gypsum, a compound having no effect on pH but supplying both calcium and sulfur. Where such responses were obtained, the soil contained about 300 lbs. of available calcium per acre and plants showed no special deficiency symptoms.

Besides gypsum, it is possible to apply coarse limestone to such soils. There is some indication that such treatments improve calcium levels and growth without having marked changes on pH.

Soils that are kept acid for such crops as white and sweet potatoes, rhododendron, azaleas, etc. may have shortages of calcium. There is less likelihood with white potatoes than with the other crops because the former usually has been fertilized with large amounts of phosphates. Here again, the phosphates are good carriers of calcium. The use of large amounts of phosphates for crops grown on low pH or acid soils is usually worthwhile. However, like any other good practice, it may be overdone. In such cases excess phosphates may lock up other trace elements such as copper, iron, manganese, and zinc. If the pH is very low, a small amount of lime can and should be used even on these crops, especially where the calcium is also low. If the pH value is already above 5.0 it is best to use phosphates alone wherever possible. If, however, the phosphates are high and pH above 5.0 it would be wise to use gypsum, neutral calcium carrier.

Magnesium: Magnesium is a vital part of chlorophyll, the green coloring matter of plants. Where shortages of magnesium exist, there is usually lack of green color between the veins of the leaves. Since magnesium can be removed from older parts of the plant to the newer growth, the older leaves are usually affected first. Not all plants are affected in the same manner. Blueberries, Ranger sweet potatoes, and some other plants show a reddening of leaves when magnesium is deficient. It must also be remembered that as with other elements, mild deficiencies of magnesium cause crop reduction without giving any external symptoms. Magnesium deficiencies occur most often and are most severe on light acid soils. Crops such as sweet potatoes are often seriously affected, although the deficiency has been observed in the field on white potatoes, azaleas, rhododendron, snap beans, tomatoes, and even corn.

For those plants which can be grown on limed soils, it is easy enough to prevent magnesium deficiencies by proper use of lime. Not all liming materials contain enough magnesium to supply crop needs. However, there are enough dolomitic (high magnesium) liming materials to prevent any magnesium deficiencies. Research has shown that when the available magnesium drops below about 25 lbs. per acre, there is a good possibility of severe magnesium deficiency. For best results the level should be kept over 100 lbs. or more per acre. At least occasional use of dolomitic limestone will keep sufficient magnesium in the soil.

Even for plants that have to be grown under acid conditions, it is possible to occasionally use dolomitic limestone. The amounts should be small, 500 lbs. or less per acre, and should be used only after a careful pH test is taken.

Where pH value doesn't permit the use of lime and there is need for magnesium, it is possible to add a soluble magnesium salt in the fertilizer or as a spray directly to the leaves.

Iron: Most soils contain large quantities of iron. However, most of it is present as ferric iron which is unavailable for plants. The ferric iron is reduced to ferrous iron, a form which can be utilized by plants. Normally, a certain amount of reduction takes place in all soils and is sufficient to meet crop needs. However, a high pH value and large amounts of phosphates tend to keep iron in an unavailable state. Such conditions not only limit the amount of soluble available iron in the soil, but what is equally serious will often make iron useless even when it has been absorbed by the plant.

Iron deficiencies are more apt to occur on acid-loving plants such as rhododendron, azaleas, and blueberries which have a high requirement for iron. Nurseries are often troubled by iron deficiencies. At first, a mild deficiency will cause no more than a stunted growth. As the deficiency becomes more severe, considerable mottling or loss of color may occur. In extreme cases, leaves may be paper-white and death of the plant is quite possible.

Even the most serious deficiencies can be overcome by means of ferrous sulfate sprays. This seems to be the most practical solution since a few ounces of ferrous sulfate will correct the situation for the time being. Correction through soil applications requires much larger amounts and may be difficult to obtain unless some fundamental soil changes are made. This involves lowering the pH, which may take some time.

Considerable work has been done to show that it is not only the total amount of available iron but rather its ratio to available manganese which is important. That is, an iron deficiency in many cases is nothing more than a manganese toxicity and vice versa. One can readily see that considerable care must be exercised in fertilizing with iron salts so that manganese deficiencies are not induced.

Besides this difficulty, soluble iron salts applied to normal soils soon oxidize so that the iron is in the ferric or unavailable state. True, some of this may be again reduced to available iron by organic matter or during wet periods. However, this uncertain reaction cannot be depended upon to supply sufficient iron in case of existing deficiencies. About the only time that soil applications of iron seem to be justified is when total iron content in the soil is very low and added iron becomes a reservoir for future crop needs. When such additions are made, fairly large supplies of manganese must also be made lest the ratio of iron to manganese be upset and a manganese deficiency result. Generally, an addition of 25-50 lbs. of ferric oxide per acre should be ample even on soils with extremely low iron contents. If ferrous sulfate or other more soluble iron salts are resorted to, 10 lbs. per acre should be sufficient. Larger amounts may be injurious until some of this application is oxidized.

Manganese: Manganese in the soil behaves much like iron. The manganic or oxidized forms of this element are unavailable to plants. The manganous or reduced forms are utilized by plants. As with iron, large amounts of lime and phosphates or arsenates tend to lower the concentration of available manganese.

Because of these facts manganese deficiencies occur most often on intensively farmed soils. A shortage of manganese ultimately reveals itself as a yellowing or chlorosis of leaf areas between the veins. It primarily affects the younger leaves but may be present over the entire plant. Ornamentals, legumes such as beans, and alfalfa, oats, spinach, and many other crops including peaches have been affected by shortages of this element. Application of manganese to peaches has increased vigor of tree and given peaches of larger size and better quality. There is considerable evidence that such trees are more resistant to disease.

Because the total amount of manganese in the soil is invariably much smaller than that of iron, deficiencies of the former occur more often. There is also more need for soil applications. To correct deficiencies which have occurred, sprays of soluble manganese seem to be the answer. However, in preventing deficiencies, a soil application of the manganese seems to be justified. Applications of manganous sulfate at rates of 5-150 lbs. per acre have been used with considerable success. Care should be taken that the larger applications are not made to acid soils lest considerable damage occur from excess soluble manganese. In fact, soil applications of soluble manganese should not be made to acid soils unless the supply of available manganese is shown by soil tests to be very low.

Boron: This element has received considerable attention in the last two decades. It is now apparent that shortages of it are responsible for a number of so-called diseases among which are "cracked stem" of celery, "black spot" of beets, "measles" and "corky core" of apples, and "yellows" of alfalfa. Lack of boron affects the growing point of shoots and roots. A mild deficiency slows growth but in a more advanced stage, the growing points of the plant are definitely affected. In many plants, this is shown as a cracking. Certain types of cracking in sweet potatoes, radishes, apples, beets, pears, and plums are examples of this type of injury. Death of the growing point occurs in many cases. Tipburn of lettuce and dieback of apples and peaches, with or without rosetting, are examples of this latter type of injury.

Boron is also essential for seed setting, and poor seed set of certain plants such as crimson clover has been markedly improved by additions of this element.

As has been previously pointed out, boron availability is markedly affected by lime applications, becoming less available as lime is increased. There is considerable evidence that not only pH but ratio of calcium to boron is involved. Boron is quite soluble under acid conditions and much of this element may be removed from very acid soils. After considerable leaching, such soils may fail to supply enough boron for crop needs. These soils invariably are a problem when limed because liming even further reduces the available supply.

Boron deficiencies are also increased during dry weather. Many a soil that previously has had no history of boron deficiency will fail to provide sufficient boron after a prolonged period of drought.

Plants vary considerably in their boron requirements. Alfalfa, cauliflower, broccoli, apples, and clovers have high requirements while the cereals such as corn, rye, oats, and crops such as potatoes and snap beans have relatively small requirements. Boron deficiencies of the former group have occurred quite often but field examples of boron deficiency in the latter group are quite rare.

In most soils there is a relatively small differential between deficient and toxic amounts of boron. This is more pronounced in the light soils and with certain crops. In some cases, a 10-lb. application of borax per acre will supply sufficient boron for crop needs, while if this amount is increased to 20 lbs. per acre, toxicity due to excess boron may be produced.

Deficiencies due to boron can be corrected by applications of borax or other boron compounds directly to the soil or by sprays of soluble boron compounds directly on the plant. The soil applications are entirely practical and have been most generally used. There is some justification for including some borax with all fertilizers—about 5 lbs. per ton—on Coastal Plain soils, especially those that have been well limed. Since borax readily leaches from soils, there is little danger of accumulation. However, care should be exercised to avoid toxic amounts.

Copper: Very little attention has been given to this element in many parts of the country. Applications of copper have been made indirectly for disease control. In many cases, increases in crop yields due to application of copper fungicides such as Bordeaux, yellow-Cuprocide, etc. have been noted even though no plant diseases were apparent. There is some indication that copper even when applied to the soil helps to stop certain plant diseases or at least to make such diseases less effective. The symptoms of deficiency due to this element for most plants have not been too well described. Mild deficiencies slow down growth and slight yellowing of leaves is apparent. Under more severe deficiencies considerable dieback of trees has occurred, and yellowing of leaves is much more pronounced. Copper has been used for a number of years on muck soils to give better color to onions. The muck soils seem to be especially in need of copper, although recent studies have indicated that the light Coastal Plain soils are also in need of this element. It has been used with considerable success in the Everglade regions where agriculture without copper does not seem possible. It has also been put to very good use in other portions of Florida for various crops including vegetable, flowers, citrus, and pastures.

Deficiencies of this element can be corrected by addition of soluble copper salts to the soil or by sprays directly to plants. Additions of 10-20 lbs. copper sulfate per acre on the light soils are generally sufficient, but much larger amounts (about 100 lbs. per acre) are needed on the muck soils. Sprays of the copper fungicides seem to be sufficient to correct deficiencies.

Zinc: As with copper, this element is important in disease control. Much of the response to zinc has been noted when various zinc compounds have been originally applied as fungicides. However, plant response has occurred even when no disease has been apparent. Such commercial zinc preparations as Zerlate and Dithane have been responsible for this type of response. Recently another organic zinc compound manufactured by Goodrich and known as z.a.c. has given substantial increases of lima and snap beans on certain soils when sprayed on the leaves. There was no indication of increases being due to disease control, since unsprayed checks appeared entirely healthy.

Zinc deficiency affects the color of the leaves, giving a mottled yellow color. Zinc deficiency of corn is known as "white bud" because of its effect upon color of the shoot. In some zinc deficiencies, there has been death of the terminals. Also a rosette pattern at the end of terminal shoots has been observed. In peaches this is usually accompanied by thin, small leaves giving this deficiency the characteristic name of "little leaf." On peaches, apples, and cherries, zinc deficiency is marked by premature dropping of leaves. Occurring on the young shoots except for the tip, it gives such trees an open or naked appearance. In peaches, a shortage of zinc may also be associated with considerable borer damage. This is evidently an indirect effect as zinc seems to affect the hardness of the wood. In severely affected trees it is possible for a man to completely twist a tree so that it breaks at the trunk. It is evident that such trees are much more subject to mechanical injury such as storm damage and breakdown due to fruit weight.

The greatest need for zinc applications appears to be on light Coastal Plain soils where considerable lime and phosphate have been applied. On the experiments with z.a.c. previously noted, response was greatest where phosphate accumulation gave high readings of available phosphorus. If zinc is included with mixed fertilizer containing appreciable quantities of phosphates, some of the zinc is immobilized and greater quantities are necessary than when zinc compounds are applied directly to the soil.

Arsenates also tie up zinc in an unavailable form. Wherever large amounts of arsenates have been used either for disease control or for Japanese beetle control, there is a good possibility of response to added zinc. Recently it has been shown that the "shot hole" (small circular holes) damage of peach leaves can be corrected by large applications of zinc sulfate. In certain cases as much as 5 lbs. of zinc sulfate per tree have had to be applied to the soil to correct this condition. In a peach orchard owned by James Page, Richland, N.J., a cooperative experiment was established by the author and Atlantic County Vocational Agricultural Teachers, Wm. Powers and S. J. Cesare. Peach trees received 2, 4, 6, 8, and 10 lbs of zinc sulfate per tree but showed best results with the 6-lb. treatment. Since arsenates remain in the soil for long periods of time, many orchard soils are unsuitable for crops when the orchard is removed. The addition of large amounts of zinc to such soils will greatly reduce the ill effects of the arsenates.

Usually, 10 to 20 lbs. of zinc sulfate per acre applied to the soil are sufficient to correct very mild deficiencies of zinc. When large amounts of phosphates or arsenates have accumulated, it may be necessary to use several hundred pounds per acre to do the job. Such large applications are expensive. Correction can be accomplished at a fraction of the cost by applying zinc in form of sprays. The zinc compounds used for disease control are especially useful. The use of z.a.c. appears to be very promising. An organic compound of low solubility, it remains on the leaf for a long time, constantly feeding a small amount of zinc to the leaves. The application, if accompanied by use of p.e.p.s., a sticker, greatly lengthens the life of the z.a.c.

According to Dr. N. F. Childers of the New Jersey Agricultural Experiment Station, leaf sprays of zinc to apples and peaches have caused injury. He obtained good results with heavy zinc applications to the soil or with a dormant spray of zinc sulfate. The spray was made by dissolving 25 lbs. of zinc sulfate in 100 gallons of water and was applied two weeks before buds opened.

Molybdenum: Molybdenum has only recently been added to the list of elements necessary for plant growth. Since only minute quantities are needed by plants, it has been thought that soils could supply amounts sufficient for plant needs. However, it has been recently shown by the New Jersey Station that application of molybdeum has greatly increased nitrogen fixation and therefore bettered the growth of legumes such as clovers and alfalfa. A strange disease of cauliflower known as "whiptail" and so designated because of leaves appearing as whips (petioles with little or no blade) has been corrected by additions of modybdenum in New York. Molybdenum deficiencies in tomatoes resemble to a marked degree symptoms that are thought to be due to certain virus infections. It is not known whether any of these so-called virus symptoms are due to shortages of molybdenum, but their similarity suggests the need for further investigation. Only very small amounts of molybdenum are needed to correct a deficiency. An application of ½ lb. of sodium molybdate is sufficient for acid soils but only ¼ lb. is needed on well-limed soils. As with other elements, care should be taken to avoid excesses.

Trace Elements Mixed With Fertilizer

The mixing of small quantities of copper, iron, etc., in the fertilizer presents a most serious problem to the fertilizer manufacturer. Not all soils and crops need the same amounts of these elements, requiring the manufacturer to mix each farmer's fertilizer separately if he is to include the trace elements in quantities to correct deficiencies. The inclusion of different amounts of trace elements with each lot of fertilizer means extra mixing and delays his operation at a most critical time.

Also, there is a real problem in trying to mix 5 lbs. or even 20 lbs. of borax or any other material with a ton of fertilizer. That less than perfect mixes have occurred is not difficult to imagine. When they occur, part of the fertilizer may have toxic amounts of the trace element while other parts of the fertilizer may have insufficient amounts.

If it is necessary to include trace elements in the fertilizer, the manufacturer would like to see a definite amount of each trace element included; at least definite amounts for each analysis. Such additions must be kept small lest a large application of such fertilizer add so much of the trace element that injury results. If the amounts are kept to such quantities, the additions are useful only from the standpoint of preventing or delaying future deficiencies. There is not enough for correction of immediate deficiencies.

There are other defects in trying to add these elements in the fertilizer. Such elements as iron, manganese, and zinc are readily fixed in the soil or in the fertilizer. Applications may fail to correct the deficiency. Also, such large quantities have to be used in certain cases that the application is not economical.

The application of boron, manganese, iron, copper, zinc, and molybdenum as dilute sprays seems to obviate most but not all of the defects

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Fig. 1. A Terrebonne Parish group comes by boat to meet the bookmobile in Louisiana.

Books for Better Crops

By C. B. Sherman

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THAT books are instrumental in bringing forth both better crops and new crops, whether these books are used at the agricultural schools and colleges or in remote farmhouses, is so thoroughly recognized now in many quarters that rural library services expand continuously, if more slowly than effects already gained may seem to justify.

It is well known that the Extension Service, and particularly its honorable director, M. L. Wilson, is squarely behind the whole idea of bringing books to the rural families. Many state agencies, the large farm organizations, and innumerable smaller groups have helped in diverse ways to extend the services. States themselves take part—their parts are more active and extensive in some instances than in others. Although much is yet to be done, results today are probably more concrete and practical than many realize.

Farmers and farm families who have had good library service are convinced of the practical value of the books they get from these sources. The families, from farmer and housemother down to the young children, often revel in the general or special information they glean from these volumes or in the entertainment and amusement that other books provide, for most rural library services make a point of providing what is wanted by all ages.

By mail, by bookmobile, by jeep, by horseback, and on foot, rural book services from the larger centers now reach far out into the country in most states. Sometimes the people meet the carrier at certain points along the highway; sometimes the carrier leaves the books for a certain period at designated places where the people come to get them—at small branch or local libraries, at country stores, at county agents' offices, at schools, at private houses, sometimes at farmhouses.

On the streets of Little Rock the returning bookmobile, splashed to the top with red mud, is a common sight. Down in the bayou country, people row over in their boats to the stopping place of the bookmobile. Up in the mountains they ride by muleback. Out on the plains a high-powered motorcar speeds 40 miles to meet the bookmobile and bring back books for the ranch house and for the distant neighbors.

The service is best when an experienced and energetic library worker comes along, or drives the bookmobile, or rides the horse—a library assistant who can give practical suggestions about books and materials, answer the questions, help make selections, and take requests for other books on other subjects.

What They Say

One such driver-worker reported books or pamphlets on these subjects as taken out or asked for by bona fide farmers on her last trip; new crops and new uses for crops, new fertilizers and new insecticides, directions for building a modern chicken house. One farmer wanted ways of making a farm pay better—by better varieties of crops, or better yields, or better methods. He thought he was open to any suggestions that would help, if they were given in simple language.

In the South in localities where cotton-growing is yielding to a cattle industry, the farmers in numbers ask for The Pasture Book by W. R. Thompson. On an R.F.D. route out from Dodson, La., Harvey Walker says, "I have used this book for a month. It is one to be studied and used. It is very practical and I have now recommended it to many farmers." The bookmobile rider in another part of the State reports that their copy is in constant use and many of the borrowers say it is the best book on pastures for Louisiana and Mississippi. The recent Yearbooks of the U. S. Department of Agriculture come in for farmer commendation, according to many of these itinerant librarians.

Often a farmer reads several of the best books on a subject and will be ready to make his own evaluation: "Cotton Insects of the United States by Van Allen Little gave me more real information on cotton pests than any other three books I have read," says one. Many of the farmers and other readers buy their own copies when they find just the book they want. The book by Cox and Jackson called Crop Management and Soil Conservation has had frequent endorsement by farmers in many localities who said they were helped by it in their every-day farming. About Collings' book on Commercial Fertilizers and Andrews' on Response of Crops and Soils to Fertilizers and Manures, one borrower said, "They are both excellent. Each is one of the best in its field."

Overcoming Skepticism

Evidence seems to say that even those farmers who deprecate books and bulletins in their regular farming turn to them as a way of keeping up with newer developments or to help them establish sidelines. A man on a small farm wanted to try raising frogs. He borrowed books about it, read and experimented, and is now raising frogs for sale. Another farmer, wanting to preserve the hide of a calf, asked the bookmobile driver to bring him a book on tanning. Eventually he tanned hides to make all the leather he needed for mending harness, and then he found an opening in the next state for supplying the material for making book covers. He estimates that the books lent him by the Louisiana Library Commission, including the expensive technical volumes, have saved or earned for him about $200 a year.

And, "If the librarian comes out to the schoolhouse on community night and shows Battling Brucellosis, the farmers are interested, they want more films, get acquainted with the library workers, and begin to think of the library service as a source of information for their farming," says Miss Miller, Head of the Jefferson City and Cole County Libraries in Missouri, a combination which has not been working with the farmers very long. Like other library extension agencies, its workers find that film strips, slides, and recordings make telling supplements. Texas is one of the states that has made extensive use of them.

Strong Central Collections

These centralized services from large book collections reaching out into the farms are found in many states. California has always been a leader in such work. Hagerstown, Md., had one of the earliest forms of farm deliveries—books were first taken out to the farm families by the enterprising librarian by means of horse and wagon, and her self-designed motored bookmobile was one of the first in this country. T.V.A. has helped to develop active book delivery in out-of-the-way localities throughout its region and has stimulated deep penetration into much of the adjacent country. Vermont's up-to-date bookmobiles, operating out from the State House at Montpelier, probably cover the remote parts of all counties more completely than other States have yet succeeded in doing. Louisiana is very active and has colorful experiences and results. These examples drawn from different parts of the United States are suggestive only. In most states there are good beginnings and frequently good progress.

The newer idea is distinctly in favor of the strong centralized collection with good extension services. Thus a community keeps supplied with the books it wants and needs instead of having to rely on a small, independent, and often out-of-date local library. Sometimes such local libraries get new life and vigor by linking up with a central service.

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Fig. 2. A librarian from a central library visits a community club bringing a new supply of books to exchange for those she has left before.

Does Potash Fertilizer Reduce Protein Content of Alfalfa?

By Arthur Wallace

Division of Subtropical Horticulture, University of California, Los Angeles, California

MANY people believe that the nutritional quality of crops is lowered when yields are increased with inorganic commercial fertilizers. Contrary to this, considerable evidence has been accumulated for many crops under various conditions showing that the use of inorganic fertilizers actually improves the nutritional quality. The use of potassium fertilizers does occasionally result in plants having more carbohydrates and less proteins on a percentage basis than do unfertilized plants. Potash fertilizer results also, nearly always, in an increase in the potassium within a plant and a corresponding depression in the calcium. The inverse nature of these potassium-protein and potassium-calcium relationships has led some plant scientists to describe high-potash plants as "carbonaceous" and those high in calcium as "proteinaceous." This generalization does not apply to all species. Spinach, for example, can accumulate extremely large quantities of potassium and at the same time contain very high concentrations of nitrogenous materials.

Alfalfa has been used as a test plant for more than 10 years by the Soils Department of the New Jersey Agricultural Experiment Station. In one phase of this long-time study an attempt was made to learn the potassium-calcium-carbohydrate-protein relationships in alfalfa and reasons for them. The major findings of this one phase are briefly described in this report.

In 1945 a field experiment with Ranger alfalfa was initiated in New Brunswick, New Jersey, for the over-all purpose of determining the relationships of mineral nutrition to the yield, longevity, and chemical composition of alfalfa. * The experiment consisted of 25 plots in triplicate and was carried on for four years. Detailed chemical and physiological studies were made on the alfalfa from this field. For the purpose of this discussion, data from four treatments only need be considered, and these are those plots top-dressed once a year with 0, 60, 120, and 180 lbs. of potash (K_2O) per acre. Similar data were obtained for each of the years except that the differences became progressively greater each year. For simplicity, data for only the third year (1948) will be discussed.

The 1948 mean yields of oven-dried hay for each treatment were 4,930, 7,080, 7,890, and 8,570 lbs., respectively, for the 0, 60, 120, and 180 lb. applications. Much of the produce in the no-potash plot was weeds and grasses. The nitrogen content ** of the hay decreased

* Bear, F. E., and Wallace, A. Alfalfa, its mineral requirements and chemical composition. Bul. 748, New Jersey Agr. Exp. Sta., 1950. The experimental design and methods of analysis are reported in detail in that bulletin, which was reprinted in full in BETTER CROPS WITH PLANT FOOD *34*: Nos. 5, 6, and 7. 1950.

** The values reported for each of the chemical constituents are the weighted means of the three cuttings made in 1948 and are on the dry-matter basis. Protein and nitrogen are used interchangeably in this discussion. Crude protein is generally considered as nitrogen X6.25. Actual determinations of many samples of potassium-deficient alfalfa revealed that 18.5 per cent of the nitrogen was in the non-protein form; whereas 14.8 per cent of the nitrogen of high-potash alfalfa was in the non-protein form.

Fig. 1. The front four markers, from left to right, are in plots receiving respectively 120 lbs. K_2O per acre per year, 60 lbs. K_2O per acre per year, no K_2O, and a heavy application of K_2O at seeding time but none since. The alfalfa was seeded in 1945, fertilizer treatments were started in 1947, and the photograph was taken in the spring of 1949. The strip of luxuriantly-growing alfalfa in the rear overlaps the ends of each of the above-named plots and resulted from an application of 300 lbs. K_2O per acre put out for demonstrational effect in the very early spring of 1949.

from 3.18 to 2.74 per cent as the top-dressing rates increased from 0 to 180 lbs. potash per acre (Table I). The potassium content simultaneously increased from 0.50 to 1.41 per cent and the calcium decreased from 2.00 to 1.30 per cent. These values illustrate the tendency for alfalfa to be more pro-

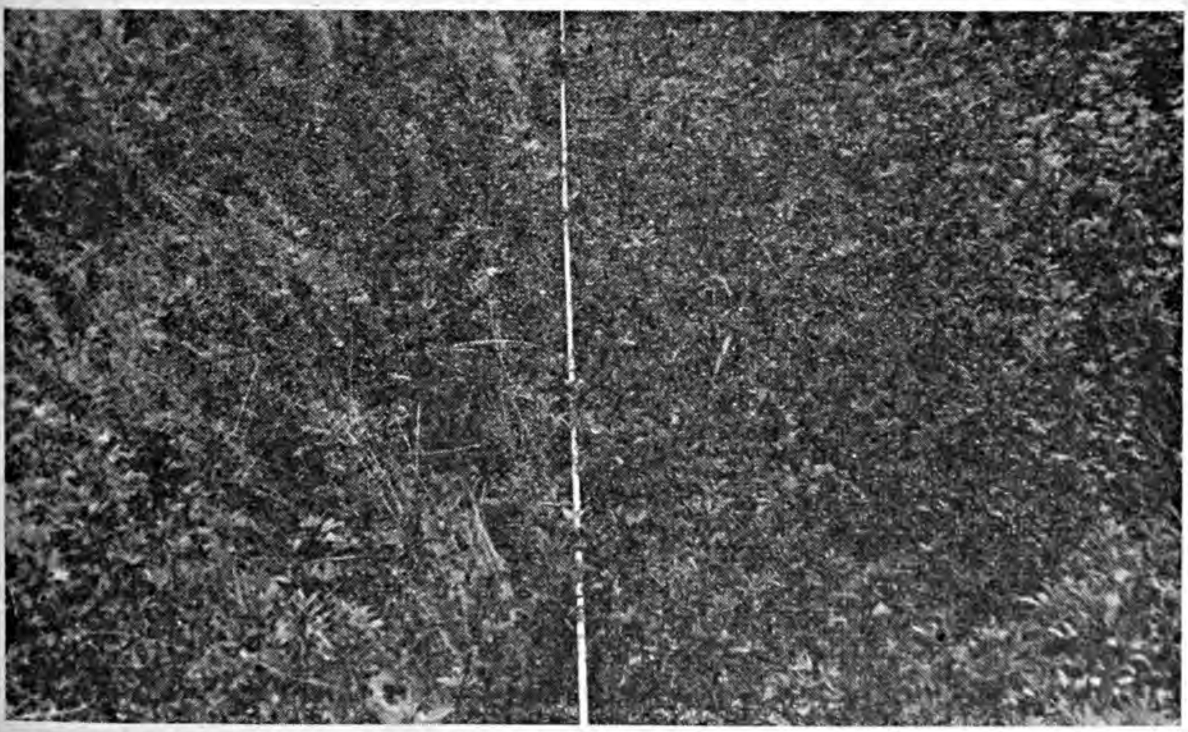

Fig. 2. Insufficient potash, at the left, resulted in a large weed population with relatively little alfalfa. Weeds including grasses that are normally low in calcium seriously compete with alfalfa for the available potash. The annual potash application to the left plot was 60 lbs. per acre and that to the right, 120 lbs.

TABLE I.—INFLUENCE OF POTASH ON THE YIELD, CHEMICAL COMPOSITION, AND LEAF PERCENTAGE OF ALFALFA HAY GROWN IN 1948 IN NEW BRUNSWICK, NEW JERSEY. *

Treatment K_2O per acre per year**	Yield of hay	Potassium in hay	Calcium in hay	Cation sum of hay***	Leaf to leaf + stem****
lb.	lb./acre	% of dry matter	% of dry matter	me./100 gm.	%
0	4930	.50	2.00	140	58.1
60	7080	.76	1.73	130	52.0
120	7890	1.11	1.58	129	48.7
180	8570	1.41	1.30	125	45.6

* Data are weighed means of three cuttings. Experiment was in third year.
** Plots were in triplicate.
*** See note in text concerning cations and anions.
**** Leaf percentage.

teinaceous when its potassium is low and its calcium is high. The information obtained in this study suggests that there are at least four factors operating collectively to cause the observed nitrogen differences. Each of these is discussed separately.

The first factor found was that of carbohydrate dilution. A more rapid photosynthetic rate in healthy plants than in stunted ones results in an increased carbohydrate concentration. As a consequence, the minerals and proteins in the plant are both diluted as the carbohydrate supply is increased. An indirect measure of the dilution of minerals and protein resulting from the increased photosynthetic activity can be obtained from the differences in the total milliequivalent summation of either the cations or of the anions. *** This is based on the evidence that alfalfa tends to maintain a constant sum of cations and of anions. The cation millequivalent sums of the alfalfa hay grown at the four potash levels from low to high potash were 140, 130, 129, and 125 (Table I). If the carbohydrate production of these plants had been uniform, thereby resulting in a constant cation sum of 125, the percentage nitrogen values of the hay from the four treatments might have been 2.75, 2.89, 2.76, and 2.74 in place of 3.18, 3.01, 2.85, and 2.74. These probable changes are recorded in Table IV and will be summarized later.

The second factor found to influence the nitrogen content was chloride absorption. The potassium fertilizer was applied as muriate. This means that the potassium was combined with a chloride carrier. Chloride and nitrate chemically are both anions; hence, compete with each other for absorption by plants. The chlorine content of the hay increased with the fertilizer application, and the nitrogen content decreased an equivalent amount (Table II). Alfalfa obtains nitrogen from symbiosis but these results imply that a considerable part of the nitrogen in the alfalfa came in the form of nitrate from the soil supply. If chloride absorption had been absent, the nitrogen values in the alfalfa from the four treatments might have increased to 3.21,

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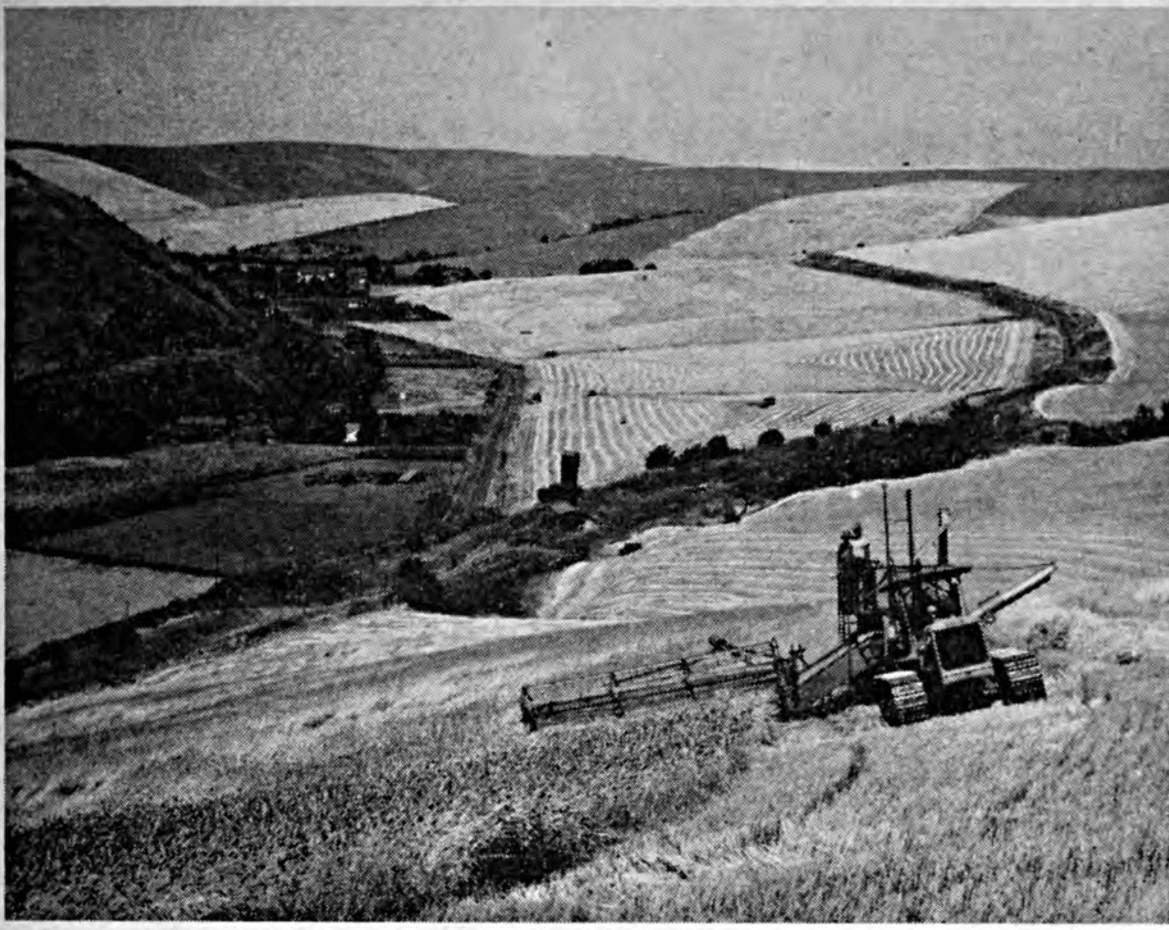
*** Chemically, cations are the basic or positive portions of salts and anions are the acid or negative portions. The cations usually absorbed by plants are combined potassium (K), calcium (Ca), magnesium (Mg), and sodium (Na). The anions commonly absorbed by plants are nitrate (NO_3), phosphate (H_nPO_4), sulfate (SO_4), and chloride (Cl). The use of chemical equivalents makes possible the evaluation of these elements on a uniform basis according to their combining powers. The sum of both cations and anions in alfalfa is usually constant as is the ratio between them. Ordinarily the cation and anion values are reported as milliequivalents (me.) per 100 grams of dry plant material. The milliequivalent (me.) values may be converted to percentage values by multiplying the me. of K by 0.039, Ca by 0.020, Mg by 0.012, Na by 0.023, N by 0.014, P by 0.031, S by 0.016, and Cl by 0.0355.

PICTORIAL

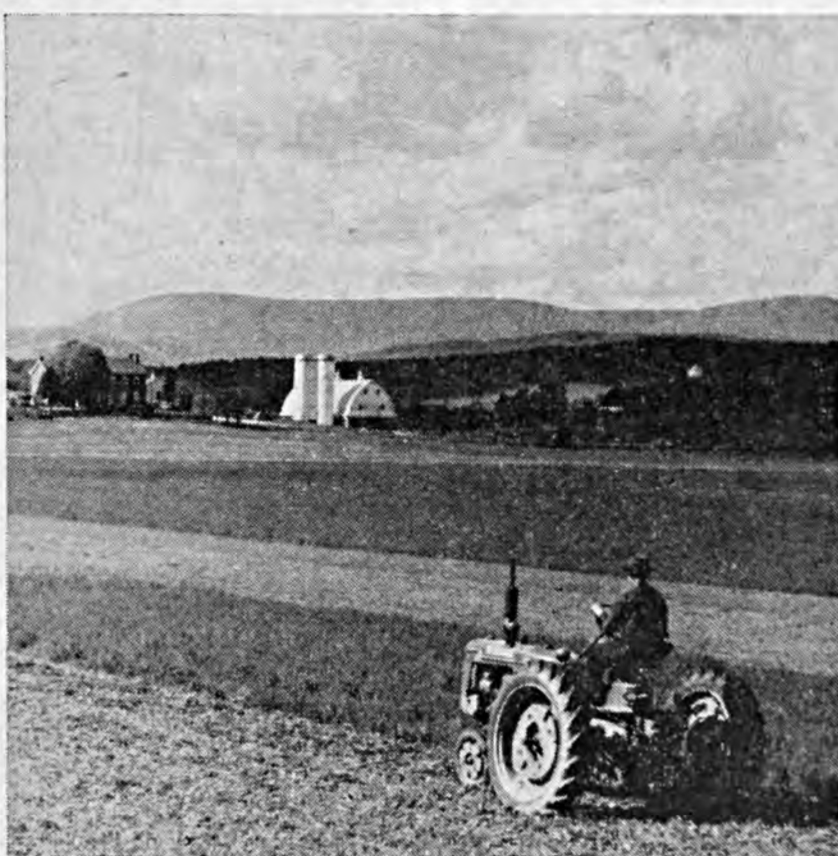
The Pay-off on Good Gardening

Above: Modern harvesting equipment is one of the big reasons why the average farmer today supplies food and fibre for 14½ persons whereas 100 years ago he produced enough for only 4½.

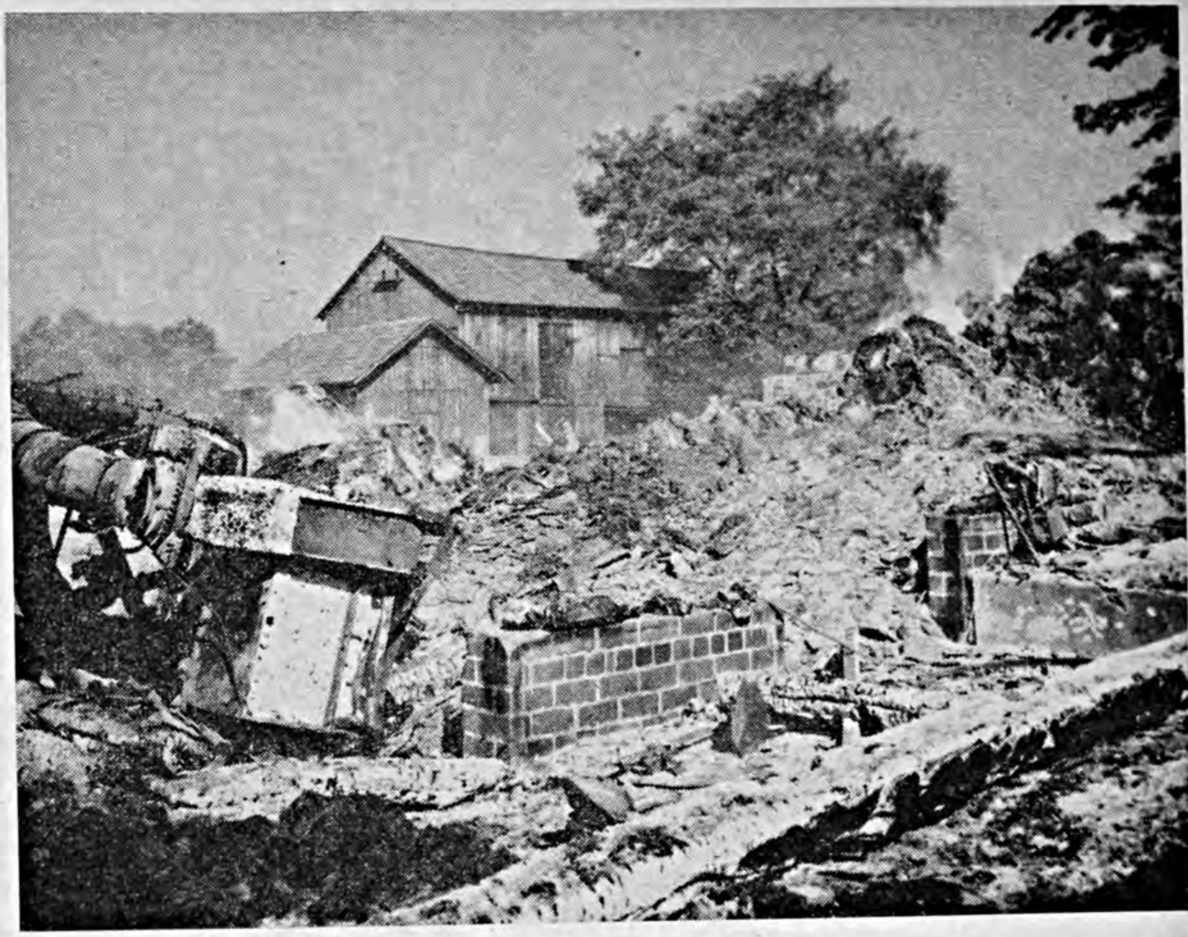
Left: Haying attracts young as well as old.



Above: Time, space, and man power yield to the use of more and better equipment, providing the efficiency which has made American agriculture a bulwark of this country's strength.



Right: Much forage is needed to fill this barn.



Fires are one of the major catastrophes of farm life.

The Editors Talk

To Hoe—or Not to Hoe?

Easily understood interest has followed experimental work over the past few years regarding the use of weed-killers and the necessity for less and less cultivation of growing crops. To anyone who ever spent long, hot summer hours at the end of a hoe, hanging onto the handles of a walking cultivator behind a fly-switching horse, or bouncing around on the hard seat of a sulky engulfed in clouds of dust, the theory of "crusting" the surface of the soil to save moisture was welcome indeed.

Now comes information from the Connecticut Agricultural Experiment Station in support of the hoe: "The increasing dependence upon chemicals for controlling weeds in agricultural crops has tended to mean less use of the cultivator for this purpose," the release says. "But experiments at this Station during the past three years show that the cultivator is not ready for retirement. Results show that, aside from its merits in destroying weeds, cultivation definitely steps up crop production."

According to Dr. C. L. W. Swanson and H. G. M. Jacobson of the Station's Soils Department, soil on cultivated plots showed improved structure and better aeration than that on plots treated with the weed-killer, 2,4-D. The better aerated soil released more nitrogen to the plants, which produced a larger yield.

The test crop used was corn. On one-half the plots, 2,4-D was used exclusively for weed control. On the other half, cultivation was relied on to take care of the weed problem.

Results were particularly striking during the 1948 and 1949 seasons, both hot, dry summers, interspersed with infrequent but heavy downpours of rain. On the 2,4-D plots, undisturbed by the cultivator, a hard crust formed, while the soil on the cultivated plots was porous and in good condition.

More striking than the variation in soil, however, was the contrast in the crop grown. The corn on the 2,4-D plots was smaller and lighter green in color. At the end of the 1948 season, the cultivated plots yielded 61.5 bushels of corn per acre, while the plots treated with 2,4-D produced only 15.2 bushels. Corresponding figures for 1949, when weather conditions were somewhat more favorable, were 94.6 and 68.3.

Yield differences were much less pronounced in 1950 which was an ideal year for corn production. All plots did well, with the area treated with 2,4-D producing only 15 bushels less per acre than the cultivated plots. However, measurements of nitrogen in the harvested corn grain showed that the cultivated corn contained substantially more nitrogen than that receiving 2,4-D treatments. It is known that protein content increases directly as nitrogen content increases, so the food value of the cultivated corn was greater.

While the experiments were not designed to compare the efficiency of the two methods in controlling weeds, but only their effect on crop growth and soil tilth, observations did show that weed mortality on the 2,4-D plots was lower.

The release points out that despite the favorable results with cultivation, there is some evidence that it can be overdone. Soil examination of the corn plots under continuous cultivation for the three years showed that in areas where the tractor wheels had traveled many times, structure was poorer than in the spots where the wheel did not strike. Plans are to continue these experiments for several more years to see just how deleterious this compacting effect is on crop growth.

From the past three years' work, it would appear that in hot years with rains which are very heavy when they do occur, cultivation is essential. In years when weather conditions are more favorable for crop growth, some cultivation will give better results than reliance on weed-killers alone. "Probably the answer will be a judicious use of both methods of weed control, with the proportion dependent upon growing conditions," the Station concludes.

The Need for More Farm Safety

In the observance of the National Farm Safety Week, July 22-28 this year, Secretary of Agriculture Brannan emphasized two of the newer "perils" to farm life—greatly increased mechanization and use of unskilled labor. During the past 10 years the number of farm workers has decreased by over 1,000,000. More than twice as many tractors and trucks are now used on farms and only half as many mules and horses. Eighty-six per cent of all farms are now provided with electrical service. Due to this increase in mechanization, together with better varieties, better methods, and other factors, the output per man-hour is 50 per cent higher than it was as recently as 1937. This mechanization has made farm workers more highly skilled and their replacement more difficult. Inroads upon these skilled workers by the military services, and the need for increased farm output, are faced with little reserve manpower to make these replacements. Younger and older men and women are filling in and their lack of experience is inducive to more accidents.

Pointing out that prevention of accidents on farms is an essential part of our defense program, Secretary Brannan urges every possible adoption of safe practices in farming and farm living. Suggestions should be given freely by the advisory forces and sincerely welcomed by all farm operators.

We Have Moved

On July 1, the editorial office of this magazine moved into the building recently purchased by the American Potash Institute at 1102 Sixteenth St., N.W., Washington 6, D. C. This is only a few doors away from our former location in the American Chemical Society building at 1155 Sixteenth St. Both the Institute and this office will welcome visitors at any time. Come in and see us.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941...........	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942...........	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943...........	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945...........	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946...........	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947...........	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948...........	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949...........	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
June........	29.91	49.7	127.0	211.0	136.0	193.0	16.05	46.20	....
July........	33.05	45.5	127.0	208.0	144.0	199.0	15.15	52.00	....
August......	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September...	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October......	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.......	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April........	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May........	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
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	89	81	109	74	87	110
1938...........	69	196	80	79	76	64	57	97	88
1939...........	73	154	100	84	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	105	117	107	82	211	129
1942...........	153	369	168	134	143	124	91	202	163
1943...........	160	405	188	235	174	154	125	231	245
1944...........	167	420	214	216	170	160	139	234	212
1945...........	181	366	205	232	198	170	127	227	207
1946...........	263	382	178	248	212	209	141	319	182
1947...........	257	380	232	248	336	259	148	381	226
1948...........	245	482	222	253	201	226	155	298	214
1949...........	231	463	184	244	210	210	139	192	201
1950									
June........	241	497	182	240	212	218	135	205	182
July........	267	455	182	237	224	225	128	231	200
August......	298	531	175	248	224	223	130	314	164
September...	322	554	151	219	224	219	131	349	126
October......	314	551	123	175	213	216	134	361	138
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.......	345	266	154	236	249	240	155	457	265
April........	348	253	161	231	252	242	155	457	225
May........	342	398	156	238	255	239	153	448	239

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
June	3.00	1.71	10.55	10.79	9.41	7.36
July	3.00	1.71	11.53	10.71	9.35	8.74
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25

Index Numbers (1910-14 = 100)

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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
June	112	60	301	306	279	209
July	112	60	329	303	277	248
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291

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[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910-14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
June	.760	3.76	5.47	.336	.647	12.77	.176
July	.760	3.76	5.47	.368	.704	13.98	.193
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.75	5.47	.368	.704	13.98	.193
October	.760	3.73	5.47	.386	.704	13.98	.193
November	.760	3.73	5.47	.386	.732	14.72	.193
December	.798	3.73	5.47	.420	.796	16.00	.210
1951							
January	.810	3.73	5.47	.420	.796	16.00	.210
February	.810	3.73	5.47	.420	.796	16.00	.210
March	.810	3.73	5.47	.420	.796	16.00	.210
April	810	3.73	5.47	.420	.796	16.00	.210
May	.810	3.73	5.47	.420	.796	16.00	.210

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
1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
June	142	104	112	63	68	53	80
July	142	104	112	67	74	58	82
August	142	104	112	67	74	58	82
September	142	104	112	67	74	58	82
October	142	103	112	70	74	58	82
November	142	103	112	70	77	61	82
December	149	103	112	75	84	66	85
1951							
January	151	103	112	75	84	66	85
February	151	103	112	75	84	66	85
March	151	103	112	75	84	66	85
April	151	103	112	75	84	66	85
May	151	103	112	75	84	66	85

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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
June	247	245	230	126	85	293	142	66
July	263	247	238	128	85	301	142	70
August	267	248	243	131	85	321	142	70
September	272	252	247	131	85	324	142	70
October	268	253	247	131	85	323	142	73
November	276	255	251	132	85	328	142	74
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78
March	311	272	269	142	91	357	151	78
April	309	273	268	141	91	353	151	78
May	305	272	266	139	91	334	151	78

* U. S. D. A. figures, revised January 1950. 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] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] 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 is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 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

"Cotton Fertilization," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 234, Mar. 1951, L. L. Brimhall and W. T. McGeorge.

"Commercial Fertilizers, Report for 1950," Bul. 544, Dec. 1950, H. J. Fisher; "Ammonium Nitrate and Poultry Manure in Fertilization of Tobacco," Bul. 546, Mar. 1951, T. R. Swanback; Agr. Exp. Sta., New Haven, Conn.

"The Role of Plant Foods in Permanent Soil Productivity Systems," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., AG-1486, Mar. 1951, E. H. Tyner.

"Commercial Fertilizers for Corn in Central and Eastern Nebraska," Agr. Exp. Sta., Univ. of Neb., Lincoln, Neb., Outstate Testing Cir. 14, Apr. 1951, G. W. Lowrey and H. F. Rhoades.

"Fertilizers for Irrigated Soils of New Mexico," Agr. Exp. Sta., N. Mex. College, State College, N. Mex., Press Bul. 1050, Mar. 1951. H. E. Dregne and J. E. Chapman.

"Commercial Fertilizers—1951," Dept. of Agr., Madison, Wis., Bul. No. 306, Mar.-Apr. 1951, W. B. Griem.

Soils

"Soil Organic Matter for High Productivity," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., AG-1485, Mar. 1951, R. H. Bray.

"Coahoma County Soils," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 475, July 1950, C. G. Morgan and H. B. Vanderford.

"The Value of Soil Tests in New Mexico," Agr. Exp. Sta., N. Mex. College, State College, N. Mex., Press Bul. 1052, Mar. 1951, H. E. Dregne and J. E. Chapman.

"Soil Studies in Lajas Valley," Bul. No. 86, Aug. 1950, J. A. Bonnet and P. Tirado Sulsona; "Soil Studies in the Projected Coamo Irrigation Area," Bul. No. 88, Sept. 1950, J. A. Bonnet and M. A. L. Lopez; Agr. Exp. Sta., Univ. of P. R., Rio Piedras, P. R.

"How to Recognize Erosion in the Northeast," USDA, Wash., D. C., Agr. Inf. Bul. No. 27, Dec. 1950, W. W. Reitz.

Crops

"Cotton Planting," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 233, Mar. 1951, W. I. Thomas, E. R. Holekamp, and K. R. Frost.

"Herbaceous Perennials for Canadian Gardens," Pub. 784, Nov. 1950; "Annual Flowers for Canadian Gardens," Pub. 796, Nov. 1950; Exp. Farms Serv., Dept. of Agr., Ottawa, Ont., Can., Rev. by R. W. Oliver.

"Dominion Experimental Station, Summerland, British Columbia, Progress Report 1937-1948," Exp. Farms Serv., Dept. of Agr., Ottawa, Ont., Can.

"Report of the Station for the Year Ending June 30, 1950," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Bul. 271, Dec. 1950.

"The Influence of Seedbed Conditions on the Regeneration of Eastern White Pine," Agr. Exp. Sta., New Haven, Conn., Bul. 545, Feb. 1951, D. M. Smith.

"Vegetable Gardens," Agr. Ext. Serv., Univ. of Del., Newark, Del., Ext. Bul. No. 55, Apr. 1951, R. F. Stevens and E. K. Bender.

"The Importance of Pasture," Agr. Ext. Serv., Univ. of Del., Newark, Del., Mimeo. Cir. No. 73, Feb. 1951, C. E. Phillips and W. H. Mitchell.

"1950 Report Florida Agricultural Extension Service," Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla., June 30, 1950.

"Herbaceous Perennials," Bul. 146, Jan. 1951, J. V. Watkins; "Strawberries in Florida Culture, Diseases, and Insects," Bul. 148, Feb. 1951, A. N. Brooks and E. G. Kelsheimer; Agr. Ext. Serv., Gainesville, Fla.

"Watermelon Production Guide," Cir. 96, Dec. 1950; "Sweet Potato Production Guide," Cir. 97, Dec. 1950; "Tomato Production Guide," Cir. 98, Dec. 1950; "Sweet Corn Production Guide," Cir. 99, Dec. 1950; "Snap Bean Production Guide," Cir. 100, Mar. 1951; "Cucumber Production Guide," Cir. 101, Mar. 1951; Pepper Production Guide," Cir. 102, Mar. 1951; "Squash Production Guide," Cir. 103, Mar. 1951; Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla.

"50th Anniversary Report, 1901-1951," Agr. Exp. Sta., Univ. of Hawaii, Honolulu, Hawaii.

"The Life of the Land Extension in Hawaii 1948-50," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii, Bul. 51, Apr. 1951.

"Snap Bean Production in Hawaii," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii, Ext. Cir. No. 306, Apr. 1951, Yukio Nakagawa.

"Fiftieth Annual Iowa Year Book of Agriculture—1949," Dept. of Agr., Des Moines, Iowa.

"A Preliminary Report on Experiments Conducted by the Crops and Soils Department of the Louisiana Agricultural Experiment Station 1950," Agr. Exp. Sta., La. State Univ., Baton Rouge, La.

"Fourteenth Biennial Report for the Years Ending June 30, 1949, and June 30, 1950," Dept. of Agr., Lansing, Mich.

"Sixty-third Annual Report Mississippi Agricultural Experiment Station, Fiscal Year Ending June 30, 1950," Agr. Exp. Sta., Miss. State College, State College, Miss.

"The Year-Round Home Garden," Agr. Ext. Serv., Miss. State College, State College, Miss., Ext. Pub. 161 (15M), Feb. 1951, K. H. Buckley.

"Tall Fescue in the Southeast," Agr. Edu. Dept., Miss. State College, State College, Miss., Apr. 1951, R. Y. Bailey.

"Home Floriculture," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Cir. 352, Dec. 1950, J. E. Smith, Jr.

"Corn Growing for the Potato Areas," Agr. Ext. Serv., Rutgers Univ., New Brunswick, N. J., Leaf. 48, Feb. 1951, J. C. Anderson, J. C. Campbell, J. W. Carncross, and B. B. Pepper.

"Cultural Practices for New York Vineyards," Agr. Ext. Serv., Cornell Univ., Ithaca, N. Y., Ext. Bul. 805, Dec. 1950, N. Shaulis.

"Progress Report, 1951: Pasture Fertility Research Station Coalgate, Oklahoma," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Mimeo. Cir M-221, May 1951, H. J. Harper, W. C. Elder, and A. B. Nelson.

"Science for the Farmer," Agr. Exp. Sta., Pa. State College, State College, Pa., Supl. No. 3, Bul. 529, 63rd A. R., June 1951.

"Woodland as a Farm Enterprise," Bul. 536, Feb. 1951; "Woodland as a Farm Enterprise," Bul. 536P, Feb. 1951; Agr. Exp. Sta., Pa. State College, State College, Pa., P. I. Wrigley.

"Vegetable Variety Trials—1950," P. R. No. 42, Feb. 1951, M. L. Odland and C. J. Noll; "Practices Used on Tobacco Seedbeds at the Tobacco Research Laboratory, Lancaster Pennsylvania," P. R. No. 48, May 1951, E. O. Schneider and W. S. Beach; Agr. Exp. Sta., Pa. State College, State College, Pa.

"Annual Report of the Secretary of Agriculture and Natural Resources for the Fiscal Year Ending June 30, 1949," Dept. of Agr., Manila, Philippines.

"Performance of Legumes at the Angleton Station, 1949-50," P. R. 1309, Jan. 12, 1951, M. E. Riewe and W. F. Turner; "Cool Season Grasses at College Station, Denton and Iowa Park, 1948-50," P. R. 1310, Jan. 12, 1951, E. C. Holt, D. I. Dudley, L. E. Brooks, and R. C. Potts; "Production Practices for Sugar Beets on the High Plains of Texas," P. R. 1311, Jan. 12, 1951, W. C. McArthur, C. A. Bonnen, and A. C. Magee; Agr. Exp. Sta., Texas A & M College, College Station, Texas.

"Diseases of Forage Crops," Bul. 188, Jan. 1951, S. B. Fenne; "Garden Roses for Virginia," Bul. 189, Jan. 1951, A. G. Smith, Jr.; Agr. Ext. Serv., Va. Poly. Inst., Blacksburg, Va.

"Alfalfa Helps to Safeguard Feed Production in Wisconsin," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 393, Mar. 1951, L. F. Graber and D. Smith.

Economics

"Cigar Leaf Statistics and Outlook, Spring, 1951," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Inf-25, May 2, 1951, A. W. Dewey.

"Hawaiian Coffee, With Some Information About World Types, Grading, and Trading Practices," Agr. Econ. Rpt. No. 5; "1950 Statistics of Diversified Agriculture in Hawaii," Agr. Econ. Rpt. No. 7; May 1951, Agr. Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii.

"Suggested Adjustments for Southwestern Kansas Agriculture," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Cir. 267, Nov. 1950, R. J. Doll and E. Castle.

"Maryland's Sweet Potato Industry," Agr. Ext. Serv., Univ. of Md., College Park, Md., Feb. 1951, H. L. Stier.

"New Jersey's Farm Economic Situation," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., May 1951.

"Keeping up on the Farm Outlook," Ext. Serv., Wash. State College, Pullman, Wash., Ext. Cir. No. 189, Apr. 26, 1951, K. Hobson.

"Corn Needed for Defense," PA-151; "Wheat Needed for Defense," PA-152; USDA, Pro. & Mkt. Adm., Wash., D. C.

"Agricultural Statistics 1950," USDA, Wash., D. C.

"Gains in Productivity of Farm Labor," USDA, Wash., D. C., Tech. Bul. 1020, Dec., 1950, R. W. Hecht and G. T. Barton.

"Some Questions . . . and Answers on Where and How to Get a Farm," USDA, Wash., D. C., Leaf. No. 299, Rev. Dec. 1950, M. Thompson.

"Report of the Secretary of Agriculture to the President of the United States, 1950," USDA, Wash., D. C.

"1951-Crop Rye Price Support Program," USDA, Pro. & Mkt. Adm., Wash. D. C. 721 (Rye 51)—1.

Seek Quick Starting Forage Strains

A STRONG tendency to get going early—what is called the ability to establish themselves in spite of unfavorable environment—has long been a quality greatly desired in crop plants. Quick starting, say U. S. Department of Agriculture scientists, enables such strains to yield well when the stand is good and production factors are satisfactory later.

Early establishment of forage crop seedings is getting attention at the Department's Pasture Laboratory at State College, Pa. Speaking of the establishment factor, Dr. Angus A. Hanson of the Laboratory and the Pennsylvania Agricultural Experiment Station says there are great differences in this regard between species, but he thinks advantages are to be gained by picking out superior plants within species. He says research men already know there are such differences in the ability of seedlings to withstand short periods of drought, not yet demonstrated under field conditions. "But," he says, "capacity to develop a root system rapidly in early growth would have a marked effect on drought resistance and stand."

Hanson notes another establishment factor—a plant's tolerance to low light intensity—especially important in forage plants planted in mixtures with tall, shading plants. So far, he says, there is little evidence of variations in this factor within most species. But in ladino clover the Pasture Laboratory has found significant differences to tolerance of low light. Some strains (clones) died soon after they were given only limited light, while others lived all through the experiment—up to 130 days.

In bromegrass, Hanson reports, one defect is lack of seedling vigor, but in their research the scientists have found individual seedlings differ greatly in the length of the punch-like first leaf which pushes through the covering soil. This indicates a possibility for improving emergence of bromegrass seedlings. Another important factor in getting better establishment here, he says, is variation in plumpness of the seed. The investigators have noted similar opportunities in orchard grass and alfalfa.

Most Tobacco Used in Cigarettes

CIGARETTE production has mounted rapidly in the United States and is now more than 100 times as great as it was 50 years ago, the U. S. Department of Agriculture reports.

About 3 billion cigarettes was the annual output at the beginning of the century. Last year 392 billion were produced with domestic consumption accounting for about 9 out of every 10. Domestic consumption amounted to 361 billion, a new high record, according to Kathryn Parr, agricultural economist. Cigarette manufacture now takes more than three out of every four pounds of the leaf tobacco grown in the United States and also calls for some imports of foreign tobaccos for mixing with native leaf. Before World War II imports were about 10 per cent of the native leaf used. The war made American cigarettes more nearly all-American, and imported tobacco now amounts to only 5 to 6 per cent.

Taxation accounts for about half the retail price of the popular brand cigarettes. The Federal tax is 7 cents a package. Forty States and the District of Columbia now tax cigarettes, and Economist Parr estimates that the average State tax is 2.3 cents a pack. A few cities impose a tax in addition to Federal and State taxes.

SCS Stands for Sound Common Sense

"THE public is beginning to realize that food comes from productive land and from nowhere else, for all practical purposes," says the Soil Conservation Service.

"They are beginning to understand that when erosion strips off the productive layer of topsoil, it takes with it the available plant nutrients, major and minor elements alike, which the topsoil contains. Finally, they are beginning to realize that the subsoil that is left—usually relatively infertile and often essentially sterile—can produce food only in small quantities, and that the food so produced is almost certain to be low in the health-producing elements that dietitians and medical scientists know to be necessary to normal growth and functioning of the human body.

"Much research, properly conceived and guided, is needed to establish beyond question the exact relationships between soil and human nutrition. Until such time as that research has been completed, it is only common sense to bend every effort to see that the land that produces our food crops is kept in as good condition as possible and is used as soundly as possible. This can be accomplished only under a sound soil and water conservation plan, based on the use of every acre according to its capabilities and the treatment of every acre according to its needs."

Neglected Plant-food Elements

(*From page* 16)

noted above. Much smaller amounts are necessary and therefore cost is appreciably reduced. It is much more practical to make "shotgun" spray applications where the exact deficiency is unknown and correction is attempted by applying several materials at once. If the spray is dilute enough no harm will result even if the element is already in good supply. However, it is possible to correct a deficiency with this dilute spray if the element is in short supply. This is a definite advantage over soil applications of this type. It is so much easier to cause toxicity by soil applications of an unneeded element since the amounts that would be applied are so much greater.

Trace elements supplied as sprays function despite dry soil, high soil pH values, or soil accumulations of phosphates or arsenates.

Spraying is not the perfect answer to trace-element deficiencies. It usually increases costs due to inclusion of a special operation. However, in some cases, it can be combined with a spray program for disease or insect control. Spraying of the trace elements usually has to be repeated to cover new growth or replace material lost by rainfall washing off the spray. The inclusion of stickers or adhesives may reduce the number of applications necessary. Also, sprays are not very useful until the plant has enough leaf surface to absorb sufficient amounts of the element. Fortunately, the amounts needed by plants are small until the plant has grown considerably in size. However, in extreme cases, the deficiency may be so severe as to limit growth almost from the very beginning. Crops that do not have much leaf surface (asparagus) or leaves that are extremely waxy and difficult to wet (onions, cauliflower) do not lend themselves too well to sprays.

Trace Elements As Dusts

Some attempts have been made to supply the various trace elements as dusts. When the leaf surfaces are moist when applications are made, some quick responses have been noted. Generally this method is inferior to sprays and there is more possibility of injury.

Summary

Shortages of certain neglected elements have become increasingly more numerous in the U.S. Such deficiencies have not occurred everywhere and in many areas deficiencies are unknown. However, light soils of the Coastal Plain and the muck soils have shown need of one or more of the trace elements. Deficiencies of the various trace elements have been described. The necessary elements can be added directly to the soil, mixed with fertilizer, or applied as dusts or sprays directly to the plants.

Correction of deficiencies is made difficult because of the small amounts needed and the relatively narrow range between deficient and toxic amounts. Additions of an element when not necessary may cause injury. This is more probable with soil applications than with spray applications.

For best results, a combination of methods of application may be used. Small amounts of certain trace elements can be included with fertilizers as a possible means of preventing future deficiencies, and spray applications will be most useful in correcting existing deficiencies.

These applications, judiciously used, promise to increase yields of many crops now grown on certain soils as well as improve the quality of such produce. Certainly the time has come when the American farmer can no longer ignore or neglect these elements. He must make a determined effort to find out whether these materials can benefit the crops grown on his farm. In many cases, the results will show that these "neglected" elements need to be a definite part of his fertilizer program.

Books for Better Crops

(*From page* 19)

How To Get Such Services?

How to get such services as these? Methods differ in the different states, but Farmers' Bulletin 1847 entitled Rural Library Service gives some suggestions and adds a directory of State Library Extension agencies to which specific inquiries may be made.

The Louisiana State Library, the hub of the alert rural work in that State, celebrated its 25th anniversary last April. Along with the Lieutenant Governor and the presidents of several institutions, a Czech farmer on the program spoke for 15 minutes, choosing as his topic, On the Receiving End. "He was the hit of the evening," confides Miss Culver, the State Librarian.

"After many years of experience," said Mr. Welcek, who also values greatly the cultural possibilities in this work, "I can in all sincerity say that the establishment of the bookmobile library in the rural sections is really 'the ultimate' of all the 'benefits' the farmers of our State now enjoy."

The March of Progress in Soil Conservation

(*From page* 8)

with available materials and labor, but also to suit the land conditions. More than 300,000 farmers in these nine Southeastern States have seized the opportunity to use these principles in advancing the agriculture of this region.

I am sure that there will not be in our time a 100 per cent soil and water conservation program applied to the farmlands of our country. But we know that there are certain phases of this program, mainly land capability and use, that should be completed within a period of a very few years. This information is needed not only as a basis for all agricultural programs, but also as a guide in industrial development.

We also know that in the matter of applying needed soil conservation measures to the farm lands of this country a large part of that job should be completed within a period of 20 years. It costs a lot less to do it now than it will cost a few years later, and then we avoid the risk involved in putting it off. We are anxious that the bulk of the application job of soil and water conservation be finished at the earliest practicable time. It is more important that America be safe than it is that we have a long-continuing job.

Does Potash Fertilizer Reduce Protein Content of Alfalfa?

(*From page* 22)

3.09, 2.98, and 2.94 in place of the 3.18, 3.01, 2.85, and 2.74. These probable changes are also listed in Table IV. At the fertilizer rates used, there was no indication that the chlorine had influenced the yields.

The third factor found to influence the nitrogen content was the differential ratio of leaves to stems. Small alfalfa plants always had a higher ratio of leaves to stems than larger plants (Table I), and leaves are always richer in nitrogen than are stems. The increased content of nitrogen in the low-potassium alfalfa hay resulted partly from the fact that such hay contained more leaves and less stems than did the better-growing alfalfa. There was no satisfactory basis from the data obtained for determining exactly how a uniform leaf percentage for each of the potash levels would have influenced the nitrogen content. It is believed that the third and fourth factors are so related that one nitrogen correction will suffice for both.

The fourth factor was the differential distribution of nitrogen between the tops and the roots. Metabolic disturbances sometimes result in an abnormal accumulation of a mineral element in one part of a plant and a reduction of it in the rest of the plant. Previously in this discussion, only the top or hay portion of the alfalfa has been considered. The roots of the potassium-deficient alfalfa were found to be very low in nitrogen. Moreover, the nitrogen content of the roots increased with each larger rate of potash fertilizer (Table III). In other words, the alfalfa that had the highest nitrogen content in the hay portion had the least in the roots and, conversely, that having the least nitrogen in the tops had the most in the roots. This could be expected, since the low-potash plants had higher proportions of leaves than

Fig. 3. Potash hunger manifests itself in white fleckings on the margins of alfalfa leaves.

did the high-potash plants. This can be described as a compensating influence, since in the former plants more nitrogen was used in leaves, leaving less for the roots. If the root production in each of the four treatments had been equal and if the nitrogen content of all roots had been 1.67 per cent, the nitrogen contents of the tops might have been 3.18, 3.32, 3.44, and 3.55, respectively, in order of increasing potassium.****

The nitrogen changes resulting from these factors are summarized in Table IV. When the four factors are equalized there is little difference in the probable nitrogen contents. The range is from 3.05 to 3.10 per cent instead of the original 2.74 to 3.18 per cent. Carbohydrate dilution indirectly decreased the nitrogen content, chloride absorption directly lowered it, but the differences in the leaf percentages and distribution of nitrogen between the tops and roots can be ignored if the entire plant is considered as a single unit. It is of interest to note that chloride gave the only direct reaction and that the potassium influences were all indirect. It is possible that a deficiency of any other element could have resulted in a similar series of reactions.

Any advantage of the extra nitrogen in the low-potassium alfalfa was more than offset by decreased yields and stands even when the alfalfa contained as much as 1.11 per cent potassium.

**** Of necessity these values assume that all plots were uniform at the end of the 1947 season.

TABLE II.—THE INVERSE RELATIONSHIP OF NITROGEN AND CHLORINE IN THE SAME ALFALFA HAY.

Treatment K_2O per acre per year	Nitrogen in hay	Chlorine in hay	Proportion of total anion milliequivalents*		
			Nitrogen	Chlorine	N+Cl
lb.	% of dry matter	% of dry matter	%	%	%
0	3.18	.07	85.8	0.8	86.6
60	3.01	.21	83.6	2.6	86.2
120	2.85	.32	82.2	4.1	86.3
180	2.74	.50	79.8	6.4	86.2

* See note in text concerning cations and anions.

TABLE III.—THE INFLUENCE OF POTASH ON THE LONGEVITY OF ALFALFA, ON THE WEIGHT OF THE ROOTS, AND ON AN INVERSE RELATIONSHIP BETWEEN NITROGEN IN THE ROOTS AND IN THE HAY PORTIONS.

K_2O per acre per year	Number plants per acre	Dry weight of roots*	Nitrogen in roots	Nitrogen in hay
lb.	thousand	lb./acre	% of dry matter	% of dry matter
0	65.5	455	1.67	3.18
60	218.0	1638	1.79	3.01
120	290.6	2174	2.10	2.85
180	370.5	3591	2.49	2.74

* Total for first 30 inches of soil.

The extent of overwintering of the alfalfa was largely controlled by the amount of potash topdressing (Table III). Better stands, better yields, more leaves per acre, and higher nitrogen contents in the roots were obtained when the potassium content of the hay was 1.41 than when it was 1.11 per cent.

Enough potassium should certainly be used on alfalfa in the humid region to insure maximum yields and longevity. That should be enough to result in at least 1.4 per cent of potassium in the hay at cutting time. A recent survey of alfalfa fields in New Jersey revealed that in 40 per cent of them the alfalfa contained less than 1.2 per cent potassium, a value which is definitely too low for continued maintenance of this crop. The potassium content of 10 per cent of them was over 3 per cent, a value which is expensive and perhaps unnecessary to maintain. It has been repeatedly demonstrated that small but frequent applications of this element will prevent excess accumulations of it.

The feeding value of the alfalfa to animals cannot be overlooked. One might ask if the nitrogen differences in the hay at the various potash levels are great enough to significantly influence the feeding value. A nitrogen content of 2.74 per cent (the lowest value obtained) represents 17.1 per cent

TABLE IV.—SUMMARY OF THE CALCULATIONS SHOWING THE CHANGES CAUSED BY CERTAIN FACTORS IN THE NITROGEN CONTENT OF ALFALFA HAY WHEN GROWN AT DIFFERENT POTASH LEVELS.

Factor	Potash treatment lb./acre/year				Maximum deviation in total nitrogen
	0	60	120	180	
	Original per cent of nitrogen				
	3.18	3.01	2.85	2.74	0.44
	Calculated changes in the per cent nitrogen				
If carbohydrate production had been equal	2.75	2.89	2.76	2.74	0.15
If chloride absorption had been absent	3.21	3.09	2.98	2.94	0.27
If the distribution of nitrogen between tops and roots had been equal*	3.18	3.32	3.44	3.55	0.37
	Means of probable values				
	3.05	3.10	3.06	3.08	0.05

* This factor also compensates for the differences in leaf percentage.

of crude protein. Such hay is generally considered to be of very high quality. The highest yielding alfalfa was thus still in the high-protein class even though 180 lbs. potash were applied per acre per year. This potash treatment resulted in hay with the lowest calcium content (1.30 per cent), but such hay still provides calcium for animals in very liberal quantities. The feeding quality of the hay was definitely reduced when the potassium content of the hay fell below 1.41 per cent because the proportion of weeds and grasses in association with the alfalfa increased rapidly.

Lines by a Landscraper

(*From page* 5)

heaps of a neglected and forsaken zone. A chap out there who can grab a hoe and sail into the quack grass encroaching on his carrots and violets is not apt to seize a torch and set fire to the courthouse.

Even for the apartment-house dweller, the fine art of landscraping is by no means taboo. This summer an elderly couple with memories of many home gardens behind them asked permission of the apartment manager to "landscrape" a little strip of soil along the bare foundations facing the busy street. Nothing in that area has done more to make folks friendly and natural in their attitude toward each other. They stop to admire the old-fashioned flowers and foliage plants and soon begin to chatter eagerly about old times back home and old ways and vanished pleasures.

So my idea simply is that *landscraping* may not be as high-toned and as distinguished as *landscaping* itself, but it does pack its own special compensations for a guy in my grade. Particularly, if we are willing to go a little harder on labor than on Latin.

What makes for a wider interest in growing things that taste good and look pretty is the general zest that some leaders have put into the program through informal but quite effective organization. Aside from the organization which is thrown around the schools and the churches, there is nothing in our modern life that compares in strength and verve to the multitude of garden clubs and floral societies that have sprung up as stoutly as the weeds they worry about.

We have them blossoming forth in ever greater numbers and membership right in the heat-baked cities, where some vacant lots are still left for experimentation. The suburbs of every sizeable town claim their quota of hot enthusiasts. Not only have the urban leaders pushed the plant culture idea, but the rural sections have found new and better ways to make their homes more pleasant and their larders more diversified under the guidance of the agricultural extension services. It is not all done for beauty's sake either, owing to the present high cost of fresh and canned vegetables and the necessary government set-asides pertaining to defense.

Earlier in the season a group of garden guiders and planners with many years of experience held a session at Washington. The whole field was carefully reviewed and a decision was made to engage in a general community revival of garden incentives. Just how far and how fast to go with these plans were the only unsolved problems. Many suggestions were given as to the slogans and titles by which the effort was to be introduced and kept alive.

"Defense" gardens was one idea proposed. It didn't register, owing to obvious reasons. "Security" gardens was debated and laid aside. Finally, somebody proposed "Liberty" gardens and it drew majority favor, but when the proposition was put up to the Secretary of Agriculture for his blessing as a semi-public-sponsored deal, little encouragement was at first secured. By midsummer somebody in the general committee had inveigled a casual sort of permission from headquarters to use the "Liberty" title for what it might be worth. Many of the original sponsors of this summer's garden drive had already used the name anyhow, as this is a free country and used to adopting trade-marks and shibboleths to further any cause.

THE local fervor has spread, although not with quite the power and purpose that we had to hoe our own rows back in World War II. Over in Fauquier county, Virginia, they made a community garden in a day. A group of Future Farmers changed a bare space of 50 by 100 feet into a well-planned and fully planted garden, including proper tillage and conservation methods, the right balanced fertilizers, the suitable varieties, and some hints on insect and disease control thrown in for extra measure.

North Dakota has swung into the garden-growing program as a major part of its civil defense planning. Texas expects to increase its 475,000 home gardens by several thousand, to contribute, they estimate, fully fifty million dollars toward reducing the State's out-of-pocket food bills. Official "Governors' committees" are reporting good progress in gardening in Maine, Missouri, Michigan, and Washington.

Prominent public leaders have voiced special endorsement of the garden directives. Hon. Clarence Cannon of the House of Representatives heartily supported the program recently in an address when he urged more home gardens because of the uncertain times and the inflated cost of vegetables. Charles Wilson of the Defense Production Agency also spoke encouragement to home gardeners, his argument being that it supplements the food which our hard-pressed commercial farms can raise.

Right in that point there seems to be just one small divergence of opinion worth noting, but not worth much concern. It seems that some of our loyal and expert professional "green goods growers" in the expansive truck belts of the country give a rather wry glance at all these home-garden plans. Some of them are afraid that their acreages will grow more good nutritious vegetables than the consuming public can absorb, if the dear public devotes so much time to its own tomatoes. However, hastily gathered consumer figures tend to show that a home vegetable grower seldom satisfies all his newly acquired taste for succulent variety and quality—so he simply goes and buys more from the food stores and roadside stands. Contrariwise, the chap who leans on his hoe all the time and talks politics while the weeds banish his beets, or he who considers it all a nuisance, is not as steady a customer through the year for the truck farmer or the frozen food dealer as his garden-tending neighbor. I cannot support or refute these opposite pleas. Some truck growers scoff at such evidence. But anyhow, it will be a long time indeed before enough extra recruits and enough extra lots are available in the home-garden sport to cut the sales of the experts to any appreciable degree. To overplant any annual crop is unwise, which is as good a rule for truck growers as for other cash-croppers.

Quite aside from harsh commercial urges for open-air gardening by hopeful couples, we have the newly acquired human scenery pertaining thereto. When I was a lad the women-folks hied themselves to the hot sunny gardens in calico gowns and fusty old sunbonnets—and some of them even wore cotton mittens and gloves. In those days they were more afraid of tan and freckles and sunburn than our girls are now. How joyous it is now to hoe a weedy row back and forth beside a charming damsel with shapely legs and plump arms and shoulders, willowy and competent, and as natural and openly aboveboard about both vegetable and human charms as possible. Ah yes, that old geezer that Edwin Markham dubbed "the man with the hoe" lived a couple of generations too soon. His look of despair and frustration and grouchy disdain would change to ardor and admiration in these happy times of curves amid the cucumbers. Gardening keeps one young, no doubt of it!

Going back with regret again to mundane arguments for gardening, I see that the leaders are stressing the culture of tomatoes and sweet corn. Only about half the reserve stocks of these canned vegetables were on hand last spring, although the frozen stocks were more nearly normal. On the other side of the ledger we hear that several kinds of fresh fruits will be in greater abundance. Here, of course, the annual efforts of the new gardener cannot be expected to alter the situation as to supplies—but when it comes to home-preserving efforts, the prospects for more fruit should spur the kitchen canners to outdo themselves.

Tin for home and commercial canning will probably be plentiful. The prospects for rubber closures and covers of various kinds have become brighter. Materials for quick-freezer bags made out of chemical compounds are scarce. The sale of home-freezers in the first half of 1951 was up about 75 per cent over 1950, and the manufacturers will hardly be able to take care of the demand if it keeps up at that rate. Other likely places to salvage and store the fruits of 1951 gardens are the nearly 12,000 locker plants serving consumers throughout the nation.

How all that vast and complex field of food preservation we have today differs from the situation back at the turn of the century, only a minority of us fully realize. Chemical and synthetic processes had little or nothing to do with the goods and utilities we required for growing and keeping garden vegetables and fruit. I presume that spelt considerable loss and waste which we did not appreciate. It did, however, make each family self-sufficient and self-reliant. Far-off strikes or other disturbances of commercial routine did not affect our tools and equipment very much in those days.

Yet I for one would not care to go back and rely upon the whisk broom and a mixture of paris green or kerosene to combat hordes of garden pests; and have to stand by in despair over the appearance of a mysterious and sudden leaf blight or blotch which blasted all hopes for the harvest. And remember the ravages of those army worms and grasshoppers before the advent of "aldrin" or "chlordane" and "toxaphene?"

Of course, science shows us that the bug battle has just begun. Nature is busy raising generations of insects which show strong resistance to all these modern compounds. Nobody knows how they do it and how rapidly we must move to checkmate them with fresh irritants and poisons. This enterprise on the part of the worms and their friends should cause more folks to enlist in the garden game. It gives it a certain zip and challenge, a tinge of the same threat that we have from communism. It may mean more in the end than the atom bomb to have destructive bugs and diseases flout our best efforts at control. I guess the lot of the ordinary home-garden variety of soil tiller is not so humdrum after all.

So hand me that there old tool kit and my brogans, don't let me forget the spray gun, give me a lift with the plant food bag, and wish me well on my crusade. I'll meet you around the lot sometime in October, to pick the beets and pull the deep-rooted Brussels sprouts.

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

F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
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?
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—the Aristocrat
GG-6-45 Know Your Soil
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
AA-5-46 Efficient Fertilizers Needed for Profit in Cotton
WW-11-46 Soil Requirements for Red Clover
A-1-47 Fertilizing Vegetables by Applying Fertilizer to Preceding Cover Crop
I-2-47 Fertilizers and Human Health
P-3-47 Year-round Grazing
T-4-47 Fertilizer Practices for Profitable Tobacco
AA-5-47 The Potassium Content of Farm Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are You Pasture Conscious?
R-4-48 Needs of the Corn Crop
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
OO-11-48 The Use of Soil Sampling Tubes
TT-12-48 Season-long Pasture for New England
E-1-49 Establishing Bermuda-grass
F-2-49 Fertilizing Tomatoes for Earliness and Quality
CC-8-49 Efficient Vegetable Production Calls for Soil Improvement
EE-8-49 Why Use Potash on Pastures
GG-10-49 What Makes Big Yields
KK-10-49 An Approved Soybean Program for North Carolina
QQ-11-49 Some Fundamentals of Soil Building
RR-11-49 Alfalfa as a Money Crop in the South
SS-12-49 Fertilizing Vegetable Crops
B-1-50 More Corn From Fewer Acres
F-1-50 A Simplified Field Test for Determining Potassium in Plant Tissue
I-2-50 Boron for Alfalfa
K-3-50 Metering Dry Fertilizers and Soil Amendments into Irrigation Systems
L-3-50 Food For Thought About Food
N-3-50 Can We Afford Enough Fertilizer to Insure Maximum Yields?
O-4-50 Birdsfoot Trefoil—A Promising Forage Crop
P-4-50 Potash Production a Progress Report
S-4-50 Year-round Green
U-5-50 Reseeding Crimson Clover Adds New Income for the South
V-5-50 Potassium Cures Cherry Curl Leaf
X-5-50 Fertilizers Help Make Humus
Z-6-50 Potash Tissue Test for Peach Leaves
AA-8-50 Alfalfa—Its Mineral Requirements and Chemical Composition
BB-8-50 Trends in Soil Management of Peach Orchards
CC-8-50 Bermuda Grass Can Be Used in Corn Rotations
GG-11-50 Tall Fescue in the Southeast
HH-11-50 The Minor Element Problem
II-11-50 Tree Symptoms and Leaf Analysis Determine Potash Needs
JJ-11-50 Insect Control Goes With Cotton Fertilizer Plan
KK-12-50 Surveying the Results of a Green Pastures Program
LL-12-50 Higher Fertilizer Applications Recommended in Wisconsin
MM-12-50 Erosion Removes Plant Nutrients and Lowers Crop Yields
NN-12-50 Plenty of Moisture, Not Enough Soil Fertility
OO-12-50 Know Your Soil. VI. Elkton Sandy Loam
A-1-51 Soil-testing Reduces Guesswork
B-1-51 Alfalfa, Queen of Forage Crops
C-1-51 Know Your Soil. VII. Magnesium-potassium Relation for Sweet Potatoes on Sandy Soils
D-1-51 The Vermont Farmer Conserves His Soil
F-2-51 The Land-use-pattern Scale
G-2-51 Grassland Farming Brings New Management Problems
H-2-51 Kay-two-oh in California
I-2-51 Soil Treatment Improves Soybeans
J-3-51 Fertilizing the Corn Crop in Wisconsin
K-3-51 Increasing Cotton Yields in North Carolina
L-3-51 Know Your Soil. VIII. Penn Silt Loam
M-3-51 A Look at Alfalfa Production in the Northeast

THE AMERICAN POTASH INSTITUTE

1102 16TH STREET, N. W. WASHINGTON 6, D. C.

FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)
The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)
The Plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)
The Plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)
Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)
Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)
Potash Production in America (Silent, running time 40 min. on 400-ft. reels.)
In the Clover (Sound, running time 25 min. on 800-ft. reel.)

OTHER 16 MM. COLOR FILMS AVAILABLE ONLY FOR TERRITORIES INDICATED

South: Potash in Southern Agriculture (Sound, running time 20 min. on 800-ft. reel.)
Midwest: New Soils From Old (Silent, 800-ft. edition running time 25 min.; 1200-ft. edition running time 45 min. on 400-ft. reels.)
West: Machine Placement of Fertilizers (Silent, running time 20 min. on 400-ft. reel.)
Ladino Clover Pastures (Silent, running time 25 min. on 400-ft. reels.)
Potash From Soil to Plant (Silent, running time 20 min. on 400-ft. reel.)
Potash Deficiency in Grapes and Prunes (Silent, running time 20 min. on 400-ft. reel.)
Bringing Citrus Quality to Market (Silent, running time 25 min. on 800-ft. reel.)
Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm

DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.
Southeast: Vocational Film Library, Department of Agricultural Education, North Carolina State College, Raleigh, North Carolina.
Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.
Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.
West: Department of Visual Education, University of California, Berkeley 4, California.
Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.
Department of Visual Instruction, Oregon State College, Corvallis, Oregon.
Bureau of Visual Teaching, State College of Washington, Pullman, Washington.
Canada: National Film Board, Ottawa, Ontario, Canada.

IMPORTANT

Request 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 loan.

Request bookings from your nearest distributor

A Few Whinnies

A government crop inspector visited a farm and began asking questions. "Do you people around here ever have trouble with insects getting in your corn?" he inquired.

"Balls o' fire, we sure do!" said the farmer. "But we jes fishes 'em out an' drinks it anyhow."

* * *

She: "Let's sit this dance out—no one will be the wiser."

He: "Oh, yes; you will!"

* * *

Two snowy-haired old ladies, jouncing along in an antiquated automobile, made an illegal turn on the town's main street. The traffic cop had to blow his whistle vigorously and repeatedly before they came to a stop. "Didn't you hear my whistle, lady?" he asked.

Wide-eyed and innocent the little lady looked at him. "Yes, indeed," she said, "but I never flirt while driving."

With a grin, the amazed cop waved them on.

* * *

"Do you suffer from the heat in summer?"

"Yes, indeed, more than in any other season."

* * *

Middle age is the time of life when a man stops wondering how he can escape temptation, and begins wondering if he is missing anything.

A colored country preacher, who was strong on visiting the female members of his flock, was traveling along the road to the home of one of his congregation when he met the small son of the lady member.

Parson: "Where's your mother?"

Small Negro: "She's home."

Parson: "Where's your paw?"

Small Negro: "He's home."

Parson: "Tell 'em howdy fuh me."

* * *

Two men worked side by side in a War Production Board office in Washington. They never spoke, but each watched the other. One man quit work daily at four o'clock. The other toiled on till six or later.

Months passed. Then the harder working of the two met the other.

Hard Worker: "Beg your pardon. Do you mind telling me how you clean up your work every day at four o'clock?"

Other Worker: "Not at all. When I come to a tough piece of detail, I mark it, 'Refer to Commander Smith.' I figure that, in an outfit as large as this, there is sure to be a Commander Smith. And I must be right; none of these papers come back to me."

Hard Worker (starting to remove his coat): "Brother, prepare for action. I'm Commander Smith!"

* * *

A soldier eats twice as much canned goods as a civilian—80 cans a year as against 40 cans. That includes newlyweds, too.

Better Crops WITH PLANT FOOD

August-September 1951 10 Cents

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R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXV NO. 7

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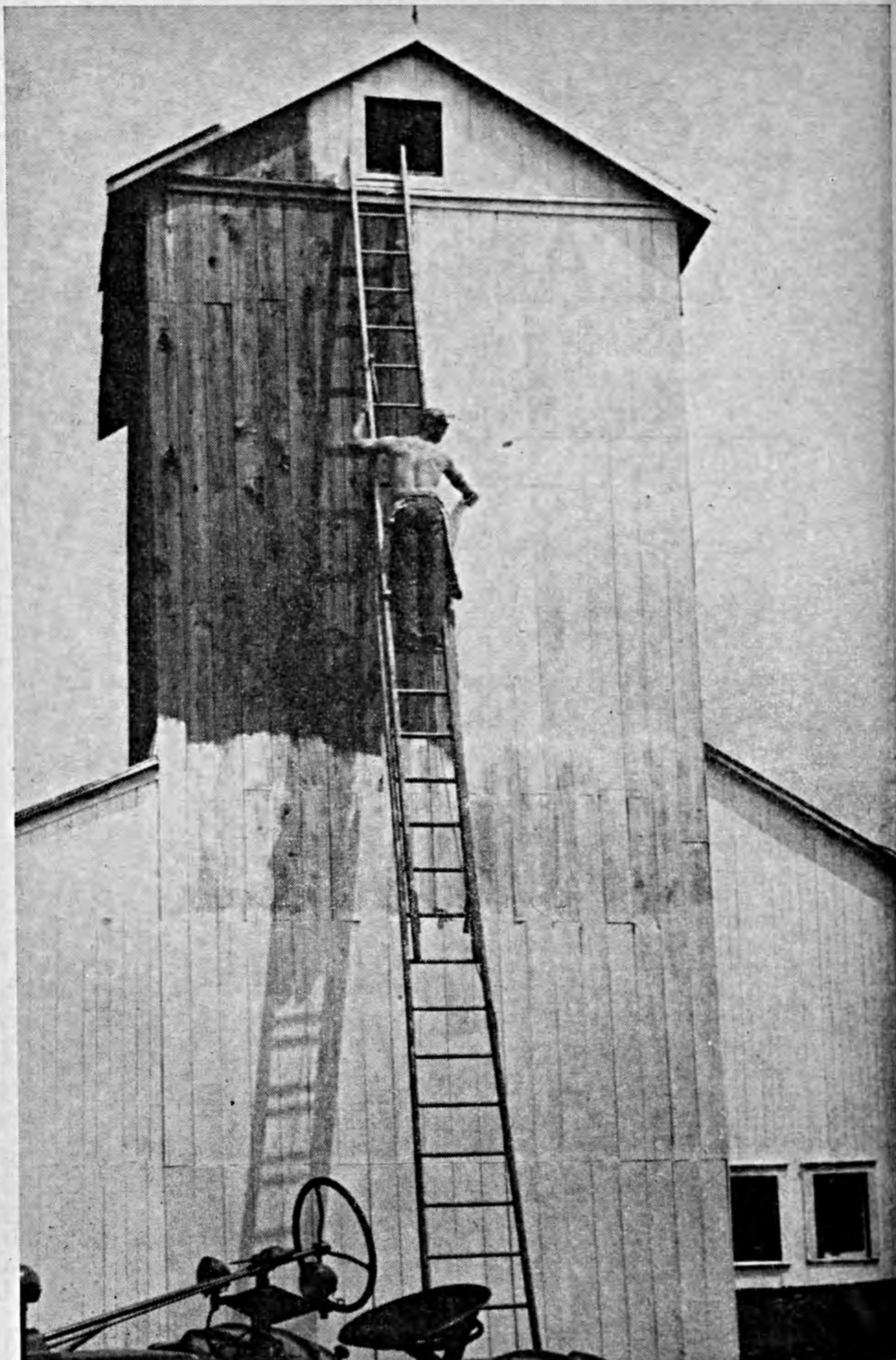

A Need for Proper Balance

Better Crops with PLANT FOOD

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VOL. XXXV WASHINGTON, D. C., AUGUST-SEPTEMBER 1951 No. 7

Nowadays It Is . . .

The Man With the "Know"

Jeff McDermid

GONE forever are the days of yore when Edwin Markham's famous poem of satisfied and dullard rural life brought out the painting of a weary peasant leaning with resignation on his hoe. "The Man With the Hoe" caused no end of controversy on and off the farms. There was just enough stark truth about conditions in rural America then to furnish the basis for pros and cons to argue whether our producers were sunk in frustrations and low in morale. Since the turn of the century when these debates were rife, the change in farming and rural living has been so sweeping and complete that such old theories and fears no longer have much excuse for existence—except in a minority of our most backward zones.

People were dubious, however, as to whether agricultural expansion could continue after the free homestead land offered by the benevolent Government was entirely gone. If farmers were to be limited in their power to produce by the comparatively crude equipment and haphazard methods in vogue about 1900, it was doubted that the rapidly growing population could be adequately fed by the 33 million persons working the land at the time. But now we have 24 million farm folks generally able to produce plenty and some to spare for over six times their numbers—and sometimes raising cane and election chatter about supporting prices on a burdensome surplus.

Poor land and uncertain weather, hordes of noxious insects and troublesome weeds, insidious livestock diseases, lack of sufficient power for field jobs in all seasons, guesswork and superstition—these handicaps were then accepted as part of the inevitable lot of the tanned and toughened farmer. Nobody ever imagined that poor land sometimes made good land or that weed battles could be won easier than by hoeing; and few believed that science might even work out ways to get around many of the worst weather hazards through soil management and plant breeding.

The marshalling of scientific knowledge put to practical use right on the farm has, of course, been the real answer to this vast improvement—so marvelous that only we who lived in the dismal and deprived era can really grasp its full significance.

IN former times farmers noticed that certain varieties or strains of plants invariably did well, and exceeded the average run raised in their communities. The natural thing was that all of the farmers within earshot, and often those in distant states, sought the source of the new and better plant or variety. No thought was given as to whether latitude or climate or soil treatment or other factors combined to make such plants do better than others. Hence there were some big disappointments when a much touted specimen failed to live up to its lurid claims in some place other than where it first demonstrated its superiority.

This led men to ponder as to the advisability and usefulness of tests and trials carefully handled at more than one location. Here was the nub of the idea that finally led us to pass legislation enabling states to create agricultural experiment stations, linked eventually with each other and with the federal scientific staffs.

It is now just 50 years since the last step was taken in the field of plant physiology, wherein about a dozen state experiment farms signed up to conduct a series of investigations in cooperation with the, then, newly created Bureau of Plant Industry and the Bureau of Soils. B. T. Galloway was the first director of this effort, and he had only about forty persons on his staff, with the scene of activity lying southwest of the Potomac river at Arlington Farms—now the site of the gigantic Pentagon building.

It was not long thereafter until the old States Relations Service came into the picture, because scientific men—however much they are often criticized for lack of "farm sense"—believed that pure science begets applied science, and from here it is a logical step to enlist dirt farmers in the proving-up process and the practical use of the discoveries. In a few years the Extension Service succeeded the States Relations staff, and soon thereafter the Office of Experiment Stations forged the machinery for tying up the rapidly expanding sources of farm achievements in new fields.

WHEN a large group of our present-day leaders of agricultural research meets at Beltsville, Md., this year to notch the milestones of our wonder era, they will traverse old ground and check over the outstanding discoveries and adaptations which were charted in the books of plant history. When we recall that the plant realm is only one segment of the entire complex cosmos that gives life and meaning to agriculture, we realize how vast and inter-related must be the continuing work of all our busy delvers in farm advancement.

Only a few months ago, at the request of Congress, a hefty set of reviews and historical papers on the achievements of agricultural and related research was printed—in three volumes, I believe. Not only are these books of great permanent value, but they show the tremendous scope of the tireless and enthusiastic army of devoted scientists who have pledged their lives to fitting small pieces into a gigantic puzzle picture, only a fairly good corner of which can now be seen and appreciated. Credit for all that such publications reveal to those who have the time to scan them belongs to the scientists first and foremost—but with

painstaking and trained information personnel contributing indisputably to their ultimate worth and usefulness.

I say that it is high time for the farming world to eke out a modicum of praise and thanks to the "translators" and readability molders, the good storytellers and word-painters who go alongside the extension forces in popularizing and interpreting so many topics that otherwise stir up dust and make folks yawn.

It is not always thus. Too often we dish up far too much jargon of the laboratory for publications mainly intended for creating favorable opinion and positive action. You can't blame the chemist or the physicist for wanting to spread his formulas and definitions, but everything has its proper place. Unless men understand, they go to sleep and forget.

RETURNING to the main stem of the plant diorama which began to grow and prosper soon after 1900, we can call the roll of positive annual revelations which had their genesis in this cooperation of farm and state and federal government. And always the crossroads forum and the excited and zealous extensioneer furnish scenes that no film record of progress may overlook.

Ladino clover was brought from Italy in 1903. Tung trees came from plant explorers in China in 1904. Dryland and irrigation research got its feeble start in the Great Plains stations in 1905. In that year the first report was filed on a cross involving inbred strains of corn. The Dillon variety of cotton, resistant to fusarium wilt, was perfected for planters.

The year 1908 saw further varied progress. Introductions from Asia led to the establishment of a thriving domestic date industry here. Yuma, an American-Egyptian cotton, as well as Acala cotton from Mexico, were first developed. The wild plantations of blueberries, long sought by the settler and the red man, were caught in the net of improvement.

Pre-cooling fruit for overland shipment, white pine blister rust discoveries, and the famous Hegari grain sorghum imports from Africa labeled 1909 as eventful. In 1910 Ladak alfalfa came over from India. In 1911 the cotton growers started their now famous and successful community betterment program—and it was in that same year that research began on the resources for potash fertilizers here.

Momentous advancement marked 1914, when the fixation of atmospheric nitrogen for fertilizer had its inception in cooperative and industrial research and tests.

Again, in 1915, there came to light the new concept worthy of a gospeler—that soils are living organisms, not inert and supine matter. New ideas were tested which exploded the once sturdy belief that dust mulch and capillary action governed everything in soil treatment.

Just a bit later, in 1917-18, the science of the "plant doctors" had gone far enough to make it feasible to set up competent field aides and observers of plant diseases. This led to the initiation of the valuable plant-disease survey system—still open for further perfection. Great new gains were made in

(*Continued on page* 40)

Orchard Fertilization—Ground and Foliage

By J. R. Magness

Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Md.

SUPPLYING the orchard tree with essential nutrients differs in a number of respects from fertilizing annual crops. In the first place, the tree grows in one location for 15 to 50 or even more years and thus it is possible, if we know the nutrient supplying level in a particular soil, to plan long-range fertilizer treatments. Also tree roots take in nutrients through much of the year. When these nutrients are not being utilized in the formation of new tissues they are stored and are then available to the tree during periods of rapid growth. Roots of mature trees occupy large soil areas and may obtain sufficient quantities of certain of the nutrient elements for optimum growth and fruiting where these same elements would be insufficient for rapidly developing annual crops.

We should keep in mind that the purpose of fertilization is to increase the quantity of the nutrient elements not supplied by the soil in sufficient amounts to promote optimum growth and fruiting. Nutrient elements are present in varying amounts in agricultural soils. Some agricultural soils may supply sufficient quantities of practically all nutrient elements for satisfactory tree growth and fruiting. Other soils may be deficient in the available quantity of a number of elements. When we consider fertilizing the orchard, therefore, we must always keep in mind that the purpose is to add the nutrient materials that are not supplied by the soil in sufficient quantity for the needs of the trees. Usually these materials are applied to the soil, but some may also be supplied to the tree by spraying or dusting them onto the leaves.

We often speak rather loosely of a complete fertilizer, meaning one containing nitrogen, phosphorus, potassium and possibly magnesium. These, however, are only three or four very important elements of the 14 which we now recognize as absolutely essential for the development of any fruit plant. Let us consider these 14 elements and their role in orchard fertilization.

Three of the 14 elements are not obtained by the plant from the mineral or organic part of the soil. One of these, carbon, makes up the great bulk of the plant and is obtained from the air in the form of carbon dioxide. The composition of the air cannot be modified appreciably. The quantity of carbon dioxide which the plant can obtain from the air is determined by the extent of the leaf system. Sunshine is necessary for the building of the carbon compounds in the plant. So far as orchard production is concerned the limitation of carbon building is likely to be due to lack of sunshine and an insufficient or unhealthy leaf system rather than to insufficient carbon dioxide supply. Lack of sunshine may often be limiting in humid, cloudy areas such as our eastern growing districts.

The two other elements important in plant nutrition not obtained from the mineral or organic part of the soil

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 1. York Imperial apple tree growing in potassium and magnesium deficient soil and fertilized with nitrogen only—Plant Industry Station, Beltsville, Md.

are oxygen and hydrogen. These are derived mainly from the breaking down of water in the photosynthesis process. So long as the plant has water there is no shortage of these elements, at least for direct nutrient use. Lack of oxygen in the soil may result in injury to the roots and unsatisfactory

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 2. York Imperial apple tree growing in potassium and magnesium deficient soil and mulched annually for three years with 200 lbs. of orchard grass hay previously fertilized with NH_4NO_3 at rate of 300 lbs. per acre. Nutrients released from the mulch each year were as follows: N 1.14 lbs., K 2.93 lbs., P .28 lb., Ca .17 lb., Mg .15 lb., B .002 lb., Mn .006 lb., Cu .0009 lb. Note unmulched tree in background left—Plant Industry Station, Beltsville, Md.

root growth, particularly if soils are full of water, but there is no lack of oxygen in the tree for direct nutrient use so long as moisture is present.

Thus only 11 of the elements known to be essential to plant growth are obtained from the mineral and organic components of the soil. Six of these are often referred to as major elements, while five are classed as minor. This classification refers to the quantity of these elements required for optimum plant development. It does not mean that one group is more or less essential to the functioning of the plant than the other. A minor element that is in short supply may be just as disastrous in its effect on the plant as a so-called major element that is deficient. The following paragraphs give an indication of the relative quantities of these elements present in the leaves of a well-nourished fruit tree. By well-nourished we mean trees that are making ample growth and that are not, so far as can be determined, lacking in any nutrient element. We give the elements in parts per million based on the dry weight of the leaves in order that the quantities may be readily compared. The quantities of these materials present in the leaves are closely correlated with the relative quantities that the tree crops require. These amounts vary somewhat with different kinds of fruit crops but those given form a general background of the nutritional requirements of orchard trees in general.

Major Nutrient Elements

Nitrogen—Nitrogen is generally present in the foliage of fruit trees in larger quantities than any other of the mineral elements with the possible exception, under certain conditions, of potassium and calcium. Fully developed leaves of most fruit trees in well-nourished condition contain 20,000 to 25,000 parts per million of nitrogen when sampled in midsummer. Only the strongest orchard soils maintained under cultivation, or under a mulch of organic matter, supply this quantity of nitrogen without supplemental fertilization. Practically all orchards in the United States require supplemental nitrogen for optimum growth and production.

Potassium—Potassium ranks a little lower than nitrogen in the quantity present in the foliage. With most fruit trees a level of about 12,000 parts per million, or above, in the foliage means that the tree is amply supplied with potassium. In many orchards where there is an abundant supply of potassium available to the tree, the level may be as high as 18,000 to 20,000 parts per million. In many orchard areas, trees are able to obtain abundant quantities of potassium from the soil without supplemental fertilization. There are, however, a number of areas where potassium is generally low and supplemental potassium feeding is therefore essential for optimum production. That condition is general along the Atlantic Coastal Plain from New England down through New Jersey, the Carolinas, Georgia, and Florida and in the Coastal Plain along the Gulf Coast. In other areas of the country the situation is much more variable. Many orchards are in the luxury range so far as potassium is concerned in that the soil supplies more potassium than the trees can possibly use. However, in many sections there are individual orchard soils which do not supply the full potassium requirements of the tree. Fortunately, we have in leaf analysis a method of determining what the potassium situation is in a particular orchard. By making chemical analyses of the leaves taken under proper conditions it is possible to determine the level of potassium as well as of other elements. If the potassium content is less than about 12,000 parts per million, or 1.2 per cent, the orchard is at least near the point of insufficient potassium supply. If the content is well above this figure the trees are obtaining the potassium they need from the soil and no benefit would be expected from supplying additional quantities.

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 3. Potassium deficiency, Elberta peach, fertilized with only $NaNO_3$.

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 4. No potassium deficiency, Elberta peach, fertilized with KNO_3.

The use of leaf analyses is discussed further under the heading "diagnosing nutrient deficiencies."

Calcium—The quantity of calcium contained in fruit tree foliage is about the same, or a little higher than that of potassium. It generally runs 15,000 to 25,000 parts per million. So far as we know, direct calcium deficiencies for the growth of trees are rather rare. Calcium in the form of lime is used to correct excessive soil acidity and promote the growth of cover crops rather than to supply calcium to the trees. It is possible, however, that under some conditions, particularly where large quantities of sulfur and other acid-forming materials have been used resulting in the leaching out of calcium, or in soils naturally very acid, the calcium may be a direct nutrient deficiency.

Magnesium—Magnesium generally runs from 2,500 to 4,000 parts per million in the foliage of a well-nourished fruit tree. In recent years it has become apparent as a result of research that magnesium may be a limiting element for tree nutrition. An area where magnesium deficiency is known to be rather general is the Atlantic Coastal Plain from New England southward to the Gulf States. Magnesium deficiency in orchards was recognized first in citrus fruits in Florida, but in recent years numerous cases of magnesium deficiency have been recognized in other areas and with other tree crops.

Phosphorus—Although it is one of the most important fertilizer elements for annual and pasture crops, phosphorus is not generally deficient for tree fruits. Phosphorus is generally present in the foliage in the range of 2,000 to 3,000 parts per million. Fruit trees in most soils obtain this quantity of phosphorus without special fertilizer treatment.

Sulfur—Sulfur is an essential nutrient element present in the foliage in about the same quantity as is phosphorus. So much sulfur is added to orchards in connection with spraying for control of diseases and pests and in connection with the addition of other fertilizers such as sulfate of ammonia or sulfate of potash that the orchard requirements are apparently amply supplied. In fact, the large amount of sulfur used frequently causes excess acidity in the soil. We know of no orchard areas where additional quantities of sulfur are needed from the standpoint of tree nutrition.

The Minor Elements

The five minor elements known to be essential for the nutrition of orchard trees are present in the foliage not in thousands of parts per million but generally as less than 100 parts per million.

Iron—Iron, a major constituent of soils, in general runs from 100 to 300 parts per million in the foliage, the highest level of the so-called minor elements. Iron deficiency occurs primarily in calcareous or alkaline soils where a sufficient quantity of iron in usable form cannot be taken up by the tree. Chlorosis due to iron deficiency is widespread in many areas from the Plains States west to the Pacific.

Zinc—Zinc in the foliage of the well-nourished tree runs from 25 to 50 parts per million. Zinc deficiency is widespread throughout the Western States and zinc is deficient for certain orchard crops, notably pecans and citrus in the Southeastern States. It is possible that some benefit from zinc would be obtained in other areas. Many peach orchards have appeared to be stimulated by the use of zinc-lime sprays.

Boron—The boron level in the foliage of tree fruits is generally about the same as the zinc level or from 25 to 50 parts per million. Symptoms of boron deficiency, particularly corky areas in the fruit, are widely recognized in many apple-producing districts. Soils derived from limestone are very likely to be deficient.

Manganese—Manganese is recognized as deficient in some citrus and tung orchards in Florida and must be supplied for optimum growth and fruiting. The level in normal fruit leaves is generally in the range of 50 to 100 parts per million.

Copper—Copper has been applied in large amounts in many orchards in the form of Bordeaux spray. Like manganese, it is recognized as sometimes deficient in Florida. It is generally present in healthy leaves at approximately 10 parts per million.

Diagnosing Nutrient Deficiencies

Visible symptoms of excessive nutrient deficiencies of the various elements have been described frequently. The small yellowish-green leaves, the reddish-brown bark, and small amount of twig growth characteristic of nitrogen deficiency in apple and peach orchards are generally recognized. Acute potassium deficiency results in slender twig growth, puckering and rolling of the leaves, and marginal burn of the foliage. Magnesium deficiency shows first as a yellowing in the areas between the veins of the leaf followed in acute cases by dying of the tissues of these areas. Excessive boron deficiency results in dying-back of new growth. Acute copper deficiency causes somewhat similar dieback symptoms. Zinc deficiency also results in dieback and in the formation of rosettes of very small, usually yellowish leaves. The almost white leaves resulting from iron deficiency are well known to Western orchardists.

The orchardist, however, is interested in preventing the development of such acute deficiency conditions. It is important to him to know when the trees are slightly deficient in potassium, magesium, or other nutrient elements so that he can correct the condition before acute leaf symptoms and serious lack of production develop. The use of leaf analyses to determine the nutrient level in the tree is proving of much value in this connection.

While leaf analyses will indicate the nitrogen level in the trees, a low nitrogen condition can usually be determined by general orchard observations of such items as color of leaves, amount of terminal growth, and general vigor. At present, leaf analyses seem to be of greatest value for determining the levels

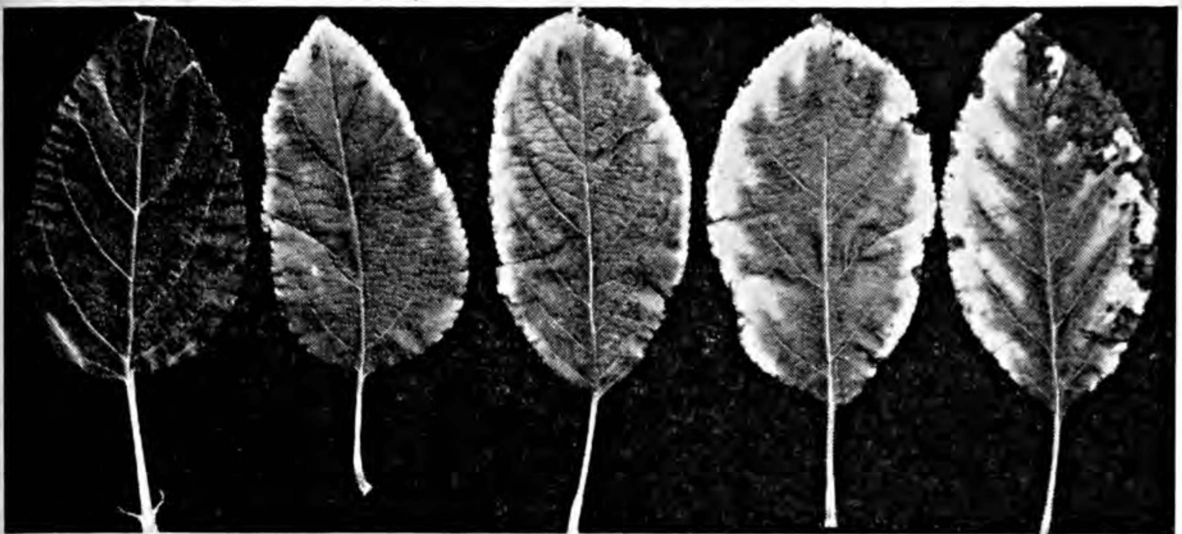


Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 5. Magnesium deficiency, Golden Delicious apple, normal leaf at left—Plant Industry Station, Beltsville, Md.

of potassium, magnesium, and calcium. The method is also valuable for determining phosphorus level although phosphorus deficiency rarely occurs in bearing orchards. Leaf analyses are also helpful in detecting deficiencies of the minor elements although visual symptoms of these deficiencies usually indicate the need for corrective measures before production is seriously affected.

The levels of the nutrient elements in the leaves do not remain stationary during the growing season. Nitrogen and potassium tend to decrease as the leaves become older while calcium and magnesium tend to increase. Samples taken near midsummer when the leaves are full grown and still relatively young appear to be best for diagnostic purposes.

Results of leaf analyses need to be carefully interpreted. They are of greatest value in developing a long-time program for the orchard. It is now well recognized that the elements potassium, calcium, and magnesium need to be in approximate balance in the leaves and other plant parts. Thus if the level of calcium is very high, larger quantities of potassium are required in the

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 6. Magnesium deficiency, Kieffer pear, normal leaf at left—Plant Industry Station, Beltsville, Md.

leaves than if the calcium supply is moderate. Conversely, heavy applications of potassium may accentuate a magnesium deficiency. Thus the level of all three of these elements should be known before the most satisfactory diagnosis can be made. If this situation is recognized, however, leaf analyses become a very valuable means of diagnosing potential deficiencies before the tree reaches an acute condition of nutrient element shortage.

Supplying Nutrients Through the Leaves

It has long been known that the leaves absorb soluble materials deposited on their surface. The leaf is a porous, sponge-like tissue and soluble materials, if applied to the surface, will penetrate the leaf. Nutrient elements so applied apparently enter readily into the nutrient compounds formed in the leaf.

Solutions of many chemicals applied to the leaves in appreciable concentration cause injury. Hence feeding a tree with nutrients applied to the leaves depends on finding materials that will not cause leaf injury. Boron in the form of boric acid or borax can be applied to the leaves without injury and the tree requirement can be supplied by spraying the leaves with these compounds. Copper and zinc can be applied through the leaves of certain plants such as citrus and pecans, but the zinc and copper compounds now available that are soluble generally cause injury on deciduous fruits. The same is true of soluble iron salts.

In recent years there has been great interest in supplying nitrogen through the leaves in the form of organic compounds such as urea. These compounds can be used in considerable concentration (up to about 5 pounds in 100 gallons of water) without causing leaf injury. It has been throughly demonstrated that practically all of the material that sticks on the apple leaf enters the tissue. Peach leaves, on the other hand, are much less effective in taking in organic nitrogen. Since nitrogen is required in very large amounts in the tree and is particularly needed in the early spring when rapid growth occurs, it is difficult to supply the full needs of the tree through the leaves. This could be done even with apples only by repeated spraying. Under some conditions, however, where it is desirable to get a quick nitrogen intake into the tree, foliage applications to apples are of value. If the tree has been well supplied with nitrogen as a result of soil applications there seems to be little special benefit from foliage spraying with nitrogen.

When the soils are alkaline or calcareous, applications of potassium, phosphorus, zinc, and iron to the soil frequently result in no increase in these materials in the tree. So far as tested, potassium and phosphorus are taken in through the leaves only to a limited extent. Research is needed on the possibility of developing organic compounds of these materials which could be applied to the foliage in high concentrations. Such compounds would have to be noninjurious to the leaves and at the same time soluble in water. If such compounds of potassium, phosphorus, iron, and zinc could be developed, their usefulness in tree nutrition under conditions where they are not available to the tree from soil applications would be very great.

Much progress has been made in the last decade in our understanding of orchard nutrition. The use of leaf analyses in studying nutrient levels in trees has contributed greatly to the progress. The possibility of supplying nutrient elements through the leaves is now more generally recognized but wider use of this method is dependent upon developing and testing suitable compounds that will not cause injury. Supplying these materials through the leaves would be of greatest value in areas where soil applications of certain of the nutrients are unsatisfactory because of the high fixing power of the soil.

Know Your Soil
X. Woodstown Sandy Loam

By J. B. Hester, R. L. Isaacs, Jr., and F. A. Shelton

Department of Agricultural Research, Campbell Soup Co., Riverton, New Jersey

THE Woodstown sandy loam is an important soil along the North Atlantic Seaboard. This soil consists of a light brown to brown sandy loam and in some places is a heavy sandy loam. The surface soil, where not severely eroded, is 7 to 10 inches deep. The Woodstown series is an imperfectly drained soil. Therefore, the subsurface below the 10-inch depth grades into a mottled yellow or yellow brown and bluish gray sandy clay. In many cases, below the 20-inch depth, the soil changes to a somewhat plastic clay. The soil is generally between 4 and 5 feet deep and rests on sand or gravel or a combination of sand and gravel. This soil is from slightly sloping to level in topography and is often characterized by the presence of water-worn pebbles.

The Woodstown series is generally recommended for pasture land, corn, and grain. A typical analysis of the Woodstown soil is as follows:

pH	Lbs./A.		Toxic	% Organic	Lbs. per acre		
	Ca	Mg	Aluminum	Matter	P_2O_5	K_2O	Mn
5.2	450	150	High	2.3	2	50	5

Hester extracting solution

It is obvious that this soil is low in available phosphorus. This condition is created by the imperfect drainage condition which brings into solution ferrous iron. The ferrous iron precipitates the phosphorus as insoluble ferrous phosphate. The available potassium is low and the soil responds to potash. Ten pounds of borax per acre are needed for most crops.

Since this series of soils has somewhat of a marginal tendency, it may be interesting to study some of the things that have been done through research to make this soil productive. Liming to an optimum pH value is essential. It requires from 1 to 2 tons of a finely ground limestone to establish a pH value favorable for most vegetable and agricultural crops. The liming of this soil does more than correct the pH value; it eliminates the solubility of

Fig. 1. Carrots in foreground cultivated and those in background weeded but uncultivated.

Fig. 2. Suffocation of plant roots by accumulated water due to an improperly sloped headland.

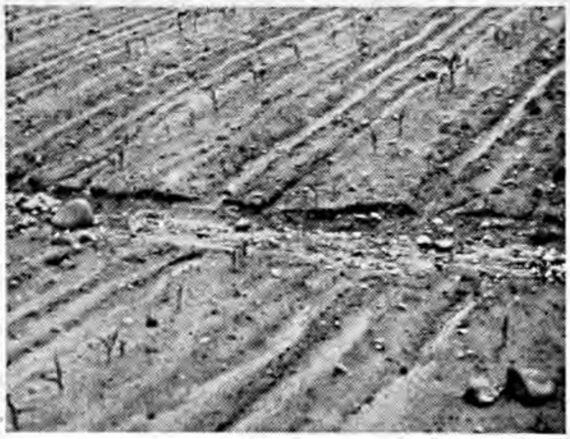


Fig. 3. Surface erosion in one year because of improper consideration of soil problems.

Fig. 4. Better than a 100-bushel corn crop through proper fertilization on the Woodstown sandy loam.

toxic elements like aluminum and even iron and manganese which are essential to plant growth but toxic in excessive concentrations. It tends to coagulate the clay and make the soil more friable and better aerated for plant roots. It tends to facilitate the movement of water through the soil and create a more favorable medium for desirable micro-organisms.

Aeration of the Soil

Among other things essential to this soil is aeration. Aeration can be enhanced by cultivation. Deep cultivation is essential. Figure 1 shows carrots on cultivated and uncultivated Woodstown sandy loam. Where the soil was uncultivated, but weeds otherwise controlled, carrots made practically no growth; whereas when the soil was properly cultivated, carrots made excellent growth. The increase in yield was seven times the uncultivated. Oxygen is essential for root growth and is essential for the favorable micro-organisms in the soil. Where there is insufficient oxygen in the soil, anaerobic bacteria flourish, bringing into solution toxic concentrations of ferrous iron and manganous manganese.

Drainage

Since this soil is imperfectly drained, drainage is extremely important. Where this soil is slightly sloping, underground drainage can be very effective. However, many other methods of eliminating excessive water are also effective. The rows of the particular crop concerned can be contoured in such a manner as to effectively eliminate excessive rainfall standing on the soil. Excessive water tends to accumulate in pockets, particularly at the headlands. Figure 2 shows the effect of water accumulated at a headland which has been improperly sloped. A limited amount of effort in removing the accumulated soil on the headlands would have prevented the accumulation of water which suffocated plants in that area. Properly sloping headlands is far less time-consuming than the actual planting and cultivating of the plants concerned in that area.

Erosion

Slightly sloping Woodstown soil will erode if proper contouring of the rows and inclusion of organic matter in the soil have not been provided. Figure 3 shows erosion of the soil caused by the lack of these conditions. Allowing these conditions to develop makes it more difficult to effectively utilize this marginal soil.

Organic Matter

The Woodstown soil is characterized, as mentioned before, as a grain, corn, and pasture soil. Advantage should be taken of this fact to grow these crops effectively. With the proper use of fertilized it has been possible to

(*Turn to page* 40)

How to Buy a Sprinkler System

By John W. Wolfe

Oregon State College, Corvallis, Oregon

BEFORE a man buys a sprinkler system he should first make sure that sprinkling is the best method of irrigation for his farm. Sprinkling has many advantages, but it also has one big disadvantage and that is cost. There are some cases where gravity irrigation can do just as good a job and do it cheaper than sprinkling. Sprinkling does, however, seem to be gaining advantage on more and more farms in the Willamette Valley.

When the selection of method has been made, an inventory of the resources must follow before any money is invested. It may be necessary to test the yield of a well or to verify a water right. A rule of thumb that can be used to determine if the water supply is adequate is to multiply the number of acres intended to be irrigated by six gallons per minute. The resulting figure is approximately the quantity of water that will be required to irrigate the acreage if it flows 24 hours a day 7 days a week.

Another important point to check is the power supply. It is never wise to buy a system until a check has been made with the power company to make sure they will be able to supply the power needed. For example, single phase lines usually have a limit of 5 or 7½ h.p.

Assuming that all of the conditions mentioned have turned out favorably for sprinkler irrigation, a sprinkler dealer should be approached. It is suggested that particularly when buying a larger system entire dependence is not put on the design from one dealer, but that two or three dealers be asked to design and bid on the system. This, of course, invites a certain amount of difficulty because then a choice between two systems must be made and sometimes the designs different dealers make will vary quite a bit. The figures presented here might help make this selection.

First, check the system capacity to see whether or not it will supply about six gallons per minute per acre. Next, check the size of mainline to see whether or not the most economical size has been selected. The selection of mainline size should actually be carefully figured for each system. The figures presented here are only guides because there are so many variable factors which affect them. However, they are somewhere near specifications for a typical condition in the Willamette Valley. If the flow is 0 to 30 gallons per minute, a 2-inch pipe is suggested; for 30 to 90 gallons per minute, a 3-inch pipe; for 90 to 160 gallons per minute, a 4-inch pipe; for 160 to 300 gallons per minute, a 5-inch pipe; for 300 to 500 gallons per minute, a 6-inch pipe; for 500 to 700 gallons per minute, a 7-inch pipe; and for 700 to 900 gallons per minute, an 8-inch pipe.

Another thing to check is the rate of application of the water. For a very heavy soil, the sprinklers should not discharge more than 6 or 7 gallons per minute on a 40 by 60 spacing. For medium soils, the sprinkler should discharge not more than 7 to 10 gallons per minute. For very light-textured soils, the rates can go higher but the usual accepted rates are between 7 and 15 gallons per minute per sprinkler on a 40 by 60 spacing. If the sprinkler designated applies less than 6 or 7 gallons per minute, it must be placed on spacing closer than 40 by 60 to get uniform distribution.

Another important item to check on the system is the size of the lateral. Some consideration should be given to the selection of the sprinkler lateral size by economy. This process gets involved, however, because the labor cost of moving the pipe also enters in. Usually what determines the size of a sprinkler lateral is the required uniformity of distribution from one end to the other. Agricultural engineers have suggested a figure for maximum pressure loss in a sprinkler lateral. They consider that the maximum pressure loss should be no more than 20 per cent of the initial pressure. To stay within this 20 per cent, the following figures represent the maximum number of sprinklers of a given size that can be put on a given size pipe.

Pipe size	Sprinkler size	Max. No. sprinklers
2″ pipe........	6 g.p.m.	9
2″...........	8	7
2″...........	10	6
3″...........	6	20
3″...........	8	16
3″...........	10	14
4″...........	6	33
4″...........	8	28
4″...........	10	24

These maximum figures apply to level land. If a sprinkler lateral goes uphill from the mainline, the maximum number of sprinklers on the line must be materially reduced. Figures are based on uniform pipe size in a lateral. If pipe size is reduced, these figures do not apply.

Speaking of pressures, there is a recommended pressure at which each of the common sprinklers on the market operates best. The distribution pattern from the sprinklers is not good if the pressure gets too low and it is not good if the pressure is too high. These data can be obtained from the manufacturers for individual sprinklers. The following figures, however, might be used as a general guide for a suggested pressure at the last sprinkler on the line: For 6 or 7 gallons per minute, 30 pounds; for 8 to 10 gallons per minute, 35 pounds; for 12 to 15 gallons per minute, 40 pounds.

There are some practical points also that should not be overlooked. The system should be able to reach all parts of the field with a minimum amount of labor in moving the pipe. It must be suited to the special crop being grown, and the labor schedule must fit into farm operations.

It might be a good idea to ask the equipment supplier to attach a couple of fittings to the pump for the application of fertilizer. Soluble fertilizer can be successfully applied to the soil through the sprinkler system. Fertilizer can be drawn from a barrel through a hose to the suction side of the pump. As it goes through the pump, it is thoroughly mixed with the water and is discharged out through the sprinklers. The barrel can be refilled by a hose from the discharge side of the pump.

Last, but not least, of the points to select is the pumping system. The dealer should be able to guarantee at least a 60 per cent pump efficiency and 75 per cent pump efficiencies are not uncommon. It is possible that the dealer who designs the best irrigation system may not have the most efficient pump to sell for the particular set of operating conditions under consideration. It may be desirable, therefore, to compare selections of more than one make of pump provided the sprinkler designer will supply the head and discharge specification needed for selecting a pump.

If an irrigation system is purchased, it should be used. It should not lie idle while crops are drying up. It is also important to follow the irrigation schedule which has been worked out with the dealer. If this is not done, too much pressure may be lost before the water reaches the sprinklers.

Topdressing Legume Meadows in Iowa

By George Stanford and John Hanway

Iowa State College, Ames, Iowa

TOPDRESSING phosphate and potash fertilizers on legume meadows often pays dividends where soils are deficient in these nutrients. Of course, this doesn't mean that topdressing should be substituted for the firmly established practice of fertilizing the new seeding. Topdressings should supplement rather than substitute for fertilization at seeding time. The initial fertilizer application gives the new seeding the boost it needs for good stand establishment and early vigorous growth. Later applications may be needed on the low-fertility soils where not enough phosphate, potash, or both of these elements were supplied initially.

Topdressing Phosphate

Topdressing superphosphate on leguminous meadows has increased yields under a rather wide range of soil and seasonal moisture conditions in Iowa. It has been known for several years that poor growth of alfalfa or red clover on the neutral to high-lime soils of northcentral and western Iowa often is due to phosphate deficiency. Topdressing 300 to 400 pounds of 0-20-0 per acre in such cases has given spectacular results, often doubling or even tripling the yields of hay.

On the soils where heavy applications of phosphate are needed, farmers often fail to apply enough of this nutrient at seeding time to maintain good hay production over a two- or three-year period. An example of such a low-phosphorus soil is the calcareous Ida silt loam in western Iowa. During 1950 on one of these Ida soils, yields of second-year alfalfa-bromegrass meadow were 0.5, 1.8, 2.8, and 4.0 tons per acre on plots which had received none, 300, 600, and 1,200 pounds of 0-20-0 per acre respectively when the mixture was seeded. In this same experiment, topdressing 300 pounds of 0-20-0 on second-year meadow plots, which also had received this amount of phosphate at seeding, resulted in an additional 1.3-ton per acre yield increase. The corresponding yield increase in 1949 from topdressing phosphate in this experiment was only 0.4 ton per acre, but moisture conditions were much less favorable than during 1950.

Topdressing phosphate fertilizer also has been very profitable in Iowa on acid soils testing low to very low in available phosphorus. Most of the field trials have been conducted in eastern and southern Iowa on various prairie and forest-derived soils during the past few years. In 1949 we studied the effect of topdressing phosphate on first-year stands of alfalfa. Superphosphate (0-20-0) was applied in early April at the rate of 300 pounds per acre, alone and in combination with potash. At 12 of 16 locations, alfalfa yield increases due to phosphate ranged from 300 to 1,200 pounds of cured hay per acre. Dry weather following the first cutting probably prevented top yield responses. Ten of these fields had received the equivalent of 150 to 200 pounds of 0-20-0 and four others had gotten either manure or rock phosphate at time of seeding.

Again in 1950, phosphate topdressings gave good results on both alfalfa and red clover. Average responses for 1950 are shown in Table III. Moisture conditions were generally favorable, especially for the first cutting. On eight very low-phosphorus fields in northeastern and southeastern Iowa, yield increases of alfalfa from an early April topdressing of 300 pounds of 0-20-0 averaged 1,200 pounds per acre. Average increase from a 600-pound rate was 1,600 pounds per acre. Table I shows the relation of soil test values to yield responses in these 19 experiments.

TABLE I. YIELD RESPONSES TO PHOSPHORUS IN RELATION TO SOIL-TEST VALUES FOR AVAILABLE PHOSPHORUS

No. of expts.	Phosphorus level in soil* (lbs./A.)	Average yield increases (lbs./A) from applying	
		330# 0-20-0/A	600# 0-20-0/A
8......	3 or less	1,200	1,600
6......	3.1-5	600	800
5......	5 or more	300	500

* Bray No. 1 extractant, used by Iowa State College Soil Testing Laboratory. Soil samples from 0"-6" layer.

From these results it is evident that alfalfa and red clover utilize topdressed superphosphate quite effectively. Alsike and ladino clover also respond well to topdressing according to our limited results and the data obtained in other states. Apparently the roots near the soil surface are rather efficient feeders. Samples of legume taken from each of the experiments in 1950 were analyzed for total phosphorus content. Without exception, phosphate topdressing increased the percentage of phosphorus in the plants even where marked growth responses occurred. This is illustrated in Table II for two soils which differed considerably in phosphorus status.

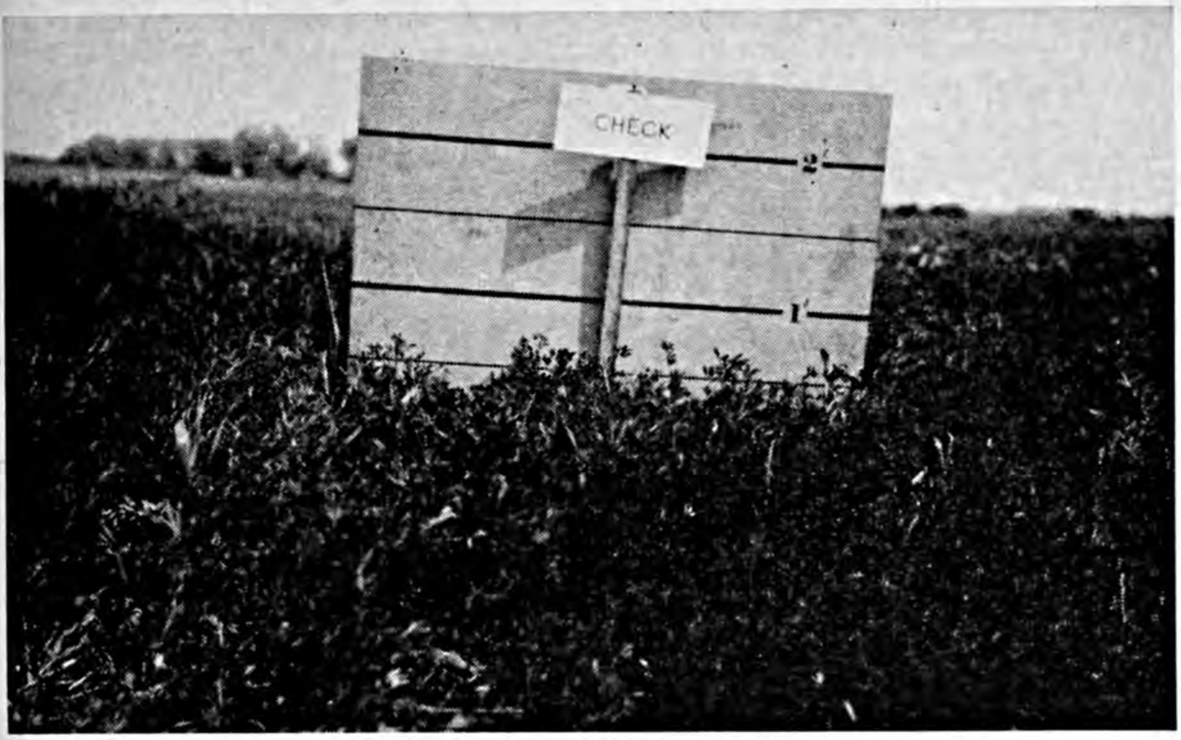
Notice that the phosphorus content of the alfalfa was only 0.14 per cent on the Glew field where no phosphorus was applied. This percentage is regarded by some authorities as being too low to supply the phosphorus needs of growing livestock and dairy cows without supplemental phosphorus. Such a low content of phosphorus, or even lower, has been found in alfalfa from certain high-lime soils of northcentral Iowa. Fertilizer increased the phosphorus content of the hay on the Glew field to a point well above the critical level, even though the yield of hay was increased approximately threefold.

Need for Potash

In Iowa, the need for potash on legume meadows is not so widespread as the need for phosphorus. However, legume meadows are likely to be lacking in potash rather often in certain soil areas, particularly on the Carrington-Clyde soil area in the northeastern part of the State. The most severe cases of potash deficiency occur in this area. A relatively high proportion (approxi-

TABLE II. EFFECT OF PHOSPHATE TOPDRESSING ON YIELD, PER CENT PHOSPHORUS IN THE PLANTS, AND TOTAL PHOSPHORUS REMOVED BY THE CROP

Lbs. 0-20-0 applied	Glew field, pH *6.25* (Dodgeville silt loam)			Mielke field, pH *6.7* (Fayette silt loam)		
	None	300	600	None	300	600
Yield, 2 cuttings (T/A).........	0.93	2.40	2.90	2.36	2.74	3.08
% P, 1st cutting...............	0.14	0.21	0.26	0.24	0.31	0.34
Lbs. P removed/A, 2 cuttings....	2.8	9.7	14.0	12.2	16.7	20.8



These pictures of an alfalfa-clover-timothy meadow in Delaware County, Iowa, show results of top-dressing. On this field, 300 pounds of 0-20-20 gave a total yield increase of about 1.7 tons per acre for two cuttings.

mately 20%) of the soils sent in by farmers of this area test very low—less than 100 pounds of available potassium (K) per acre. In other areas, the proportion of very low-potash soils is considerably less than this. Soils testing low (100-130 pounds of potassium per acre) occur rather frequently in the northcentral, eastern, and southern sections of the State. Soils in the western part of the State are generally well supplied with available potassium.

Potash top dressing can be expected to increase the yield of alfalfa on practically all soils testing low in available potassium. This was true in 1950 on 16 low-potash fields in northeastern and southeastern Iowa, none of which had

TABLE III. EFFECT OF TOPDRESSING PHOSPHATE AND POTASH FERTILIZERS ON ESTABLISHED LEGUME MEADOWS UPON HAY YIELDS, 1950[1]

No.	Soil	pH	No. of cut-tings	Yield without fertilizer (Lbs/A)	Average yield responses from top-dressing (Lbs/A)			
					Phosphate		Potash	
					300#/A 0-20-0	600#/A 0-20-0	100#/A 0-0-60	200#/A 0-0-60
1	Fayette silt loam	6.7	1	1,450	0	200	250*	300*
2	Fayette silt loam	6.6	2	5,300	200	600*	350	600*
3	Fayette silt loam	6.7	2	4,750	700**	900**	250	400*
4	Fayette silt loam	6.7	2	4,700	850**	900**	600*	800**
5	Dodgeville sandy loam	6.3	2	1,850	2,650**	3,600**	700**	700**
6	Floyd silt loam	6.0	1	2,700	800**	1,300**	300*	750**
7	Floyd silt loam	6.2	2	6,250	950**	1,500**	200	1,200**
8	Floyd silt loam	6.3	1	4,380	0	0	300	450
9	Carrington sandy loam	6.5	2	5,100	1,800**	2,650**	1,450**	2,250**
10	Carrington silt loam	6.2	1	3,880	350**	500	450	450
11	Lindley loam	6.4	3	5,900	1,000**	1,350**	800*	900**
12	Weller silt loam	6.3	3	6,000	600**	800**	200*	650**
13	Weller silt loam	6.2	3	4,200	850*	1,200**	800*	1,000**
14	Weller silt loam	6.5	3	4,100	1,450**	1,800**	500*	850**
15	Weller-Marion	6.1	3	6,950	500**	800**	350	400*
16	Marion silt loam	6.8	2	4,750	350	500	350	50
17	Grundy silt loam	6.4	3	7,050	300	600*	500*	750**
18	Givin silt loam	6.3	3	7,700	650**	600**	400*	850**
19	Seymour silt loam	6.6	2	5,350	350	200	200	400*

[1] All were alfalfa or mixtures predominantly alfalfa, except Nos. 6 and 8 which were predominantly red clover.

* Significant at 5% level.
** Significant at 1% level.

received any potash at seeding. Plots were topdressed with 100 and 200 pounds per acre of muriate of potash (0-0-60). On fields responding to potash, yield increases ranged from 200 to 1,450 pounds per acre for the 100-pound rate, and from 300 to 2,250 pounds per acre for the 200-pound rate, as shown in Table III.

It is obvious, of course, that significant increases from these rates of application were not always profitable increases. However, such an increase even though relatively small, reveals a need for additional potash, but at a lower rate than was used in the experiments. Using an 0-2-1 rather than an 0-1-1 ratio might be desirable in such cases where the need for potash is considerably less than the need for phosphate.

Although all the experiments were located purposely on fields where the surface soil tested low to very low in available potassium, yield increases on some of the soils were relatively small while others were large. Results obtained on two soils differing widely in potassium supplying power are presented in Table IV for the purpose of illustration.

That the potash deficiency of alfalfa on the Carrington soil was greater than on the Weller soil is shown by plant analyses. First cutting hay from the plots that received phosphate but no potash contained only 0.57% potassium as compared to 1.78% on the Weller soil. According to studies in New York, Wisconsin, and elsewhere, 0.57% would be regarded as a critically deficient level of potassium in alfalfa.

New Jersey workers have set 1.4% potassium as the critical level for alfalfa, below which definite yield increases should be obtained from potash application, and 2.0% potassium as an ideal value for alfalfa.

TABLE IV. EFFECT OF POTASH TOPDRESSING ON YIELD AND POTASSIUM CONTENT OF ALFALFA ON TWO IOWA SOILS

Soil	Humes field Carrington loam, pH 6.5			Martin field Weller silt loam, pH 6.25		
Soil treatment (lbs/A)	600 0–20–0	600 0–20–10	600 0–20–20	600 0–20–0	600 0–20–10	600 0–20–20
Yield (T/A)*	3.78	4.54	4.89	3.29	3.63	3.70
% K in 1st cutting	0.57	0.95	1.49	1.78	2.21	2.47
K removed* (lbs/A)	51	97	144	115	149	167

* No. of cuttings taken: Carrington—2; Weller—3.

potash in the soil samples from the plow layer. Two important factors are involved. In the first place, the Carrington soil releases potassium from relatively unavailable to available form much more slowly than the Weller soil, according to recent unpublished data from this station. Secondly, the distribution of available potassium with depth differs considerably as shown below (expressed as pounds of available potassium per acre 6 inches):

Depth	Carrington loam	Weller silt loam
0–6″	72	96
6–12″	70	104
12–24″	92	260

It is obvious that such differences between soils must be taken into account in establishing useful correlations between available potassium content and crop response to potash fertilization.

It is worthy of mention that although an application of phosphate alone on the Carrington soil increased the yield by 1.23 tons per acre, no more potassium was removed in the hay from the plots that received phosphate than from the plots that received no phosphate. Thus, phosphate application resulted in an increase in yield and a proportional decrease in potassium percentage in the hay. This would indicate that most of the increase in potassium in the hay from potash-treated plots was derived from the fertilizer potash. The data in Table IV indicate that the hay removed in two cuttings from the plots topdressed with 120 pounds of K_2O (100 pounds of K) per acre contained 93 pounds per acre more K than the hay from the plots that received no potash. Apparently most of the potash applied was removed by the hay crops in this one season. On the Weller soil approximately one-half the fertilizer potash was removed by the hay in three cuttings. In the latter case, it is evident that the plants took up more potash than was needed for normal growth. In other words, luxury feeding occurred.

The extreme difference in uptake of potassium by the alfalfa from these two soils cannot be explained on the basis of the relative content of available

The method of potash fertilization should be quite different for these two soils. For the Weller soil a moderate application of potash at seeding time to insure establishment of a good stand and supply some potassium in the surface soil would probably be all that is needed, since after the first year the alfalfa will draw on the available potassium in the subsoil. However, on the Carrington soil not only is potash at seeding time needed to establish the stand but subsequent topdressings

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Plentiful Seed for Soil Conserving

By T. S. Buie

Soil Conservation Service, Spartanburg, South Carolina

TEN million acres planted to grass and legumes in 1951!

That is the potential acreage which can be planted from the 354 million pounds of seed, kudzu crowns, and grass stolons harvested by farmers in soil conservation districts in the nine Southeastern States and Puerto Rico last year.

The estimate made by Soil Conservation Service workers assigned to cooperate with the more than 400 soil conservation districts in the Region shows that a total of 306 million pounds of grass and legume seed and 48 million pounds of kudzu crowns and grass stolons were harvested.

Most of these are perennials or reseeding annuals. Once a stand is secured, it is not necessary to plant the same field again, so long as satisfactory growing conditions are maintained. Thus the 1951 planting, as well as every other year's, represents a tremendous total increase to the acreage already established. While none of the seed can be used for human food or even for animal consumption, the growing plants of most species provide excellent grazing, hay, or silage—thus contributing to the increasing livestock production in the Southeast.

All of these things make for a better type of agriculture. Throughout agricultural history, the South has suffered from a system of farming based on annual row crops. It has been necessary to prepare the land anew every year, and it is well known that every time sloping fields are plowed more soil is lost.

The close-growing grasses and legumes of which we are talking fit into the current program for soil and water conservation which is so popular in all the states of the South today. There are at present in the nine Southeastern States, Puerto Rico, and the Virgin Islands 345,537 farmer-cooperators with the more than 400 soil conservation districts; and their combined farms represent a total of 57 million acres, which is approximately 35 per cent of the total land in farms in the Region.

Each one of these cooperators is doing his part in the development of a sound soil and water conservation program. Most of them already have realized the importance of an adequate supply of planting material if the necessary acreage of these crops is to be planted and if the land is to be conserved while being used to produce ever larger crops.

Many of the crops grown from these seed serve not only as feed for livestock, but the residue after grazing—or in some cases the entire plant, as with blue lupine—is returned to the land for soil improvement.

Need for Fertilizers

Farmers are finding it to their advantage to fertilize such crops and it is not unusual to see farmers using more fertilizer per acre for their pasture or for hay than they formerly used for cotton or other cash crops. It is a well-recognized fact among farmers as well as agricultural scientists that legumes require large quantities of

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Reseeding strains of crimson clover that have been developed during recent years have greatly increased the importance of crimson clover as a winter cover and grazing crop. This has volunteered for 10 years on the farm of J. B. Mask in Spalding County, Ga.

Left: **Blue lupine is another important new winter cover crop in the lower South, particularly for peanut lands. The 19-acre field seen here on the farm of V. E. Avery, Jr., near Powersville, Ga., was seeded in October, following watermelons.**

Below: **Annual lespedeza is not a new crop in the Southeast, but its acreage is expanding in the new grassland farming program that is spreading across the region. This is first-year Kobe lespedeza on the farm of D. J. White, near Eastman, Ga.**

Above: Caley (wild winter) peas are becoming increasingly popular for overseeding on kudzu and other perennial summer legumes to extend the grazing period. In this field on the farm of J. L. Cooley, near Mize, Miss., they are being used for winter cover and seed production.

Right: Crotalaria has become a popular summer legume in the Coastal area and sandhills of the lower South, where it is adding heavy tonnages of green manure to sandy soils. The variety seen here on the farm of Sam G. Long, near Sandersville, Ga., is giant striata and is more than six feet tall.

Above: **Outstanding among the new grazing crops in the Southeast is Kentucky-31 fescue. This scene shows a two-year-old planting being harvested for seed on the farm of Peden Gaston, near Woodruff, S. C.**

Below: **Ladino clover is being widely used in grass-legume mixtures. Kentucky-31 fescue is one of the popular companion crops in grazing mixtures. Ladino is seen here with orchard grass on a land-utilization project.**

The Editors Talk

Mobilizing Agronomists for Defense

Recognizing that in a national emergency a man's value to his country may depend more upon his being assigned to duties he is well qualified to perform than on his nearness to the front, there is now under way a move to secure a registration of all established agronomists (crops and soils). The information obtained will be made available to the National Security Resources Board.

Why is an agronomist militarily important? First to come to mind is his influence on increased food production. The development of high-yielding strains of crops, the use of soil tests to govern land management and the efficient use of fertilizer supplies, the release of manpower for industry and the armed forces through teaching methods resulting in greater unit production, all bespeak his value.

More specifically, a Committee appointed by the American Society of Agronomy made up of Wm. A. Albrect, Chairman, Department of Soils, University of Missouri, W. H. Leonard, Professor of Agronomy, Colorado State College, J. B. Peterson, Head, Department of Agronomy, Purdue University, S. C. Vandecaveye, Professor of Soils, State College of Washington, and chairmanned by C. L. W. Swanson, Chief Soil Scientist of the Connecticut Agricultural Experiment Station, has some twenty suggestions for use of these trained men in the Armed Forces, including:

1. To supervise the establishment and maintenance of grass and other suitable vegetation at military airports to safeguard airplane engines from dust, reduce local air instability, and reduce visibility hazards from dust.
2. To supervise the establishment and maintenance of vegetative cover on local watersheds to prevent silting-in of harbors and navigable waterways, or the damaging of military and civilian operations by flash floods or soil erosion.
3. To investigate soils and their treatment for temporary runways, roads, and landing beaches.
4. To map soil types, to collect soil information, and to interpret such information in terms of military usage for possible trouble areas.
5. To interpret the soil types, cover, and terrain from aerial photographs.
6. To investigate methods of destroying enemy crops and of safeguarding our own.
7. To supervise the production of food for the rehabilitation of conquered areas, on military bases isolated from supply centers, for the United States and allied countries by maintaining production and saving of crops for local usage during invasion to prevent starvation in combat areas.
8. To supervise the development and production of chemurgic plants and textile crops such as guayule for rubber, castor beans for airplane engine oil, hemp for ship lines, etc., and cotton for clothing, etc.

9. To help in wartime chemical industry and research, chemical warfare research, wartime physics, military ordnance, soil mechanics, and permafrost research.

10. To advise on efficient utilization and distribution of basic fertilizer materials, since the chemicals used in the production of fertilizers are also used by the munitions industry.

11. To aid in biological warfare, medical research, and sanitary engineering, and in civilian defense in the instruction of line officers and others in the techniques of protecting personnel in the hazards of atomic warfare.

12. To plan and supervise the camouflaging of military installations by rapid establishment of vegetation.

13. To plan and supervise the handling and storing of perishable foods.

14. To study enemy food potential, topography, soils, vegetation, climate, etc.

15. To act as food and agriculture experts in the military government.

16. To aid in the procurement of food for the military.

17. To appraise lands acquired by the military and also damages to land or crops.

It is to be hoped that these specialized skills of our soils and crops men will be given due consideration by the National Security Resources Board. In World War II far too many of these younger scientists were drafted for combat duty and their long years of training and their talents were wasted. The agronomists are not asking for special privileges. They are merely suggesting that they be assigned to services where they can render full value to their country.

Don't Work in Dark

Dr. F. J. Salter, in charge of the Soils Inventory Laboratory at Ohio State University, stated in a recent publicity release that applying lime and fertilizer without testing the soil is like painting a house in the dark. You may not apply the right material, you may not use the right amount, and you may get it in the wrong place.

"Some people use 3-12-12 when they need 3-9-18," he says. Where potash is needed, he recommends 3-9-18; to correct a phosphorus deficiency, 4-16-8 instead of 3-12-12. There have been cases where farmers applied lime that was not needed. Soil tests will correct such mistakes. Most efficient lime and fertilizer programs include soil testing before applications are made.

This is a good time for farmers to have their soils tested. Laboratories are not as crowded as they will be later and samples that come in now will get faster processing. Fields going into wheat this fall and legumes and grass next spring can be tested now. Lime, phosphate, and potash needs must be supplied for good wheat yields and are even more important to legumes. Dr. Salter says that lime applied early will become available and will be more effective than if it is applied closer to legume seeding time. Tests now will help farmers know where and how much lime is needed so that it can be spread right away.

This good advice on the fall testing of soils is being emphasized throughout the country. It is to be hoped that it will be heeded—not only for a more efficient and economical use of fertilizer materials but for a saving of time in next year's farming operations.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
August	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July	39.11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
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	89	81	109	74	87	110
1938	69	196	80	79	76	64	57	97	88
1939	73	154	100	84	88	78	67	94	91
1940	80	160	78	97	96	77	64	96	111
1941	137	264	116	105	117	107	82	211	129
1942	153	369	168	134	143	124	91	202	163
1943	160	405	188	235	174	154	125	231	245
1944	167	420	214	216	170	160	139	234	212
1945	181	366	205	232	198	170	127	227	207
1946	263	382	178	248	212	209	141	319	182
1947	257	380	232	248	336	259	148	381	226
1948	245	482	222	253	201	226	155	298	214
1949	231	463	184	244	210	210	139	192	201
1950									
August	298	531	175	248	224	223	130	314	164
September	322	554	151	219	224	219	131	349	126
October	314	551	123	175	213	216	134	361	138
November	332	525	126	169	213	219	139	436	188
December	325	472	128	197	226	230	144	452	211
1951									
January	333	459	141	221	240	236	150	448	324
February	337	325	148	233	249	250	155	443	333
March	345	266	154	236	249	240	155	457	265
April	348	253	161	231	252	242	155	457	225
May	342	398	156	238	255	239	153	448	239
June	339	490	155	239	252	235	142	424	189
July	315	495	169	249	254	232	130	346	204

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12.37	10.06	8.68	8.56

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish scrap	Tankage	High grade ground blood
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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243

Wholesale Prices of Phosphates and Potash * *

	Super-phosphate, 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[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.81	5.47	.368	.704	13.98	.193
October	.760	3.98	5.47	.386	.704	13.98	.193
November	.760	3.98	5.47	.386	.732	14.72	.193
December	.798	3.98	5.47	.420	.796	16.00	.210
1951							
January	.810	3.98	5.47	.420	.796	16.00	.210
February	.810	3.98	5.47	.420	.796	16.00	.210
March	.810	3.98	5.47	.420	.796	16.00	.210
April	.810	3.98	5.47	.420	.796	16.00	.210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193

Index Numbers (1910-14 = 100)

	Super-phosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash in bags	Sulphate of potash magnesia	Manure salts
1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
August	142	104	112	67	74	58	82
September	142	106	112	67	74	58	82
October	142	110	112	70	74	58	82
November	142	110	112	70	77	61	82
December	149	110	112	75	84	66	85
1951							
January	151	110	112	75	84	66	85
February	151	110	112	75	84	66	85
March	151	110	112	75	84	66	85
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
August	267	248	243	131	85	321	142	70
September	272	252	247	131	85	324	142	70
October	268	253	247	131	85	323	142	73
November	276	255	251	132	85	328	142	74
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78
March	311	272	269	142	91	357	151	78
April	309	273	268	141	91	353	151	78
May	305	272	266	139	91	334	151	78
June	301	272	265	134	91	311	151	69
July	294	271	261	135	93	297	151	74

* U. S. D. A. figures, revised January 1950. 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] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] 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 is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 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 1950 Official Inspections 217," Agr. Exp. Sta., Univ. of Me., Orono, Me.

"Know Your Fertilizers," Ext. Serv., Miss. State College, State College, Miss., Pub. 193, (Rev.-18M) Apr. 1951.

"Fertilizer Inspection and Analysis; Fall, 1950," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 557, July 1951.

"Ohio Fertilizer Sales—1950," Dept. of Agron., Ohio State Univ., Columbus, Ohio.

"Inspection Report (Summary) of Official Samples on Seed, Feed and Fertilizer 1947-48 and 1948-49 Fiscal Years," Dept. of Agr., Oklahoma City, Okla., P. A. Yeats.

"County Fertilizer Data, July 1 through December 31, 1950," Agr. Exp. Sta., Tex. A & M College, College Station, Tex.

"The Effect of Fertilizers on the Yield of Corn and Sorghum at Nacogdoches," P. R. 1315, Jan. 29, 1951, H. C. Hutson and J. C. Smith; "Anhydrous Ammonia Fertilizer Tests on Various Crops at Bluebonnet Farm, 1950," P. R. 1316, Jan. 29, 1951, B. D. Hargrove and H. O. Hill; "Distribution of Fertilizer Sales in Texas, July 1-December 31, 1950," P. R. 1325, Feb. 14, 1951, J. F. Fudge; "The Effect of Different Amounts and Combinations of Nitrogen, Phosphoric Acid and Potash on the Yield and Quality of Sweet Potatoes at Nacogdoches," P. R. 326, Feb. 14, 1951, H. C. Hutson and J. C. Smith; "The Effect of Nitrogen, Phosphorus and Potassium on the Yield of Forage and Grain from Camellia Oats," P. R. 1327, Feb. 19, 1951, E. D. Cook, J. C. Smith, L. E. Crane, and R. P. Bates; "Effect of Sulphur, Nitrogen and Phosphorus Amendments on Cotton Production at the Blackland Station, 1950," P. R. 1336, Mar. 6, 1951, E. N. Stiver, R. J. Hervey, H. E. Hampton, and J. R. Johnston; "Corn Fertilizer Studies Near College Station 1949-50," P. R. 1339, Mar. 8, 1951, J. C. Smith, J. S. Rogers, J. F. Fudge, and J. E. Roberts; "Supplying Phosphorus to Range Cattle Through the Fertilization of Range Land," P. R. 1341, Mar. 12, 1951, E. B. Reynolds, J. F. Fudge, and J. M. Jones; Agr. Exp. Sta., Tex. A & M College, College Station, Tex.

"Commercial Fertilizers Consumption in the United States 1949-50," Bur. of Plant Industry, USDA, Beltsville, Md., W. Scholl and H. M. Wallace.

Soils

"Exploratory Study of the Principal Soil Groups of Alaska," USDA, Wash., D. C., Agr. Mono. 7, Mar. 1951, C. E. Kellogg and I. J. Nygard.

"Sulfur Requirement of Soils for Clover-Grass Pastures in Relation to Fertilizer Phosphates," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 475, Apr. 1951, J. R. Neller, G. B. Killinger, D. W. Jones, R. W. Bledsoe, and H. W. Lundy.

"Results from Long-time Field Experiments on Hillsdale Soil," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Sp. Bul. 366, Jan. 1951, A. G. Weidemann and C. E. Millar.

"Contour Strip-Cropping," Ext. Serv., Cornell Univ., Ithaca, N. Y., Ext. Bul. 800, Dec. 1950, H. M. Wilson and H. A. Kerr.

"Soil Survey—Woods County Oklahoma," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Series 1939, No. 7, Oct. 1950.

"Irrigated Crop Rotation on the Clay Soils of Western South Dakota," Cir. 83, Dec. 1950; H. E. Weakly and L. B. Nelson; "Soils . . . of South Dakota," Cir. 88, May 1951, F. C. Westin, A. J. Klingelhoets, and G. B. Lee; Agr. Exp. Sta., S. D. State College, Brookings, S. D.

"Land Capability Methods for Conserving Washington Soils," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Pop. Bul. No. 200, Dec. 1950, W. A. Starr and L. C. Wheeting.

Crops

"Dates in Arizona," Ext. Serv., Univ. of Ariz., Tucson, Ariz., Cir. 165, H. F. Tate and R. H. Hilgeman.

"Thirty-First Annual Report Period Ending December 31, 1950," Dept. of Agr., Sacramento, Calif., Vol. XXXIX, No. 4.

"Annual Report of the Director Experimental Farms Service 1949-1950," Dept. of Agr., Ottawa, Ont., Canada.

"*The Construction and Care of Lawns*," Exp. Farms Serv., Central Exp. Farm, Ottawa, Ont., Can., 1939, Rev. 1948, 1949, 1950, J. H. Boyce.

"*Let's Grow Cucumbers*," Ext. Serv., Univ. of Del., Newark, Del., Ext. Fldr. No. 20, Apr. 1950, R. F. Stevens.

"*Agricultural Experiment Stations Annual Report for the Fiscal Year Ending June 30, 1950*," Univ. of Fla., Gainesville, Fla.

"*Pecan Growing in Florida*," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 437, June 1951, G. H. Blackmon and R. H. Sharpe.

"*Virginia Type Peanuts in Georgia*," Agr. Exp. Sta., Univ. of Ga., Experiment, Ga., Bul. 267, Mar. 1951, W. K. Bailey.

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Plentiful Seed . . .

(*From page* 22)

mineral elements, especially phosphate and potash, if best yields are to be secured.

In the early days of the soil conservation program initiated by the Federal government in 1933, the fear was frequently expressed that farmers who might be willing to withdraw land from cultivation under the conditions prevailing then—and plant it to a close-growing crop such as annual lespedeza, sericea, or kudzu—would plow up such crops and go back to row crops, should the opportunity arise for them to do so. The present-day reluctance of farmers to plow up their better pastures for other crops shows that they now recognize the value of grassland agriculture.

The seed of many of these new crops has been increased by the Soil Conservation Service in its seven regional nurseries and distributed to farmers through local soil conservation districts. For instance, in 1941, the Service bought 70 pounds of seed of a grass which had been growing for many years on the W. M. Suiter farm in eastern Kentucky. This grass has been found on the Suiter farm by an agronomist from the Kentucky Experiment Station and was planted in trial plots at the Station. It has been given the name "Kentucky-31 fescue," although it is still known as Suiter's Grass by many people.

The 70 pounds of seed purchased

from the eastern Kentucky mountain farm were planted in the Soil Conservation Service nursery at Chapel Hill, North Carolina, and in a few years the supply of seed was sufficient to distribute to farmers. One or more 5-acre seed-increase plots were established by soil conservation district supervisors in each of the 687 counties then in soil conservation districts in the Southeastern Region. It was conservatively estimated in 1950 that 17 million pounds of seed of this highly valuable grass were produced by farmers living within soil conservation districts in the nine Southeastern States. Most of these seed came from the 70 pounds purchased nine years previously by the Service.

Similar progress has been made with other crops. There are at least 25 or 30 new crops being extensively grown today which, 25 years ago, were entirely unknown or were not known in areas where they are common at present. Farmers talk freely about sericea lespedeza, kudzu, bicolor, Caley peas, button clover, and a host of other crops about which they had no knowledge at all a few years ago.

At last the South is developing a permanent type of agriculture, one that can be built upon and improved as the years go by. This is a situation which was not possible so long as a fresh start had to be made every year with annual crops most of which were planted in rows.

Topdressing Legume Meadows

(*From page* 21)

would be essential to maintain good yields.

In summary, present indications are that on many Iowa soils which have only slight to moderate potassium deficiencies, as indicated by available potash level in the surface 6 inches, the initial application at time of seeding may be all that is needed. In cases of more severe deficiencies, such as on the Carrington soil (see chart), the application of a moderate amount at time of seeding (40-60 pounds K_2O per acre) followed by the topdressing of 60 to 120 pounds K_2O on the second-year alfalfa is more desirable than application of a large amount at time of seeding. On extremely deficient soils, especially sandy soils, annual topdressings may be needed.

It should again be emphasized that topdressing applications should not be substituted for the application at seeding time. The application at seeding time is especially important in the establishment of stands on low-potash soils. Topdressing should only be used to supplement this practice where needed. Of course, potassium deficiencies should be corrected on fields with good stands, whether or not potash was applied at seeding time.

Need for Phosphate-potash Combination

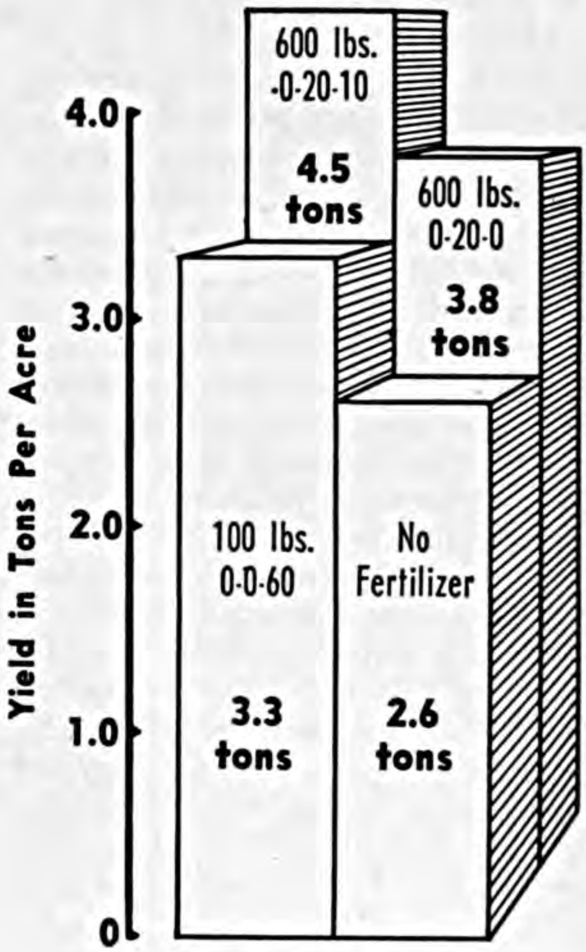
Soils which are deficient in available potash often need additional phosphate as well. In 1950, for example, 19 sites were selected for topdressing experiments where soils were low to very low in available potassium, according to soil tests. Although no attempt was made to include phosphorus-deficient soils in this study, it turned out that 14 of the fields responded to phosphate as well as potash.

There are numerous phosphate-deficient soils, on the other hand, which do not require potash fertilization. This is borne out by summaries of soil-test results on samples submitted by farmers as well as by field experimental results.

With some experiments carried out

on soils deficient in both phosphate and potash, 300 pounds of 0-20-20 per acre appeared to be the most profitable rate for topdressing. On a few soils, such as the Carrington loam in Buchanan County (see chart), a higher rate was very profitable. In other experiments where significant responses to potash of about ¼ ton per acre or less occurred along with appreciable responses to phosphate, it is probable that 300 pounds of 0-20-10 per acre would have given more profitable returns from use of potash. In our experiments, the lowest rate used was 100 pounds of 0-0-60 per acre.

Meadow Response to Phosphate and Potash (Buchanan County)



Carry-over of Phosphate and Potash

Increased hay yields for one year tell only part of the story on what to expect from topdressing with phosphate or potash fertilizers. The carry-over or residual effects will likely turn out to be important, especially with phosphate fertilizers. Some of the results obtained last year on meadows topdressed with 300 pounds of 0-20-0 in 1949 bear this out. In one case the hay increase was 1,200 pounds in 1949 and about the same from residual phosphorus in 1950. In certain experiments, there was no carry-over from the same rate of application.

Carry-over of potash is another question. If a meadow receives more potash than it needs, legume and grass will take up more of this nutrient than is required. Taking off a hay crop removes an excessive amount of potash. If this hay is fed on the farm much of this potash may be returned to the soil in manure.

Time to Topdress

An early spring topdressing (late March or early April) has given good results in Iowa experiments. Usually larger responses to both phosphate and potash have occurred with the first cutting than with subsequent cuttings. In some of the eastern states, good results apparently have been obtained from topdressing potash between the first and second cuttings. Moisture conditions in Iowa often are more favorable before the first hay harvest than in the following months, whereas in eastern United States there is relatively a more uniform seasonal distribution of rainfall. This may account for the differences noted above in response of legumes to potash topdressings.

There's still plenty to be learned about time, method, and frequency of phosphate and potash application. For the present the important thing to remember is this: Use a topdressing if soil tests show a need for phosphate or potash. But don't try to make it a substitute for fertilization at seeding time.

Research Boosts Soy Prospects

IN their efforts to meet production goals for soybeans this season, U. S. farmers will have the benefit of considerable help from scientific research, the U. S. Department of Agriculture points out. The emergency calls for production much higher than in the first years of World War II. But since that time the breeding program has introduced eight new varities. These improved soybeans yield from 10 to 20 per cent more beans than the varieties they have replaced, and the beans supply a higher percentage of oil.

Dr. Martin G. Weiss, in charge of the program in which the U. S. Department of Agriculture is cooperating with the State experiment stations in improving soybean varieties, estimates that the new beans will average an increase of about three bushels an acre over the pre-war varieties. They are also easier to harvest with the combine, because most of them stand up well and do not "lodge" when loaded with the matured beans.

Blackhawk is the latest of the eight to be released, and there was not seed enough this year to supply all the farmers who would have liked to plant it. The other seven have been out long enough so that there are ample supplies of the seed of each to plant the acreage for which each is best adapted. These varieties are named: Hawkeye; Adams; Lincoln; Wabash; Monroe; Ogden; and Roanoke.

Research has also proved the economy of closer planting of soybeans, has worked out fertilizer applications for some areas where deficiencies of certain minor plant nutrients have cut yields, and is now breeding soybeans resistant to some of the diseases that attack the crop. So far, diseases have not been serious on a wide scale.

The breeding program got under way in 1936 and is continuing. Successful research accounts in large measure for the rapid rise in the importance of soybeans as a crop. In the United States it now ranks as fifth in importance.

Upward Trend in Cotton

AMERICAN cotton growers in recent years have been harvesting as much cotton from 160 acres as they did from 270 acres a quarter of a century ago—or as they did in the 1870's—U. S. Department of Agriculture records indicate. This is revealed by the "trend yield" record of cotton. The "trend yield" is one of the interesting and important devices by which the statisticians average out the seasonal effect of weather and get a measure of long time-developments in production of the crop.

The "trend yield" for any given year is the actual average yield per acre for the year averaged with the corresponding figure for the four crops preceeding and the four following. Thus the latest year for which the Bureau of Agricultural Economics has a "trend" figure is 1946. When the 1951 yield is known the "trend yield" for 1947 can be added.

From 1870 to 1917 there was a gradual upward trend, from about 160 pounds an acre to about 175 in 1917. Then came the boll weevil. The trend dipped sharply, and in 1925 had lost the previous gains and was slightly below the 160-pound mark of 1870.

Since 1925 the trend has been sharply upward, and the latest figure (for 1946) registers 271 pounds, an increase in average yield of more than 100 pounds to the acre since 1925. "This steady rise," says the Bureau, "was undoubtedly due to improved varieties of cotton, better production methods, and shifts to cotton arcreage in new areas."

Seek Hard Shell Volunteers

SEEDS with hard shells have generally been regarded as a nuisance, whether the plant was a crop or a weed. But nowadays soil conservation specialists of the U. S. Department of Agriculture are actually searching for harder shelled strains in several plant families. Harder shells would be useful in plants grown for winter ground covers.

As any farmer knows, hardness of the bindweed's shell is one of the reasons this serious weed pest is so hard to eradicate. New plants will keep sprouting for years after old plants have been killed. So it is, also, with useful crop seeds.

Popularity of hard-shelled "reseeding crimson clover" in Southern orchards, pastures, and crop lands is a result of its volunteering. It does reseed. But if it is turned under in spring for green manure before seeds ripen, there is little reseeding. The Caley pea, a winter legume, has some excellent qualities, and is a good reseeder because of its hard shell seeds. If a farmer allows one crop of Caley peas to ripen seed before plowing it under, he has a reserve of reseeding power for another year or two. Seeds lie dormant in summer, some sprout and grow in early fall; and others wait a year or more longer and thus provide continuing and more dependable ground protection. Button clover also has hard seeds and volunteers well.

At their seed nurseries, Soil Conservation Service specialists are alert to the need for better strains of ground cover plants that seed well and are easy to harvest. They are now also watching for strains of clovers, vetches, peas, and other legumes that have a high proportion of hard seeds that make them better reseeders. These could be used in rotations that allow a farmer to plow under a seed crop every few years with the expectation of having volunteer soil savers for the next season or longer.

To improve the initial stand from a seeding of sweetclover, farmers "scarify" the seed so that more plants will germinate promptly instead of lying dormant for a year or more. Likewise, in an original planting of Caley peas, "scarification" may be needed.

In humid areas, a winter ground cover can be a great soil saver when planted after the last cultivation of a row crop—corn, cotton, tobacco. It protects the soil. If plowed under as green manure it improves soil tilth. If the cover crop is a legume, it also supplies some nitrogen and eases the fertilizer bill. And if it reseeds well, the grower is spared the cost and labor of replanting. Hard-shell reseeders are worth watching for.

Productive Balance

RESEARCH on the use of fertilizers and methods of soil management have revealed facts that aid farmers to make specific soils more productive, says P. V. Cardon, Administrator of Agricultural Research in the U. S. Department of Agriculture. Because techniques based on this research have been put to use on many farms throughout the country, productivity is on the come-back in many areas where yields were falling off because of declining soil fertility. On hundreds of thousands of farms in the eastern part of the United States, the soil is much better today, as a result of good management, than it ever was under natural conditions. On the other hand, there are still many farms on which soil productivity is on the down grade. For the Nation generally, he says, we have not yet fully reversed the downward trend.

Know Your Soil . . .

(*From page* 14)

Fig. 5. Corn fodder being returned to the soil to increase organic matter.

produce better than 100 bushels of corn per acre, 40 bushels of wheat, and 70 bushels of barley on this soil. With this production it is possible to add considerable organic matter to the soil if only the grain is removed. Figure 4 shows the corn that produced better than 100 bushels of corn per acre as the result of the use of 300 pounds of a 5-10-10 fertilizer at planting time, 300 pounds of cyanamid immediately after planting, and 300 pounds of ammonium nitrate at the "knee-high" stage with a population of 15,000 stalks per acre. Of course, this crop followed a 15-ton tomato crop which was limed to a pH value better than 6.2 and fertilized with 1,500 pounds of a 5-10-10 fertilizer mixture.

Figure 5 shows the organic matter from the corn crop being returned to the soil. This organic matter is very essential to the Woodstown sandy loam. It increases the number of favorable aerobic micro-organisms, the aeration, and the drainage.

It becomes evident from the experimentation and observations discussed above that the Woodstown sandy loam, if properly managed, can become an important agricultural and vegetable-producing soil. Carefully considered and practical handling, liming, and fertilization of this soil place it in a productive category.

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The Man With the "Know"

(*From page* 5)

those years also in citrus fruit culture and breeding, and the selective way in which different strains of stem rust attack the varieties of wheat.

Then in 1920 the federal plant scientists discovered that length of daylight controls flowering and seed setting in many kinds of plants. Soon thereafter you saw night lights burning in greenhouses at your nearest experiment farm, and thought the professors were crazy to waste so much funds on electric lights. This was the year, too, when soilsmen found a way to study soil profiles as the best way to classify the land's varied types. In 1922 the first agreements were drawn up to link the state and the federal breeders in developing promising inbred lines for hybrid seed corn.

As a plugging writer in that period, it was my stuttering attempts to learn about crossed corn that brought the early work of breeders in a leading Midwest state more clearly before the farmers. Gone would be all our old ideas about curing seed corn on the farm from plump, well-filled ears, imitating the best-formed ones we saw at the winter shows. That line of herculanian research from meager and misunderstood beginnings — fraught with complex genetic rules—has probably achieved the greatest single agrarian revolution in our time. It has made men rich on farms and given the "cloistered breeders" secret joy and pride of personal achievement in being able to help their day and age for a program of peace and plenty.

One might go on at tiresome length reciting all the forward steps taken in research projects, but wearying readers is bad medicine for selling any kind of proposition. It's enough to observe that even during the past two years such innovations as methods for preparation of radioactive phosphates have been launched and the tracer techniques improved. There has been cooperative work in propagating better foundation stocks of grasses and legumes, and a hybrid strain of guayule originated with nearly 50 per cent more rubber content.

Most fascinating of the wonders wrought by plant chemists and others are the new uses perfected for old denizens of our plant world. It is in this realm, bounded on one side by training and skill and on the other by lofty imagination and resolve, that race and creed and color vanish—and all men meet as equals for their own salvation.

Here is the field where that noted black man, George Washington Carver, contributed with such industry and zeal. He was the first research director at Tuskegee Institute, and the laboratories under his command fashioned an amazing list of useful things from Alabama clay, peanuts, sweet potatoes, and cotton. Congress has finally deposited requisite funds to set up a memorial monument to Carver's work. As an infant, he was kidnapped during a raid incidental to the war of 1860-65, but after a long period of silence, he emerged with two academic degrees at Iowa State College, and soon pressed on to become a foremost rescuer of his land from a tedious and pauperizing one-crop agriculture.

Moreover, a life such as his has inspired many more of his race to uplift their ambitions and train themselves to work unceasingly for the common good. It has also taught boys and girls of all races that America still affords a great opportunity to those with foresight, industry, and imagination—always and forever *imagination*. The imagination of the scientist exceeds in its final contribution to humanity all the flights of fancy and of plot which grace the talents of the novelist and the poet.

IN the transformation of the fibers and proteins and acids of plants and their residues into some new commodity of value, corn may head the list for all we know. It represents one of the older examples of these magical tricks of legerdemain—but it is not by any means the most outstanding. Usually these new uses emerge whenever a product gets so common and abundant that growers find their outlets blocked or limited. So we can turn to citrus groves for another sample of what's been going on in offering the public something made from overly abundant plant life.

From Clyde Beale of the Florida Agricultural Extension Service comes a brief tale of a mighty piece of salvage work. He says that when the orange is served fresh, the peelings and the "rag" are wasted. But when the modern processing plant handles the orange crop, the first simple steps provide us with candied peel, marmalade, cattle feed, juice for beverages, sliced sections for canning, powdered and frozen concentrates, an oil for use in soaps and perfumes, and orange wine. However, this is just getting the process steamed up, as it were. More magic is forthcoming when chemists really try to unlock and divide and stew up this fruit for what it's worth. Oranges and other citrus products are now able to give us methane fuel gas, citric acid, vitamin C or ascorbic acid, flavoring oils, feed molasses, dry pulp for vitamin P, pectin, naringin—a medicinal and beverage element—candy, pectin-albedo for colitis sufferers, seed cake for cattle, and hulls for both feed and fertilizer. This just trots out the tricks for one product only in the vast scale of the plant drama now unfolding.

Some such alleviating transformations are in the making, too, for countless other specialized farm industries. Along with them also go the studies made under the Research and Marketing Act of 1946, to relieve and improve and refine many purely commercial, manual, and economic movements related to the complex field of processing and selling.

Now all these successful programs in the agricultural and livestock realms were made originally, and for a long time singly, by researchers trained and employed at public expense. There is no doubt whatever about the origin and the stimulus involved. It was started and kept alive by legislatures and Congress, at the suggestion of college and university men whose achievements were so startling and valuable that even the skeptics were "sold." Slowly, and then at a faster clip, we saw wealthy and businesslike corporations with farm interests begin to set up private laboratories. They could do much of that kind of investigating without standing in the glare of public payroll scrutiny. They wanted to do it also for their own financial security.

From this initial urge it was only a step to the more recent building of powerful foundations. These are of at least two kinds — the quasi-public ones set up by alumni and their allies at larger colleges, and the trusts and foundations in memory of noted industrialists. Here then we behold a surge of mental volleys fired at the same targets as the experiment stations aimed at with considerable "haggling" over appropriations. Now comes a new idea besides. A Southern state has set a date next November in which their farmers are invited to vote on the taxing of small sums on the tonnage sales of fertilizer, and using the income for soil research. To cause farmers to willingly accept some of the financial responsibility for carrying on basic research seems to be logical. But less than 20 years ago any such idea would have entitled the one who hatched it to spend his last days in the dog-house.

Yes, farmers of this day and age are a different "breed of cats" in matters of science applied to humdrum tasks. They do not claim to know what it all means. They can't usually talk the lingo clearly. Yet they have found that brains count as much as the weather in making or marring a season's effort.

Bear in mind, that in the immediately preceding thought I did not mean that the younger generation could not speak and understand the language of the test tube and the microscope. I referred to their elders. As it stands now I never try to converse very deeply with the modern youth of farm origin over the intricate terms and aims of plant science. Like all smart alecs with some false pride, I know when to refrain and not get tangled up in technique. All I do is grin and nod and applaud and exclaim that the "good old world do move indeed."

So when I go afield again to peer around in hopes of discovering a man with the hoe, bent over some weary chore, my search is unrewarded. Even in the old, weed-infested, hard-pan, brush-covered zones of my youth there are hoe-wielding gentry no more.

I find them still in suburban garden patches, it's true, and I presume they do exist on southern hillsides of remote location. Yet in the garden plots of urban striving, the hoe is not the sacred, single, and indispensable tool it once became. Palm callouses from grasping hoe handles are not so generally used in proof of outdoor aboreal craftsmanship. Our happy garden delvers have seen the wonders of the new universe of plant coaxing and soil renewal. Their stocks of DDT, lindane, toxaphene and chlordane, 2, 4-D, and kindred accoutrements are making them partners with the progress of the farm. Maybe this makes them aware that farming is expensive and meticulous and skillful. Maybe the consumers thus fortified with personal experience in buying garden supplies will realize that farm work is a science, and a close kin to scientific procedure. Maybe this will help undue a lot of spoiled bolony which newspapers and magazines have been serving to city readers.

At any rate, I am foolishly happy as the elder years draw nigh because I have been spared to behold the new day in agriculture. If destiny decrees that farmers must be commercial and businesslike to succeed, instead of being hawk-hunting hermits, I am for giving them all the new tools and methods necessary. I don't want my three grandchildren to suffer either from underfed bellies or prejudiced ideas about agriculture.

If they are to get the right food in proper variety and quality, I expect them to appreciate what it costs to serve them well and why. And above all, they will find out that research and improvement all through the farming business will cut the loss and overhead as far as the production goes. What happens in the market place and among the middlemen is another line of investigation entirely. We can only hope that science will get around to that job soon.

Clerk to young man buying perfume: "Now here's one called 'Perhaps.' It's $35 an ounce."

"Thirty-five dollars!" exclaimed the young man. "For $35 I don't want 'perhaps,' I want 'sure.' "

* * *

"My boy," said the successful man lecturing his son on the importance of thrift, "when I was your age I carried water for a gang of bricklayers."

"I'm proud of you, father," answered the boy. "If it hadn't been for your pluck and perseverance, I might have had to do something of that sort myself."

* * *

A girl applied for a job as a stenographer and they gave her a test in spelling.

"How do you spell Mississippi?" she was asked.

"The river or the state?"

* * *

Yes, life begins at forty. Also arthritis, stomach ulcers, bifocals, bellyache, gall bladder, colic, hay fever, toothache, and an inclination to talk continuously about the good old days.

* * *

A six-year-old was getting ready for his first day of school, and his mother was very sad at the thought of her baby growing up and leaving her every day.

As they drove toward the school, the child turned to his mother consolingly. "Don't take it so hard, Mom. Just as soon as I learn to read the comics by myself, I'll quit."

Mandy was in the hospital having a baby. She kept screaming and screaming. Finally a doctor came up to her and said, "Mandy, there is no need to scream so loud—if you would concentrate more you wouldn't scream so much." She paid no attention to the doctor and kept right on screaming. Suddenly she stopped.

Mandy—"Is Jasper still downstairs?"

Doctor—"Yes, he is downstairs pacing the floor."

Mandy—"Well, you go right down and tell him that if this is a sample of married life—I don't even want to be engaged."

* * *

The shapely co-ed's sweater was much too tight, and the rest of her debate was drowned out by loud laughter when she stood before the class and started off with: "Now there are just two interesting points I'd like to bring out."

* * *

A mother was instructing her young son in table manners just before he was to leave for a party at the home of one of his little friends.

Mother—"Now, Junior, if you're offered a second piece of cake, be a little gentleman and refuse, just as nicely as your father does."

When the boy returned home after the party, his mother asked:

Mother—"Did you refuse the second piece of cake, as I told you to?"

Junior—"Sure, mother, just like father does. I said: 'Take the damned stuff out of my sight!' "

Better Crops with Plant Food

October 1951 10 Cents

The Pocket Book of Agriculture

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXV NO. 8

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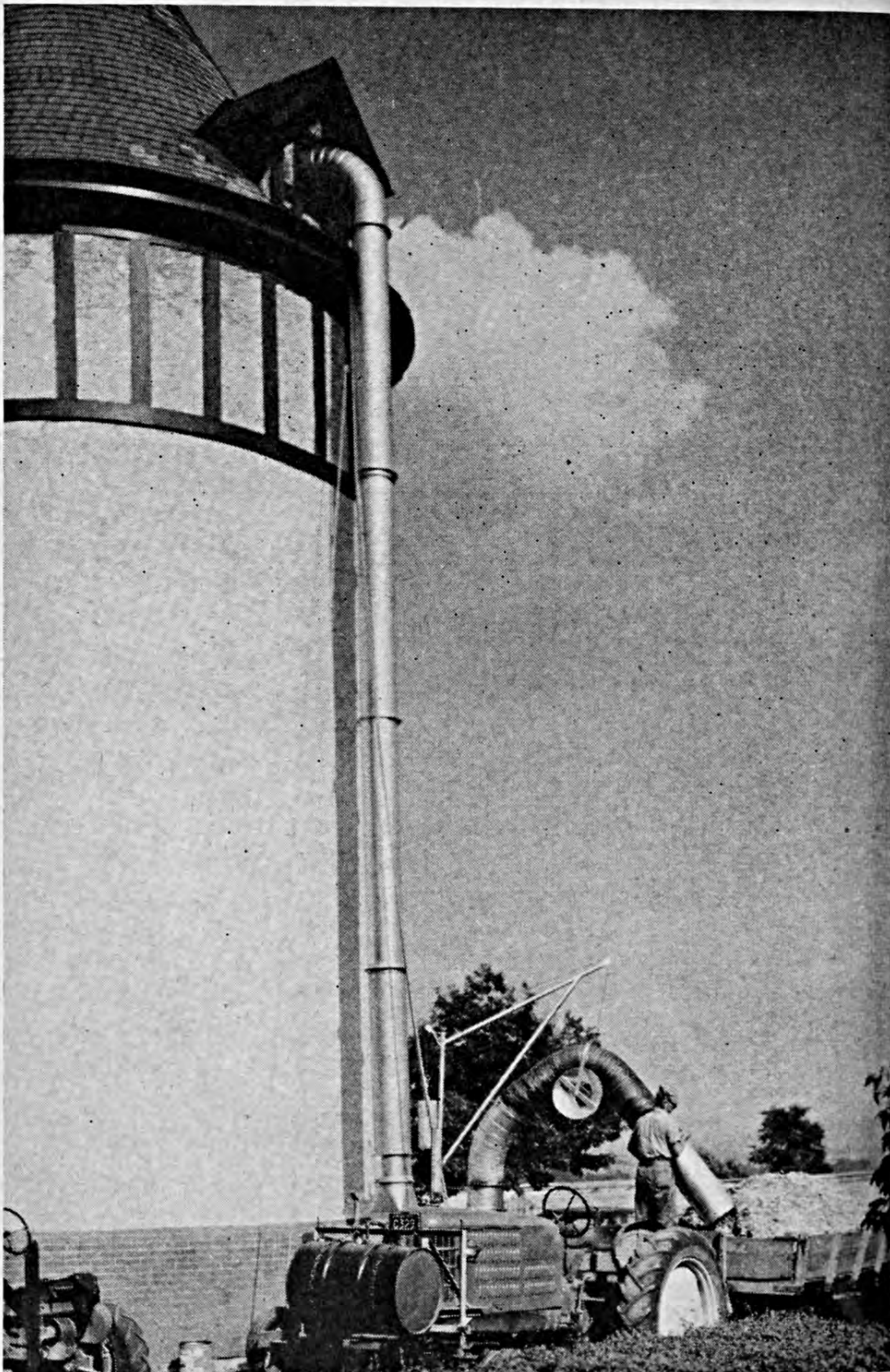

Shooting High!

Better Crops with PLANT FOOD

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Vol. XXXV WASHINGTON, D. C., OCTOBER 1951 No. 8

Time Has Improved . . .

Tillers and Tellers

Jeff McDermid

IT was once an old-fashioned idea that bankers and farmers were as hard to bring together in harmony as fire and water or weeds and crops—or in a modern metaphor—north and south Korea. Even though a cow might be grazing in the bank's front lawn and you could see the smoke of threshing engines from the cashier's window, the ties of a common bucolic background did not always unite the tiller and the teller.

It was along in those ancient times that some of the cooperative production credit systems took root and the National Farm Loan Associations were launched with initial Government capital. There were inherent stubborness and prejudice on both sides. The fact that many country bankers laid the cornerstones of their enterprises on successful farm operations of their own did not signify that they were eager to take any kind of collateral or grant any length of life or easy interest rates to all their country customers.

Quite the contrary in all practical counts! For if one is a top-notch expert in a complex industrial field he is the first one to scan the financial horizon for hazards, or find risks inherent to the business—considerably more so when old Dame Nature sits in as an unpredictable partner. This is not to say that rare discrimination was not often made, and that the banker usually placed reliance on his hunch in regard to what really amounted to "character" loans. But, of course, his ledgers reminded him not to get sentimental when cents were concerned, because the best and most honest characters were as much in the pathway of unforseen depressions and droughts as the loosest and the laziest of his importunate borrowers.

MY own kid recollections of a country bank stem to the period prior to marble floors, walnut and mahogany trims, murals of local scenery on frescoed walls, heavy steel vaults, gold-lettered desk names, and a beauteous damsel deftly sorting lucre with lacquered fingernails. Our bank was in a frame shack with a high "false front," its plain interior resembling the postoffice, with a small room at the rear where they put the client through the wringer before hanging him up on the best line of credit he deserved.

Financial life was simple—maybe too simple, then. Farmers needed much less credit for much fewer costly equipments and materials. A youth could inherit or rent a farm and eke along with a team or two, a few common cows and hogs, a little set of machinery, some harness and axle grease to match his faded overalls and elbow grease—and go to it. There were no Joneses to keep up with, and checkbooks were as scarce as account books. You can consult those famous New York State records kept on the operating costs of a group of farms in relation to net income and investment and see what a load the land tiller assumes under modern, high-pressure agriculture. This brings the tiller more often to see the teller, and if you remark that financial life is burdensome, their answer is: "You're telling me?"

Back in the 1900-1910 decade there were not so many lending agencies open to the farmer seeking a real estate mortgage. At that time the total mortgage debt farmers were carrying was about $3 billion dollars and the interest charges were close to 23 cents an acre for all land in farms, based on the existing debt, whether mortgaged or not. The land boom had not started. Life insurance companies had but small investments in farm mortgages. Federal credit agencies were not yet in business. So the other main taker of farm paper was the individual looking for a safe place to hatch out his nestegg.

From 1930 on through 1945, federal land banks came into being and caught up fast, so that they had from $1 to $2 billions outstanding in mortgages. Along with this rush of new business in the federal banks, the life insurance concerns toted a heavier load through these decades up through 1945. Their totals hit $2 billion one year and ran an average of $1 billion right along. Only once, in 1920, did the private banking system carry as much as $1 billion in farm paper. It ran close to half a billion dollars until 1947. Thereafter the insured commercial banks began to build up their farm business slowly until the records indicate they held almost a billion dollars of such security in 1951.

STILL the individual and the "miscellaneous" lender occupy the top spot in our present farm mortgage field. Life insurance companies rank second. Today the insured and uninsured banks together own more farm mortgages than the federal land banks. The subsidiary, the Federal Farm Mortgage Corporation, built up its volume steadily from 1935 on through 1940 and then slackened. Authority to make new loans by the FFMC expired by law in July 1947. The U. S. Treasury has been repaid all it ever advanced for this mortgage deal, with many millions more as profits.

Farm mortgage debt has been rising, but its present $5.8 billions is a good long ways from the tip level of $7 to $9 billions chalked up on the records during those corn-burning, moratorium nightmares of the big depression period. In general, the existing farm mortgage debt is believed to be about 55 per cent of the highest peak of history—that of January 1923. But not all states boast as relatively low farm mortgage debt as that, the ones nudging the old record closer being New Hampshire, Rhode Island, New Jersey, Delaware, the Virginias, North Carolina, Florida, Tennessee, Alabama, Louisiana, and New Mexico.

No good reason is given as to why this situation varies as it does by states and regions. It can't be shown that the states named have greater changes in land values or a greater number of farm transfers.

Forced sales of farms do not enter the picture much yet and may not do

so while the keen demand for farm products rules the economy. Voluntary sales have risen about 6 per cent or more in the past year. Values quoted for farm real estate give some inkling to the real reason for higher mortgage debt. Such values advanced 15 per cent or more as a national average during 1950-51. About 65 per cent of the farm sales were financed in whole or in part with credit. This is a trifle higher than the average in the post-war years.

More inflated acre values are bound to come as long as the era we are in continues in its tempo and turmoil. This raises many knotty questions that the banker and the farmer must face, and for which they must find some kind of reasonable answers. The heavy capital requirements of farming today, its enormous risk, and the net income with which to pay loans are going the rounds of debate, carrying with them the most perplexing of all questions for the future—how can a capable young person get into farming as an owner, and how long can he stay there after he gets there?

ASIDE from the full realization that to succeed on this margin and meet this stiffer hazard calls for a high degree of education and experience, we have another morsel to chew upon. How soon are we going to invent and use a new kind of mortgage credit, maybe one that will not require the farmer to ever pay off his debt in full; but the mortgage will run for 99 years, with perhaps a suitable amortization plan of funding principal and interest regularly. What are we going to drift into, or be swept into, in case the rapid flood of inflation destroys all those familiar financial high-water marks of vanished days? This is a gnawing conundrum for the banker to ponder, and if somebody starts the change and sets the pace, he and all the biggest farm land investors must keep step or find better places to invest. And we doubt if there is anything supported by a surer demand than agriculture, which is underwritten by the alimentary canal. (I also call that "elementary.")

Of course, this doesn't always mean that inflation is one-sided. The gross and net incomes have risen also with the general advance in farm prices. Likewise the ability to produce more per unit of manpower as well as per acre is made possible by the greater investment farmers have in the modern things. So if there are no terrific weather reverses or sudden depressions, this larger volume of goods for sale by farmers gives them a larger gross income from which to meet overhead. Naturally, the shrewd money-lender

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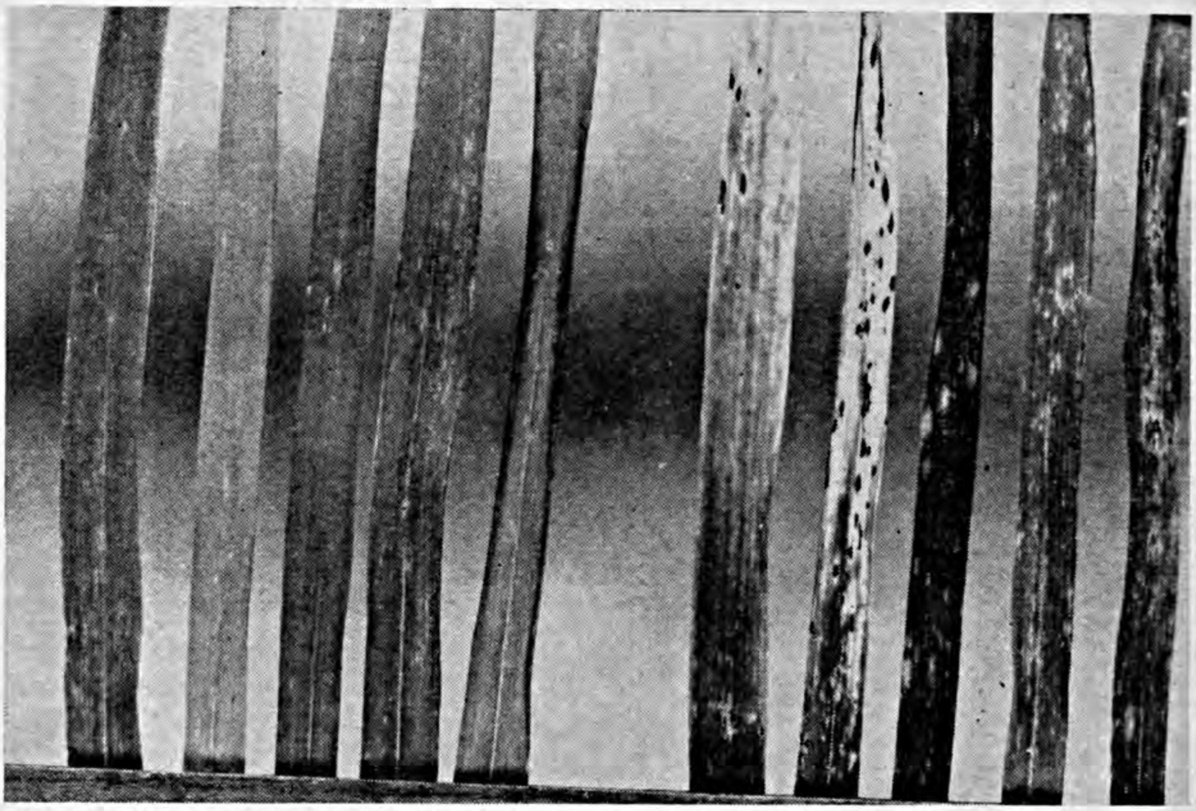

Fig. 1. Healthy wheat plants (left) on land fertilized with potash resisted infection by mildew. Severe infection (right) occurred on land that received no potash.

HEALTHY PLANTS Must Be Well Nourished

By C. M. Woodruff

Department of Soils, University of Missouri, Columbia, Missouri

PLANT diseases are commonly associated with some microbe or insect that attacks the plant. In the "fight" on these enemies, the diseased or infected plants are often sprayed or dusted with a compound which is lethal to the organism but can be tolerated by the plant. A currently hopeful approach to the control of plant diseases is looking to the breeding of disease-resistant varieties. Little by little, evidence and experience are accumulating to suggest that some of the plant diseases may be the sequel to the deficient mineral nutrition of the plant.

Organic materials that grow in nature are attacked and decomposed by a host of organisms as soon as life wanes or ceases to exist. Single cells or tissues in the growing plant which weaken or die through certain nutritional deficiencies provide ready seats of infection for plant diseases.

The essential nutrient elements which a plant absorbs from the soil either enter into combinations with other elements to form physiological or anatomical parts of the plant or they function in physiological processes as ions, catalytic agents, enzyme activators, and so forth. A single element may play a number of different roles. Of the three major plant elements, nitrogen, phosphorus, and potassium, the nitrogen and phosphorus enter definitely into combinations with other elements to form compounds which are a part of the anatomical structure and physiological activities of the plant. Both of these elements are essential in the processes of cell multiplication and reproduction. They form integral parts of the protein molecule. Potassium, in contrast, is an element which exists primarily as a diffusible ion in the plant. Little is known about the tendency of alkali metals to form undissociated chemical compounds. However, the role of potassium in the physical biochemistry of proteins is well established.

Translocation of Elements

If the supply of available phosphorus or nitrogen in the soil is exhausted, growth of the plants either stops or continues through the dissolution and translocation of these elements from the lower leaves of the plant toward the growing tops or the reproductive organs. Plant tissue that is weakened or dead through deficiencies of nitrogen and phosphorus is not such a fertile site for disease organisms. They also require nitrogen and phosphorus for their own growth and reproduction. The "fired" leaves of corn will hang bright and yellow until worked into the soil. Even here decomposition of such buried organic matter worked into the soil is slow, if extra nitrogen is not available. Cornstalks plowed under for wheat in the fall have been turned up apparently undecomposed the following year in preparing for the second wheat crop. But cornstalks well supplied with nitrogen begin to mold and decompose while standing in the field following their maturity.

The role of potassium in the plant is a regulatory one. Potassium is essential to the physiology of the plant, but is not a part of the plant anatomy. In this respect its function resembles that of certain of the minor elements. It is in this group of the plant nutrients that the potential health of the crop resides. Inadequate nitrogen and phosphorus represent plant starvation in the same sense that an animal is short of feed to build its body. Inadequate potassium represents sick and dying tissue because of a disturbed physiology. The condition of a potassium-deficient plant is analogous to the condition of an animal that lacks salt. The sodium of the salt does not combine to form an essential compound in the anatomy of the animal but its importance in the physiology of the circulatory system is undisputed. A deficiency of potassium in the plant disturbs the reactions of synthesis, translocation, and metabolism whereby the products of the leaves feed the growing and metabolizing cells of the root and top of the plant.

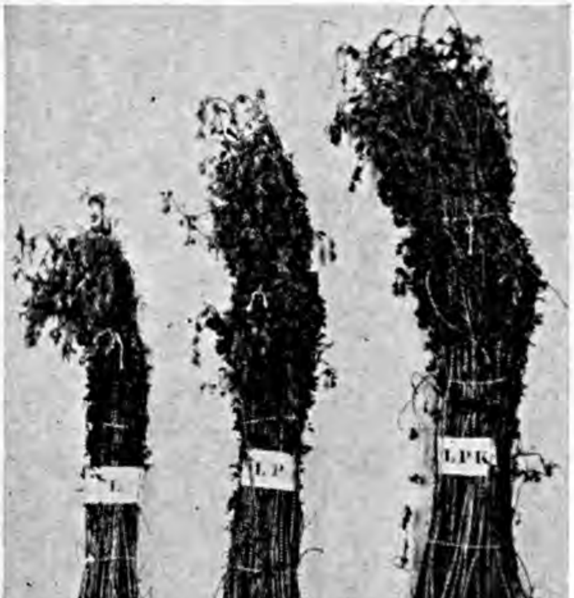

Fig. 2. Sweet clover grown without the benefit of potash fertilizer (left) suffered not only in total growth but also in its susceptibility to root rot. The decomposing taproots were pulled up easily. But where potash and phosphorus were used in combination (right), the roots could be removed only with a spade. Phosphorus without potash (center) was helpful but inadequate.

Sources for Infection

The dying leaf tissue of a potassium-deficient plant provides a ready source for infection by microorganisms. The cells contain the nitrogen and phosphorus necessary for the reproduction of the organism along with the carbohydrates needed for metabolism and energy. Wheat growing in plots on Sanborn Field that received no potash was attacked by mildew (Figure 1). This produced prominent black spots on the leaves in the advanced stages of the attack. A count of the infected areas on the leaves of the unfertilized wheat showed an average of 17½ colonies per plant whereas wheat fertilized with potassium was infected to the extent of only 2½ colonies per plant.

Plant roots, although they are in direct contact with the potassium supply of the soil, are dependent upon the synthesis and translocation of material from above-ground parts of the plant. Roots which are weakened through a disturbed physiology of the above-ground parts of the plant brought on by a potassium deficiency are readily susceptible to infection. Root rot of sweet clover was shown by Albrecht and Klemme* to be associated with inadequate fertilization with potash (Figure 2). Root rot and lodging of corn have also been traced to deficiencies of this nutrient.

The grain of a plant represents an accumulation of products synthesized in the leaves. Deficiencies of potassium in the soil lead to a disturbance of the physiology of the plant which prevents the filling of the kernels of grain. Potassium-deficient corn produces ears with unfilled tips that protrude through the end of the husk (Figure 3). These protruding tips are sources of infection for diseases and ear-worms. They also provide easy entrance for rain-water that trapped in the husk causes the corn to rot.

*Albrecht, W. A., and Klemme, A. W.—Root Rot of Sweet Clover Reduced by Soil Fertility. Better Crops with Plant Food, February 1948.

There are other visible effects of a potassium deficiency in addition to the infection, by disease organisms. Weakened straw in small grain and weakened stalks in corn were correlated with potassium-deficient soils in early studies with lime and sweet clover at the Missouri Agricultural Experiment Station. Similar results have been obtained more recently where heavy amounts of nitrogen and phosphorus fertilizers were applied to a soil that was moderately low in potassium according to the soil test (Figure 4). In the latter study, a count of the cornstalks down at harvest time showed 67 per cent of them broken over as the result of either weakened stalks or root rot. The sensitivity of a corn plant to potash treatments was noted in the early stages of maturity. Where the soil was treated with muriate of potash at 200 pounds per acre, the shank that supports the ear was broken over on all stalks, whereas with 600 pounds per acre, 90 per cent of the ears remained erect until harvest.

The Delivery of Potassium by the Soil

The first problems with potassium on the fertility plots of the Missouri Agricultural Experiment Station appeared when lime and sweet clover were introduced in 1923. Phenomenal increases in yields of corn were obtained following the sweet clover for the first few years of the study. Thereafter, the yields declined and severe lodging of the corn occurred. A complete analysis of the cornstalks after a soil-treatment period of 10 years showed a potassium concentration of 1.5 per cent in the stalks from the untreated check plot, 1.0 per cent in the stalks from the manured plot, and 0.2 per cent in the stalks from the plot that had been limed in order to grow sweet clover as a green manure for the corn. All crop residues had been removed

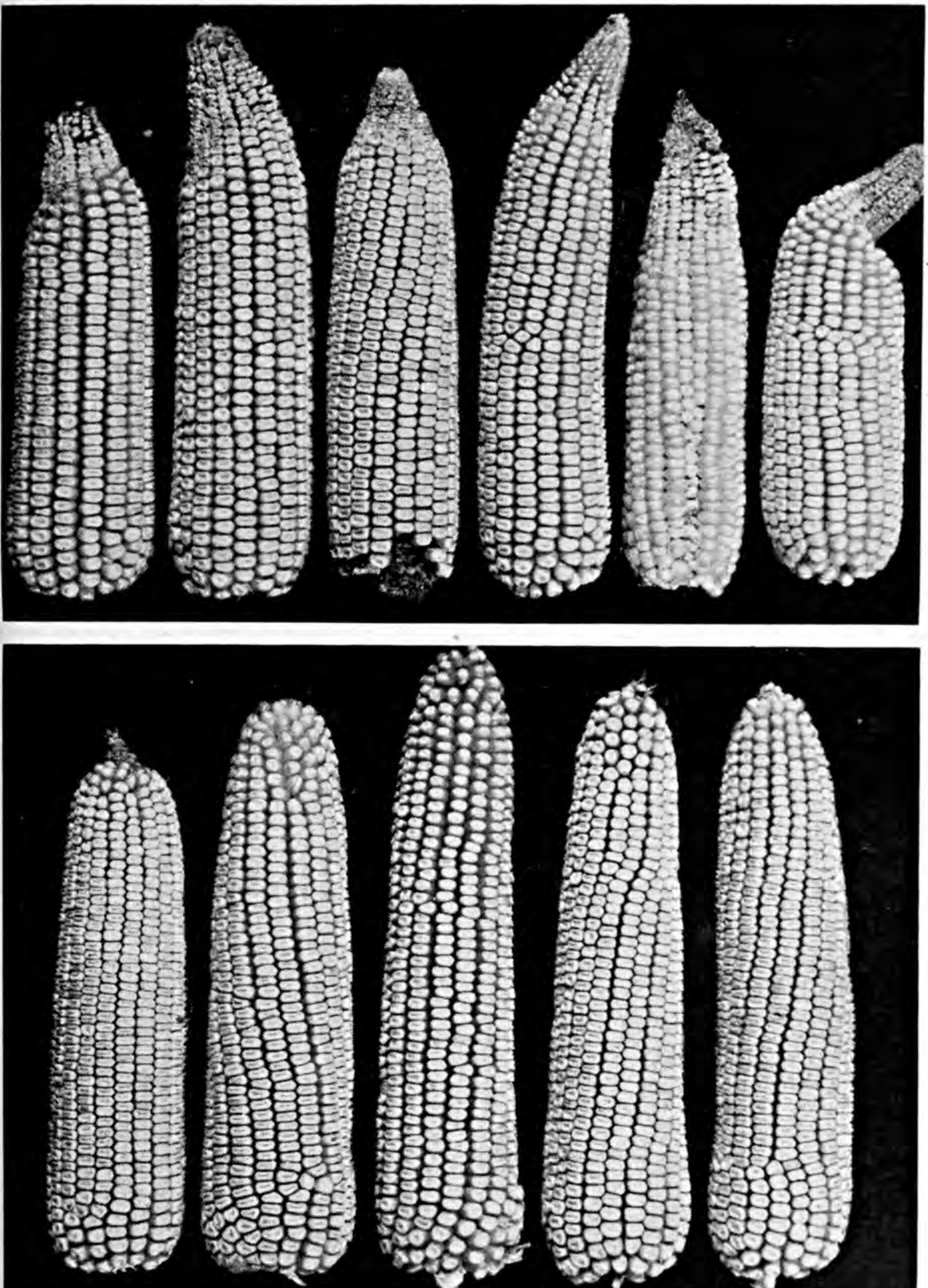

Fig. 3. Potassium-deficient corn (above) produces unfilled ears that often protrude through the husk where they are attacked by ear worms or rot because of water that enters the husk before harvest. Corn fertilized with potash (below) produced well-filled ears.

during the preceding 10 years and no fertilizer had been added.

In order to study this question in greater detail, a complete set of new fertility plots was established in 1936. These plots included comparisons of a number of different crop rotations. Each crop rotation had as its variables,

Fig. 4. Corn root rot and weak stalks caused by a deficiency of potassium. The soil which was low in potassium, according to soil tests, was fertilized with 300 pounds per acre of ammonium nitrate and 500 pounds per acre of superphosphate, but no potash was added. The available potash supplies of the soil are depleted rapidly when production is stepped up through the use of fertilizers that do not include potash.

the soil treatments of lime, lime and phosphorus, and lime, phosphorus, and potash.

The effects of the fertilization with potash appeared of little significance during the first 10 years of the study. In recent years, the crops that were planted without potash fertilizers in the rotations where large amounts of forage were removed from the land annually have developed severe potassium deficiencies (Figure 5). Large yields of grain induced through the use of nitrogen fertilizers have brought about a rapid depletion of the available potash reserves of the soil. Small grain and lespedeza when utilized as pasture have not reduced the available potash level of the soil over a 10-year period of study. But when the grain, including the straw, was removed and only the lespedeza was pastured, then the level of available potash was reduced to half of its original amount over the 10-year period of the study.

These results emphasize the importance of returning crop residues to the soil as a means of maintaining a balance between the delivery of potassium by the weathering minerals of the soil and the removal of it by crops. The results also emphasize the impossibility of knowing whether or not the level of available potassium in the soil is being maintained under a specific cropping system without the use of soil testing as a guide. The indiscriminate use of potash fertilizers, although it will insure adequate supplies of potassium for the plant, fails to take advantage of the delivery of potassium by the soil which in most instances contains abundant amounts of unavailable potassium.

The demands of strong healthy plants are not confined to potassium alone. Lime, phosphorus, and nitrogen each play their part and must be supplied.

Even the less familiar minor elements cannot be neglected as improved practices are extended to the less fertile soils. But wherever crops are grown, well-nourished plants are healthy plants. They are their own line of defense against many of the problems that beset the producer of poorly nourished crops.

The benefits of a well-balanced and adequate supply of plant food extend well beyond the results as measured in terms of higher yields. These include resistance to disease, stronger stalks, and well-filled ears. Well-nourished, healthy crops grow up and root down so that the low-growing weeds and wild grasses perish in the struggle for light and water (Figures 5 and 6). The protection afforded the land by a healthy, vigorous crop eliminates erosion, which is nothing more than a symptom of depleted fertility. The philosophy of well-nourished plants is summed up well in the sage advice that a farmer offered his neighbor who was complaining about a den of muskrats that had destroyed a small field of corn. "Bill, why don't you fertilize that land, then you won't miss the corn those muskrats eat?"

Fig. 5. Large yields of crops made possible through the use of lime and phosphorus over the past decade are not limited by potassium. Potash fertilizer provides the element needed to enable the soybeans to outgrow the crabgrass which could not be removed because of wet weather.

Fig. 6. Healthy crops are the rule rather than the exception if plants are well nourished. "Wet sickness" of corn is usually traceable to deficiencies of nitrogen and potassium. The wet weather of June and July that produced the floods of 1951 also produced good corn on plots where potassium was supplied as a fertilizer.

Producing Small Grain More Efficiently

By W. H. Rankin

Agronomy Department, North Carolina State College of Agriculture, Raleigh, North Carolina

RESEARCH and development precede quantity production of the most wanted and profitable products. When a superior article reaches the market, the less desirable and usually older competitive ones are superseded by its better qualities and characteristics. Likewise, small grain research is developing strains of wheat, oats, and barley, with more disease resistance, more tolerance to freezing temperatures, and stiffer straw that resists lodging, which are taking the place of older strains. All of these characteristics contribute to higher yields and more efficient production.

With better automobiles have come better highways on which to use them. So with better small grains, there is a need for better cultural practices for them to perform most efficiently. Herein are potentialities for doubling the per-acre yields of small grains.

Proved by Experiments

Experimental work has proved that yields more than double the average are easily attainable on fields and farms throughout the small-grain-producing area of North Carolina. For 15 consecutive years in field-scale production at the Piedmont Experiment Station, Statesville, N. C., the average yield of wheat has been 31 bushels per acre, barley 35 bushels, and oats 63 bushels. These may be compared to the State averages of 15 bushels of wheat, 24 bushels of barley, and 28 bushels of oats for the same period.

At this Station in 1949, a season classified as unfavorable for small grains, yields of 35 bushels of wheat per acre, 66 bushels of barley, and 80 bushels of oats were grown. These yields were produced on a soil like thousands of acres of other red uplands of the Piedmont plateau.

The principal causes of low and unprofitable yields of small-grain crops have been determined for North Carolina conditions. Means for correcting the causes and overcoming the deficiencies are available from research on 60 or more fields during the past eight years.

There are five major factors affecting small-grain yields: Seedbed preparation; quality and character of seed; seeding date; soil fertility and fertilizer practices used at seeding; and the available nitrogen supply during the period of maximum growth March, April, and early May. If any one of these factors is limiting, then conditions with respect to all others fail to result in high yields. Yields can be increased only if all conditions are near optimum.

Table I.—A Comparison of Good and Poor Practices on Yields of Wheat and Oats.

	Good practices	Poor practices	Increase due to good combination
Wheat....	31 bu.	12 bu.	19 bu.
Oats......	63 bu.	23 bu.	40 bu.

Fig. 1. Date of seeding influences yield of wheat and oats.

Above	left:	Wheat	seeded	Oct. 20	Yield	42	bus. per acre
	right:	"	"	Nov. 20	"	13	" " "
Below	left:	Oats	"	Oct. 1	"	65	" " "
	right:	"	"	Nov. 20	"	28	" " "

A number of demonstrations have been conducted comparing an unfavorable combination of practices, similar to that used by many farmers, with a favorable set of conditions like that recommended by the Experiment Station and Extension Service. These demonstrations produced further proof that average yields of wheat, oats, and barley can be more than doubled. Higher yields per acre usually reflect themselves in a lowered cost per bushel.

Small grains are members of the grass family and as such respond to liberal supplies of nitrogen. On a depleted upland soil that only produced 8 bushels of wheat per acre when fertilized at seeding, a yield of 29 bushels was harvested where adequate nitrogen was supplied. Nitrogen may be obtained either through such legumes as red clover, sweet clover, and exceptionally heavy crops of lespedeza or by purchasing it in commercial forms.

The use of more seed or more fertilizer will not overcome late seeding. Neither will seeding on time overcome the deficiency in fertilizer or a lack of nitrogen.

When seedbeds are well prepared, high-yielding superior performing varieties are used, seeding is done at the optimum time, fertilizer is used according to soil conditions and crop history, and a supply of nitrogen is provided for the plant to use during the period of maximum growth, higher and more efficient yields will be produced.

Fig. 1. Tall Telephone peas growing on muck near Puyallup, Washington. Good soil, good climate, grower know-how, plus 1,200 pounds of 3-10-10 per acre, produced this fine crop.

Fertilizers for Vegetable Crops—Rates, Placement, and Ratios

By Karl Baur, F. T. Tremblay, and George Wickstrom *

WESTERN Washington farmers have supplied fresh vegetables for local and distant markets for many years. The development of the canning industry in the late twenties and the quick freeze industry in the thirties greatly enlarged the outlet. To-day, the production of vegetables for processing is an important part of the agriculture of western Washington. It is a growing industry and a good business that adds much to the stability of the agriculture of the area.

* Director of Research, Pacific Supply Cooperative, Portland, Oregon; Assistant Soil Scientist, Western Washington Experiment Station, Puyallup, Washington; Agronomist, American Potash Institute, Sumner, Washington respectively.

Growers and processors alike are well aware of the fact that top quality in the finished product must be maintained, if the products of the Northwest are to hold and gain markets. Fortunately for the area and those concerned, a combination of soil and climatic factors plus the "know-how" of growers and processors make it possible to supply high-quality products to buyers throughout the country. The bright green frozen peas from the Northwest find a ready market. No area packs a more attractive green bean than the famous Blue Lake variety that reaches its perfection in western Oregon and western Washington.

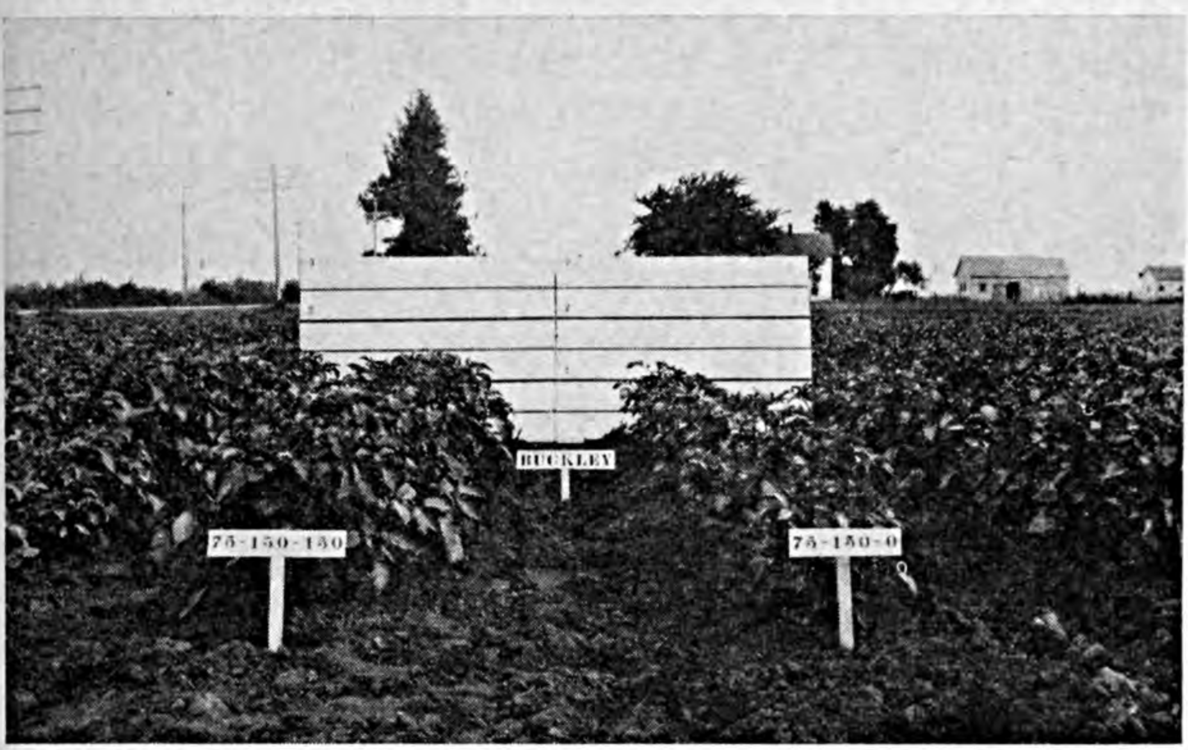

Fig. 2. The plot on the left received 750 pounds of 10-20-20 per acre, and the plot on the right, 750 pounds of 10-20-0, near Buckley, Washington. The response to potash is shown by the differences in growth.

The cool weather which prevails during sweet corn harvest is a real aid in packing high-quality corn. Lots of natural sugar makes sweet corn sweet. The speed of conversion of the sugar in sweet corn into starch is determined largely by the temperatures which prevail between the time the corn is harvested and the time it is processed. The higher the temperature, the more rapidly does this undesirable change occur. The higher the temperature, the shorter the period in which the corn is at prime maturity.

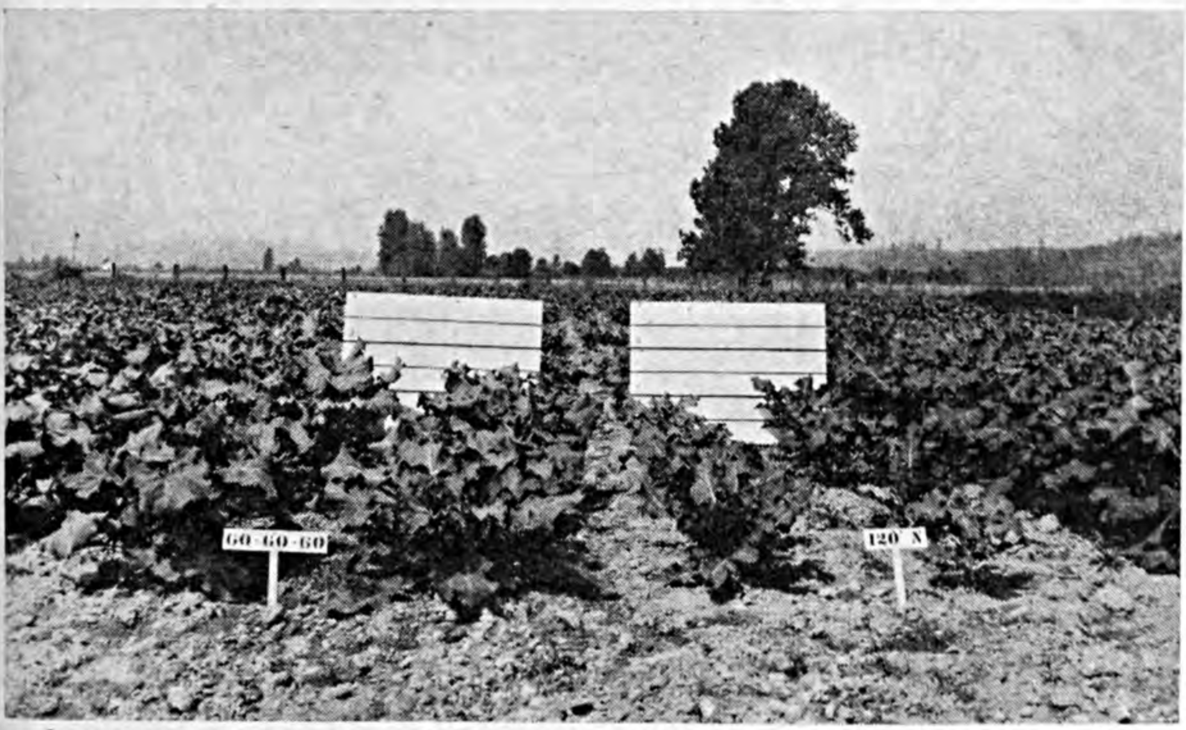

Fig. 3. Nitrogen alone was not enough for good growth of broccoli in this field near Puyallup. The plot on the left received 600 pounds of 10-10-10 per acre, the plot on the right 120 pounds of actual nitrogen and 6 sacks of ammonium sulphate per acre.

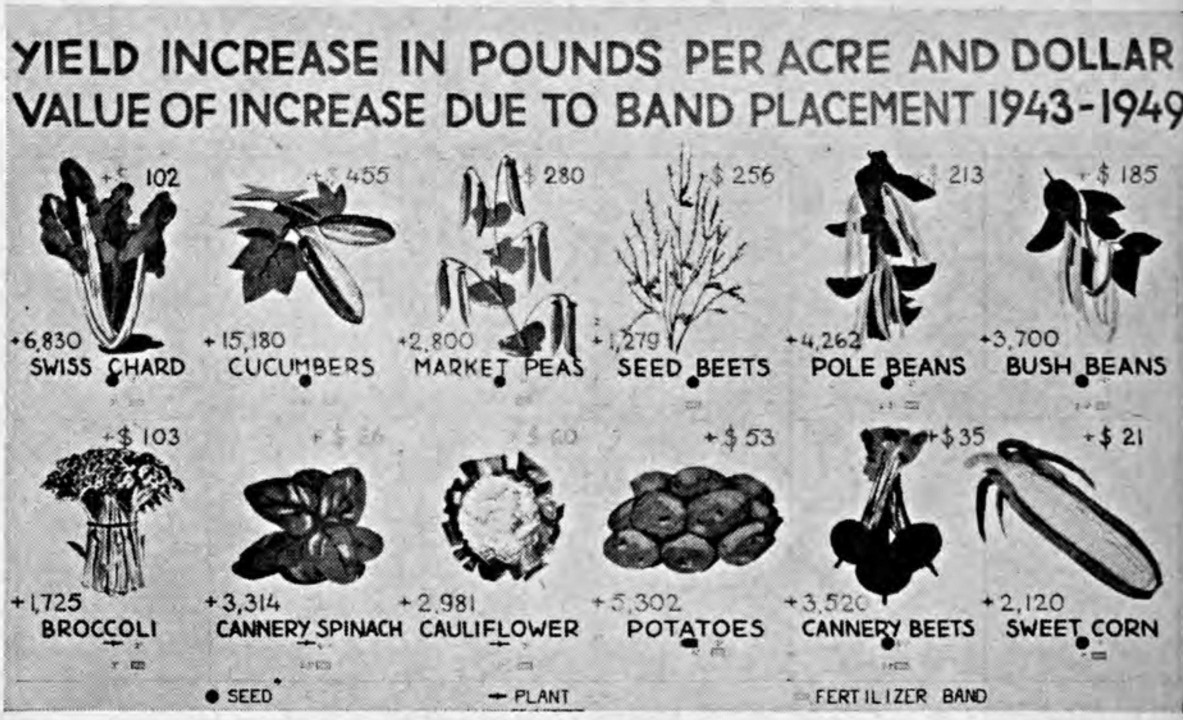

Fig. 4. Results of fertilizer placement work in western Washington carried on from 1943 to 1949 by the Western Washington Experiment Station and U. S. Department of Agriculture.

Green sprouting broccoli, a newcomer among the processing vegetables, is planted so that most of it is harvested in the cool months of September, October, and November when the shoots are firm, crisp, and green.

Grower "know-how" is important no matter what the crop. It is particularly important in the efficient production of vegetable crops such as Blue Lake beans which have very high fixed acre production costs. When fixed costs include items such as poles, posts, wire, strings and insecticides, in addition to usual costs of land prep-

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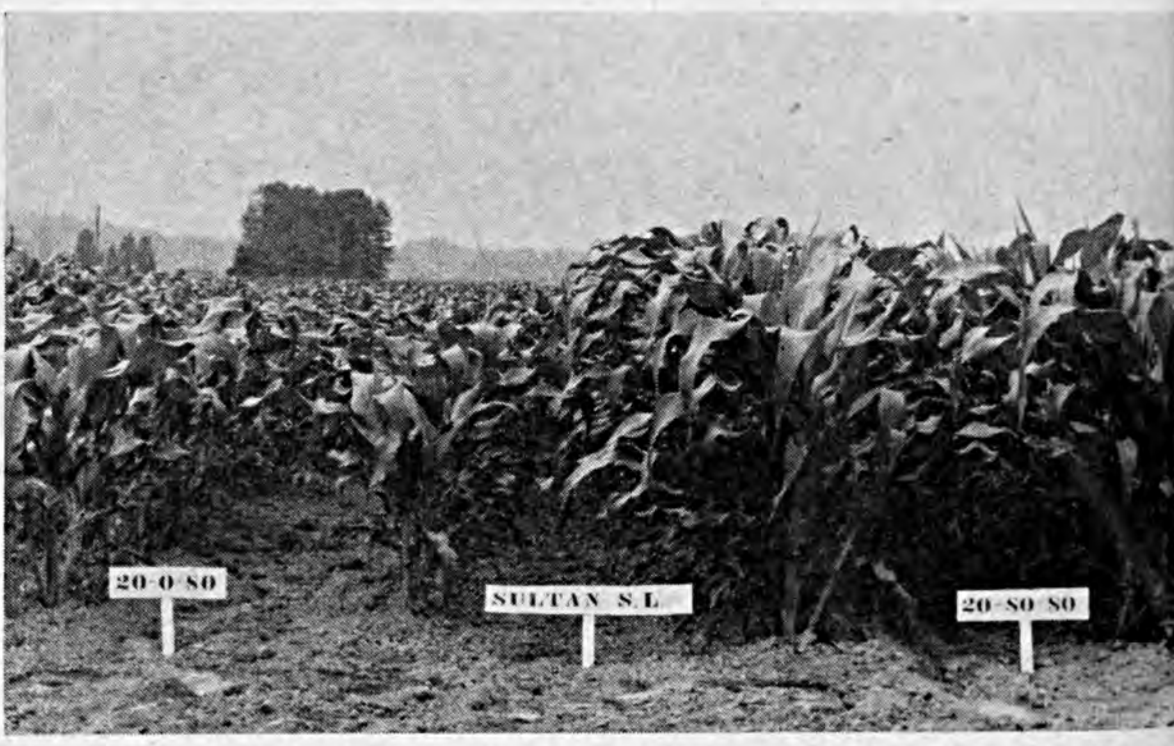

Fig. 5. The effect of phosphate application (banded) on corn growth near Puyallup, Washington. The corn on the left received nitrogen and potash but no phosphate, while the corn on the right received a complete fertilizer.

Fig. 1. Fertilize the entire rotation! This shows contour strips in the rich Conyngham Valley section of Luzerne County, Pennsylvania. The first demonstration in this valley was laid out by the county agent in 1937.

Rotation Fertilization

By James H. Eakin, Jr.

Agronomy Department, Pennsylvania State College, State College, Pennsylvania

THE "Big Three" of soil productivity maintenance are lime, fertilizer, and organic matter. Haphazard systems of soil management may provide adequately for one or even two of these essential factors; but to neglect the third may seriously limit crop production. The use of lime and fertilizer will be greatly enhanced if provisions are made for the replenishment of organic matter. Research has shown that crop yields may be limited as often by poor soil physical condition as they are by lack of essential plant nutrients. Conversely, if adequate plant nutrients are not used, lime and organic matter cannot work efficiently to produce high yields.

Lime needs are comparatively easy to correct, and many of our farmers are doing a good job of liming their fields. A soil acidity test will show the amount of liming materials needed. On the other hand, many soil management programs do not make adequate provision for replenishment of organic matter and plant nutrients. Perhaps these two soil productivity factors are not properly understood since they must be considered at the same time. For instance, many farmers tend toward a short rotation, high fertilization, and little sod. They attempt to substitute plant nutrients for organic matter. The former can be purchased in commercial ferilizers; the latter cannot. Such a program may increase total production for a few years, but as the supply of organic matter decreases, fertilizer efficiency drops sharply.

What is the explanation for this drop in the crop-producing power of fertilizer? It takes about five million pounds of water to produce 100 bushels of corn. Soil robbed of organic matter through insufficient use of sod crops cannot efficiently absorb rainfall. It lacks spongy humus for holding water. When crops cannot secure enough moisture, fertilizer additions will not increase yields; in fact, under this condition, fertilizer salts may actually decrease yields. For this reason and many others the maintenance of organic matter at a level that is normal for any particular climate is essential for efficient crop production.

Several other reasons why organic matter maintenance should be considered one of the basic objectives of good soil management can be cited: (1) Improves soil aeration; (2) allows maximum expansion and development of plant roots; (3) absorbs toxic substances from the soil solution which could be injurious to plant development; (4) provides a storehouse of nitrogen as well as other plant nutrients; (5) stabilizes soil granules; this, in turn, helps to prevent erosion.

To study further the inter-relations between organic matter and fertilizer, let us cite another example of poor management. All too frequently farmers fertilize their cash crops, which is a good practice, but fail to apply any fertilizer to their sod crops. This has resulted in hay yields that average only from 1 to 1½ tons per acre. Much of this hay is of doubtful quality because of the poor performance of the legumes in the mixture. This half-way fertilization practice also results in lower yields of cash crops because the poor sods turned under are shy in organic matter. With such a program the farmer loses every time. It takes commercial fertilizer to produce humus, and it takes humus to produce crops.

Any effective system of soil management must take into consideration all of the factors that contribute to successful crop production. The best entry into an efficient soil-building program is by way of the crop rotation. The rotation should employ, at the minimum, 25 per cent of the cropland in sod at all times. The fields should be fertilized according to the rotation used. Instead of considering each crop individually, the entire rotation should be kept in mind. Every acre of cropland should receive an annual application of fertilizer. Special effort should be directed toward higher producing sods as these automatically increase yields of cash crops and total production.

Pennsylvania's new plan of rotation fertilization attempts to keep the basic fundamentals of soil productivity in line at all times. All crops receive an ample supply of lime and plant nutrients. The fertilization system is not recommended for those farmers who do not employ sod crops in their rotations.

An example of how rotation fertilization works can be cited in the corn, grain, hay rotation. Any one of the following conditions may exist on potential corn land—and each condition requires a different fertilization program:

1. Legume sod, (6-8 tons phosphated manure)
2. Grass sod, (6-8 tons phosphated manure)
3. Legume sod, not manured
4. Grass sod, not manured

If the legume sod has consistently received good fertilizer and manure treatments, high rates of fertilization generally will not be a paying proposition. Under this condition 100 to 200 pounds of 5-10-10 per acre applied in the row will be sufficient fertilizer to produce the most efficient corn yields. Number 4, poorest situation of those listed, usually involves a deficiency of

Fig. 2. Orchard grass-ladino pastures have been maintained for periods of 10 to 15 years with annual fertilization and good management practices.

nitrogen. Plowing down 50 to 75 pounds of actual or elemental nitrogen per acre will supply that plant nutrient. In addition, 300 pounds of a 5-10-10 fertilizer per acre should be applied in the row. The first step toward rotation fertilization has been accomplished; the crop was fertilized according to the specific condition that existed.

In planning a small grain fertilization program, either of the following two conditions may exist:

1. Small grain seeded to hay or pasture.
2. Small grain, not seeded.

The first condition presents two crops to be fertilized; the second, only one. When small grain is seeded to a legume grass mixture there is an excellent opportunity to place fertilizer in the feeding zone of next year's hay crop. Therefore, it is recommended that 300 pounds of 0-20-20 fertilizer per acre be plowed down or drilled deeply when preparing the seedbed. In addition, 300 pounds per acre of grain fertilizer, such as 5-10-10, 4-12-8, or 2-12-12, should be drilled when the small grain is sowed. If the small grain is seeded alone, 300 pounds per acre of a complete fertilizer, such as 5-10-10, should be sufficient in most cases. If lodging of the grain has been a problem in the past, fertilizers carrying no nitrogen should be used.

After the first year hay or pasture crop is removed, it is time to consider replacing in part those plant nutrients that have been removed. In Pennsyl-

Fig. 3. Orchard grass roots. Grass roots and organic matter are the key to crop production.

vania, good results have been obtained by topdressing those hay fields in the fall of the year. About August 15 to September 15, 400 pounds per acre of 0-20-20 fertilizer should be applied. A similar application is recommended each fall as long as hay is to be cut the next year. This timing of fertilizer application enables the legume plants to build up sufficient carbohydrate root reserve to winter over and shoot a good top the next spring. It also means the soil is receiving fertilizer when plant-nutrient reserves are at their lowest point. Cooler weather and increased rainfall will enable the legumes to make quick use of the fertilizer.

Fertilizer

To many farmers, 400 pounds of 0-20-20 per acre per year seem to be a great deal of fertilizer. However, in view of what is coming from the land in plant nutrients they might think otherwise. One ton of alfalfa hay removes about 45 pounds of potash per acre. Suppose a yield of 4 tons is removed. This would represent a removal of 180 pounds of potash. Through weathering processes the soil will return approximately 20 to 50 pounds per acre per year. Erosion, leaching, and fixation by clay minerals will cut down on that supply. Six tons of well-preserved farm manure will return about 60 pounds of potash of which approximately one-half will be available the first year. With the 4-ton yield of hay there will be 100 to 130 pounds of potash that must be replaced. These figures represent only one year's production. When one considers a 20- or 30-year period, it is easy to see why certain farms which once produced good alfalfa and clover hay yields cannot produce half a crop now.

Examples of crop situations cited in preceding paragraphs have been used merely to show how rotation fertilization applies under specific conditions. Far too many soil-improving practices are based on generalizations or habit. Rotation fertilization is based upon fitting the practice to the situation that exists. Over the last 50 years, agricultural research has developed much information on use of fertilizer. This information has been disseminated to farmers through extension teaching.

(*Turn to page* 48)

Fig. 4. Nitrogen starvation on the right, normal corn on left. If the entire rotation is fertilized including annual application of plant nutrients for grass-legume mixtures, cash crop production will remain high with moderate fertilizer applications.

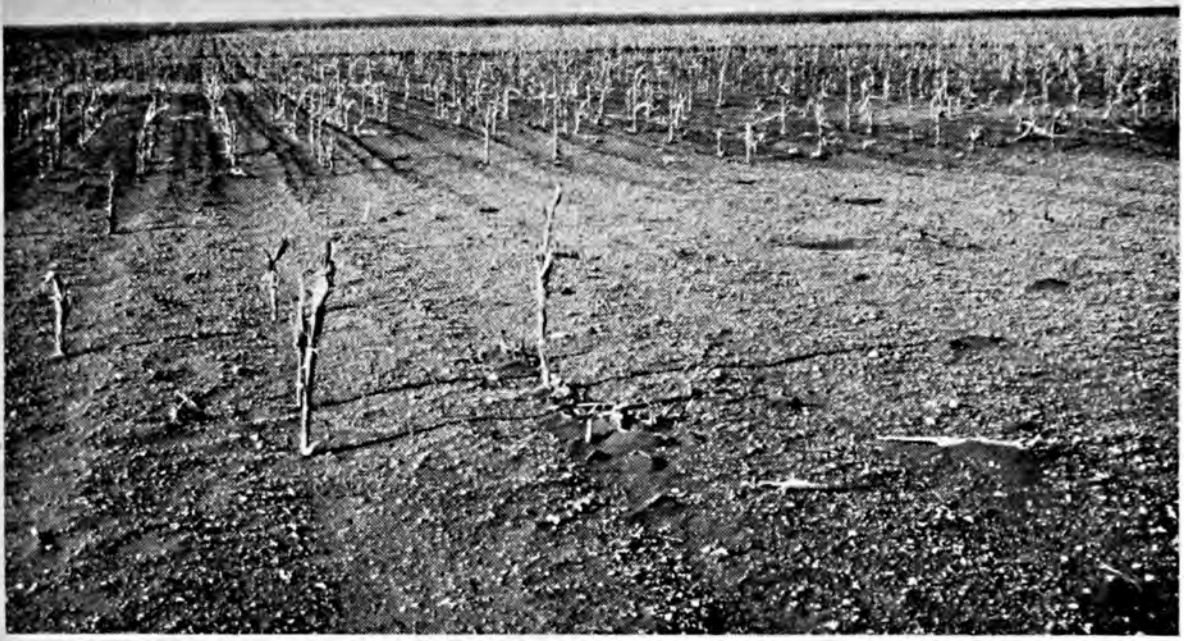

Fig. 1. The wind acts as a fanning mill, removing the organic matter, silt, and clay and leaving the sand and gravel.

Soil-fertility Losses by Erosion

By J. H. Stallings

Research Specialist, Soil Conservation Service, USDA, Washington, D. C.

THE importance of fertility erosion —caused by the action of wind and water sorting, sifting, and removing the lightweight fertility-bearing portion of the soil while leaving sand and other heavy material—is not fully appreciated. The loss of this fertile material may be the most serious immediate effect of soil erosion. The amount of topsoil may be reduced materially by the removal of sand, gravel, and other inert material over a period of years, but the removal of organic matter and plant nutrients decreases soil fertility most rapidly.

The most fertile portion of the soil is the part that is often removed first by wind and water in the erosion process. The soil at the surface of the ground is stirred by wind and rain water and sorted into different-sized particles. Due to its turbulent nature, the action of wind on the soil is similar to that of a fanning mill. It removes organic matter, fine silt, and clay particles, and leaves the larger, heavier sand and gravel (Fig. 1). The lighter, more fertile fractions are picked up and lifted into the pathway of higher air currents, which often carry them for hundreds and sometimes thousands of miles (Fig. 2). The coarser, less fertile particles skip, slide, or roll along the surface and often pile up in drifts.

Raindrops falling on bare soil splash and stir the soil particles at the surface into a muddy, watery mixture. Much of the coarser, heavier material settles out as soon as the turbulence caused by the splashing raindrops subsides sufficiently. The smaller, lighter particles which contain the fertility elements remain in suspension and may be floated away—sometimes entirely off the field—by surface flow. Other factors being equal, the average amounts of soil lost through sheet erosion vary in accordance with the violence of the raindrop impacts which stir them into suspension and set them in motion.

Wind Removes Most Productive Part of Soil

Soil material deposited on snow and ice at Clarinda, Iowa, by a dust storm originating in the Texas-Oklahoma Panhandle contained 10 times as much organic matter, 9 times as much nitrogen, 19 times as much phosphoric acid, and about 1.5 times as much potassium as there was in the dune sand piled up where the dust storm originated (2)[1]. The transported material was much finer and contained no sand whatsoever, whereas the drifting dune that was left behind contained nearly 92 per cent sand.

The sorting action resulted in marked differences, also, between the deposited material and the soil of the virgin grassland in the general vicinity of the storms. The unaffected grass-covered soil contained 79.2 per cent total sand and 19.6 per cent silt and clay. The dust contained no sand and 97 per cent silt and clay. The dust contained more than three times as much organic matter and nitrogen, respectively, as the virgin soil, nearly 5 times as much phosphoric acid, and 1.25 times as much potassium.

Material deposited by the same storm at Hays, Kansas, (about 300 miles from the area of the disturbance) contained 3.7 per cent sand, 67.8 per cent silt, and 25.3 per cent clay, indicating in comparison with that deposited at Clarinda, Iowa, (500 miles from its point of origin) that even the coarser materials in dust gradually settle out as the dust storms move away from their point of origin.

The soil in the drifts resulting from the earlier dust storms in the Texas-Oklahoma Panhandle area was found to contain 24.5 per cent less organic matter and 28 per cent less nitrogen than the virgin soil (6). Other studies have shown that soils which have been drifted by wind have a lower organic matter, nitrogen, and phosphoric acid content than undrifted soil (16), and that dust resulting from dust storms are high in organic matter (17).

More than 75 per cent of the dust collected during a storm in Massachusetts on February 20, 1942, was fine enough to pass through a screen with 300 meshes to the inch (13). This dust contained 4.5 per cent organic matter, which is far above the normal of 1 to 2 per cent for good, fertile soil in the area.

After the Oklahoma dust storm of April 1935 the greatest difference between drift material, cropped soil, and virgin surface soil occurred in the coarse- and medium-textured types (4). The drifts contained an average of 37.8 per cent less silt and clay and 29.3 per cent more sand than adjacent virgin soil. The increase in percentage of sand in the drifts was in proportion to the amount of silt and clay removed by the wind.

Samples of dust collected in Oklahoma during the dust storms of 1930 contained, on the average, 62.5 per cent silt and 14.3 per cent sand (10). The original soil contained 42 per cent silt and 35.4 per cent sand, whereas the drift soil contained only 15 per cent silt and 58.2 per cent sand (Fig. 3). Dust deposited in buildings contained about twice as much material suitable for plant food as there was in the original soil.

After a dust storm in Kansas in 1948 both the drift and eroding soil, which originated principally from sandstone, contained much less organic matter than similar soil in noneroded fields (26). Much of the organic matter in

[1] Figures in parentheses refer to literature cited.

Fig. 2. The lighter, more fertile fractions of the soil are picked up by the wind and lifted into the path of higher air currents which often carry them for hundreds and sometimes thousands of miles.

these soils was carried into the atmosphere and completely removed from the affected area.

As a result of the sorting action of the wind during this windstorm the quantity of particles averaging 0.016 mm. and not exceeding 0.05 mm. in diameter was more than five times as great in the soil from which the drift material was derived as in dunes formed during the storm. Evidently most of the small particles in the wind-eroded soil were removed.

Windstorms removed an average of 0.85 inch of topsoil from fields near Salina and McPherson, Kansas, during March 1950 (26). It was estimated that about three-fourths of this soil was piled into drifts in the vicinity of the eroding field. The rest was carried away, mainly as dust particles ranging up to 0.1 mm. in diameter.

On loess soils virtually all parts of the soil can be removed by the wind. Wind erosion on such soil does not appear to alter appreciably the texture of either the residual soil or that of the drifts. The organic matter content of the accumulated drifts was slightly higher for soils derived from loess than for the residual soil of the windblown fields. The organic matter included not only particles held together with a mineral portion of the loess soil removed by the wind but also loose, finely divided organic residues.

The wind tends to change the texture of non-loess soils by removing silt and clay fractions, and it may deplete

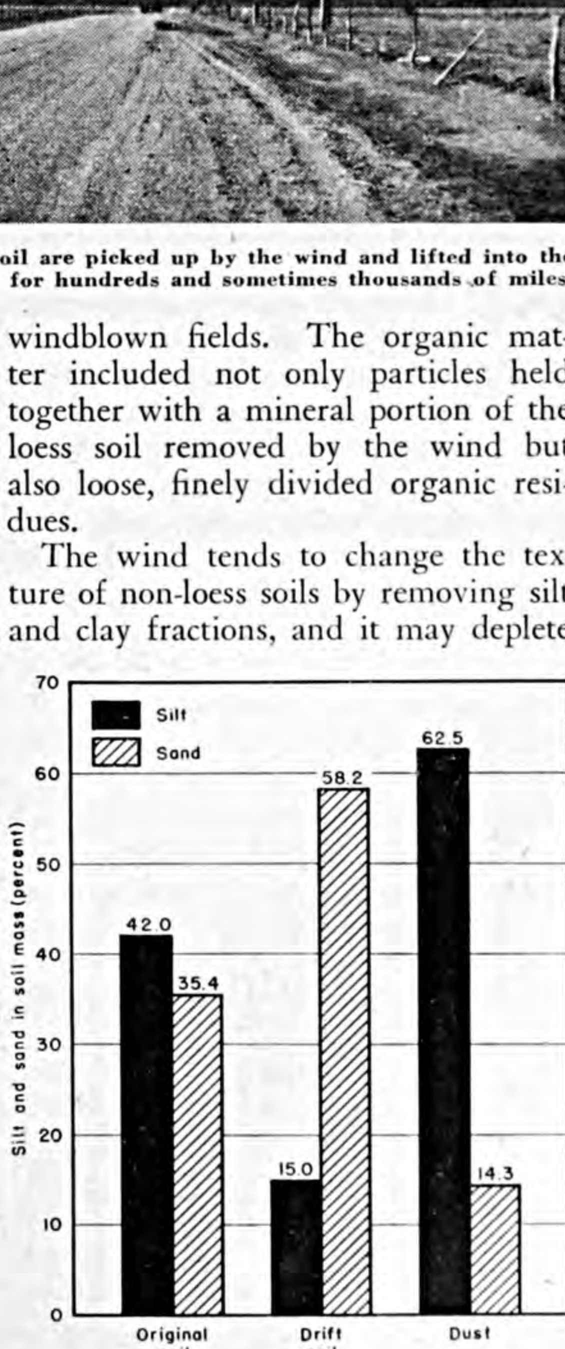

Fig. 3. Changes in silt and sand content of Richfield silt loam caused by the sifting and sorting action of wind in the erosion process.

the total fertility of the soil by sifting out the lighter and more fertile portion and carrying it away.

On sandy soils, such as those in much of the Plains country and certain other parts of the United States, approximately one-fourth of the soil mass is removed as dust beyond the boundaries of the eroding fields. The other three-fourths is drift material which accumulates against fences and other obstructions (2). On finer-textured soils a higher proportion is removed as dust.

Both the eroded fields and the drifts were more sandy than adjacent noneroded fields on soils derived from sandstone as a result of the Kansas storms (26). The original content of silt was reduced by about 65 per cent and the sand content was increased in like amount in the drifts on residual soils. These changes were brought about by only two or three windstorms. The storms changed the texture of the transported soil material from a loam to a sandy loam. Much of the silt, which apparently was not as well aggregated as in loess soils, was blown completely away, together with much of the organic matter which was held with it. The clay content remained about the same in the windblown portion as in the residual soil. The clay was held in close association with that of the drift material which was aggregated sufficiently to remain in the vicinity of the eroded area.

On the average, over 60 per cent of the total dust contained in that portion of the soil shifted by wind was carried away. Soils of noneroded fields contained 46.7 per cent silt, whereas the drifts from similar fields contained only 17.5 per cent silt. There was a loss of silt from the field equal to 29.2 per cent of the weight of the soil that was moved by the wind. It was estimated that 41 tons of silt and 4 tons of clay per acre were lost from the eroding fields as a result of these windstorms. It may be expected that soils containing large quantities of sand will become sandier with each windstorm.

It was estimated that the dust storm of May 12, 1934, moved 300,000,000 tons of soil from the Great Plains (2). More than 100 tons of dust fell per square mile in parts of the country affected by this storm, which covered a vast territory extending from the vicinity of the Rocky Mountains to several hundred miles over the Atlantic. It was reported that 85.8 tons of dust fell per square mile in Westphalia, Germany, during the dust storm of 1859, which was thought to have originated in the Sahara (11).

Wind Erosion Reduces Crop Yields

The loss of organic matter and lightweight particles of soil during the dust storms of the 1930's marked the beginning of serious inroads on the fertility reserves of the soils in the great dry-land winter-wheat belt of the Southern High Plains. Initial removal by wind of the rich topsoil in this area lowered crop yields 4.5 times as fast as did later removals of the surface and subsoil (8). Where land had been in cultivation about 30 years or so, and no effort had been made to control erosion, the loss in production averaged 7 bushels of wheat per acre (9). Of this 7-bushel loss in yielding capacity, 4.2 bushels were due to removal of fertility by erosion and 2.8 bushels due to the removal of fertility by crops grown on the land.

Removals by cropping progressed directly in relation to yields. But erosion damages reduced yields very rapidly during the first few years after erosion started. During these years the rich organic matter, silt, and clay were rapidly being removed from the topsoil.

Wind erosion reduced the productive capacity of High Plains wheatlands an average of 2.2 bushels per acre annually on land in continuous wheat culture and 4.29 bushels on land in summer fallow. Erosion reduced the yield 0.52 bushel per acre per year the first 4 years after the land began eroding, and at the rate of 0.11 bushel an-

Fig. 4. Organic matter, silt, and clay floated down from higher areas and formed a deposit several inches thick in this corn field.

nually for the next 21-year period. Serious erosion usually began 2 to 4 years after the land was first put in cultivation.

Water Erosion Is a Selective Process

Erosion caused by the combined action of raindrop and surface flow is a selective process. Not only are fine particles of surface litter removed, but the finer soil particles (which are relatively high in organic matter and plant nutrients) also tend to be removed (14) (Fig. 4). The loss of organic matter by erosion on fallow soil was 18 times as great as that normally lost by oxidation (23). The material removed by erosion contained about 200 times as many microorganisms as the original soil (25). This is because so much of the finer soil particles and organic material is usually washed off in comparison with the amount of coarse particles.

The selective feature of soil erosion is the major factor contributing to the rapid depletion of fertility and productivity of cultivated lands (18). The material eroded from a Collington sandy loam in New Jersey from June 12, 1938, to December 31, 1941, contained 4 times as much organic matter, 1.5 times as much phosphoric acid, 1.4 times as much potassium, and 2.3 times as much calcium as the original soil.

Likewise, material which eroded from a silt loam soil planted to corn in Indiana contained 2.3 times as much nitrogen as the surface 7 inches of the original soil (1). The total losses of solids from all crops in a rotation contained an average of 0.44 per cent nitrogen, or nearly 3 times as much as the surface soil. Material lost from land in hay contained approximately 9 times as much nitrogen as the original topsoil. The eroded material contained about twice as much organic matter as the topsoil.

With moderate erosion, such as that produced by light rains or under sod cover, the proportion of organic matter and fine soil particles in the soil removed is higher than with more severe erosion. As the rate of erosion increases in severity, the eroded materials tend to become similar in composition to the eroding soil (24). However, the aggregate fertility losses by slight erosion may be more detrimental than those resulting from more severe erosion.

The organic matter lost by erosion varies in amount and character. The amount tends to be high in proportion to the total amount of soil that is removed.

Eroding surface soil in New Jersey contained an average of 15.8 per cent of particles less than 50 microns in diameter whereas the eroded material contained an average of 58 per cent of this size particle (19). The eroded material contained 4.7 times as much organic matter, 5 times as much nitrogen, 3.1 times as much phosphoric acid, and 1.4 times as much potassium as the field soil. The phosphoric acid in the eroded material was of the same availability as that of the eroding soil. The availability of potassium in the eroded material was 3.7 times greater than that left in the original soil.

During the 2-year period, Sept. 1, 1920, to Aug. 31, 1922, 207,849.6 pounds of soil per acre were lost by erosion from a plot in Missouri that had been spaded 4 inches deep and left fallow (7). This eroded soil contained 190.8 pounds of nitrogen and 90.94 pounds of phosphoric acid per acre. Measurements during the first year of this study showed that the eroded material contained 337.89 pounds of calcium and 69.61 pounds of sulfur.

Material which eroded from Dunmore silt loam with slopes ranging from 5 to 25 per cent in Virginia when cropped to corn was 11 and 16 per cent higher in total phosphoric acid and nitrogen, respectively, than the eroding soil (21). In one year 8.5 per cent of the soil's total supply of soluble phosphoric acid was removed by erosion. The eroded material contained 50 per cent more exchangeable basis than the eroding soil. The average annual loss of potassium exceeded 100 pounds per acre.

Erosion caused the loss of relatively much more clay than sand from Vernon fine sandy loam in Oklahoma when planted to sweet clover than when planted to cotton (15). The material which eroded from the cotton plot was more nearly similar in composition to the eroding soil. The material which eroded from the sweet clover land was much higher in silt and clay and lower in sand than the eroding soil.

The widest range between the composition of soil and eroded material is to be expected from loams and sandy loams while the narrowest is to be expected from silt and clay soils. Erosion of weakly aggregated or single-grained soils also may be expected to produce a product which varies widely in composition from the parent soil.

The sorting action of raindrops beating upon bare loams, sandy and sandy loam soils separates out the organic matter, silt, and clay from the sand. The organic matter, silt, and clay are then floated away by surface flow and the sand is left exposed at the surface (Fig. 5). This sand is turned under at the next plowing of the field or is mixed with the surface layer of the soil at the next cultivation. In either case a fresh supply of topsoil is brought to the surface for further action by raindrop splash. The repetition of this procedure over a period of years produces a sandier and less productive soil.

Erosion Prevents Accumulation of Organic Matter

It generally has been assumed that the difficulty experienced in building up or maintaining a high level of organic matter in the soil was due to rapid oxidation of this material. This was thought to be true especially in the South and other sections of the country where the average temperatures are high. However, more recent findings indicate that erosion and not oxidation is the major factor responsible for this condition.

The loss of organic matter by erosion on fallow soil in Iowa and Missouri was found to be 18 times as great as that normally lost by oxidation (23).

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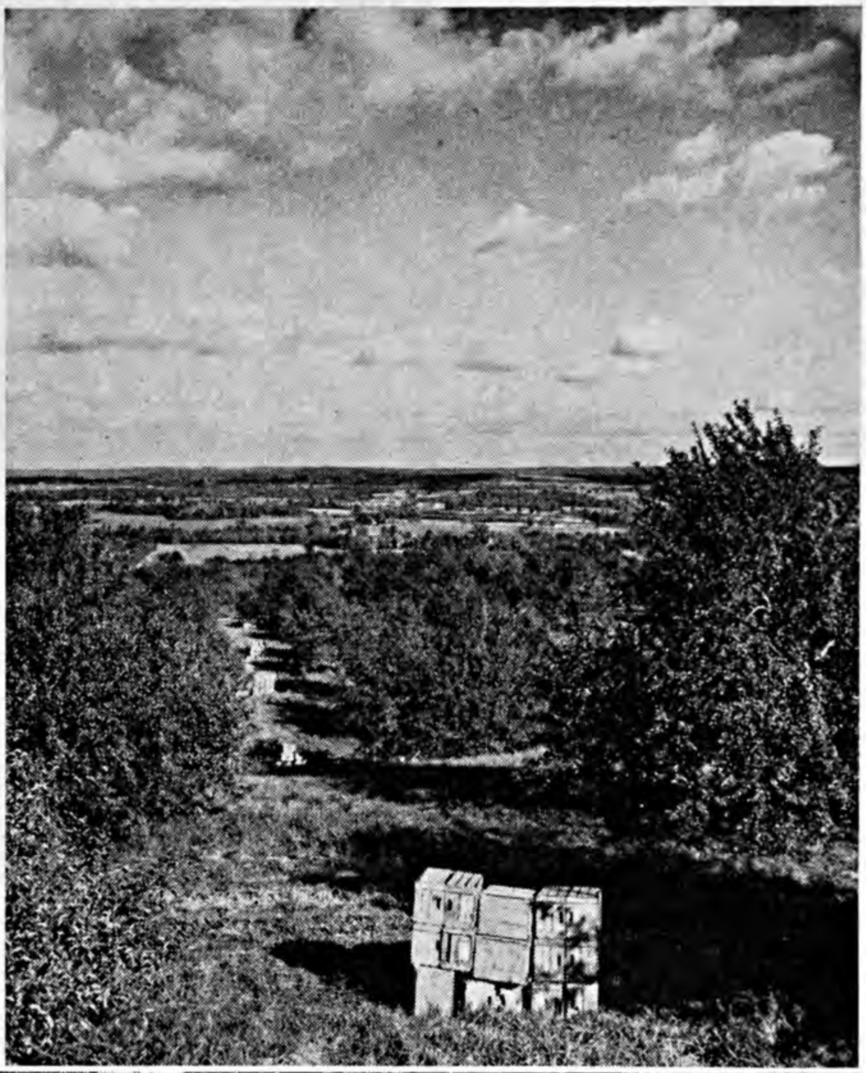
PICTORIAL

The Hunting Season Is Open!

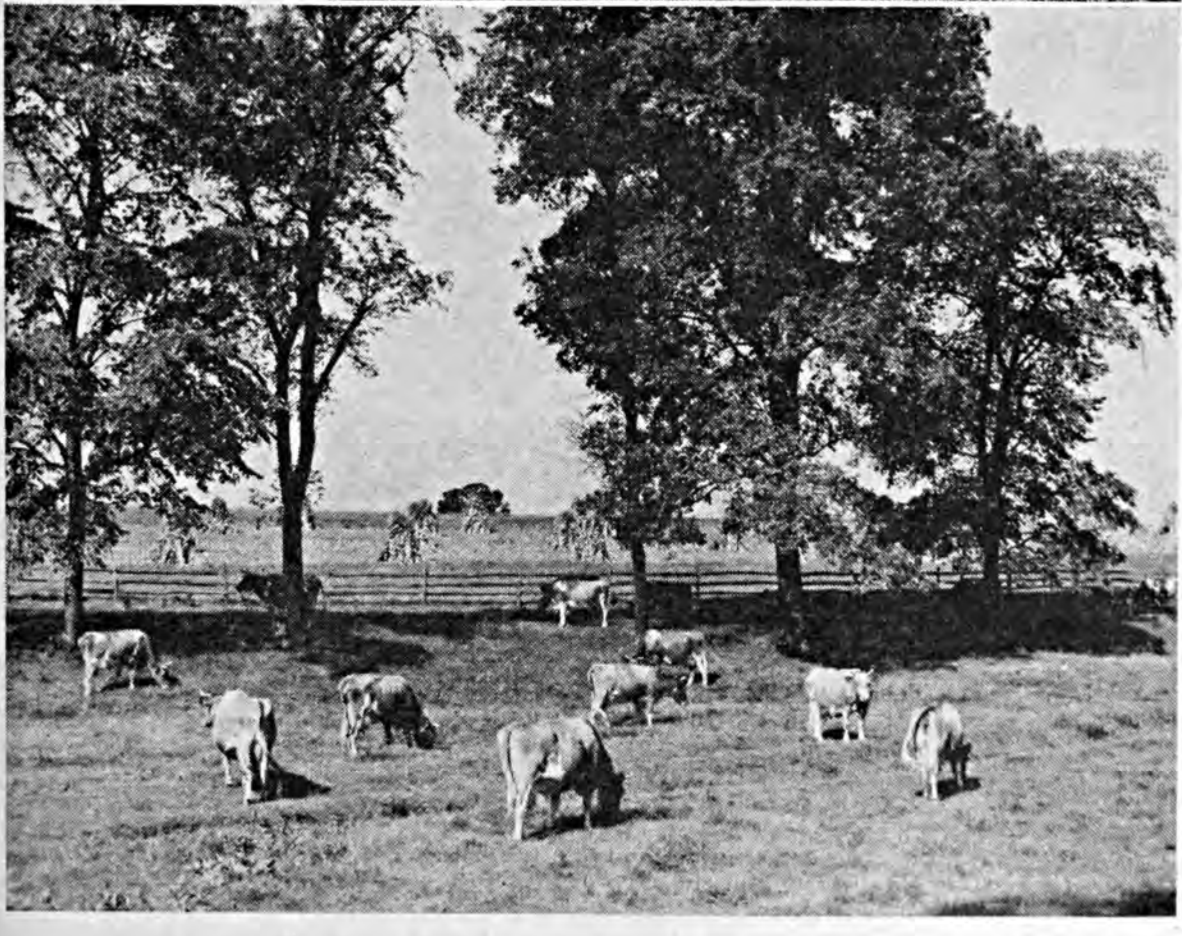
Corn in the Shock.

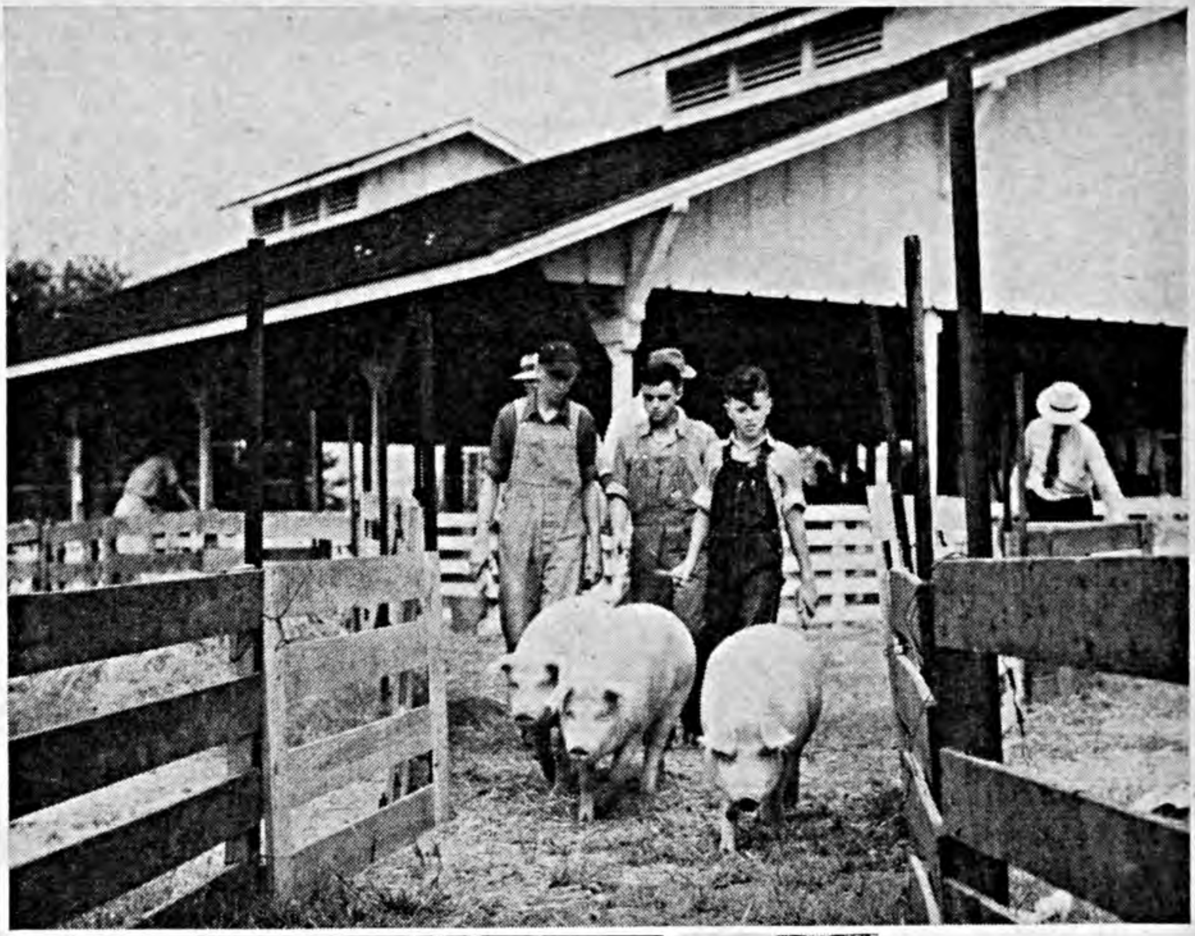
'Taters in the Bag.

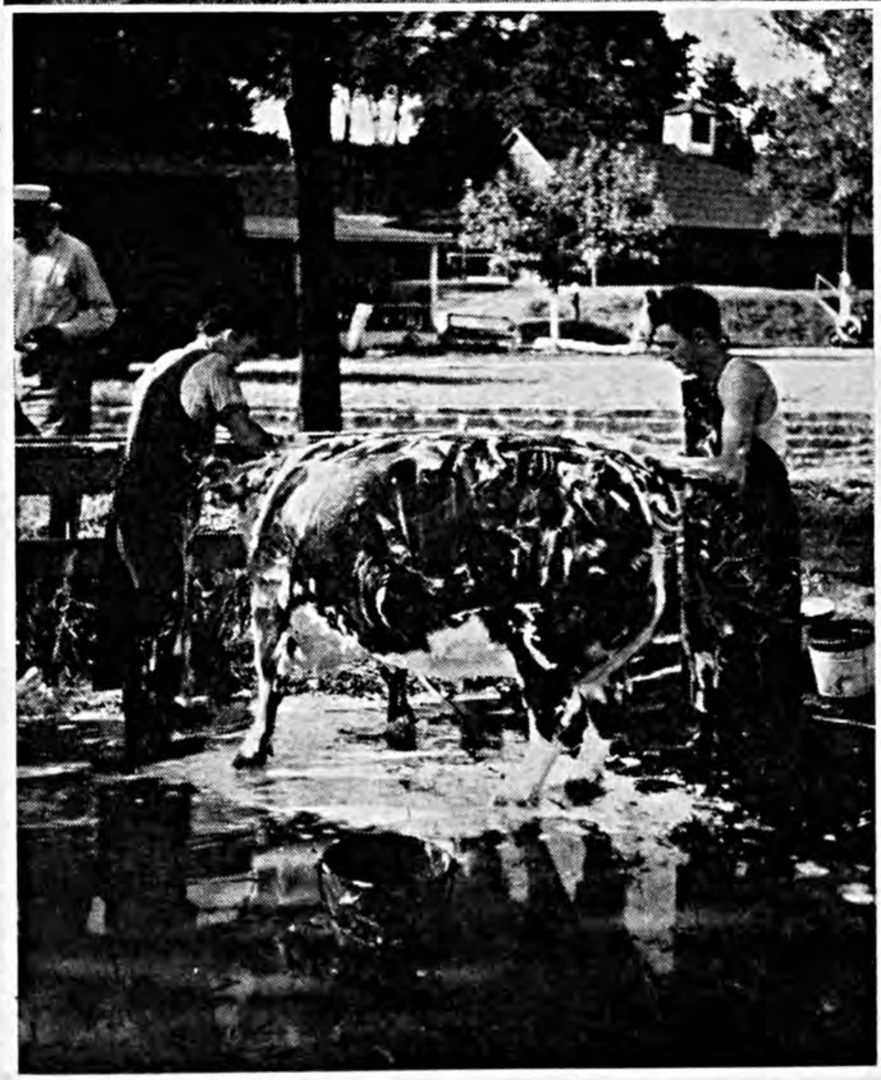
Apples in the Box.



Cows Still on Grass.







Fair Time.

The Editors Talk

Rebuilding Strength in the Land

In his talk at the awards ceremony of Piedmont Communities Soil Conservation Contest, Spartanburg, South Carolina, on September 5, Secretary of Agriculture Charles F. Brannan gave a new definition of soil conservation. "The modern concept of conservation farming," he said, "has come to mean applying the necessary practices on a farm to increase production and to build up soil productivity, both at the same time. It means making soils yield abundantly year in and year out for an indefinite period. It means REBUILDING STRENGTH IN THE LAND."

Secretary Brannan pointed out that no longer do we consider soil conservation as limited to controlling erosion. We now know that soil deterioration through cropping also may be extremely serious. For soils subject to erosion it is often necessary to check cropping losses and increase fertility along with application of erosion control measures. We have also come to understand that conservation farming can seldom be achieved by a single practice. Instead, a combination of practices is usually needed, a combination fitted to the specific soil characteristics and needs. The basic physical objective of soil conservation activities by Department agencies is the use of each acre of agricultural land within its capabilities and the treatment of each acre of agricultural land in accordance with its needs for protection and improvement.

The occasion at which the Secretary was speaking marked the conclusion of a 2½-year contest among five soil conservation districts in the Piedmont. Nearly 1,500 farmers from six counties participated. Merchants, business firms, and industries contributed more than $25,000 worth of prizes. Since the districts were organized, these farmers have put more than 77 thousand acres in soil-building grasses and legumes. They have started rotating crops on 27 thousand acres, terraced nearly 20 thousand. They are strip-cropping 10½ thousand acres, farming 37 thousand on the contour, have planted trees on 4½ thousand acres, and are practicing better woodland management on a much larger area. Farm ponds, waterways, and plantings for wildlife have been made. These farmers have limed, fertilized, and planted cover crops, and have applied many other soil-conserving practices.

Undoubtedly the contest was an incentive for all this activity. People everywhere react to the competitive influence. However, it is safe to believe that the love of the land and the opportunities offered to learn how to rebuild its strength were the major factors. Rewards far beyond those received will be forthcoming for all concerned, and other sections of the country could well benefit by staging similar contests to rebuild the strength of their communities. As stated by the Secretary—American farmers generally face the job of bringing most of the land now in use to a high level of economic production on a sustained basis. The job is so big that it calls for full cooperation from everyone—farmers, businessmen, consumers, church and civic organizations, state institutions, and federal agencies. Throughout the Nation we need the kind of cooperation that there was in the Piedmont in conducting their soil conservation contest.

The Jordan Fertility Plots

The annual meetings of the American Society of Agronomy and the Soil Science Society of America, held jointly at Pennsylvania State College the latter part of August, again afforded opportunity for exchange of ideas and presentation for world usage of the results of research. The importance of this group may not always be fully realized. These scientists are directly or indirectly concerned with the investigation of the all-important problems of the production of food, feed, and fiber. The geneticists and crop-breeders have performed wonders in developing varieties of crops with increased productivity, higher disease resistance, and improved quality. The soil scientists are constantly showing how the soil can be made to produce more and better crops without being depleted. Truly, the agronomists are serving humanity as well as their own country by their efforts to increase and improve the supply and quality of our specific needs for food and clothing.

Pennsylvania State College had much to attract the agronomists. In addition to the excellent facilities provided for the meetings, there were the grass turf plots of the experiment station and the work of the Northeastern Regional Pasture Research Laboratory of the U. S. Department of Agriculture, the corn-breeding plots, the weed-control experiments, soil conservation work, and the famous rose gardens.

Probably of most general interest and uniqueness to the agronomists were the Jordan fertility plots. The original idea for these plots was developed by Evan Pugh, the first President of Pennsylvania State College, who had worked with Lawes and Gilbert at the Rothamsted Experiment Station in England. The plots in their present form were laid out by Dr. Jordan in 1881 and thus are the oldest, continuous extensive fertility experiment in the United States. Originally, there were four tiers of plots so as to allow each crop of the four-year rotation to be grown each year. Unfortunately, the College authorities felt that space was needed for other purposes, and two of the tiers were sacrificed several years ago, leaving two tiers that now make up this world-famous experimental field.

Those who visited the plots during the agronomy meetings were much impressed with the great foresight shown by those who laid them out, in that the system of treatments even by present-day standards is of high quality. These plots have taught many valuable lessons in fertilizer usage. They offer still greater sources of material for investigations on soil fertility, soil chemistry, and soil physics. Contrast between soil in crops and continuous sod is shown by the strip between the plots.

The opportunity of studying the long-time effects of various soil treatments on the soil furnished by these plots is of incalculable value. The country has become very conscious of the necessity for conserving the great basic resource —the soil. Many wonder what certain types of treatment will do to a soil if continued over a long period of time, and many controversies have arisen over various phases of this subject. The answers to many of these questions in all probability can be found in the Jordan fertility plots.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941...........	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942...........	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943...........	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945...........	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946...........	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947...........	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948...........	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949...........	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
September...	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October......	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.......	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April........	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May.........	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June.........	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July.........	39.11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....
August......	34.60	47.7	117.0	273.0	165.0	205.0	15.65	69.10	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
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	89	81	109	74	87	110
1938...........	69	196	80	79	76	64	57	97	88
1939...........	73	154	100	84	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	105	117	107	82	211	129
1942...........	153	369	168	134	143	124	91	202	163
1943...........	160	405	188	235	174	154	125	231	245
1944...........	167	420	214	216	170	160	139	234	212
1945...........	181	366	205	232	198	170	127	227	207
1946...........	263	382	178	248	212	209	141	319	182
1947...........	257	380	232	248	336	259	148	381	226
1948...........	245	482	222	253	201	226	155	298	214
1949...........	231	463	184	244	210	210	139	192	201
1950									
September...	322	554	151	219	224	219	131	349	126
October......	314	551	123	175	213	216	134	361	138
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.......	345	266	154	236	249	240	155	457	265
April........	348	253	161	231	252	242	155	457	225
May.........	342	398	156	238	255	239	153	448	239
June.........	339	490	155	239	252	235	142	424	189
July.........	315	495	169	249	254	232	130	346	204
August......	279	477	168	311	257	232	132	306	181

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12.37	10 06	8.68	8.56
August	3.13	2.07	11.94	10.41	8.66	8.66

Index Numbers (1910-14 = 100)

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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243
August	117	73	341	295	257	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[3]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[3]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[3]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[3]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
September	.760	3.81	5.47	.368	.704	13.98	.193
October	.760	3.98	5.47	.386	.704	13.98	.193
November	.760	3.98	5.47	.386	.732	14.72	.193
December	.798	3.98	5.47	.420	.796	16.00	.210
1951							
January	.810	3.98	5.47	.420	.796	16.00	.210
February	.810	3.98	5.47	.420	.796	16.00	.210
March	.810	3.98	5.47	.420	.796	16.00	.210
April	.810	3.98	5.47	.420	.796	16.00	.210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193
August	.810	3.98	5.47	.389	.768	14.72	.193

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
1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
September	142	106	112	67	74	58	82
October	142	110	112	70	74	58	82
November	142	110	112	70	77	61	82
December	149	110	112	75	84	66	85
1951							
January	151	110	112	75	84	66	85
February	151	110	112	75	84	66	85
March	151	110	112	75	84	66	85
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	82
August	151	110	112	70	81	61	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**
1925........	156	153	151	112	100	131	109	80
1926........	146	150	146	119	94	135	112	86
1927........	141	148	139	116	89	150	100	94
1928........	149	152	141	121	87	177	108	97
1929........	148	150	139	114	79	146	114	97
1930........	125	140	126	105	72	131	101	99
1931........	87	119	107	83	62	83	90	99
1932........	65	102	95	71	46	48	85	99
1933........	70	104	96	70	45	71	81	95
1934........	90	118	109	72	47	90	91	72
1935........	109	123	117	70	45	97	92	63
1936........	114	123	118	73	47	107	89	69
1937........	122	130	126	81	50	129	95	75
1938........	97	122	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........	123	130	127	86	56	130	102	77
1942........	158	149	144	93	57	161	112	77
1943........	192	165	151	94	57	160	117	77
1944........	196	174	152	96	57	174	120	76
1945........	206	180	154	97	57	175	121	76
1946........	234	197	177	107	62	240	125	75
1947........	275	231	222	130	74	362	139	72
1948........	285	250	241	134	89	314	143	70
1949........	249	240	226	137	99	319	144	70
1950								
September.	272	252	247	131	85	324	142	70
October...	268	253	247	131	85	323	142	73
November.	276	255	251	132	85	328	142	74
December..	286	257	256	138	88	346	149	78
1951								
January...	300	262	261	140	90	351	151	78
February..	313	267	268	141	91	358	151	78
March....	311	272	269	142	91	357	151	78
April......	309	273	268	141	91	353	151	78
May......	305	272	266	139	91	334	151	78
June......	301	272	265	134	91	311	151	69
July......	294	271	261	135	93	297	151	74
August....	292	271	258	135	94	294	151	74

* U. S. D. A. figures, revised January 1950. 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] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] 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 is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 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

"Fertilizers for Alaska 1951," Agr. Exp. Sta., Univ. of Alaska, Palmer, Alaska, Cir. 13, Jan. 1951, A. H. Mick, H. J. Hodgson and S. C. Litzenberger.

"Gypsum and Other Sulfur Materials for Soil Conditioning," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Cir. 403, Mar. 1951, D. G. Aldrich, Jr. and W. R. Schoonover.

"Fertilizing Materials 1950," Bur. of Chem., Dept. of Agr., Sacramento, Calif., Spec. Pub. No. 239, Mar. 1951.

"Poultry Manure, Its Nature, Care and Use," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Bul. 272, Dec. 1950, S. Papanos and B. A. Brown.

"Fertilizer Analysis—Spring 1951," State Board of Agr., Control Div., Topeka Kan., July 1951.

"Fertilizer Recommendations for Tomatoes in Maryland," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 2, Feb. 1951, F. C. Stark.

"Anhydrous Ammonia, A Good Nitrogen Fertilizer," E. C. 193; "Which Nitrogen Fertilizer Shall I Use?" E. C. 194; "What Is Liquid Fertilizer?" E. C. 195; Ext. Serv., Univ. of Nebr., Lincoln, Nebr., 1951, M. D. Weldon and W. E. Ringler.

"Fertilizer Possibilities in North Dakota," Cir. A-141, Jan. 1950; "Suggestions for Fertilizer Use in North Dakota," Cir. A-142, Jan. 1950; "Fertilizers for North Dakota Gardens and Lawns," Cir. A-152, Jan. 1951, H. A. Graves; Ext. Serv., Univ. of N. D., Fargo, N. D.

"Fertilizers for Greener Hills," Ext. Serv., W. Va. Univ., Morgantown, W. Va., Misc. Pub. No. 8, Apr. 1951.

"Fertilizer Use and Crop Yields in the Southern Region," Rpt. No. 1, July 1951; "Fertilizer Use and Crop Yields in the North Central Region," Rpt. No. 2, July 1951; "Fertilizer Use and Crop Yields in the Northeastern Region," Rpt. No. 3, Aug. 1951; Natl. Soil and Fert. Res. Comm., USDA, Wash., D. C.

Soils

"Conservation of Michigan's Muck Soil," Ext. Serv., Mich. State College, East Lansing, Mich., Ext. Bul. 307, Apr. 1951, P. M. Harmer.

"Soil Improvement and Conservation in Missouri," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Cir. 357, Mar. 1951, M. F. Miller.

"100 Questions and Answers on Liming Land," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 754, Mar. 1951.

"Fertility Status of North Carolina Soils," Dept. of Agr., Raleigh, N. C., July 1951, C. D. Welch and W. L. Nelson.

"Wisconsin Tobacco Soils, Their Fertility and Management," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Bul. 493, Apr. 1951, W. B. Ogden.

"Erosion Controlled by Terraces," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Bul. 494, June 1951, H. B. Atkinson and O. E. Hays.

"Water—Life for the Land," Agr. Exp. Sta., Univ. of Wy., Laramie, Wy., Cir. 39, Nov. 1950, B. R. Tomlinson and G. O. Woodward.

"Soil Survey, Newaygo County, Michigan," Agr. Exp. Sta., Univ. of Mich., East Lansing, Mich., Series 1939, No. 9, Apr. 1951, A. H. Mick, R. M. Basile, A. W. Gronlund, J. T. Stone, C. L. Bennett, C. H. Wonser, and M. M. Striker.

"Soil Survey, Clallam County, Washington," Agr. Exp. Sta., Univ. of Wash., Pullman, Wash., Series 1938, No. 30, Apr. 1951, L. H. Smith, H. A. Olsen, and W. W. Fox.

"Border Irrigation," USDA, Wash., D. C., Leaf. No. 297, May 1951, E. J. Core.

Crops

"Effect of Slash Mulch and Slash Burn on Pine and Spruce Plantings," Agr. Exp. Sta., New Haven, Conn., Bul. 548, Apr. 1951, H. A. Lunt.

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A friend spent the night with a farmer. The next morning he appeared downstairs with a black eye.

"How did you get that?" asked the farmer in surprise.

"Oh, I just happened to fall in the guest chamber, that's all," answered the visitor.

"Gee! you didn't break it, did you?" anxiously inquired the farmer.

Jimmy and Pete always walked to school together. One morning Pete showed up without Jimmy. Then a neighbor phoned that Jimmy had been found unconscious where he had slipped and fallen on the ice.

"Why didn't you get help when Jimmy fell, Pete?" asked teacher.

"We were late for school," replied Pete. "And anyhow, I thought he was dead."

Fertilizers for Vegetable Crops . . .

(*From page* 16)

aration, planting, cultivation, and harvesting, high yields are absolutely necessary if the grower is to remain in business. In the case of Blue Lake beans, it is generally accepted that a yield of six tons per acre is the "breaking point." In other words, the grower only begins to make a return on his investment after he has harvested six tons of beans from each acre.

Growers and processors have learned that not all soils are good bean soils or broccoli soils. They have learned also that even though the annual rainfall in the area ranges from 35 to 50 inches, supplemental irrigation is essential for high yields and good quality. So intent on this matter of quality are most processors that contracts for beans and certain other crops are not taken from growers unless they have irrigation facilities available. Irrigation, incidentally, is done almost entirely by use of portable sprinkling systems.

Grower "know-how" includes the help of fieldmen from the various processors. These fieldmen are in constant touch with new developments being made by the experiment stations and those in industry supplying seeds, fertilizers, fungicides, insecticides, machinery, etc. used in the production of the crops. The grower and fieldman "know-how" includes a knowledge of proper varieties, fertilizer requirements, planting dates, seeding rates, insect and disease control, irrigation, and harvesting methods.

A good climate, grower "know-how," and responsive soils have paved the way for the use of ever-increasing quantities of commercial fertilizers. Until about 10 years ago the amount and kind of fertilizer used and the manner in which it was applied varied from grower to grower. The work of the Western Washington and the Southwest Washington experiment

Fig. 6. When fertilizer was banded one inch to the side of and one inch below the seed, the yield of cucumbers was greatly increased over the treatment in which the fertilizer was broadcast and disced into the soil.

stations has tended to standardize fertilizer practices. Workers from these stations conducted field trials throughout the area and have made the resulting information available to all concerned. The results of these trials, a few of which are reported in the following paragraphs, brought about a sharp increase in the rate of fertilizer application, changes in methods of application, and the kind or ratios of fertilizer used.

The results of a number of studies on the effect of fertilizer rates, ratios, and placement on yield of vegetables in western Washington are discussed in the following paragraphs.

Fertilizer Ratios

Fertilizer ratios are the proportions or ratios of nitrogen, phosphoric acid, and potash to each other as contained in a sack or ton of complete fertilizer. With few exceptions vegetables grown in western Washington respond best to complete fertilizers. One of these exceptions is canning peas, which respond well to phosphates and potash but not to nitrogen. In fact, the results of numerous trials by the experiment station show that the addition of nitrogen to the phosphate-potash mix often depressed the yield. There are a few soils, such as the Felida silt loam in the southwest part of the State, in which the response to potash on nearly all crops is quite erratic.

Table I lists results which clearly show the effect of the omission of any of the three important nutrients on the yield of crops on certain soils. The Buckley loam, a soil high in organic matter, is particularly responsive to phosphorus and potash. The preliminary studies on the fertilizer requirements of this soil reported here indicate that a good fertilizer for cucumbers and potatoes on the Buckley soil should be rather low in nitrogen but relatively high in phosphorus and potash. A glance at the column "Increase over check" in Table I clearly indicates the importance of fertilizers in the production of high yields of crops. Important information not given in the table is the effect of fertilizers on the quality of the crop. Generally speaking, the more rapid the growth and the higher

Fig. 7. Much of the irrigation in western Washington is by sprinkler. Supplementary fertilizer applications are often made through the sprinkler system.

TABLE I.—EFFECT OF FERTILIZER RATIOS ON YIELDS OF VEGETABLE CROPS

Crop and Soil	Fertilizer Pounds plant nutrients per acre			Yield lbs/A	Increase lbs/A over check	Value of increase less fertilizer & added harvest costs
	N	P_2O_5	K_2O			
Cucumbers	30	90	120	34,583	27,405	$251.55
	30	90	60	32,263	25,085	231.95
	30	60	60	31,465	24,287	227.27
	0	90	60	31,030	23,852	225.02
Buckley loam	60	90	60	30,450	23,272	208.42
	30	90	0	18,270	11,092	94.70
	30	0	60	9,425	2,247	13.47
	0	0	0	7,178	0	0
	0	60	120	4,110	1,267	49.55
Peas	0	60	90	4,045	1,202	48.10
	15	60	60	3,863	1,020	38.10
	0	60	60	3,859	1,016	40.60
Chehalis	30	60	60	3,556	713	20.05
silty clay	0	60	0	3,299	456	16.20
loam	15	0	60	3,010	167	2.05
	0	0	60	2,903	60	−.60
	0	0	0	2,843	0	0
	75	150	150	41,791	20,486	166.21
Potatoes	150	150	150	41,177	19,872	146.92
	75	150	225+Mg	40,870	19,565	152.50
	75	150	225	39,845	18,540	142.25
	75	225	150	39,128	17,823	131.33
Sultan	75	150	150 (K_2SO_4)	38,923	17,618	137.53
silt loam	75	150	75	38,411	17,106	136.91
	75	75	150	36,977	15,672	126.32
	37.5	150	150	36,772	15,467	122.57
	75	150	225 (K_2SO_4)	33,392	12,087	77.72
	75	0	150	29,500	8,195	59.80
	0	150	150	26,325	5,020	24.70
	0	0	0	21,305	0	0
	75	150	225	25,239	12,474	81.59
Potatoes	75	225	150	24,890	12,125	74.35
	75	150	150	23,086	10,321	64.56
Buckley loam	75	0	150	17,926	5,161	29.46
	75	150	0	16,548	3,783	8.18
	0	150	150	16,296	3,531	9.81
	0	0	0	12,765	0	0
	90	90	60	20,134	9,196	338.14
Pole Beans	60	90	60	19,360	8,422	312.58
	30	90	60	18,973	8,035	302.50
	30	90	0	17,424	6,486	244.14
	30	60	60	17,140	6,202	232.48
	30	90	120+Mg	16,650	5,712	205.98
Sultan silt	30	30	60	16,553	5,615	212.30
loam	30	90	120	16,166	5,228	186.62
	0	90	60	13,358	2,420	83.30
	0	0	0	10,938	0	0
	30	0	60	9,002	−1,936	−86.44

the yield, the better the quality of vegetables produced.

Fertilizer Rates

The question of how much fertilizer to use is one that confronts all growers. In Table II are presented some of the data accumulated by the stations in an effort to answer this question. The actual rate per acre giving the best results will depend on the ratio of the fertilizer used. The fertilizer must be applied at rates high enough to supply the maximum quantity of each element required by the crop for its best development on the soil on which it is grown. It can readily be seen that fertilizer rate and ratio studies must be conducted simultaneously in order to obtain the needed information. Substantial increases in yield are again recorded (Table II) from the use of commercial fertilizers.

A study of the data indicates that

Table II.—Effect of Rate of Fertilizer Applications on Yields of Vegetable Crops in Western Washington

Crop and Soil	Fertilizer		Yield lbs/A	Increase lbs/A over check	Dollar Value of increase less fertilizer & added harvest costs [1]
	Kind	lbs/A			
Broccoli	15–10–10	0	4,840	0	
		300	6,292	1,452	$ 58.40
Sultan		600	8,107	3,267	134.95
silt loam		1,200	8,954	4,114	148.90
Cabbage	15–10–10	0	63,307	0	
		300	68,341	5,034	23.55
Sultan		600	75,214	11,907	60.90
silt loam		1,200	81,990	18,683	83.32
Cauliflower	10–10–10	0	5,905	0	
		300	11,500	5,595	129.37
Sultan		600	12,700	6,795	148.87
silt loam		900	14,075	8,170	172.75
Cucumbers	10–20–20	0	16,208	0	
(for pickling)		300	26,411	10,203	86.43
		450	27,042	10,834	84.94
Sultan silt loam		600	30,210	14,002	108.82
Pole Beans	5–15–10	0	14,423	0	
		500	18,973	4,550	160.00
Sultan silt loam		750	20,715	6,292	218.68
Potatoes	10–20–20	0	25,300	0	
		500	41,996	16,696	140.96
Sultan		750	37,899	12,599	86.99
silt loam		1,500	49,576	24,276	164.76
		2,000	54,902	29,602	192.02
Sweet Corn	5–20–10	0	7,422	0	
		250	7,944	522	−4.03
Sultan		500	10,076	2,654	8.04
silt loam		1,000	10,722	3,300	−4.00

[1] Values per pound paid by processors—4-year average: Broccoli—6 cents; Cabbage—¾ cent; Cauliflower—2½ cents; Cucumbers—2 cents; Pole Beans—6 cents; Potatoes—1 cent; Sweet Corn—1¼ cents.

even higher rates should be used in future studies. It will be noted that rather marked increases in yield were obtained between the treatments receiving the highest and next highest rates of application. It is apparent that as more information is developed as to the proper fertilizer rates and ratios to use and on methods of application, the quantity of fertilizer that can be effectively used for vegetable production will continue to increase.

Fertilizer Placement

Not only must the grower use fertilizer of the right ratio applied at adequate quantities per acre, but he must also consider the manner in which it is to be applied. The importance of the method of application is indicated by the data presented in Table III. In each case the results were much better from the band-applied fertilizer than when the same materials were broadcast and worked into the soil. Planters which will place the fertilizer for some crops are now available. Western Washington growers have improvised numerous "gadgets" to place the fertilizer in bands where adequate commercial equipment was not available.

Supplementary Fertilizer Applications

Results of studies to date indicate that best results are obtained when all of the phosphates needed by the crop are applied at the time of planting. Supplementary applications of nitrogen are often made later in the growing season, particularly if the appearance of the crop indicates that the nitrogen supply is becoming a bit low. Nitrogen and occasionally potash when added during the growing season are applied either as a sidedressing or with the irrigation water through the sprinkling system. The latter method is increasing in popularity.

TABLE III.—EFFECT OF FERTILIZER PLACEMENT ON YIELD OF VEGETABLE CROPS

Crop and Soil	Fertilizer		Placement*	Yield lbs/A	Increase lbs/A over broadcast	Value of increase less added harvest costs
	Kind	lbs/A				
Cabbage	15–10–10	600	Check	58,854	−9,680	−$72.60
			Broadcast	68,534	0	0
Sultan			2 Bands 2½"S x 4"B	72,213	3,679	27.59
silt loam			2 Bands 2½"S x 2"B	72,406	3,872	29.04
			2 Bands 2½"S x 3"B	74,439	5,905	44.29
			1 Band 2½"S x 3"B	74,826	6,292	47.19
Sweet Corn	5–15–10	500	Check	7,926	−435	−4.35
			Broadcast	8,361	0	0
Chehalis silty			1 Band 1"S x 1"B	9,183	822	8.22
clay loam			1 Band 2"B	10,245	1,884	18.84
			1 Band 2"S x 2"B	10,439	2,078	20.78
			1 Band 1"S x 2"B	11,261	2,900	29.00
Peas	0–20–20	300	Broadcast	3,248	0	0
Chehalis silty			Pre-drill	3,980	732	26.40
clay loam			1" below seed	3,835	587	19.15
Pole Beans	5–15–10	600	Check	15,004	−1,839	−73.56
			Broadcast	16,843	0	0
Sultan			2 Bands 1"S x 1"B	17,908	1,065	42.60
silt loam			2 Bands 2"S x 4"B	18,586	1,743	69.72
			1 Band 2"S x 2"B	19,360	2,517	100.68
			2 Bands 1"S x 4"B	19,747	2,904	116.14

* S = to side of seed or plant. B = below level of seed.

Soil-fertility Losses . . .

(*From page* 26)

It was estimated that in order to maintain the organic matter of these soils at their original level it would be necessary to apply as much as 9.2 tons of clover hay per acre annually. Soil at Guthrie, Oklahoma, which had an average of about 46,000 pounds of organic matter per acre in 1931, suffered an average annual net decline of 1,860 pounds per acre when planted to cotton during the period 1931 to 1940 (5). When planted to a 3-year rotation of cotton, wheat, and sweet clover this decline was reduced to 940 pounds per acre. Soil with a sod cover of Bermuda grass accumulated organic matter at the rate of 1,700 pounds per acre annually instead of suffering a decline. The plots planted to cotton lost the equivalent of all the organic matter returned as crop residues and in addition 1,860 pounds annually of the original reserves. The soil devoted to the 3-year rotation lost all the crop residues returned during this period plus an additional 940 pounds of its original supply. At the same time, the land devoted to Bermuda grass sod held the equivalent of its original supply of organic matter and accumulated an additional 1,700 pounds per acre annually.

During this same period the continuous cotton plots lost by erosion an average of 18.9 tons of soil per acre annually, the rotation plots 4.2 tons, and the Bermuda grass plots 0.02 ton.

A light-textured soil in Alabama, which was so nearly level that it was considered practically free of erosion, lost, by erosion, 60 per cent of all the phosphoric acid applied as superphosphate to the crops grown on it in a 3-year rotation during a 26-year period (22). During the same period 82 per cent of the phosphoric acid applied as rock phosphate was removed by erosion.

The phosphoric acid was carried away in the clay fraction of the soil that was floated off the field by surface flow. The surface soil contained only 6 per cent of clay, yet the clay fraction held over 50 per cent of the soil's supply of phosphoric acid.

The application of 200 pounds of 16 per cent superphosphate per acre annually to pasture land in the Black Belt of Alabama gradually built up sufficient reserves of phosphoric acid in the soil, after several years, to support good plant growth. However, twice this amount of superphosphate was required per acre annually to support good growth when planted to cultivated crops. An application of 550 pounds of this same fertilizer per acre annually over a 5-year period failed to build up the phosphate carryover sufficiently to maintain cotton for 2 years on Hartsells sandy loam. This suggests a serious loss of phosphoric acid by erosion.

An inch of artificial rainfall applied to pasture land in Virginia at the rate of 3 to 3.75 inches per hour washed off 9.1 per cent of a 200-pound-per-acre application of triple superphosphate made just prior to the test (20). This loss was caused by only 0.2 inch runoff or 20 per cent of the water applied. Tests made at the same time with limestone of several degrees of fineness showed that the finer the material, the greater is its removal by erosion.

More Plant Nutrients Removed by Erosion Than by Crops

Total losses of phosphoric acid by erosion where no cover crop or other conservation practices were used were double the quantity removed by tomatoes or sweet corn in New Jersey (19). Where cover crops or cover crops and manure were used annually, the loss of phosphoric acid by erosion continued to equal the quantity removed by either crop.

The removal of potassium by erosion, where no conservation practices were employed, exceeded the removal of this element by tomatoes and was nearly equal to the removal by sweet corn. Where conservation practices were employed, the potassium removed by erosion was more than half as much as that by tomatoes and continued to exceed the quantity removed from the soil by sweet corn.

The loss of the fertility-bearing fractions of the soil must be prevented if the fertility of the soil is to be maintained (12). These losses vary greatly from storm to storm and from the beginning to the end of a given storm. The rate of loss of these fractions is influenced further by soil type, ground cover, and their concentration at the surface of the soil.

Efficiency of Fertilizer Lowered by Erosion

The loss of organic matter and plant nutrients from the soil by erosion reduces the efficiency of fertilizers. The selective removal of certain parts of the soil had a more profound effect on crop growth in New York than the depth of topsoil (14). Where erosion was due to the impact of falling raindrops, had been recent, and its detailed progress recorded, the application of liberal amounts of fertilizer failed to erase the effects of plant nutrient losses on plots which previously had been cropped for a number of years in such way as to permit different rates of erosion to occur.

Several series of plots on each of the four soil types were planted to several cropping systems and given a variety of cultural practices for a period of 11 years. The different treatments permitted varying rates of erosion during the period of study. The different rates of erosion produced vast differences in the yield of corn and the efficiency in the use of fertilizer the twelth year when the whole area was uniformly fertilized with 1,000 pounds per acre of 10-10-10 fertilizer and planted to corn.

On Bath flaggy silt loam the yield of corn ranged from 17 to 88 bushels per acre as a result of the difference in the loss by erosion which occurred during the preceding 11-year period. On a second soil type the yield ranged from 40 to 106 bushels per acre. On still a third soil type the corn yield ranged from 54 to 82 bushels per acre. Even following 2 years of alfalfa-clover-timothy hay on Honeoye soil, the corn yield varied from 49 to 69 bushels per acre. In every instance the yields were consistently related to the amount of erosion that had been measured during the 11-year period preceding the planting of corn. Plant nutrients and water in the soil were used inefficiently as was shown by the small top and root growth of corn.

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Fig. 5. Fertility erosion in a cultivated field—organic matter, silt, and clay were separated from the sand by splashing raindrops. The washed sand, appearing as light-colored deposits between the rows, was left in the furrows.

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Rotation Fertilization

(*From page* 20)

As farmers become better acquainted with the factors involved in crop production, they are better able to evaluate specific conditions and utilize fertilizer recommendations. Soil-testing procedures are much more accurate today and should be used to achieve more efficient fertilizer usage. Soil tests performed by competent personnel have enabled the farmer to obtain a better idea of the amounts and kinds of nutrients to add.

Farming has become a keenly competitive enterprise. Costs and operation efficiency vary greatly from one farm to the next, but the fertilizer bill is still one of the highest costs even on the most efficient farms. Rotation fertilization is an attempt to drive the efficiency on all farms upward.

Tillers and Tellers

(*From page* 5)

sees in all this a greater need than ever for expert farm management.

The kind and amount of loans to farmers which are not in the real estate class—loans for working assets—are watched with eagle eyes these days. As of last January the total of non-real estate loans to U. S. farmers was about $6 billions. Such working and production loans have some impact on the real estate credit field. Here, too, men who handle loans in all categories have been pondering about one-package loans or other kinds known as variable-payment loans, such as Farmers Home Administration discovered and used back when it was the Farm Security Administration. Only three states had smaller sums outstanding in non-real estate loans than they had a year ago—Vermont, North Dakota, and Arkansas. The largest increases were where we'd look for them most, in Iowa, Illinois, Nebraska, and Kansas.

A country banker affirmed the general reports that commercial banks during 1950 added to their non-real estate loans to farmers by 23 per cent. Livestock loan companies and agricultural credit corporations do not have a relatively high level of such loans compared to the production credit associations. Farmers had to have new machinery and supplies to reach out and keep step with the higher goals made necessary by the national defense effort. Non-real estate credit to farmers last January was 102 per cent of the figure when the last world war ended. Since 1945 the borrowing for this reason has expanded about 18 per cent each year. Although this form of debt is hitting close to the record point, few see any signs that it is excessive when matched with the expanding farm income.

Now the trust a banker holds is an asset to his community as a whole. Or it may be a liability, if he is as poor a financial manager as the farmer with whom he places a risky loan. Irate farmers "took it out" on probate judges and country bankers back in those hectic, riotous times when "deficiency judgments" were trying to get blood out of shrunken turnips.

Probably the greatest pitfall and booby trap in the galaxy of the banks which make short-term working loans and take chattel mortgages are that there is not enough sound background information collected on a borrower. When things go sour for such a reason the confidence of the community is shaken and everyone suffers a little.

Legal forms and documents are easy to get and fill out when a lender takes a chattel mortgage. The notes are simple and convenient. The execution of the papers is a matter of swift and ordinary routine. The clerk of the township accepts and files them and we think the deal is settled.

IT'S tough on the mortgagor to find out when almost too late that the mortgagee has only a small equity in his farm or in a piece of what was imagined to be unincumbered real estate in the village. Then, in other cases, the property is in the name of the borrower's wife although her signature was not put on the chattel paper. Sometimes a contract to purchase, or land contract, is the nearest thing to a "clear title" which the borrower possesses. Or the chattel mortgage may be recorded in the wrong township through confusion with his mail address.

Experts in getting into and out of such dilemmas will also warn you that possession of equipment by a farmer doesn't signify that he is its true and legal owner. The tractor or the combine may be borrowed or rented, and some relative may have a half interest in a motor truck. The young stock in the pasture and the pigs in the pen may belong to a neighbor.

Not only is a full knowledge of the affairs of the farm a wise essential to a successful short-term operating loan, but experience has taught bankers and other lenders that you also must keep a check on the subsequent happenings out there—just in case.

Hawkshawing and snooping are not nice practices, but if they help to keep up lending morale and faith, they are useful. Quite often all is well and no untoward circumstances arise. And then, again, it pays to be alert.

Take a case where a fellow has a sizable herd of fair-producing cows with which to make good on the loan. It's a jolt to find out later that this promising herd has dwindled to five or six of the least milky ones. Naturally, a lender on chattels is often protected by state laws that say it is a misdemeanor to dispose of mortgaged property—but it's no protection against headaches and no sure way to recoup the loss.

A buyer of mortgaged chattel property is required either to hand back the said forfeited goods or make himself financially liable on what is called a "suit for conversion."

One of the best legal specialists in this field tells of a case where a cattle dealer frankly admitted that he purchased cows covered by chattels. He also asked the lender to come to his stockyard and pick out the ones that were "hot property." The joker in this loaded deck was simply that the chattel mortgage did not identify the exact cows or describe them in a way that enabled the mortgagee to select what belonged to him.

Not long ago a farmer asked for money and executed a chattel mortgage on a bunch of cows which he claimed he had just bought from a neighbor. The ear-tag numbers and such identification were supplied and properly stuck into the document for safety's sake. Subsequently it developed that the farmer had only discussed the cattle deal with his neighbor and had taken down the ear-tag numbers, without buying them. Instead he went down to a stockyard and secured some inferior cows. This upset the apple cart indeed for the chattel holder.

If a borrower gives a lender a mortgage on specific cows named and identified as such, and there is a special proviso in the paper which says it also covers cows he may later buy and own, what will happen if somebody else buys or attaches or takes a mortgage on the new cows acquired since the original chattel was issued? The answer seems to be that only the cows he owned when he made the mortgage are forfeited. This is just another ramification to make the loan business a joy forever.

QUITE often a good, decent farmer wants to retire and so he decides to hold an auction sale. But he has some property under chattel mortgage and objects to this being mentioned at the sale. Here is just one more pitfall common to the chattel business. All bother can usually be headed off by having an agreement signed by the borrower and lender. It would state that the lender agreed to having the chattels offered in the auction sale, but that there was a lien on certain goods, the proceeds from which must be kept separate by the auctioneer as a trust. There is also a risk that another creditor may show up suddenly and buy a few articles at the auction, and then try to have their value offset against the debt due him. So you can easily see why there is always a thrill about an auction—and it's not always a tear-jerking throb for the old homestead's demise, or a vague hunt for antiques.

Money makes the mare go, and nowadays has other more complex agricultural duties and responsibilities to perform. We have plunged headlong into a vortex of commercial farming. Farms are indexed more or less in types as to their prevailing source of income. The risks are written large and clear for each and every type, all part of the business of sound credit with which to fill our national cupboards and larders.

I think no discussion so brief as this about farm financing should omit to credit the banking fraternity and the government credit agents for devising and preparing a far better background of information and understanding than the country enjoyed in my youth.

At first this took the form of country banking societies, then state societies, each of which had a special agricultural committee. Out of this grew a system of farm experts who worked for one or more banks—sort of county agents in finance. They knew the countryside so well and were conversant with so many pitfalls and profitable ventures alike that few cases stumped them—and more sound loans were made.

There was a time, too, when foreign investments and big city projects attracted so much eager capital from country banks that the balance on hand with which to satisfy the normal and justifiable financial needs of the rural operators dropped to discouraging and alarming levels. To be utterly frank about it, this has happened also with government and civic bond issues—competing for stability and security against the agricultural assets of the nation.

So farmers have had to fight for credit sometimes against rather formidable competitors. This is one reason for the rise of the insured farm credit systems. Many perfectly honest tenants desiring to become owners of farms were unable to find local means to fit their pioneer situations, unless they sought this special credit available on terms a beginner could meet and yet live and prosper.

Thus on the whole, times have improved in relation to the extent of credit, and farmers don't regard such debts with the aversion that once stirred their souls to prejudice against the man behind the wicket. That they themselves have snug deposit balances is the No. 1 reason. Someday a real figure philosopher who knows all the twisted strands of farm financial history will dish himself up a book about it. I'll bet no country vet or busy sawbones can tell a story more replete with the stuff that makes Americana.

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Request bookings from your nearest distributor

A Few Whinnies

It happened in one of the large training camps. A rookie who had just recently arrived was walking down one of the paths when he met a commissioned officer. The new arrival failed to salute.

The officer stopped him and said: "Say, buddie, do you see those leggings?"

The rookie looked admiringly at the shining leather puttees and said: "Yeh, look at the damned things they gave me."

* * *

Conversation between two English professors:

"Is your wife entertaining this Fall?"

"No—not very."

* * *

The freshman's father paid his son a surprise visit. Arriving at 1 a.m., he banged on the fraternity-house door. A voice from the second floor yelled, "Whatdya want?"

The father answered, "Does Joe Jones live here?"

The voice answered, "Yeah, bring him in."

* * *

There was quite a flurry when it was discovered that at every Sunday School session the little fellow was praying, "Lead us not into temptation, but deliver us some evil."

* * *

He: "We certainly had a big time last night for ten cents."

She: "I'll say! Wonder how little brother spent it?"

A beautiful coed (from some other school) was wearing a blue sweater: it was one of those marvelous form-fitting kind.

Said she, coyly: "Don't you think it brings out the blue in my eyes?"

He: "Gulp."

* * *

A Metropolitan Symphony Orchestra had given a special performance in a small New England town. It was a new experience for many of the inhabitants. The next day some of the old-timers, gathered around the stove in the general store, were expressing their opinions of the concert.

"Well, all I got to say," commented one old character with finality, "is that was a danged long way to bring that bass drum to bang it only wunst."

* * *

Poor old Hiram! He went up to New York determined to make his living pulling some skin games on innocent strangers. However, the first fellow he tried to sell the Brooklyn Bridge to turned out to be the owner of the darned thing, and if Hiram hadn't paid him ten dollars to keep quiet they would have had him arrested.

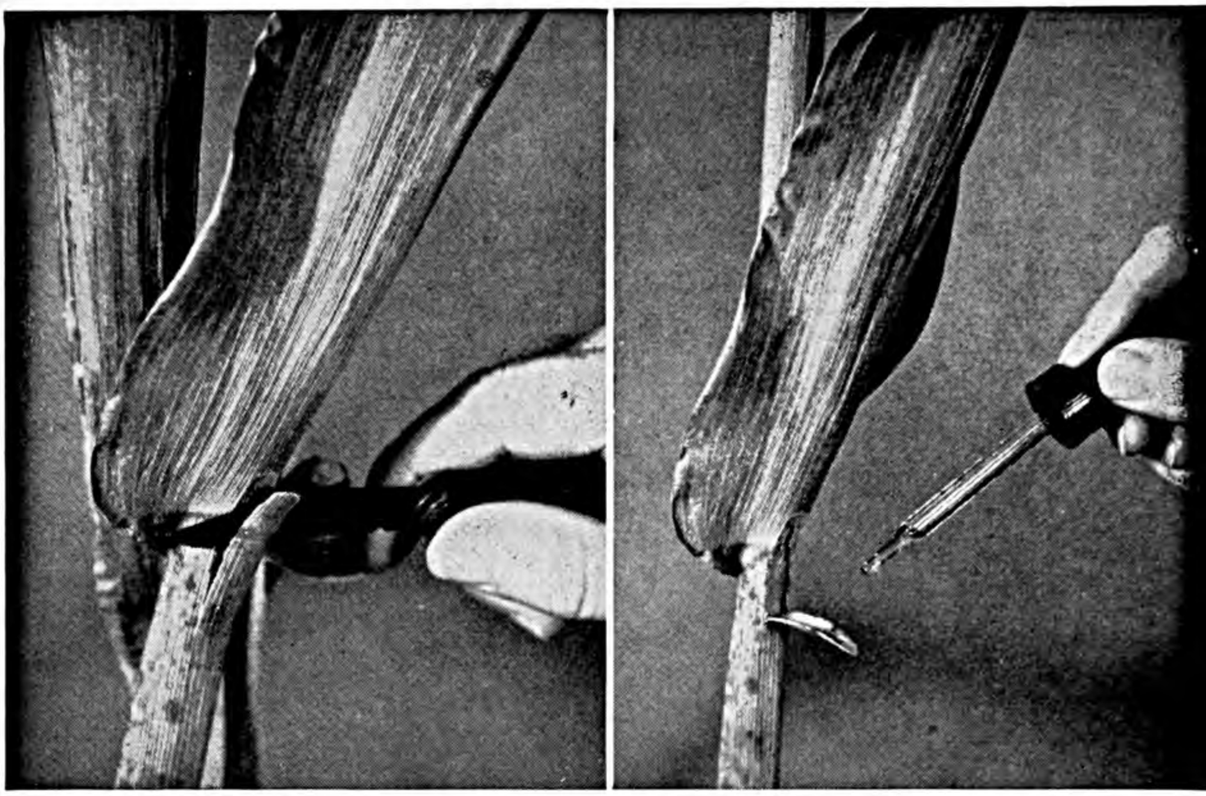
* * *

A girl telephoned her sweetheart.

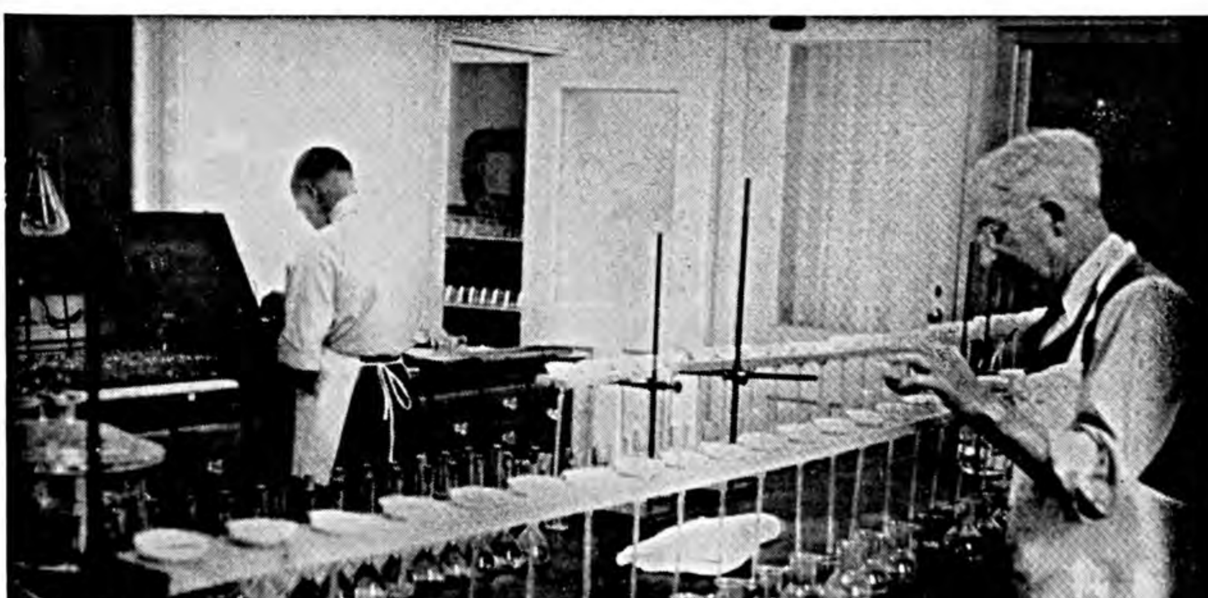
Girl: "You better not come over tonight. Daddy is mad. He found out that we used his car for joy-riding last night."

Boy: "How did he find out?"

Girl: "We hit him."



Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



Equipment used in a well-developed laboratory for soil analyses.

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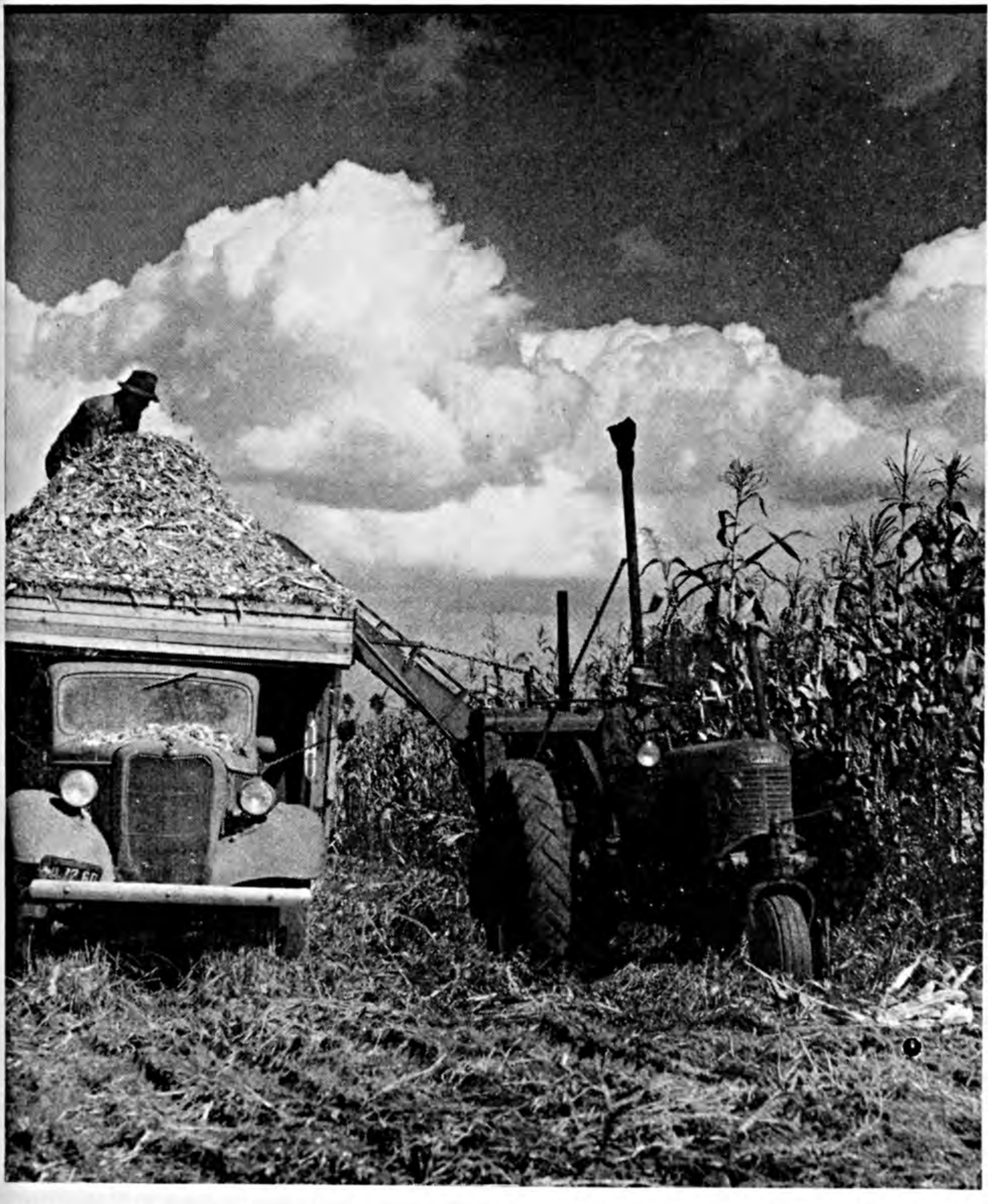

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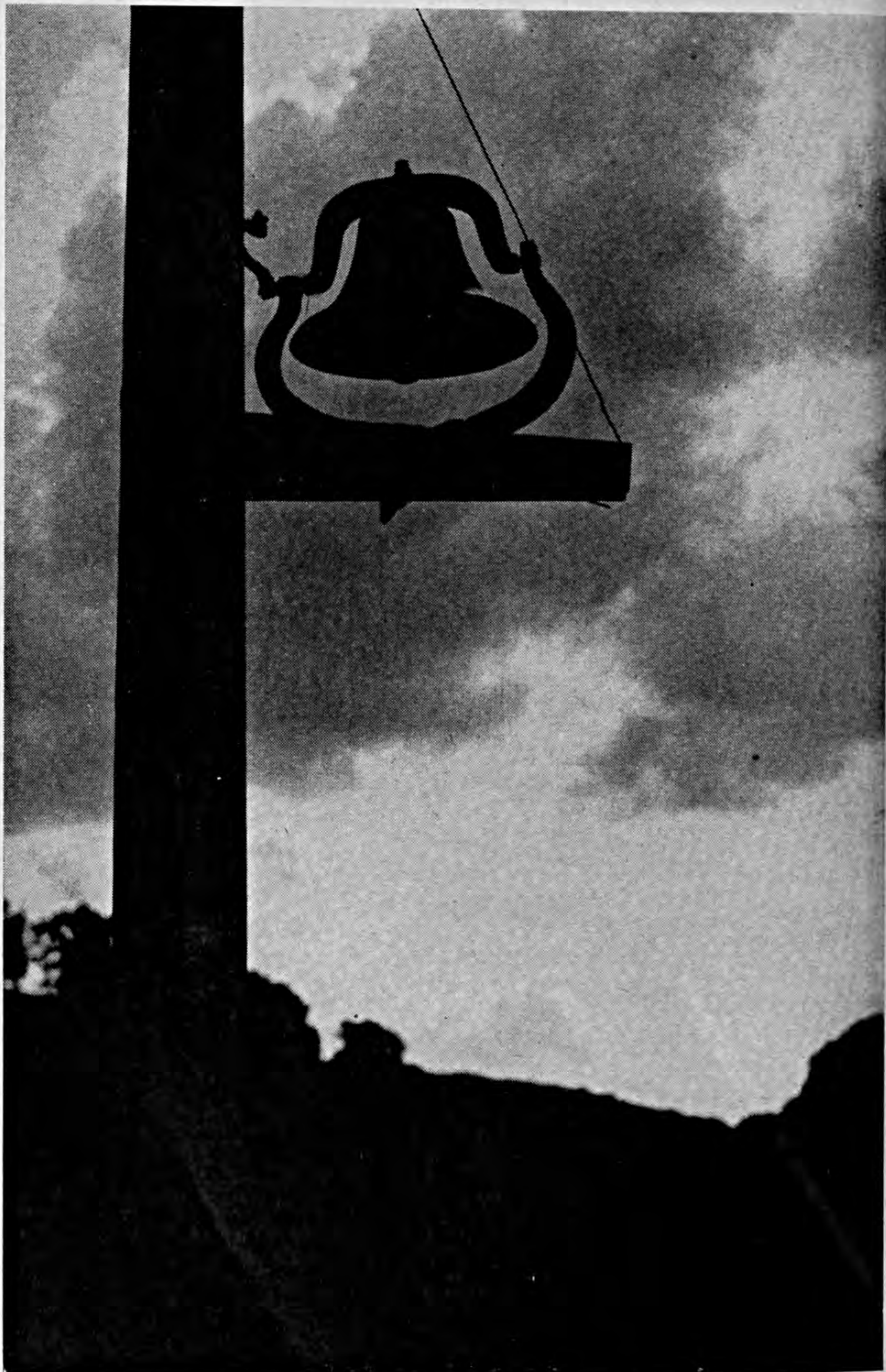

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VOL. XXXV WASHINGTON, D. C., NOVEMBER 1951 No. 9

Some Pointers on . . .

What's the Right Answer?

Jeff McDermid

COLUMBUS is the only gent I ever heard about who succeeded without much information. He carefully studied what little there was, mixed in some strong faith, and finally gave the old world a new "better half"—a new hemisphere bulging with enough information to last for centuries.

Information is always what most everyone in his right mind seems to want and need and wish for. Information is what causes men to do things, and then makes them better able to accomplish what they set out to do. We must have good information in order to spin and weave fibers and make clothes and repair them; to grow and choose foods wisely and prepare and serve them properly and appetizingly.

Parents starting out without adequate information (gained personally or by somebody's examples) are bereft of the stuff which families thrive on for success, happiness, and comfort. Religion is mostly based on faith—which Paul said is "the substance of things hoped for and the evidence of things not seen." But mankind who never have had information or experience about true Christian principles and character building surely lack any shreds of faith and cannot easily grasp any evidence, either seen or unseen. You must know and understand before you have confidence.

The Bible is a great storehouse of information. It tells about creation, original sin (which happened because of disregard for good information), and the wanderings and searchings of a pastoral people and how they relied on leadership to bring them safely to the Promised Land. It recites the solemn philosophy of the prophets, without which foundation all our knowledge is crassly material and inadequate for developing the courage and the spirit needed for life's tasks.

The New Testament is a renewal of faith based on historic facts, blended with precepts and parables which themselves are keys to the wisdom of the ages. Deprived of all this, all our modern, everyday information runs the risk of useless or improper application.

THE much-thumbed dictionary is another basic collection of information. This hefty book has to be revised and amended and extended often to keep up with the facts of progress and the new information which any such reliable source must convey. Words, like fashions, often fade and get outmoded, and new ones grow up with which to dress and embellish our mutual understanding.

Likewise, the makers of modern encyclopedias choose to print them in loose-leaf form. Obviously, this is in recognition of the constantly changing picture in the affairs of mankind. Information retailed yesterday must be modified and amplified to make it sound trustworthy today. Nothing is so discouraging as to open a book of knowledge which is as out-of-date as the parliamentary power of Joe Cannon or the Dredd Scott decision.

So we clinch one basic principle of information, one that makes it absolutely vital to keep information current and alive: *Information is necessarily a profession just as alert in its own way as the professions of medicine and law.* You can't be an in-and-outer in handling it. No dabblers or pretenders can be tolerated in the field of information, especially in technical lines. Many there are who masquerade as "information specialists" just to get into places of temporary power, where they can pour some effluvia of their own concoction into the springs of information going to the public. But our present difficulty is that we fail to separate the trained and experienced and dedicated information folks from the phonies.

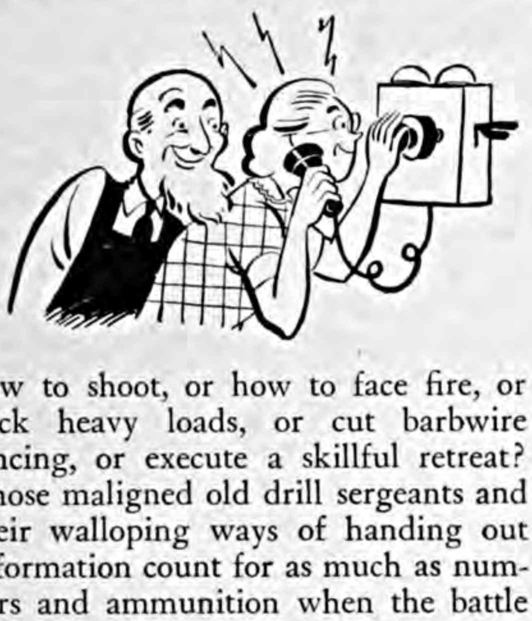
Every large corporation employs staff members of talent and training to analyze and rewrite and distribute facts and data on the operations, inventions, discoveries, innovations, and improvements wherein their firm is taking an active part. This is just as much a modern "must" in business management as the construction of a lathe or a layout for a factory. It isn't just advertising either. It is simon-pure information.

Of course, the ebullient advertising fraternity has a background of information always at hand to bolster its language and sales methods, its pictorial and radio and television technique. But advertising per se is not always true information, although based on it. It may be garbled or twisted or emphasized in certain clever ways, to suit the immediate present needs. A majority of advertising systems stick rigidly to proven facts and seldom dally with unsound or romantic and unrealistic themes. But when stripped of the fundamental information itself, sales talks are meaningless and boring, and run counter to opinions of experienced skeptics.

LARGE and small firms, associations, groups, and educational units maintain house organs to acquaint their employees and other "inside" friends with the information that cheers and inspires them to feel they are a part of a growing and a purposeful organization. This also is information jazzed up and made snappy with bright and convincing points, to hold attention and instill faith. Radio programs are built on it too.

So again we mark off a point for you to remember about information: *Information is acutely vital to the transaction of private business.* It is based on the belief that you can't fool all the people all of the time. It rests on the discovery that secrecy and bluff are poor business promoters.

Generals and diplomats absolutely rely for success on good, sound, on-the-spot information. Its absence ruins many a campaign and frustrates many a hopeful diplomatic mission. Our intelligence service in war or peace is the root of our victory and achievement. It used to be said that armies "travel on their stomachs," which in modern parlance is changed to include "flying on their briefings." To get there "fust with the mostest men" is still a good rule in warfare—but what if the men who get there don't know



how to shoot, or how to face fire, or pack heavy loads, or cut barbwire fencing, or execute a skillful retreat? Those maligned old drill sergeants and their walloping ways of handing out information count for as much as numbers and ammunition when the battle begins.

Now it may sound funny, but it's true, even our staid and hard-boiled Congressmen must have information. Sometimes they do not act on it, but they want a lot of it all the time. Their best handy source of current information is the Congressional Record, one of the country's most reliable and astonishing short-hand-reported dailies. Maybe they don't read much of it, except the fine-print appendix which carries the many speeches and letters they made or received, or sent themselves. But anyhow, it's a public record, a silent but impartial and indispensable document, and a model of accurate reporting. That is, it is scientifically reported, but the speeches are not vouched for as to logic or truth by the editors and distributors of the Record. Information therefore is not necessarily truth. It tells the reader what transpired and doesn't seek to influence him by editorial comments inserted on the side.

Moreover, Congress not long since tried to set up its own inside information service, linking it alongside the legislative reference aids open to members wishing to draft bills. Here is further evidence of the reliance of public men and women on the broad and convenient information which is prepared by experts in unbiased ways, and not by casual half-time and scheming amateurs.

Nor do members of Congress stop there. They keep their staffs busy telephoning various departments of the government, mostly to secure the answers to the vast barrage of anxious queries put to them by their importunate constituents. No day passes without hundreds of scurrying employees scattered throughout the bureaus whose pressing job for the moment is to get a reply at once to the Hon. Bill Lawmaker. If the department's hasty searchers are "misinformation" men or outright phonies, Mr. Lawmaker is going to get some bum advice.

NOW this in turn brings us to point three of our information test: *Public dependence upon sound information is the bulwark of sound and honest government.* Lack of it causes all those costly hearings.

Few there are in or out of Congress who actually sense the fact that information gathering and handling are professional tasks. Nor is it often recognized that professional information workers of the highest caliber are folks who disdain to color or distort the events and the activities unfolding before them. But the misfits and the phonies do.

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Corn Research Results At Work in North Georgia[1]

By Orien L. Brooks

Georgia Mountain Experiment Station, Blairsville, Georgia

THE adoption of better corn-growing methods by farmers in north Georgia has resulted in the production of much higher yields in this area than the present State average of 16.5 bushels per acre. When all of the improved practices are followed, yields of 6 to 10 times the State average are being produced, often on the same, previously low-yielding soils. Boosting yields from 10-20 to 100-150 bushels per acre covers a wide gap and, necessarily, requires sound soil management and proper cropping methods.

Corn fertility studies in relation to soil types were started in the mountain area in 1946. The primary aim of these tests was to discover the major problems of soil and crop management and to help farmers correct them whenever possible. Variety and spacing tests also played an important part in the over-all effort to increase corn yields. These experiments represented the frontier of basic research with field crops in this mountain area. All of the tests were conducted on outlying experimental areas under actual farm conditions. In this way the desired types of soil and levels of fertility could be obtained.

This approach brought many people who should be interested in such tests into action; and, more important, it allowed farmer participation. This was a new experience for the cooperators and has made for a working relationship among farmers and between agencies that has made field results more meaningful. As a result of this arrangement, cooperative test methods have become field practices very rapidly.

With the careful management of some 1,500 plots annually (allowing for randomization and replication to correct for soil variation and experimental error), sound recommendations for increasing corn yields after a period of five years can easily be made: (1) Use plenty of fertilizer in the right proportion and at the right time; (2) plant an adapted hybrid; (3) leave enough plants per acre to make efficient use of the fertilizer applied and the natural fertility of the soil; (4) sidedress when plants are 35 days old; and (5) cultivate lightly and often until the corn is about 2½ feet tall, and then stop plowing.

The value of these tests will be better understood if field results are noted. Most striking of all the yields recorded were those that so forcefully showed that the application of not just one but several of the major plant-food elements is necessary to produce high yields of good quality corn.

Perhaps it is too widely believed that nitrogen and moisture are all that are needed to produce corn in Georgia. The lack of nitrogen is the most common cause of poor corn yields in the mountain section, but on some soils the lack of phosphate or potash can reduce yields just as much. Also, responses to lime were obtained in sev-

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[1] Cooperative testing at Blairsville, Georgia, of the Soils and Fertilizer Research Branch, Division of Agricultural Relations, Tennessee Valley Authority; Georgia Mountain Experiment Station, the Georgia Experiment Station, the Georgia Extension Service, and various cooperating farmers.

Fig. 1. Response to complete fertilization on test area.

eral cases. On 30 different fields ranging from poor to good in fertility, lime gave an average increase of 5.3 bushels per acre. This is about one-third of the average yield per acre for the State, and enough at the current price of corn to pay the purchase and spreading costs of lime. Phosphate has given a boost of 35.4 bushels per acre on some poor soils, or 1¾ bushels of corn for each six-cent investment. On a Hayesville soil, potash increased the yield by 61.6 bushels per acre over corn grown without potash. This element is more often lacking on black, bottomland soils. The average results of four years of testing on various soils at various fertility levels have demonstrated that liberal applications of potash are economically sound.

These results are proof that the application of single elements is important in corn production only in particular situations and on individual soils. Generally, the need is for balanced amounts of all the plant-food elements just as all the required ingredients are necessary in order to produce high yields of good quality. A typical yield increase by complete fertilization is clearly proved by a recent test on a Transylvania soil. Corn was practically a complete failure on this field without fertilizer, producing only 7.5 bushels per acre. When enough fertilizer was applied, the yield jumped about 100 bushels per acre, or 14.7 times to 108.7 bushels per acre. The producer should have his soil tested to determine whether he needs one or all the plant-food elements. Soil testing is provided as a free service to all the farmers of Georgia.

Increasing corn yields, like travel to a certain point, may be approached by more than one route; and just as surely as two mules can plow a field more quickly than one, corn yields can be pushed higher by making use of more than one good practice. Adapted hybrids are outyielding open-pollinated varieties to the extent that farmers are losing money when they continue to plant the old standby. Ga. 101 and Dixie 17 have outyielded the most commonly used variety by 24 and 21 per cent, respectively.

Corn plants should be spaced according to the amount of fertilizer put down on both poor and rich soils. Yields from spacings closer than those commonly used have ranged from 8

Fig. 2. Field response to complete fertilization where potash is the greatest limiting factor. Check plot center yielded 7.5 bushels per acre. Yield on right was 108.7 bushels per acre.

to 32 per cent above those obtained from the common rates of planting.

What are farmers doing about higher corn yields per acre? Here are the returns from the effort. Even before any results were published, farmers were so well acquainted with the facts in the field that some practices became established. Three years ago we started asking for a 4-12-12 fertilizer and this was one of the first sections to obtain a fertilizer of this analysis for general use. It has proved to be a good fertilizer for pastures as well, and is being recommended even outside north Georgia. Fertilizer of this analysis is also being used on many other crops.

For average conditions these tests have shown that the best economic return can be gained and the soil left at about the same level of fertility when 500 pounds of 4-12-12 are applied at planting and adequate sidedressing is applied. The planting application places one-third of the N and all of the P_2O_5 and K_2O under the corn, while 40 pounds of N are applied as sidedressing when the corn is 35 days old, or about 2½ feet high.

On one farm that is mostly bottomland Transylvania soil, the operators stated that previous to 1947 they had never produced yields better than 40 bushels per acre on the average. A fertility, spacing, and hybrid-variety test was conducted, all the same year, on this farm. The following year, combining all of the best results from these tests, each of the five operators produced more than 100 bushels per acre on some part of his crop.

One of the first areas selected for these experiments was on a Hiawassee soil. It was estimated that the operator had produced a yield of 20 bushels per acre on the previous crop. The farmer's estimate was even lower. After cooperating in a fertility, spacing, and variety test, the same operator combined the best practices from each test in the same field. The yield, then, from one acre was 157 bushels per acre of good corn, or approximately an eightfold increase over the crop grown three years before in the same field.

During the fourth year of this corn-testing program, 194 farmers in the three counties (Towns, Union, and Fannin) in which the experiments were conducted produced 100 bushels

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Fig. 1. Japanese farmer applying night soil to area between the rows of vegetables.

Fertilizer in Japan

By E. V. Staker[1]

Chemurgy Department, University of Nebraska, Lincoln, Nebraska

FERTILIZER has played an important role in Japanese economy for centuries. It is not known when the use of commercial fertilizer began, but history records that as early as 1624 trade in fish-meal fertilizer flourished in Osaka. Authoritative Japanese sources claim that fertilizer commerce began in Japan 100 years earlier than in Europe. At first, trade was confined to organic materials. It was not until 1886, the date which marked the beginning of the superphosphate industry, that inorganic fertilizer came into use.

Agricultural conditions peculiar to Japan have resulted in fertilizer problems which are especially characteristic of that country. Soils are low in fertility. This condition stems partly from the fact that approximately 25 per cent of the arable area is derived from volcanic ash material low in fertilizer nutrients. In addition, centuries of intensive cropping have reduced the potential supply of plant-food elements in the soil to such a point that high crop yields cannot be obtained without liberal applications of fertilizer.

For many years before the outbreak of World War II, the soils of Japan were heavily fertilized in comparison with those of most other countries. Data compiled by the Ministry of Agriculture and Forestry show that with respect to commercial fertilizer consumed by the major agricultural countries of the world during 1935-1937, in pounds per acre of arable land, Japan was third in the total amount of nitrogen (37.4 lbs.), fifth in phosphoric acid (34.4 lbs.), and fifth in the amount of potash (15.1 lbs.). During the same period,

[1] Formerly Scientific Consultant, Agricultural Division, GHQ, SCAP.

Japan was the world's largest user of ammonium sulfate.

Fertilizer Requirements

On the basis of current crop acreage, the total quantity of fertilizer required for maximum economic production of all crops under present conditions is estimated to be equivalent to 2,293,000 metric tons of ammonium sulfate (20% N), 1,725,000 metric tons superphosphate (16% P_2O_5), and 607,000 metric tons of potash salts (40% K_2O). As additional land is brought under cultivation through the land reclamation program, these requirements will increase. A recent survey of farmer demand conducted by the Ministry of Agriculture and Forestry indicates that at current prices farmers would buy somewhat less than the quantities indicated above. Effective farmer demand cannot be projected accurately because of difficulties in estimating effects of prices, farmer education, etc. For planning purposes, the demand for nitrogen in US FY 51 [1] was estimated as equivalent to approximately 2,000,000 metric tons of ammonium sulfate, phosphate equivalent to 1,650,000 metric tons of superphosphate, and potash equivalent to 500,000 metric tons potash salts (40% K_2O).

Production

In 1941 the nation had ample facilities to produce most of her nitrogenous and phosphatic commercial fertilizer requirements. Phosphate rock for processing into superphosphate, however, had to be purchased from abroad; and the inorganic potash supply was entirely dependent upon imports. Indigenous deposits of phosphate rock and potash are virtually non-existent.

In 1937 Japan ranked third in world production of nitrogenous fertilizers, and sixth in the amount of phosphatic fertilizers processed. Average annual production of all three types of commercial fertilizer during the period 1936-40 was larger than during any other five-year period. Average nitrogen output (organic and inorganic forms combined) during this period was equivalent to 1,814,000 metric tons ammonium sulfate annually, superphosphate averaged 1,936,000 metric tons, and potash was equivalent to 25,000 metric tons salts (40% K_2O). More than half of the commercial potash manufactured during this period was organic material.

During World War II, Japanese fertilizer plants were badly damaged by Allied bombing raids. After the termination of hostilities, the Occupation took immediate steps to rehabilitate the fertilizer industry, and on May 17, 1946, the Supreme Commander for the Allied Powers approved the conversion of a number of nitrogen plants formerly used for munitions manufacture to the production of nitrogenous fertilizer. At that time, these plants, together with those normally supplying fertilizers, were judged capable of eventually turning out the equivalent of about 2,000,000 metric tons of inorganic nitrogen fertilizer annually.

Great progress has been made in increasing indigenous fertilizer output since 1945. The output of inorganic nitrogen materials in US FY 50 was equivalent to 1,816,602 metric tons ammonium sulfate, slightly larger than the prewar (1936-40) average production of organic and inorganic nitrogenous fertilizer combined. It is expected that production equal to the 1946 2,000,000-ton capacity estimate will be achieved in US FY 51.

Production of superphosphate fertilizer from imported phosphate rock also has increased rapidly since 1945 and will nearly equal estimated crop requirements for US FY 51. Potash supplies from domestic sources will continue to be of no commercial importance.

Fertilizer production in Japan for fiscal years 1946-50 inclusive and estimated output in fiscal year 1951 are shown in Table I. The figures do not include relatively small quantities of

[1] The United States fiscal year begins July 1 and ends June 30.

nitrogen, phosphorus, and potassium derived from organic fertilizers, reliable data for which are not available.

Imports

To help meet the pressing need for fertilizer to increase food production, the Occupation instituted an import program. Imports of fertilizer and phosphate rock into Japan during U. S. fiscal years 1946-50 are shown in Table II.

Though the data for nitrogen in Table II are expressed as equivalent to ammonium sulfate, all nitrogen imports until late in FY 50 were in the form of ammonium nitrate procured from U. S. Government-owned ordnance plants in the United States. During the closing months of FY 50, substantial tonnages of ammonium sulfate were imported.

Consumption

The combined effect of the import and indigenous production programs sponsored by the Occupation has been a steadily increasing supply of commercial fertilizer to farmers. Annual con-

TABLE I.—PRODUCTION OF INORGANIC COMMERCIAL FERTILIZER IN JAPAN [1]

(metric tons)

	Nitrogenous	Phosphatic	Potassic
US FY 46..	345,251	190,141	Negligible
US FY 47..	811,914	455,616	Negligible
US FY 48..	993,428	871,799	Negligible
US FY 49..	1,371,663	1,041,977	Negligible
US FY 50..	1,816,602	1,463,642	Negligible
US FY 51 [2].	2,000,000	1,562,000	Negligible

[1] Nitrogenous fertilizer expressed as equivalent to ammonium sulfate (20% N) and phosphatic as superphosphate (16% P_2O_5). Source: Industry Division, Economic and Scientific Section, GHQ, SCAP.

[2] Tonnages for FY 51 are estimates.

TABLE II.—IMPORTS OF COMMERCIAL FERTILIZER AND PHOSPHATE ROCK INTO JAPAN [1]

(metric tons)

	Nitrogenous Fertilizer	Potash Fertilizer	Phosphate Rock
US FY 46..	0	0	10,895
US FY 47..	118,552	112,536	782,018
US FY 48..	481,965	8,391	630,305
US FY 49..	363,471	255,473	238,293
US FY 50..	464,580	243,054	757,368

[1] Nitrogenous fertilizer expressed as equivalent to ammonium sulfate (20% N), potash fertilizer as potash salts (40% K_2O), and phosphate rock as 32% P_2O_5.

Fig. 2. Farmers near Tokyo applying fertilizer in rows before planting fall wheat. The man and woman on the left are adding a mixture of compost and superphosphate. This is covered with a shallow layer of soil upon which the man at the right distributes a mixture of ammonium nitrate and potassium chloride. Soil is again spread over the row after which the seed is sown.

Fig. 3. Japanese at work on fertilizer experiment using white potatoes as the test crop. Picture taken in May 1950, Hokkaido Agricultural Experiment Station, Sapporo, Japan.

sumption by Japanese agriculture for fiscal years 1946-50, inclusive, is shown in Table III.

The aggregate consumption of all fertilizer nutrients from inorganic sources in FY 50 was equal to 113 per cent of the 1931-40 average annual usage and 91 per cent of the 1936-40 average annual usage. In addition, the Ministry of Agriculture and Forestry estimated that organic fertilizer equivalent to 132,000 metric tons of ammonium sulfate, 63,931 metric tons of superphosphate, and 14,000 metric tons of potash salts, respectively, were consumed.

TABLE III.—CONSUMPTION OF INORGANIC COMMERCIAL FERTILIZER IN JAPAN [1]

(metric tons)

	Nitrogenous (20% N)	Phosphatic (16% P_2O_5)	Potassic (40% K_2O)
US FY 46..	452,142	32,156	8,805
US FY 47..	842,992	348,616	100,000
US FY 48..	1,462,324	705,483	15,000
US FY 49..	1,731,090	1,034,977	154,000
US FY 50..	1,750,057	1,185,139	205,498

[1] Consumption includes fertilizer used by crops, that used by government institutions, and quantities awarded to farmers as incentive goods.

Exports

Exports of commercial fertilizer from Japan during the period 1936-40 averaged the equivalent of 217,000 metric tons of ammonium sulfate and 232,000 metric tons of superphosphate annually. Potash exports were negligible. During World War II exports were insignificant except for nitrogen in 1942 and 1943 when the equivalent of 120,000 and 148,000 metric tons, respectively, of ammonium sulfate were sold abroad. Since Japan's indigenous production of commercial fertilizer during the postwar period has been drastically short of the quantities needed to maximize agricultural production in the country, Natural Resources Section, GHQ, SCAP did not authorize the export of fertilizer except for relatively small shipments to Korea and the Ryukyus. Tonnages of commercial fertilizer exported since the termination of hostilities of World War II are shown in Table IV.

Supplies of ammonium sulfate available for export in US FY 51 will be considerably larger than in any previous postwar year. Production probably will not exceed domestic requirements but carry-over from the previous year

TABLE IV.—EXPORTS OF COMMERCIAL FERTILIZER FROM JAPAN [1]

(metric tons)

	Nitrogenous	Phosphatic	Potassic
US FY 46..	0	0	0
US FY 47..	3,597	48,081	0
US FY 48..	29,354	116,554	0
US FY 49..	627	21,675	0
US FY 50..	3,782	2,915	737

[1] Nitrogenous fertilizer expressed as equivalent to ammonium sulfate (20% N), phosphatic as superphosphate (16% P_2O_5), and potassic as potash salts (40% K_2O).

will exceed materially the normal carry-over requirement. This relatively large carry-over (equivalent to approximately 455,000 metric tons of ammonium sulfate) resulted from production rates during the spring of 1950 which far exceeded expectations and which were made possible chiefly by increased availability of hydroelectric power resulting from abnormally heavy rainfall.

Allocations

The necessity for a fertilizer allocation system, as an aid to achieving efficient use of diminishing fertilizer supplies, became evident to the Japanese government during World War II. Such a system was first established through the Nogyokai or Agricultural Association. In the fall of 1944, however, the responsibility for allocating fertilizer to farmers was taken over by the Ministry of Agriculture and Forestry.

Improvement of the fertilizer allocation system was one of the first problems receiving attention by Occupation Forces. Close cooperation between fertilizer specialists in the Agriculture Division of Natural Resources Section, personnel in other sections of General Headquarters, Supreme Commander for the Allied Powers, and officials of the Japanese government brought about a satisfactory solution of most phases of the problem. One of the important results of this collaboration was more efficient allocation of the limited supplies as between various crops, on the basis of individual crop requirements. Farmer interest in allocations also was stimulated. Farmers learned to insist on fair allocation practices, especially at the village level.

The organization of the Fertilizer Distribution Kodan (Fertilizer Distribution Corporation) as a government-

Fig. 4. Preparing fertilizer plots for the transplanting of rice. Note concrete frames used. Tohoku Agricultural Experiment Station, Omagari, Japan, June 1950.

owned corporation in 1947 facilitated fertilizer distribution. This organization received domestically produced nitrogenous and phosphatic fertilizer at the factory and distributed it to prefecture, city, town, and village warehouses in accordance with the allocation plan prepared by the Ministry of Agriculture and Forestry. The Fertilizer Kodan also had the responsibility for distributing imported nitrogenous and potassic fertilizer on a similar basis.

From the closing years of World War II to the end of 1949, quantities of commercial fertilizer used by farmers were limited principally by available supplies. As a measure to minimize inflation of food crop prices and to maximize food production without placing undue burden on the farm economy, the prices which farmers paid for fertilizer were controlled by the government at a level which generally did not limit farmer purchases. Domestic production and imports of fertilizer were subsidized by the government to make up the difference between actual costs and prices paid by farmers.

With total fertilizer supplies during US FY 50 approaching the 1936-40 average level of usage and 1949 staple food crop production exceeding the 1936-40 level, SCAP and Japanese government officials believed that elimination of subsidies and controls should be initiated. This was effected on August 1, 1950, except for a government import subsidy on phosphate rock. At the same time the business of the Fertilizer Distribution Kodan was limited to liquidation sales.

Since that date all sales and shipments of fertilizer including exports have been on a free market. In the case of exports, however, the Japanese Government requires export licenses to prevent a reduction of indigenous supplies to a point below demand for the various items.

The effect of decontrol on retail fertilizer prices has not been particularly unfavorable. The price to the farmer on December 1, 1950, of ammonium sulfate (20% N) and superphosphate (16% P_2O_5) was slightly lower than on August 1 the same year. On the other hand the cost of sulfate of potash increased 35 per cent and muriate of potash about 8 per cent.

Use of Organic Materials

The importance of maximizing the use of such materials as compost, animal manures, and night soil in crop production has been emphasized by the Japanese government for many years. It is estimated that during the five-year period, 1936-40, the percentages of the total quantities of fertilizer nutrients supplied by farm manures were: nitrogen, 48 per cent; phosphoric acid (P_2O_5), 35 per cent; and potash (K_2O), 74 per cent. The current use of compost and night soil is estimated to be above the 1936-40 average.

Work of the Agricultural Division, GHQ, SCAP

The Agriculture Division has advised and guided Japanese government officials in planning and carrying out many phases of the over-all fertilizer program. Assistance has been given in the determination of import needs and timely allocations to the various crops. Research work on fertilizers has been actively promoted.

As a result of Agricultural Division advice and guidance, Japanese technicians established in 1950 a number of field plot experiments to determine the fertilizer requirements of the staple food crops. While considerable data were already available from fertilizer tests made in past years, it was impossible in most cases to arrive at any definite conclusions. This was largely because of inadequate plot layouts.

Experiments begun in the spring of 1950 were limited to potatoes, sweet potatoes, and rice. The tests were as well distributed geographically as climatic requirements for the crops would permit. A randomized block design was used which made it possible to de-

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Fig. 1. Whitehall Farm cows are getting their fifth feeding off this ladino pasture this season. Photo was taken September 4. Corey home is in background. Mr. Corey confines cattle while grazing by electric fence so that the cows are concentrated in a given area rather than allowed to meander over the whole pasture.

M. V. Corey, Middletown, R. I. 1951 N. E. Grassland Winner

By H. M. Hofford

University of Rhode Island, Kingston, Rhode Island

THE money he spends for fertilizer is the best investment Manuel V. Corey of Middletown, R. I., makes in his annual farming operation. Winner of the 1951 New England Green Pastures Contest, Mr. Corey says his program of split application of fertilizer to his fields is in his opinion a major factor in the outstanding success of his grassland farming.

On his Whitehall Farm—so named because on it is located the 222-year-old farmhouse called "Whitehall" that was built in 1729 by Dean George Berkeley, famed British philosopher—comprising some 84 acres, the backbone of his feeding program is ladino clover for pasture, and alfalfa and red clover in combination with grasses for second and third cutting hay. He has been milking 45 cows on a one to six grain to milk ratio.

Mr. Corey has been using a 5-10-10 fertilizer for seeding down and 600 to 800 pounds of 0-20-20 fertilizer per acre for topdressing, applying it in both the spring and the fall on some pastures, and about 400 pounds at each season on others. Besides, he adds a light coat of manure and superphosphate daily during the winter from the barn.

The Corey herd goes out to pasture about the middle of April and stays up to November. Some of the fields yield from four to six feedings.

Farmer Corey attributes some of the

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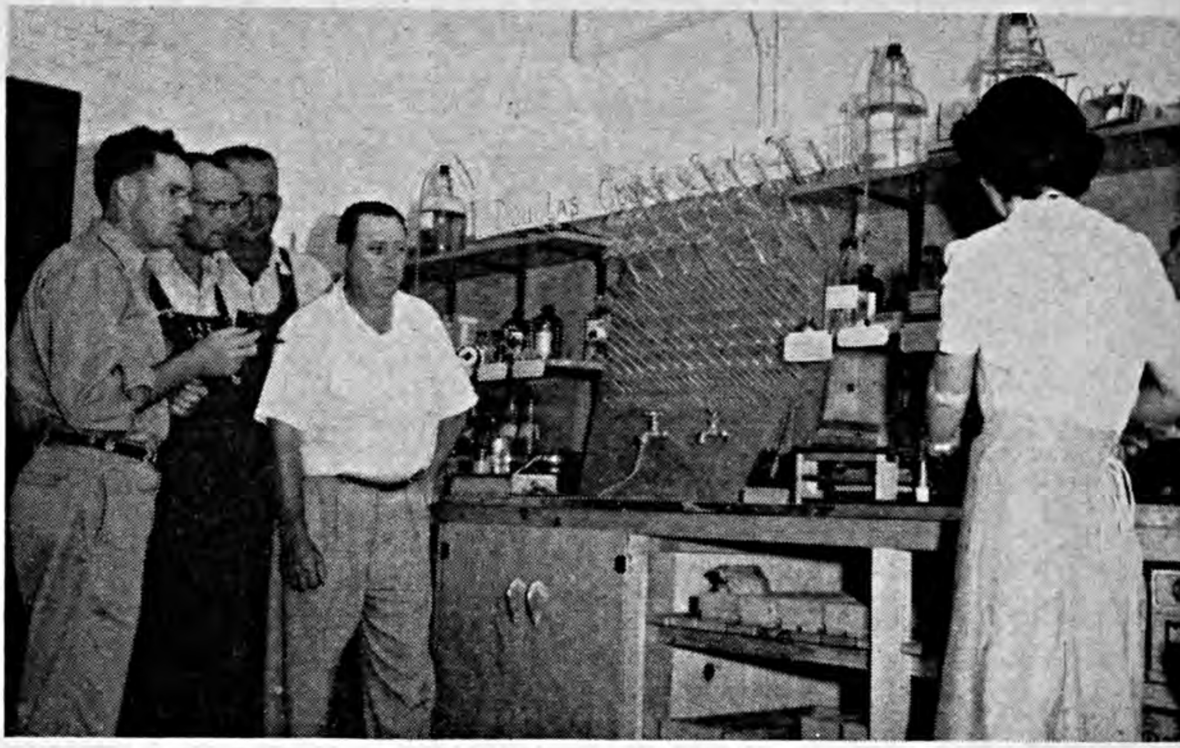

Fig. 1. While Miss Lorene Horner, Laboratory Technician, is making soil tests, Marcus Holman, County Agent for Douglas County, explains to visiting farmers the setup and operation of their county soil-testing laboratory.

Fertilizer Recommendations Based on Soil Tests

By O. T. Coleman

Soils Department, University of Missouri, Columbia, Missouri

BY integrating fertilizer recommendations with soil tests, we have been able to materially reduce the risk in production and the resulting net returns by fertilizing the soil so that plant food will be eliminated as the limiting factor in plant growth. Soil tests made possible more intelligent deep applications of the plant foods needed to bring up the level of fertility to an adequate reserve supply of the different nutrients in proper balance for maximum production of quality crops. When this is done, and this level is maintained through the use of starter or maintenance applications, the calculated risk is reduced to such other factors as unadapted varieties, poor drainage, lack of or excess moisture, improper planting and cultural practices, and disease or insect damage, or a combination of these. Usually, however, when plant foods are ample and in proper balance in the zone of the feeder roots during the growing season, there is a material reduction in the calculated risk resulting from the detrimental effects of these other limiting factors.

Considerations which should receive major attention in reducing this calculated risk to the minimum when integrating fertilizer recommendations with soil tests are:

1. The exchange capacity of the soil.
2. The species of plant and the root

surface in contact with the soil.

3. The amounts of the various plant foods that will be released from the soil during the growing season—as indicated by soil tests.
4. The nature and condition of the soil treatments applied, the soil to which they are applied, and when and how they are applied.

In our 72 county soil-testing laboratories, all financed locally, tests are made for per cent organic matter, soluble phosphate, exchangeable potash, calcium, magnesium, and soil acidity, or pH. Twenty-six of these laboratories are now measuring the pH and total hydrogen with a limemeter, developed by C. M. Woodruff of the Department of Soils. The remaining 46 laboratories use the Comber test for determining soil acidity. The phosphate and potash tests used were developed by Dr. R. H. Bray of Illinois, while the organic matter and the exchangeable calcium and magnesium tests were developed by Dr. E. R. Graham of the Department of Soils, University of Missouri.

Our first three county laboratories were established in 1946. The following table shows the number in the State the last three years, the total number of tests made, the number made per laboratory, and the number of farmers taking advantage of this service.

Year	Number of county labs.	Number of samples tested	Av. number tests/ lab.	Number farmers having tests made
1948.	46	24,331	529	12,577
1949.	60	45,369	756	19,614
1950.	69	67,648	980	29,080

In 1951 there have been three additional county laboratories set up.

Largely as a result of this testing program, fertilizer recommendations made more on the basis of pounds of plant food than pounds of fertilizer are now worked out with the farmer. Because of this, combined with our policy of thinking with the farmer rather than for him, and the cooperation given by our farm organizations and fertilizer dealers in making higher analysis goods available, the average per cent of plant food in mixed fertilizers sold in Missouri has increased from 21% in 1946 to 27.4% for the last six months of 1950. In the materials and mixed goods used, the total tons of nitrogen has increased from 4,665 to 21,865, the tons of potash from 9,964 to 26,047, and rock phosphate used from 3,954 tons to 116,451 between 1946, when our first three county soil-testing laboratories were set up, and 1950. During this same period the total tons of plant foods in all processed goods has increased from 45,677 to 100,547.

Since the exchange capacity of the soils in Missouri vary from less than 5 milliequivalents per 100 grams of soil on the sandy southeast Missouri lowlands and the highly leached Ozark uplands to about 30 milliequivalents on our heavy Wabash clay bottom soils high in organic matter, consideration must be given this factor in determining the release of plant foods and the level to which the mineral supply should be built up. Fortunately, however, most of our soils have a relatively high content of montmorillonite, or swelling clays, which serve as a storehouse for plant nutrients. The high exchange capacity of this type of clay makes it possible to build back plant-food reserves that have been exhausted by excessive cropping. The exchangeable nutrients, namely, potassium, calcium, magnesium, and the adsorbed phosphorus ion, are relatively immobile, hence move through this kind of soil quite slowly. When applying these nutrients, they should be placed well into the soil so as to be in the zone of the plant roots in order that they may be most effectively used. Since they do not leach readily out of such soils, they can safely be applied in sufficient quantities to restore deficiencies and meet the major plant-food needs for several years, especially when proper starter or maintenance applications are used.

Because of the relative immobility of these mineral nutrients, their availability to plants is largely dependent upon the extent to which their root surface is in contact with the soil. It has been shown by Dittmer[1] that the soybean has only 2.5 square inches of root surface in contact with a cubic inch of soil; the oat plant, 13.9 square inches; and the rye plant, 30 square inches. This variation in root surface in contact with the soil explains why a higher level of fertility is needed for satisfactory production of soybeans and similar crops than for rye which has a more extensive root contact with the soil. Since such plants as clovers and alfalfa have the ability to synthesize a high protein content in their tissues, they will naturally have a higher requirement for mineral nutrients than do the more carbonaceous non-legumes. Because of this, the higher protein crops grow satisfactorily only on soils with a high mineral content, while a crop such as rye which has rather an extensive feeder root system and is lower in protein does not require as high a level of mineral nutrients to make its yield of greater carbohydrate and cellulose content.

The fact that poor soil is able to release a sufficient amount of plant food for a fair crop in a favorable growing season has been responsible for the erroneous and rather widespread belief that weather is responsible for good or poor crops. Soils with a high reserve of soil fertility are able to release sufficient nutrients for a fair crop even in unfavorable growing seasons. This explains why in unfavorable growing seasons, crops on poor soils fail chiefly because of insufficient fertility. Our Missouri River bottom soils, with their high stock of reserve minerals, produce a fair crop of the protein-rich soybeans in unfavorable growing seasons, while on our depleted prairie uplands, they will be almost a failure but will produce a fair crop in good growing seasons.

Unlike mineral nutrients, nitrates are mobile and are carried down into the soil by percolating water. Because of this, nitrates cannot be stored as such in the soil and do not lend themselves so well to measure by soil tests. The amount of this nutrient present in the soil varies with bacterial activity, which in turn is affected by soil tilth, drainage, aeration, the amount and kind of organic matter, soil texture, etc. Nitrogen, however, is held in the soil in a rather stable form as organic matter or humus. A much better estimate of the nitrogen that will be released during the growing season can, therefore, be made by testing the soil for its per cent of stable organic matter.

As this organic matter decomposes, it produces the mobile nitrates which diffuse readily through the soil with the percolating soil water to the roots, and as a result they are approximately 100% available. Since under average Missouri conditions about 5% of this organic matter is nitrogen, one can readily determine from the per cent of stable organic matter in the surface 7 inches of soil how much of this plant nutrient is present. Under Missouri soil and climatic conditions, it has been found that from 4 to 6% of the total nitrogen present in stable organic matter is released annually from the sands and sandy loam soils, from 2 to 3% from the silt and silt loam soils, and about 1¼ to 2½% from the clay and clay loam soils. For example, if a soil showed 2% stable organic matter, this would mean that 2% of the surface 7 inches, or the 2,000,000 pounds of soil, would contain 40,000 pounds of stable organic matter. Considering that an average of 5% of this organic matter is nitrogen, this would be 2,000 pounds of this nutrient in the surface 7 inches of soil. If this was a poorly drained, poorly aerated silt loam soil with a relatively high lime requirement and had been poorly handled and cropped,

[1] Dittmer, H. J., *A Quantitative Study of the Subterranean Member of the Soybean*. Soil Conservation, Vol. 6, 1940, pp. 33-34.

Fig. 2. This field was treated according to soil test recommendations and the stand increased to better utilize this added fertility. Experiments and field demonstrations have strongly indicated that weeds are much easier to control and less cultivation is necessary under these conditions.

the minimum of about 2% or approximately 40 pounds of this nitrogen would be released during the average growing season. If this soil was well drained and well aerated and contained a fair supply of minerals, one could expect a nitrogen release of approximately 3% or 60 pounds during the growing season. Since it requires from 1½ to 2 pounds of this nitrogen to produce a bushel of corn, this would mean that on the poorly drained and poorly aerated silt loam soil having a test of 2% organic matter, enough nitrogen would be released for the production of 20 or 26 bushels of corn

Fig. 3. This field was the same type of soil as that in Fig. 2 but was farmed according to outmoded methods of corn production. Note the weeds and grass growing in the corn.

during the average growing season. On the other hand, on a well-drained and well-aerated silt loam soil testing 2% organic matter, one could expect a yield of between 30 and 40 bushels per acre.

Our experiments and demonstrations have shown that we can bring our yield of corn up 60 or 70 bushels by growing legumes in the rotation, but to attain higher yields it is usually necessary to supplement the nitrogen added by legumes with commercial nitrogen. These tests have shown that where mineral plant nutrients are sufficient, chemical nitrogen applications up to 80 pounds per acre can be expected to give an increase of one bushel of corn for each two to three pounds of nitrogen applied, and boost the protein content as much as one-fourth. For example, take an average silt loam soil that tested 3% organic matter, there would be a release of approximately 75 pounds of nitrogen, or enough for 38 to 50 bushels of corn (an average of about 45 bushels) during the average growing season. Now if one wished to grow 100 bushels per acre on this field and had a sweet clover crop growing on it that would furnish about two tons (air-dry basis) of green manure per acre, we would make our calculations as follows. The 55 bushels added yield of corn desired (100—45) would require about 130 pounds of extra nitrogen. Allowing 30 pounds per ton for the air-dry sweet clover turned under, or a total of 60 pounds, this should increase the yield by about 25 bushels or up to about 70 bushels per acre. The nitrogen for the additional 30 bushels, about 75 pounds, would then need to be furnished as fertilizer in order to bring the yield per acre up to 100 bushels.

On wheat, applications up to 40 pounds per acre have given a bushel increase for each 3 pounds of nitrogen applied, while with oats a bushel increase has been received for each 1½ pounds of nitrogen added. Grass seed and hay yields have been doubled with applications of 40 to 80 pounds of nitrogen, and the protein content increased where the mineral levels were satisfactory. From 8 to 10 pounds of grass seed have been obtained from each pound of nitrogen applied up to 80 pounds per acre, and frequently even more than this on our heavier soils. Before legumes can fix nitrogen from the atmosphere they must have some top and root growth. Chemical nitrogen on our low organic matter soils helps legumes to a quicker start, enabling them to fix atmospheric nitrogen earlier. This results in the establishment of thicker, more vigorous growing stands of both legumes and grasses, and a heavier sod, thus giving greater livestock carrying capacity and greater effectiveness against erosion.

Chemical nitrogen has also been used quite effectively in experiments at Columbia to narrow the carbon nitrogen ratio of straw, corn stalks, cotton hulls, corn cobs, and other carbonaceous material applied to the soil. In 1950, 20 tons of straw per acre plus 800 pounds nitrogen yielded 118 bushels of corn and 90 bushels of oats; 20 tons of corn stalks plus 800 pounds nitrogen gave yields of 120 bushels of corn and 82 bushels of oats. These tests have indicated that nitrogen used to supplement these by-products may help reduce the extent of their destruction and the resulting loss of organic matter by burning. This should encourage the return of these highly carbonaceous materials to the soil, thereby increasing the soil organic matter content, with the resulting increased intake of water and the reduction of soil erosion.

Because of the low phosphate content of the rock or parent material from which most of our Missouri soils were derived and because of the failure to replace the phosphate removed by crops and the sale of livestock products, there is a rather widespread deficiency of this important nutrient in the soils of our State. On many of our soils this deficiency has become so pronounced

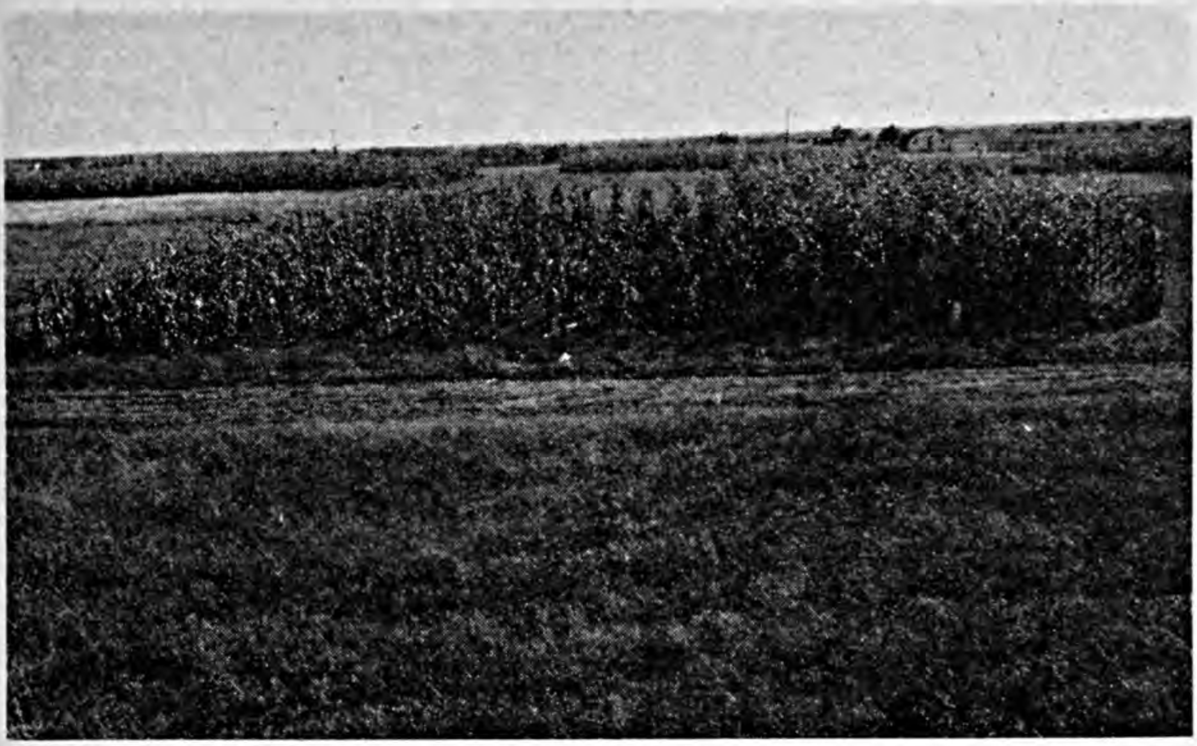

Fig. 4. The corn above shows the effects of potash removal and its restoration after 14 years of double cropping with barley and soybeans where, in each case, the whole crop was removed. All plots had 100 lbs. of nitrogen turned under ahead of this 1950 corn crop and were limed according to soil test recommendations. In addition the plot on the right had enough potash added in 1950 to bring it up to 280 lbs. The annual applications of fertilizer on each plot and the average yields of barley and soybeans the past 14 years and yield of corn in 1950 were as follows:

Plot	*Annual soil treatments*	*14-year average yields* *Barley*	*Soybeans*	*1950 yields* *Corn*
Left	None	7.5 Bu/A	2280#/A	67.0 Bu.
Center	150# 0-20-0	13.2 "	2500 "	48.5 "
Right	" 0-20-0	15.8 "	2830 "	118.5 "

that the growth and production of protein and mineral rich crops, such as legumes and grains, are seriously handicapped. The crop yields are often low and their quality poor, even though other nutrients may be present in adequate amounts for proper growth. On the other hand, where the phosphate content is at a high level and the other plant nutrients are adequate and in balance, high acre yields of high quality mineral and protein rich forages and phosphate rich grains can be produced.

Because of the relative immobility of phosphate and its inability to move through the soil to any appreciable extent, a much higher level of this nutrient than is used by the crop must be present in the soil. The amount of this nutrient that the plant can get from the soil depends largely upon the extent of its feeder root surface in contact with the soil itself. Since legume plants are heavy feeders on phosphate and have a relatively limited root surface, a comparatively high level of phosphate must be attained for their optimum growth and yield. The sorghum plant, however, having a rather extensive root system, can obtain enough phosphate even on phosphate-deficient soil to produce considerable bulk relatively low in proteins and minerals. On our higher exchange capacity silt loam soils, indications are that the phophate level necessary to remove this nutrient as a limiting factor for optimum growth of general farm crops should be at least 200 pounds per acre plow depth. For deep-rooted crops like alfalfa the 7 to 14 inches depth should also have a like amount of phosphate. In correcting the phosphate deficiencies on a phosphate-deficient soil, adequate amounts should be applied so the tiny root hairs can obtain a sufficient amount regardless of the zone in which they may be located.

Either the processed phosphates or the unprocessed rock phosphate may be used for bringing up the phosphate level in the soil. Where the processed phosphates are used they may be applied either as split applications or as a total application. In case the split application procedure is followed, sufficient processed goods should be applied to bring the phosphate level up to at least 100 pounds with the first application, or at least halfway up to the 200-pound level, and the next time the ground is plowed, preferably a year or two later, the remainder applied. With the total, or one application method, the level should be brought up to at least 200 pounds. When processed phosphates are used to bring up this level, we figure the reserve supply will be maintained when the ordinary applications of starters are made for a period of 3-5 years. When adequate starter applications are made, this period may be materially extended.

On the low phosphate higher exchange capacity silt and clay loam soils, which are quite prevalent in Missouri, rock phosphate can be used quite satisfactorily to raise the phosphate level or build up phosphate reserves in the soil. This is especially true in cropping systems which include clovers and alfalfa, and in pastures and meadows with legume and grass mixtures. The recommended applications of rock phosphate, on the basis of soil tests, are designed to bring up this level of reserve phosphate—when the usual starter applications are made—for a period of 8 to 10 years. Except with permanent pasture or alfalfa, where no starter or maintenance applications are usually made only at the time of seeding, a soil test at this time may indicate another heavy reserve application of rock phosphate may not be advisable. Where clovers or alfalfa are used in rotation with non-legume crops, their residues supply a turnover of additional organic phosphate for the other crops.

Even when these soils are limed to meet the calcium requirements of clover and alfalfa (pH 6.5), there is still considerable mineral acid present to act upon the rock phosphate. With these acids, the acids created by the action of soil micro-organisms in breaking down the organic matter and the release of hydrogen from the legume plant roots, rock phosphate is made available in sufficient amounts to meet the needs of clovers, alfalfa, and soybeans. The non-legumes can use rock phosphates directly to a lesser extent than can the above-named legumes. When plowed down it is quite important, however, to use starter applications high in phosphate, especially if legumes have not been grown on the land since its application.

Where phosphate fertilizers are worked well into the soil, experimental and demonstrational evidence has shown one can expect much deeper and a more extensive root system from the legume crops seeded on the land. One advantage of rock phosphate is that it can be applied most any time one can get over the field. At the next working of the soil it can then be plowed under or cut in as deeply as possible with a disc or field cultivator. Where rocks, stumps, or other hazards prevent the placement of the rock phosphate into the soil, beneficial results may be expected from its application on the surface, but to a lesser degree than where it is placed well into the soil.

Potash being a relatively immobile mineral nutrient, the basic application on low-potash soils should also be worked in deeply by plowing under or cutting in with a disc or field cultivator to raise the level, in much the same way as with phosphate. Bray [2] has shown that the roots of the corn plant can contact only about 20% of the immobile, yet exchangeable, potash in the surface 7 inches of soil. From this we can readily understand why a 100

[2] Bray, Roger H., *Correlation of Soil Tests With Crop Response to Added Fertilizer Requirements, Diagnostic Techniques for Soils and Crops.*

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Concerning "Bio-dynamic Farming" and "Organic Gardening"

By Selman A. Waksman

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THE ideas presented in recent publications on so-called "bio-dynamic," "organic," and similar methods of farming are a peculiar mixture of the real and the unreal, of fact and fancy, of good common sense and the supernatural. If soil treatment and crop production are to be based on dogmas or religious ideologies rather than on scientific principles, one need not argue further. One may then accept the thesis that "the farm is connected with the spiritual universe by the power of the thoughts of its leader." If, however, crop production is to be based on scientific facts, then such statements must be subjected to careful analysis and interpretation.

Continuous use of mineral fertilizers on the same soil for many years, without the use of organic manures or growth of sod crops to replace the organic matter lost by clean cultivation, may lead to deterioration of the physical condition of the soil and loss of productivity. This is well known by every intelligent farmer. Federal and State soil conservation agencies are placing particular emphasis on the use of soil-conserving crops.

It is being argued that use of mineral fertilizers unfavorably influences the chemical composition of plants and their nutritive properties for human and animal consumption. There is accumulating evidence, however, that plants grown in soil enriched with inorganic fertilizers, or in sand supplied with a balanced nutrient solution, including ammonium salts, nitrates, phosphates, potassium salts, and the necessary rare elements, differ very little, either in chemical composition or in nutritive properties, from plants grown in natural soil receiving only stable manures or composts.

In some "organic farming" publications, a mystical attitude is assumed toward plant growth, namely, "The will to grow." This suggests controlled selectivity of root systems of plants. Given an opportunity, however, plants will absorb not only useful elements but injurious ones as well, of which selenium is a good example. Some of these faddists speak of plants as effecting the decomposition of the soil. They mean that certain plants, such as legumes, are more readily decomposed in soil by fungi and bacteria than other plants, such as cereals. It is the plants that decompose, not the soil. The rate of decomposition of the plants and the nature of the resulting products depend entirely on their chemical composition, as determined by their nature, stage of growth, and manner of nutrition. Thus all plants decompose much more readily in the young stages of growth than in the mature stages.

Confusion

Numerous facts are misinterpreted in these "organic" and "bio-dynamic" publications and there is much evidence of confusion. For instance, the radioactive action of certain elements, a fact not well established as far as its significance in plant growth is concerned, is said to exert specific effects on both plants and the animals that consume them. The use of arsenic in insecticides, a practice which aids greatly in man's fight against the ravaging insect world, leads to statements implying that fruit thus treated is highly dangerous to man.

Scientific methods are discredited by these non-scientists, as shown by the following quotations: "Although the farmer was told by the use of scientific methods in agriculture he could double the yield of his farm, the fact remains that after years of scientific help, present century farmers are discovering that their 'double' yields today are no better than the single yields of previous times." "Earth and plants have become more sensitive and erratic." "Those who treat the soil with a 'pulverizer,' destroy the real creators of natural humus, the *earthworms.*" The Chinese farmer is idolized for the very reason that we tend to condole him, as shown by the following quotation: "Mineral fertilizing is still unknown here—fortunately for the Chinese. The oldest cultural methods of humanity—*humus conservation* and *manual labor.*" The author of the above publication might well have added that *man thus became the slave of the land.*

Although "the quality and amount of the humus determine the fertility of the soil," the organic-gardeners fall immediately into a trap by assuming that only the colloidal humus, which is about 40 per cent of the total soil organic matter, is the active agent of fertility. They confuse conditions of humus formation in peat bogs with those in mineral and well-aerated soils. This is illustrated by the statement, "In humus the essential factor is its condition." This is true, but only to a certain extent. The process of decomposition of plant and animal residues leading to humus formation is highly important in making the soil fertile, since the continuous stream of carbon dioxide, ammonia and nitrate, and phosphate, resulting from such decomposition is highly important for continuous plant growth.

Mystical concepts are interwoven with facts. Frequently, advice that seeding be done in relation to the moon is given in such publications. Sunspots are credited with effects on insect pests, and mysterious forces are said to govern plant growth. Such expressions as "sun-force" and "nature-soil" are commonly employed in some of these publications.

The following statement copied from one such publication indicates the type of thinking that is involved: "A half-rotten substance makes the soil sour. But if I get a humus-like substance into the soil as fertilizer, the soil is excited to develop bacteria and other life, such as earthworms, which produce the humus in the soil, and this substance can be taken up very quickly by the plant. When organic manures rot in the ordinary way there arises amongst other things a poisonous smell as the product of albumen. Such substances are not usually changed very much, and succeed in being taken up again into the plant through the soil. If such deleterious products succeed in reaching the stream of sap in the plant, they cause disturbances which in part may be responsible for the plant sicknesses, or it is made attractive to many harmful insects."

Other Examples

Other examples of such thinking are: "Fertilizers now used in agriculture kill the vitality of the soil." "The vitality of the soil determines the vitality of the vegetation and all that exists on its surface." "Corn . . . treated by the bio-dynamic method . . . has a phosphorescent gleam which bespeaks life, compared with the latter (receiving mineral fertilizers), which, in its color, resembles zinc." "The process of nitrogen-fixation by bacteria is well known. May it not be possible that a similar process exists in the case of phosphoric acid? This is a question which deserves investigation and research." "Soils intensively treated with chemical fertilizer or orchards

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Improving Pastures In Arkansas

By Edgar A. Hodson

Soil Conservation Service, Little Rock, Arkansas

NOT many years ago improved pastures were thought to be of uncertain economic value in Arkansas (and the whole South for that matter). There actually were very few really good pastures in Arkansas. Today's picture is different. It has been proved that good pastures can be developed and that the returns in livestock gains will pay good dividends on investment in land preparation, in fertilizer, and in management.

The change is founded on conservation farming. Each time a conservation farm plan was developed for land in the upland sections of the State it was found that from 40 to 75 per cent of the open land was best suited to permanent vegetation. It was too steep, the soil too thin or too badly eroded for cultivation. That meant permanent pastures and meadows.

Proper land use as it is practiced in soil conservation districts has opened up a vast new empire of agricultural land, a new frontier that, because of the long grazing season and favorable growing conditions, is attracting large numbers of livestock producers to Arkansas after seeing what conservation farming has accomplished.

It must not be overlooked that the development of an adequate pasture program requires:

1. A sound pasture plan. The plan should provide for the several types of pasture needed for seasonal grazing. It will include permanent pasture for summer grazing, and separate supplementary summer pasture. It will provide permanent pasture for winter grazing in addition to supplementary winter pasture crops. And there must be a reserve supply of hay and silage.

2. Fertilizers and lime. Almost all Arkansas soils require lime, and because the fertility level of the soils going into pasture will on the average be low, adequate fertilizer must be used. The kinds and amount must be determined by chemical analysis or, if analysis is not available, by the best local experience. Fertilizer experiments have shown that each dollar spent for fertilizer returns an average of about seven dollars in livestock gains.

3. Good land preparation. Brush must be removed, sage grass destroyed. The land must be left in a condition to permit mowing.

4. Grasses and legumes best suited to the soils. A crop can be chosen for deep well-drained soils, for poorly drained land, for good upland soil, or shallow upland soil. Choosing the crop best suited to the soil is of vast importance.

5. Good management. This includes all of the things needed to keep the pasture producing the highest possible yield of palatable, nutritious forage. It includes mowing, the application of minerals when needed, controlled grazing, a good water supply, renovation and the maintenance of a good stand of a base grass with a suitable companion legume.

Soil conservation district cooperators are developing year-round grazing programs that are furnishing good grazing all of the year except for periods of

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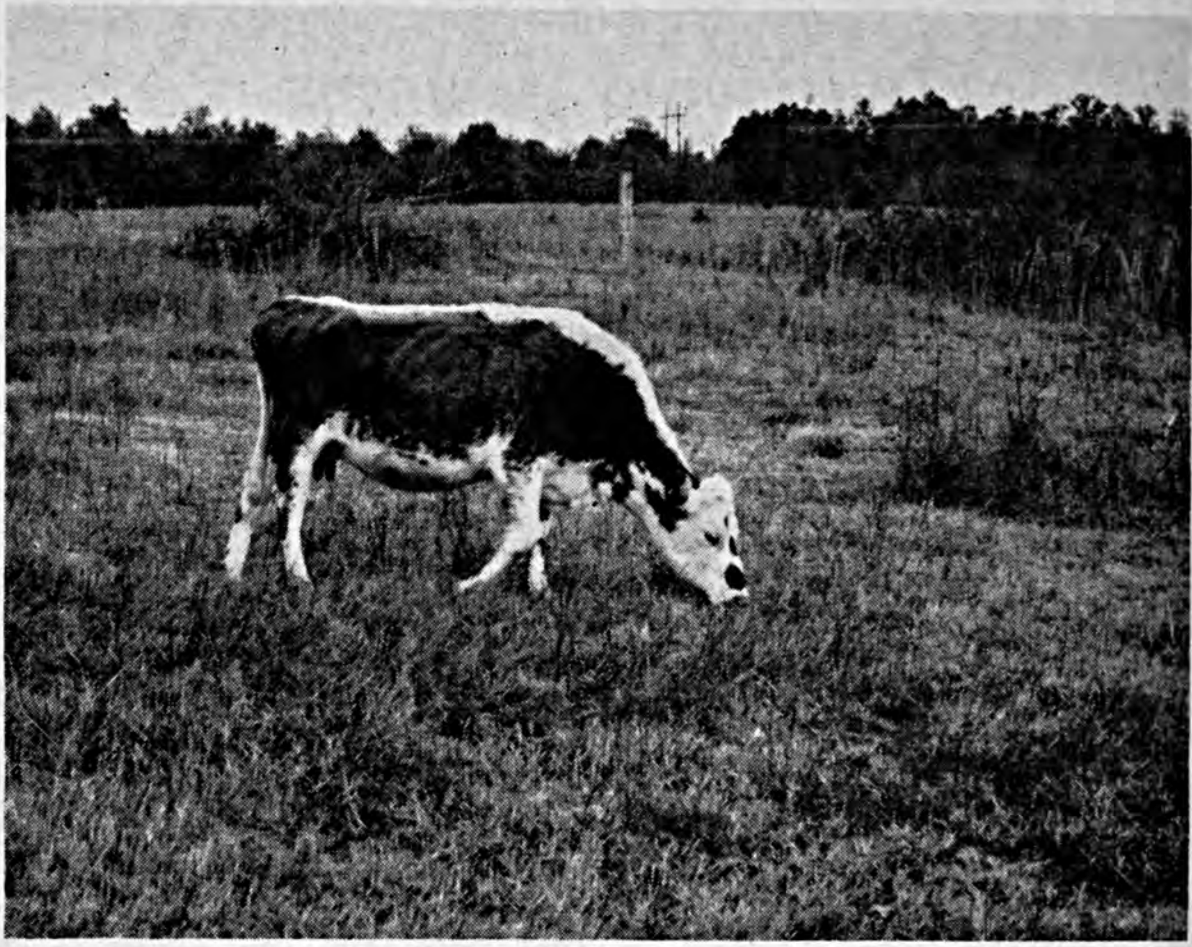
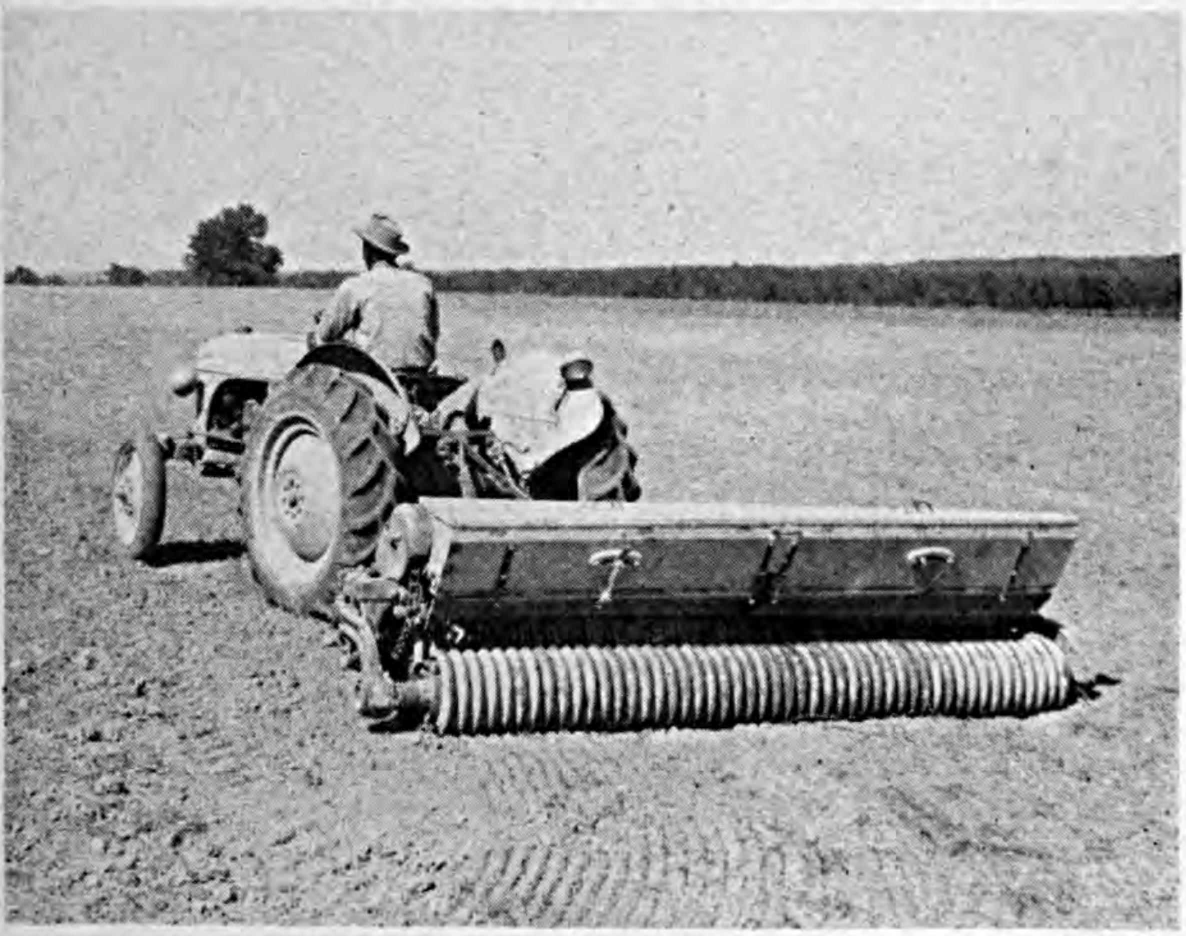


Above: **Loafing acres, like these, should be put into good pasture.**

Below: **Lime should be applied to meet pH requirements.**

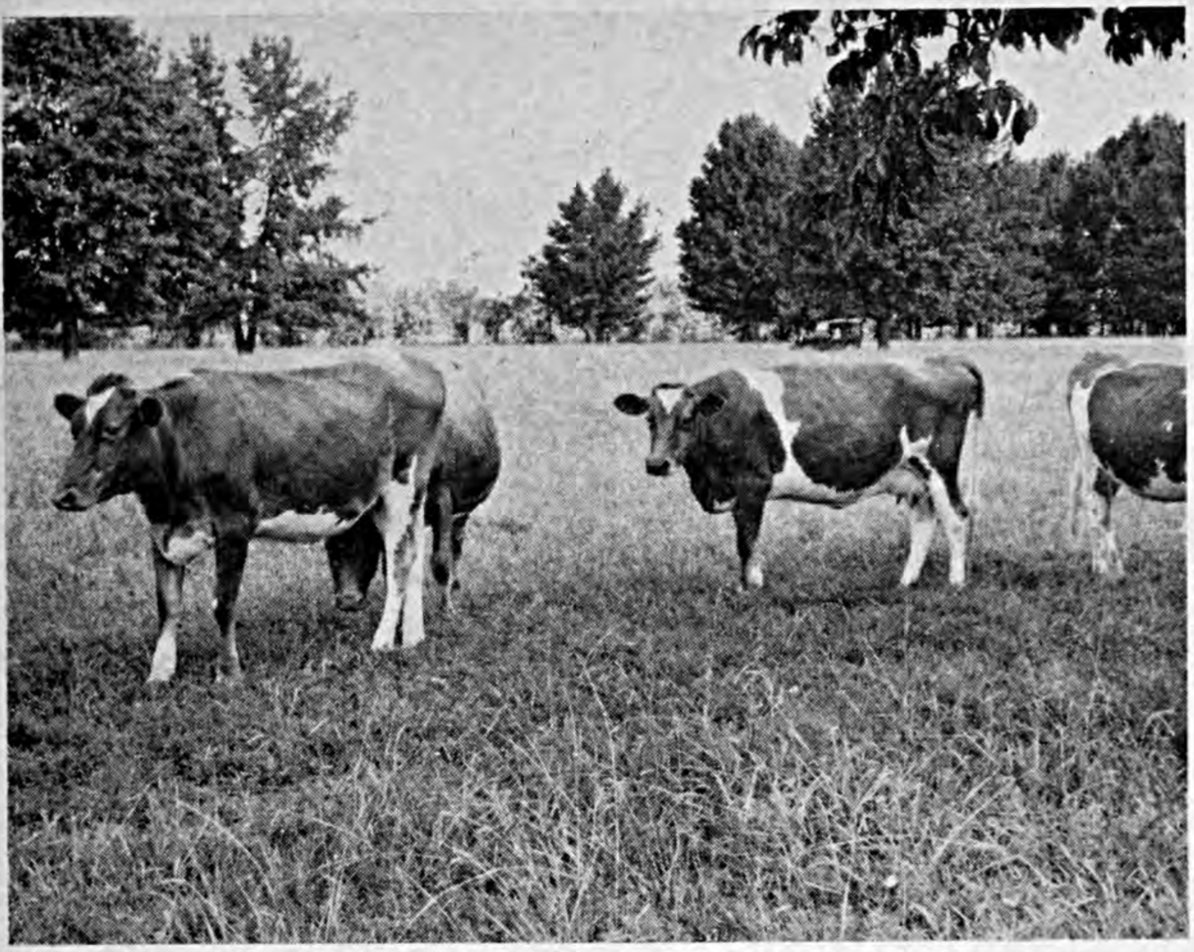
Above: **Ground should be prepared well in advance of planting.**

Below: **Seed should be planted on a well-fertilized and firm seedbed.**



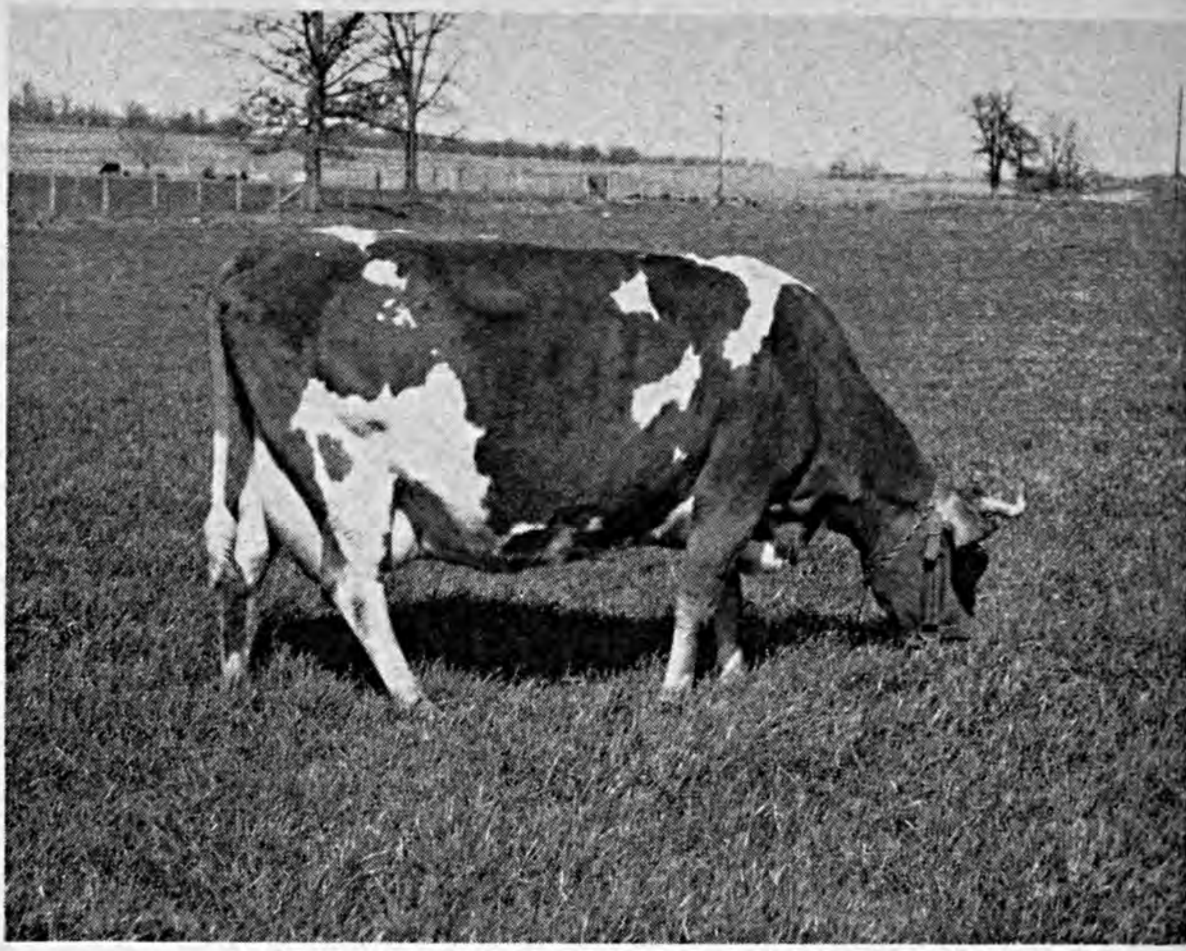
Above: Brush and weeds can be controlled by mowing.

Below: Old sod should be renovated to stimulate new grass.



Above: **Permanent summer pasture—Dallisgrass with white clover.**

Below: **Supplementary summer pasture—Sweet sudan.**



Above: Permanent winter pasture—tall fescue with ladino clover.

Below: Supplementary winter pasture—crimson clover, oats, and ryegrass.

The Editors Talk

Benefiting from Experience

"Agricultural Items" Vol. 5, No. 10, October 1951, published by the Federal Reserve Bank of Richmond, Virginia, carries some good advice to farmers under the above title.

According to the article, "If the farmers in any community were to undertake to rate their own accomplishments, most of them would be rather modest in their appraisals. And this modesty might well reflect a keen awareness of the ways in which their performance falls short of the goals they have set for themselves. Farmers know from experience some of the changes that ought to be made, but because of habit, forgetfulness, and lack of systematic planning, many needed changes are left until some more appropriate time which often never comes.

"The slack season now approaching is a good time for farmers to take stock of their farming operations with the view toward doing a better job in 1952. Now is the time to determine what weaknesses exist, to develop a course of action that will lead to improvement, and to be prepared to put needed changes into effect. While all farmers stand to benefit from such an undertaking, the incentive would seem to be greatest for those who are making little or no progress even in these prosperous times. There are numerous places in a farm business in which wide variation can occur in the quality of a farmer's performance. These should be systematically examined as a means of determining those points at which improvements would strengthen the farm business as a whole.

"Farmers might start by asking themselves just how much each field contributed to the over-all 1951 gross cash income. After allowing for those fields that produced a cash crop and those which produced products that were or will be sold as livestock, many farmers will find that large parts of their farm contributed little or no income.

"It is important that the various fields and pastures be farmed at the intensity which will return the greatest profit. In driving any considerable distance, one passes many fields and pastures that appear capable of producing greater returns if farmed differently. Such casual observation is, of course, of little practical value since only the farmer or someone intimately acquainted with his land can tell whether the farmer would likely find it most profitable to continue as at present, to strive for higher yields of the same crop, to plant some other crop, or to turn the fields into improved pasture or woodland. If farmers, however, would apply what they already know from experience about such matters, the probable effect on farm income would be to provide an ample reward."

It would seem that here are some exceptional opportunities for the agricultural advisory groups to make their work more effective. While a farmer's recollection of the strong and weak points of his 1951 operations is still fresh in his mind, a little advice and urging on the part of an adviser might result in the carrying-out of an improved practice. Winter days lend themselves to such consultations.

The Nationwide Survey on Fertilizer Usage

The U. S. Department of Agriculture has issued a series of regional reports and a national summary averaging the effects of fertilizer usage on crop yields. Using five years of results on thousands of field experiments in each State, a National Soil and Fertilizer Research Committee, made up of agronomists and soil scientists from the Department and the State Experiment Stations, has calculated the increases or decreases in yields that on the average would be obtained with changes in applications of nitrogen, phosphate, potash, and lime for the more important crops grown in the respective regions.

Such a compilation is a valuable aid in determining how changes in fertilizer usage are likely to affect agricultural production. It reveals that marked increases in yield of most crops could be obtained by increasing the use of fertilizers and lime. The results vary, naturally, with crop and region, and the amount of the increase in many cases is influenced by current usage.

Calculations included how much the yield of each crop would be increased on a nationwide scale if 10 per cent more fertilizer were used, 25 per cent more, and so on up to three times the current average rates. It was found that for the country as a whole, the greatest opportunities for increasing yields through fertilization are in grain and forage crops, which receive comparatively low rates now.

While data of this type are subject to the weaknesses of averaging figures, they undoubtedly will serve a very useful purpose in our national planning. From a long-range view, the survey shows quite clearly that fertilizer can be used to increase food production on a tremendous scale and that increased fertilization is equivalent to millions of additional acres. The data also can be very helpful to local agronomists and soilsmen in appraising the soil fertility and crop production potentials in the locality.

Monuments to Ability

Dr. Hugh H. Bennett, Father of Soil Conservation, is stepping down from Head of the Service which has restored millions of the Nation's useless acres to crop production. Effective on November 15 he will yield the post which he has held over the past 16 years to become a Special Assistant to Secretary of Agriculture Charles F. Brannan. The new Chief of the Service is to be Dr. Robert M. Salter, since 1942 Head of the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture.

Dr. Bennett will be missed, for it is probable that in his new duties and advancing years he will not be traveling throughout this country and to far corners of the world preaching the gospel of saving soil—civilization's greatest resource. Over a period of nearly 50 years his enthusiasm and sincere belief in his subject have created a public consciousness in the need for soil conservation that has made this Nation a leader in the movement and himself world-famous.

Secretary Brannan, in announcing Dr. Bennett's new position, said, "I commend him for a job well done for American farmers and for all the people. He has built a strong organization which he can safely leave with the knowledge that it will complete with efficiency the big goals he set for it. I hope that Dr. Bennett will give the world many more years of his talents and energy, but he already has monuments to his ability in every rural area of America where soil conservation is practiced."

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941...........	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942...........	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943...........	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945...........	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946...........	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947...........	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948...........	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949...........	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.......	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April........	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May.........	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June.........	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July.........	39 11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....
August.......	34.60	47.7	117.0	273.0	165.0	205.0	15.65	69.10	....
September...	33.73	52.4	123.0	287.0	165.0	207.0	16.55	66.10	....
October......	36.21	57.7	139.0	271.0	164.0	210.0	17.15	69.90	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
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	89	81	109	74	87	110
1938...........	69	196	80	79	76	64	57	97	88
1939...........	73	154	100	84	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	105	117	107	82	211	129
1942...........	153	369	168	134	143	124	91	202	163
1943...........	160	405	188	235	174	154	125	231	245
1944...........	167	420	214	216	170	160	139	234	212
1945...........	181	366	205	232	198	170	127	227	207
1946...........	263	382	178	248	212	209	141	319	182
1947...........	257	380	232	248	336	259	148	381	226
1948...........	245	482	222	253	201	226	155	298	214
1949...........	231	463	184	244	210	210	139	192	201
1950									
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.......	345	266	154	236	249	240	155	457	265
April........	348	253	161	231	252	242	155	457	225
May.........	342	398	156	238	255	239	153	448	239
June.........	339	490	155	239	252	235	142	424	189
July.........	315	495	169	249	254	232	130	346	204
August.......	279	477	168	311	257	232	132	306	181
September...	272	524	176	327	257	234	139	293	161
October......	292	577	188	309	255	238	144	310	171

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12.37	10.06	8.68	8.56
August	3.13	2.07	11.94	10.41	8.66	8.66
September	3.13	2.07	11.50	10.78	9.26	9.26
October	3.13	2.07	12.85	11.28	10.56	10.32

Index Numbers (1910-14 = 100)

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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243
August	117	73	341	295	257	246
September	117	73	329	305	275	263
October	117	73	365	320	313	293

Wholesale Prices of Phosphates and Potash * *

	Super-phosphate, 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[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[3]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[3]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[3]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
November	.760	3.98	5.47	.386	.732	14.72	.193
December	.798	3.98	5.47	.420	.796	16.00	.210
1951							
January	.810	3.98	5.47	.420	.796	16.00	.210
February	.810	3.98	5.47	.420	.796	16.00	.210
March	.810	3.98	5.47	.420	.796	16.00	.210
April	.810	3.98	5.47	.420	.796	16.00	210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193
August	.810	3.98	5.47	.389	.768	14.72	.193
September	.810	3.98	5.47	.386	.768	14.72	.193
October	.820	3.98	5.47	.386	.768	14.72	.193

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
1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
November	142	110	112	70	77	61	82
December	149	110	112	75	84	66	85
1951							
January	151	110	112	75	84	66	85
February	151	110	112	75	84	66	85
March	151	110	112	75	84	66	85
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	82
August	151	110	112	70	81	61	82
September	151	110	112	70	81	61	82
October	153	110	112	70	81	61	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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
November	276	255	251	132	85	328	142	74
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78
March	311	272	269	142	91	357	151	78
April	309	273	268	141	91	353	151	78
May	305	272	266	139	91	334	151	78
June	301	272	265	134	91	311	151	69
July	294	271	261	135	93	297	151	74
August	292	271	258	135	94	294	151	74
September	291	271	258	135	94	300	151	73
October	296	272	259	140	94	335	153	73

* U. S. D. A. figures, revised January 1950. 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] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] 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 is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

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 1950-51 Season," Ala. Coop. Crop Rptg. Serv., Office of the Agr. Statistician, Montgomery, Ala., Aug. 17, 1951.

"Effects of Fertilizers upon the Yields, Size and Quality of Orange Fruits," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Bul. 722, Mar. 1951, E. R. Parker and W. W. Jones.

"Lime Fertilizer and Manure for the Home Garden," Ext. Serv., Univ. of Conn., Storrs, Conn., Fldr. 50, Feb. 1951, E. C. Minnum.

"Drilling vs. Banding of Fertilizer for Lima Beans," Agr. Exp. Sta., Univ. of Del., Newark, Del., Bul. No. 291, Feb. 1951, E. M. Rahn.

"Tonnage of Commercial Fertilizer Reported by Manufacturers as Shipped to Kansas in the Spring of 1951, by Counties," State Board of Agr., Control Div., Topeka, Kans., Jan. 1, 1951 to June 30, 1951.

"Suggestions for Fertilizing Field Crops in Kentucky," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Apr. 1951.

"Fundamental Facts About Fertilizers," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 20, Apr. 1951, F. L. Bentz.

"Anhydrous Ammonia as a Source of Nitrogen," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 482, Apr. 1951, W. B. Andrews, J. A. Neely, and F. E. Edwards.

"Fertilizer and Lime Recommendations for New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 541, Aug. 1951.

"North Carolina Fertilizer & Fertilizer Materials Tonnage Report, 1950-51 Fiscal Year," "Fertilizer Sales by Grades in Order of Tonnage, Jan. 1, 1951-June 30, 1951," N. C. Dept. of Agr., Raleigh, N. C.

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Judging Native Grasslands

By Edd Roberts

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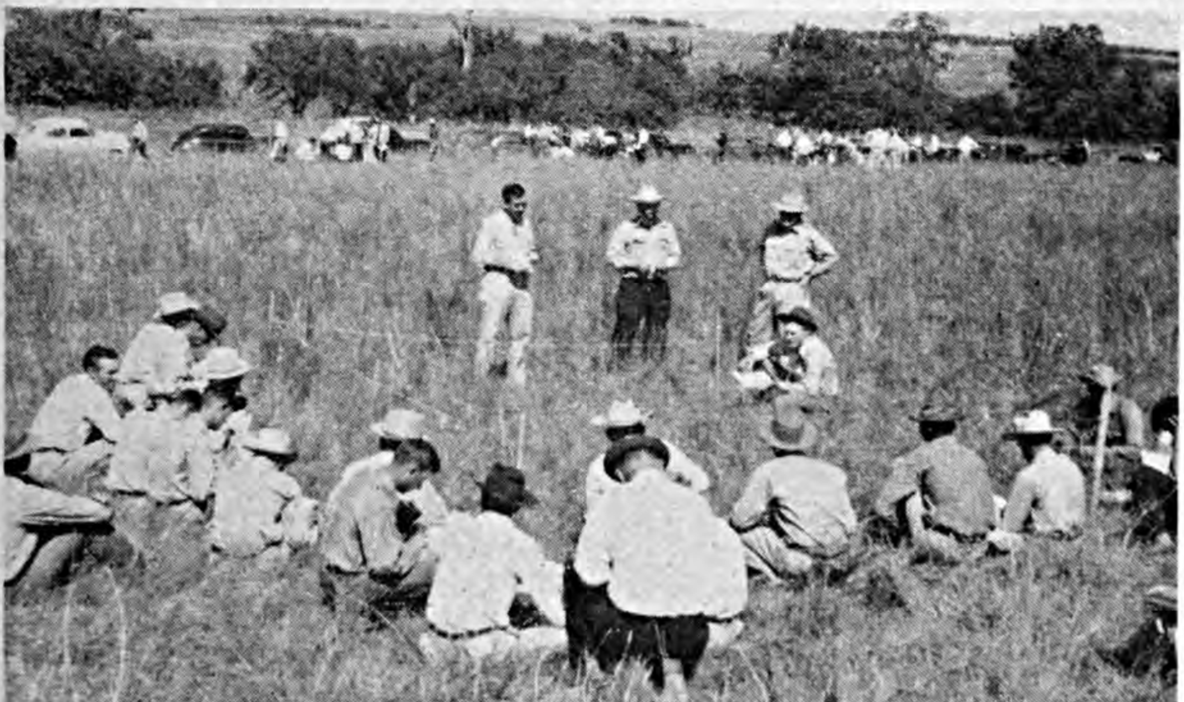
OKLAHOMA ranchers and stockmen are participating in range conservation training schools. Native grassland judging contests are popular with the cattlemen.

"Rings of native grass" are judged like a ring or class of beef cows. The judging has contributed to care and improvement of native grass like judging work has contributed to the care and improvement of livestock.

The idea "caught on" after the "land judging" contests started at the Red Plains Experiment Station at Guthrie, Oklahoma. A placing sheet has been designed whereby the contestant de-



A group of ranchers and stockmen participating in a native grassland judging contest near Duncan, Oklahoma.

cides: (1) How hard the native grass has been grazed; (2) the kind of land or site the grass is growing on; (3) condition of the pasture; (4) the conservation practices needed to give the pasture the proper care, management, and protection.

Two pastures are selected in this division to judge. The usual perfect score is about 120 points per pasture.

In addition, two range plant identification judging stations are established. Usually about 30 range plants, grasses, wild legumes, and weeds are to be identified. Besides naming the plants, decisions must be made on such things as determining if the plants are annuals or perennials, warm weather or cool weather, growing native or introduced plants and climax or invader plants. The perfect score runs 5 points per plant. Thirty plants identified correctly total up 150 points. In all, about 390 points constitute a perfect score for a native grassland judging contest.

Ranchers and stockmen spend the morning studying range conservation in a meeting. The contest is conducted in the afternoon.

As a result of this method of teaching, ranchers and stockmen are convinced that "range grasses can be fattened or starved" just as the cow grazing on them. They are impressed with the fact that green leaves manufacture the food required for current plant growth or for "laying on fat" for the future early plant growth. "Fat" for future growth is stored by perennial grass in the roots, crown, and seed. Annuals store up "fat" in seed alone. "Fat grass" out-produces "starved grass." "Fat grass" survives drought, hard winter, and insect damage when starved plants die. Range grass is the basic resource for western livestock operations.

The details and sample copies of the judging sheets may be obtained by writing to Extension Soil Conservationist, Oklahoma A & M College, Stillwater, Oklahoma.

M. V. Corey . . . Grassland Winner . . .

(*From page* 15)

Fig. 2. Mr. Corey still adds to the rockpile which has been accumulating over the years as fields are cleared. Even his winning pastures still yield unproductive rocks.

success of his program to "frost seeding" where he simply throws the seed on the ground in early March. But another practice he strongly advocates is the careful clipping of each field after the cows have finished grazing it. Clipping allows the new crop to start without the interference of "the dead stuff on top," as he phrases it.

This year he started cutting silage on May 30. The first cutting of the heavy, difficultly cured hay fills his two silos with grass silage. Molasses is added. The second cutting of hay provides 3,200 bales of top quality. The silage cutting and filling job was done by June 17. Despite drought periods, he has not had to resort to any barn feeding. Silo capacity is 240 tons.

Newport County Agent Herbert W.

Peabody cites the sustained production record per cow each month from May to November, the average being from 870 to 890 pounds of milk with no additional barn feeding.

Because of the high quality of his crops Mr. Corey will reduce his 16 per cent protein ration to 12 per cent. The cows are in lush pasture night and day, and because of the arrangement of pastures, do not travel far from them to the barn and the resting lot adjacent to it.

A native of the Azores, Mr. Corey came to this country in 1922, at the age of 22. His wife, also a native of the Azores, was brought here when she was less than three. She serves as the accountant and business manager of Whitehall Farm. A son, Manuel, is herdsman. There is only one other full-time employe, a nephew. The silage loading is a custom job.

Mr. Corey grows a cash crop of potatoes, of which he has 33 acres. He has no corn. "It's not dependable because of the weather. Besides, corn makes too much work. Since I get more grass silage and hay than I can use, I don't need to worry."

Corn Research Results . . .

(*From page* 8)

or more per acre. The highest yield among this number was 185 bushels per acre, and 88 per cent of all the test cooperators were 100-bushel per acre producers. During 1950, 266 farmers, 4-H, and FFA members from the same three counties were members of the 100-bushel clubs in Georgia.

By putting down plenty of fertilizer on soil that is well limed, leaving enough plants of an adapted hybrid that was planted early, and by practicing shallow cultivation, striking increases in corn yields may be obtained. In fact, twice as much corn can be grown on half as many acres as were planted to this crop under past methods of management.

This means fewer acres planted to corn and some may say that a problem of land use is presented. But for an area that has never had enough livestock and livestock products, the answer is rather simple. With adequate rainfall and a good average temperature, perennial grasses and clovers are yielding as high here as anywhere in the country. The highest producers of corn are going to grass the fastest, and using corn to the best advantage.

Complete results of the corn tests described herein may be had by requesting Georgia Experiment Station Bulletin 264, Corn Production in North Georgia.

Fertilizer in Japan

(*From page* 14)

termine for any location the response of a crop to various levels of nitrogen, phosphorus, and potassium.

In measuring the crop response to different applications of one fertilizer, the other two were applied at estimated maximum required rates. For example ammonium sulfate was applied to different plots as follows: 0, 13.4, 27.0, 40.4, 54.0, 67.4, 202, 270, 337 and 81 lbs. N respectively, per acre. On these plots 16% superphosphate was applied uniformly at the rate of 108 lbs. P_2O_5 per acre and potassium sulfate at the rate of 202.4 lbs. K_2O per acre. Each plot was replicated three times, making a total of four plots receiving the same treatment. The results from a typical

Fig. 5. Plowing the paddy and transplanting rice seedlings in Japan. Nearly all of the 7,000,000 acres of rice grown is transplanted by hand.

experiment on soil derived from volcanic ash are shown in Table V.

It will be noted that potatoes responded markedly to all three fertilizers although stable manure and some commercial fertilizer had been applied to the plot area in previous years. Under the conditions of the experiment, optimum yields for this crop required approximately 40 lbs. of N, 80 lbs. of K_2O, and more than 108 lbs. of P_2O_5 per acre.

In comparison with the highest yield of 286 bushels shown in Table V, it is interesting to note that the average yield of potatoes for all Japan during the period of maximum fertilizer usage (1936-40) was only 166.8 bushels per acre.

Supply and Utilization of Fertilizer

Opportunity still remains for increasing the production of food crops to a level even above that reached in prewar years. The opportunities with fertilizers lie in two directions: (a) maintenance of an adequate supply of fertilizer materials; and (b) changes in fertilizer practices.

Japan has never had sufficient commercial fertilizer for maximum economic production. Yet the return per unit of fertilizer in terms of increased crop yields is large in Japan. On the other hand, crop production decreases sharply if insufficient quantities of plant nutrients are used. The supply of commercial fertilizers is a critical factor because little opportunity exists for increased use of farm manures. Achievement of increased crop production in

TABLE V.—YIELDS OF POTATOES AS AFFECTED BY VARIOUS LEVELS OF NITROGENOUS, PHOSPHATIC, AND POTASSIC FERTILIZER, KANTO-TOZAN AGRICULTURAL EXPERIMENT STATION, JAPAN, 1950.

Lbs. N per acre applied	Bu. per acre	Lbs. P_2O_5 per acre applied	Bu. per acre	Lbs. K_2O per acre applied	Bu. per acre
0	138	0	97	0	188
13.4	192	21.6	152	40.4	249
27.0	222	43.2	197	80.8	278
40.4	253	64.8	236	121.6	279
54.0	259	86.4	268	162.0	276
67.4	276	108.0	286	202.4	286
81.0	286	....	....	....	....

the future will depend to a considerable extent on the availability of even larger amounts of fertilizer than were available in 1950.

The Japanese farmer, however, needs to be educated in the intelligent use of fertilizers including the minor elements. It is essential that he learn the importance of time of application in fertilizer usage and the effect on yields of delaying the basic treatment. He knows practically nothing of the effect on crop quality of intermittent applications of fertilizers, especially nitrogen. His knowledge of the possibilities of fertilizer placement has been gained largely from experience, although recent experiments have indicated that on irrigated rice fields attention to the mixing of fertilizer in moderate depth (to approximately six inches) may improve yields as compared to surface applications.

At the present time Japan is importing approximately 20 per cent of its yearly food requirements. Solution of that country's fertilizer problems will go far toward eliminating this deficit. Under the guiding hand of the Occupation, satisfactory progress in this direction is being made.

Concerning "Bio-dynamic Farming". . .

(*From page* 24)

sprayed for a long time with chemicals have no longer any biological activity." "The struggle between the microbes themselves maintains a certain ferment of organic activity." "The presence of wormwood, speedwell, and dog's mercury shows a wrong decomposition of the soil—less fermentation but more decay."

The soil is said to be a vital system. Thus: "Contrary to the general popular belief, we feed the soil by manuring. We do not feed the plants." "Especially objectionable is the absorption of the decaying products of half-rotted albumin which may be taken up directly by the plant roots. This can have a disturbing effect on plant and also on human health." "Horse manure being especially a protection against denitrogenizing bacteria."

The "bio-dynamic" groups are actually offering for sale a mysterious bio-dynamic substance to be used as an inoculum for composts. The fact that equally good composts of stable manure can easily be prepared without such supplementary substances is overlooked thereby. All that is required is addition of certain mineral fertilizers, in order to obtain excellent composts from plant residues, such as straw, cornstalks, leaves, and other vegetable refuse.

Much is made of the possible injurious effect of mineral fertilizers upon the beneficial microorganisms in the soil. Certainly, a concentrated salt solution may have an injurious effect upon various bacteria and other microorganisms. In the soil, however, the various fertilizer salts, some of which are identical with those produced by the soil microbes, are diluted and either adsorbed in the base exchange complex or transformed otherwise into less soluble compounds. In the presence of plant residues, microorganisms absorb mineral elements and transform them into microbial cell substance, which becomes a source of plant nutrients and of soil humus.

Part of the blame for the apparent success of the spreaders of these fanciful half-truths is to be placed at the door of some of our "fertilizer experts." They have been so carried away by the tremendous possibilities for increasing crop yields through the use of mineral fertilizers that they have too often neglected to recommend the supplemental use of lime and organic matter. Fortunately, however, the recently accumulating knowledge on vitamins, hormones, and microbial growth-promoting substances, their importance in human and animal nutrition, and their presence in the organic residues in the soil has again centered popular attention upon soil organic matter and its function in the soil.

No truly serious problem is presented by soil organic matter save that of developing systems for the maintenance of the supply of this very necessary material into wide-scale operation on the farms of this country. What we are dealing with is the practical problem of replacing the large amounts of animal manure that were lost to agriculture by the substitution of the automobile and the tractor for the horse. We now possess the knowledge as to what should be done, although this does not assure at all that it is being done. Vague generalizations, based upon theories that date back to the times of the alchemists, merely confuse the issue and serve no useful purpose.

Improving Pastures in Arkansas . . .

(*From page* 25)

severe weather in winter months. To fill that gap they are maintaining a reserve supply of hay and silage.

Here are the principal pasture crops to consider in making a pasture plan:

Grasses:

Permanent Pasture:

Bermudagrass—Can be grown on a very wide range of soils anywhere in the State and with the use of fertilizer can be grown on soils with low fertility.

Coastal Bermudagrass — On the more fertile soils.

Dallisgrass—On the more fertile soils well supplied with moisture in all of the State except the Ozark Plateau.

Carpetgrass—On the Coastal Plains soils in South Arkansas well supplied with moisture.

Suiter's grass (tall fescue or Ky. 31)—On the more fertile soils and also on the poorly drained soils anywhere in the State.

Orchardgrass—On the more fertile well-drained limestone soils in North Arkansas.

Winter Supplementary Pasture:

Ryegrass — On any well-drained fertile soil or with adequate applications of fertilizer on the less fertile soils any place in Arkansas.

Small Grains—Same as for ryegrass.

Crimson clover—On any well-drained crop land.

Legumes:

Permanent Pasture:

Alfalfa—On the most fertile soils where conditions are favorable. (Suitable acreage is very limited in the upland sections of the State.)

White clover—On the more fertile soils well supplied with moisture. All parts of the State. (Ladino should be used only on the more favorable situations.)

Sericea lespedeza—On any well-drained upland soil. Commonly planted where other pasture crops could not be grown successfully.

Annual lespedezas—On a very wide range of soils anywhere in the State.

Summer Supplementary Pasture:

Sweet sudan—Best suited to very fertile soils.

Pasture Mixtures Commonly Used:

Bermudagrass-annual lespedezas (white clover on more fertile soils).

Dallisgrass-white clover

Carpetgrass-annual lespedezas

Suiter's grass-white or ladino clover

Orchardgrass-white clover or alfalfa.

Fertilizer Recommendations . . .

(*From page* 22)

bushel crop of corn, which requires about 100 pounds of potash during the growing season, will need to have around 500 pounds in exchangeable form in the surface 15 inches of soil. In most Missouri soils there is more potash in the second 7 inches than in the surface 7 inches. We have found that when the potash level reaches 300 pounds per acre in the surface 7 inches, it is no longer a limiting factor in plant growth, except possibly in wet growing seasons. Then potash in starter applications becomes increasingly important.

Where heavy crops of forage, especially legume hays, have been removed, large quantities of potash are taken from the soil. Its need may not be very much in evidence at first, but continuous removal of such crops will further emphasize the importance of this mineral plant food. In our experiments, the need for potash is quite evident after crops of red clover, soybeans, or alfalfa have been removed. On the other hand, where crops like sweet clover have been turned under or where the crops are pastured off, the need for potash does not develop so rapidly. However, this year for the first time potash deficiency is showing up on corn in a rotation of corn-small grain-sweet clover, which has been running 15 years. On an adjoining plot where red clover was used in a similar rotation and the red clover was removed for hay, serious potash deficiencies were quite evident after 10 years.

One of our most significant evidences of potash starvation has been winterkilling of wheat and barley on our experimental plots at Columbia where no potash was applied but where phosphate and nitrogen were used. When 50 lbs. of potash were applied on plots where soil tests showed about 100 lbs. per acre of exchangeable potash, the barley yields were increased from 18.2 to 33.2 bushels per acre. In another experiment where 200 pounds per acre of 3-12-0 were applied to the corn and wheat in a corn-soybeans-wheat-red clover rotation, about 95% of the crop was lost through winterkilling last year; while in the same ex-

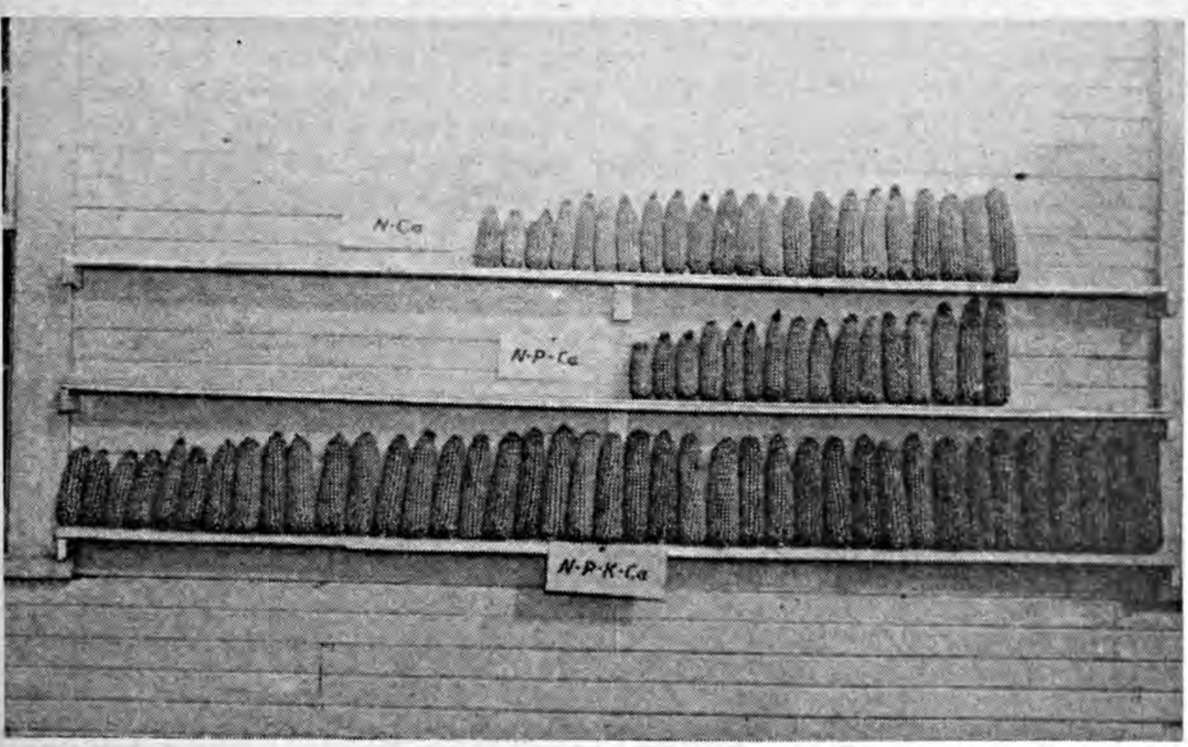


Fig. 5. This shows the quality of corn and relative yields produced after 14 years of small grain and soybeans with the treatments as described in Fig. 4.

periment where a like amount of a 3-12-12 fertilizer was applied, there was much better survival and the wheat made 20 bushels to the acre. On this same soil in a similar experiment, the oat yields were increased 20 bushels per acre where fertilizer containing potash was used. When soils are not limed sufficiently and receive but little nitrogen or phosphate, the soil minerals can frequently supply the potash needed for the low yields ordinarily obtained. With the adequate use of lime, nitrogen, and phosphate, the potash supplied by many of our soils can no longer meet the requirements for the higher yield of crops, especially where these crops are removed from the land as forage or hay.

During 1950, when the rainfall was more adequate during the growing season, greater evidences of potash deficiencies showed up on many of our Missouri soils. This can be largely attributed to the fact that the plant roots did not penetrate as deeply as in normal years and were not able to use the potash that might otherwise have been available to them from the subsoil. Such deficiencies showed up especially on those soils where the starter or maintenance application used with seedings of small grains, grasses, and legumes, and with plantings of corn did not contain potash.

Essentially the procedure followed in reducing the calculated risk when integrating our fertilizer recommendations with soil tests in the use of nitrogen, phosphate, and potash is:

1. Apply the nitrogen over and above the average released by the soil and the barnyard and green manure added, on the basis of annual needs to meet the planned yield requirements.
2. Bring the phosphate and potash up to the desired level and endeavor to maintain this level through starter or maintenance applications with seedings of small grains and plantings of row crops, based upon nutrient removal by the harvested crops.

When land is seeded to pasture the situation is somewhat different because one does not have as good an opportunity to get the starter or maintenance phosphate and potash into the soil, as is the case with row and small grain crops grown in rotations. It is therefore usually advisable to retest the soil each 6 to 10 years and bring up the levels of these minerals again when re-renovating the pasture. Since nitrogen is mobile, however, it can be added to pasture crops as topdressing on the basis of their immediate, or annual needs.

As we know, limestone is also relatively immobile in the soil and its level should be brought up in much the same way as for phosphate and potash. We do not normally plan to maintain its level in the soil, however, as we do with nitrogen, phosphate, and potash, through the use of starter or maintenance applications. A retest should be made of the soil each 6 to 10 years and the level again brought up in much the same way as with phosphate and potash on pasture.

We base the need for lime on the history of liming on the field in question and the exchangeable calcium and acidity, or pH tests. For instance, if a silt loam soil has been limed 2 or 3 years and the lime worked well into the surface 7 inches of the soil, and the calcium and acidity tests do not indicate that more is needed than applied, no more is recommended. If, however, only two tons per acre were applied and worked well into the soil within this period and an exchangeable calcium and acidity, or pH, test indicates a need for four tons, the difference of 2 tons is recommended.

If exchangeable calcium tests show medium, or between 4,000 and 5,000, pounds, and the acidity test is medium, or the pH range is between 5.5 and 5.9, two tons of limestone are recommended. When the acidity, or pH test, is the same (medium acidity or between pH 5.5 and 5.9) and the exchangeable calcium test is very low, or less than 2,800 pounds, we would recommend three tons of lime per acre. If the exchangeable calcium was very high and the acidity and pH range was the same as above, the amount of limestone recommended would be reduced to one ton per acre.

When the acidity test shows very slight or the pH range is around 6.5 but the exchangeable calcium is low or very low, as sometimes happens on our low exchange capacity soils, no more lime is needed to change the soil reaction, but some calcium as plant food then becomes advisable. Under such circumstances only small applications of lime are recommended. These are usually drilled or worked into the soil with seedings of small grain or with grass and legumes. Where heavy applications of rock phosphate are used according to recommendations, however, this need for extra calcium is usually met. Our 26 county laboratories that are equipped to measure both the pH and the total hydrogen are in a better position to determine the soil situation, especially in regard to the need for lime.

When a plant removes basic ions, such as calcium, magnesium, or potash, from the exchange spots on the clay, it leaves hydrogen to replace these ions. The exchangeable hydrogen can, therefore, be looked upon as a measure of the amount of spots devoid of bases in the exchange complex of the soil. A soil with a low pH, such as pH 5, has a low saturation with basic ions. On many soils that have not already been limed or the limestone has not been completely mixed, or where it may not have been on long enough to react with the soil, the tests will show a high reading for exchangeable hydrogen. The presence of unreacted limestone in the soil may, however, affect the pH reading. This fact furnishes helpful evidence as to whether or not a soil has been previously limed. This and the measure of the total hydrogen will therefore furnish a better measure of the lime needs and the percentage saturation of the soil with basic ions.

Fig. 6. Corn in an Ozark field will equal the best in Missouri if the rock-bottom land is treated right with ample plant food according to soil test recommendations. This field was entered in a State-wide corn yield contest and was estimated to run 15,000 stalks to the acre and equal the 1950 yield of 140.1 bushels. This land previously produced only 35 to 40 per acre. The increase was obtained by bringing up the fertility level through deep applications and keeping up this level by starter or maintenance applications with the crop.

Our tests for exchangeable magnesium are used in two ways—to determine whether more of this mineral is needed directly as a plant food and whether it should be used because of a wide calcium-magnesium ratio. For example, if the test for exchangeable magnesium is high or very high, over 600 pounds per acre, it is not likely that more will be needed as a plant food. If the test is low or very low, less than 200 pounds per acre, it is fair evidence that more of this plant food is needed to meet the requirements for a high-yielding crop.

Now where the tests show between 200 and 600 pounds of exchangeable magnesium per acre, the ratio between this and the exchangeable calcium is used to determine whether there might be a deficiency of this nutrient. If this ratio is as wide as 20 pounds of calcium to 1 pound of magnesium and the soil tests for exchangeable calcium and acidity, or pH, indicate that more limestone is needed, the best method of meeting the needs for it would be through the use of dolomitic or magnesium limestone. By using this method, the magnesium level in the soil would be brought up and the requirements for this mineral should be met for several years through the reserve supply added.

However, on these soils that have been adequately or over-limed with calcium limestone to the point where the tests showed additional limestone might raise the pH too high or if more calcium limestone was used it might cause the calcium-magnesium ratio to become even wider, magnesium in some other form would be advisable. Such applications would then be on the annual or short-time basis rather than a basis to bring up the level or reserve supply as is done with magnesium limestone. In such cases, should the soil indicate a need for potassium as well as for magnesium, sul-po-mag could be used to advantage. This contains 22% K_2O and 18.5% MgO. In those cases where neither limestone nor potassium was needed, magnesium sulphate, trace minerals containing magnesium, or fertilizers—usually used as starter or maintenance applications—containing trace minerals including magnesium could be used. Since most Missouri soils contain more magnesium in the subsoil than in the surface, it would usually be advantageous to plow deeper in order to bring up some of this magnesium. For those soils that have acid clay subsoils this might also be an advantage, when they have been overlimed, by reducing the pH and helping narrow the calcium-magnesium ratio. On low organic matter soils the addition of barnyard or green manure, or organic matter in some other form, should be helpful in buffering the imbalance of the calcium-magnesium.

In conclusion, might I repeat that the fundamental idea in our whole soil-testing and soil-fertility program is to reduce calculated risks to the minimum through the use of soil tests as the basis for soil-treatment recommendations, in order to eliminate plant food as the limiting factor in crop production. We endeavor to do this by bringing the minerals up to the desired level. We apply the nitrogen needed, more on the annual basis, to supplement that released by the soil and the organic material added. We also use starter or maintenance applications of phosphate and potash and in some cases magnesium and calcium, where they can be properly made, to help meet the immediate needs of the crop for these minerals and to help maintain their level in the soil.

What's the Right Answer? . . .

(*From page* 5)

Now to pursue this hunt a bit further, there are professional information workers serving the private field for hire, and another group of (some say) alarming numbers, who serve the states and the federal government for a graduated scale of remuneration fixed by law. At first glance you'd say these two related and similar sets of information people perform their jobs in the same way in general, and therefore usually endorse each other's activities. But this would be a pardonable error for the laity. They do not work exactly alike and their ordinary professional alignments and associations are seldom shared in common.

Having belonged to both the private and the public schools of this profession during nearly 40 years of information service, I can look fairly and objectively at both. Both groups have at least one sad item of common experience—each has its share of misfits, frauds, and phonies. But in a larger sense and to the glory of the profession, it has been our experience that information of either private kinds or in the public service has been adorned with a mighty fine, capable, and honorable set of producers. The time-serving element has been definitely in the minority.

It is true, however, that too few opportunities are afforded for the members of the commercial and industrial information squads to belong to the same societies and professional groups as those working for the public—with at least one major exception. This body to which masculine devotees of high professional ethics and standards of information belong regardless of the units they work for is known as Sigma Delta Chi, a society, by the way, which had its origin in the academic fold, nursed by the alma mater as it were, and is therefore closely akin to public service in its highest essence. Its pioneers and many present leaders are able information personnel employed by states or the federal government. (The "gals" have their own similar working professional society, be it known.)

NOW in an everyday practical sense, there are extremely close relations between the working press and radio operators and the folks who write the "hand-outs" and bulletins and background information sheets on behalf of the public institutions. Such routine mutual associations should acquaint the private information folks with the performance of their public cousins. Likewise, it does separate the sheep from the goats in the eyes of the public service men, as they deal with the inquiring personnel who put their stuff on the wire or on the air.

Yet too often we read snide editorials and see "colored" news articles, in which the fellow who tries to "shoot it straight" for the government is held up to ridicule as a nuisance and a needless burden on taxpayers. Too often such statements appear in the very newspapers and magazines whose reporters and editors have received much constant help and relied quite generally upon the integrity of the public information officers. It's worth noting, however, that if you corner one of these worthies and ask him his honest opinion, he'll say that his own newsbeat is so large and so complex that without aid from public information men and women his job would be a lot harder and less effectively done. He makes no bones about that, and certain recent questionnaires in respect to public information sources submitted to experienced newshawks and editors bear it out.

ONE other difference exists between the private and the public purveyors of information. Accuracy is the first and foremost ideal of the whole profession, but the two branches go at it according to different methods. The routine, ever-ready commercial reporter, who "sells" news and features to make a living and make a newspaper pay, seldom agrees to submit his copy to an authority whom he has quoted or discussed. In fact, a few of them are insulted at any such suggestion. They rely on their own eyes and ears to get it right. Their resultant danger from overstatement or unconscious bias or misinterpretation is often great and harmful. They work so fast that few lawyers hired to ward off libel can keep up with them.

Yet—and here we tread on slippery ground—the public institution reporter and information writer is invariably required to get "clearance" or what amounts to an O. K. from the scientific or administrative authority he quotes or relies upon. This makes the copy more authentic. I hasten across the "slippery" spot by saying that this is not usually "censored" or "classified" information of the kind which prying reporters so often claim is being withheld or deftly evaded. That is in a special class of its own and has no bearing on the ordinary routine give and take between the sources of public information and those who release it and distribute it to readers.

Despite the fact that there are many hundreds of college courses and scores of college departments teaching journalism today, the whole profession is too loosely organized and buttressed. Its ineffective free-for-all system invites those with little training or background to enlist and proclaim themselves past masters. I honestly think that information people are just about at the stage of medicine and surgery back in the middle ages. That is, any charlatan or conjuror, mountebank or adventurer who could pull a trick cure out of the bag was able to get a host of credulous followers and victims.

WE have in the agricultural information profession no fixed rule for advancing aspirants to a fling at the works. Of course, there is a behind-the-scenes idea that to succeed in farm information work and become an ornament to the profession, one should be raised on a farm of some kind and have had more or less academic training in both agriculture and journalism.

But the demand for new publications and new radio programs and such avenues reaching the farmer is keen these days. In our Southwest region there are more regulation newspapers publishing extra supplements than the standard agricultural press itself can boast, either in numbers or total circulation. The fact that a bulk of those daily newspaper readers are not farmers doesn't conflict with this thesis. One who tries to interpret and explain agriculture and its risks and problems to the urban dweller is a mighty potent force, for good or ill. Unless all our citizens come to know the facts of life in agriculture—as in labor—an opening for bitter cleavage is a nasty threat.

By this I do not insist that we must educate tyro information guys to become selfish special pleaders. What we want in them is broad understanding and not a quick and skimpy newshawk's hunch. It has become a frequent practice among public institution informationists to put too much emphasis on puffs and boosts for their college or their department, and forget the basic reason for the existence of the institution—which is to serve the public and help it avoid pitfalls and overcome obstacles.

Spending public money to salve or oil up some executive or anticipate some smart political maneuver by cooking up another smarter one is not in the code of the best professional informationists. The mere boastful recital of power or privilege, without showing how our people have derived some benefits and encouragements from governments or other public institutions, is debasement of the craft.

BUT like all fragile and vulnerable human things, our information is subject to vagaries and whims and misdirected effort. It can never be perfect. It can hardly ever know for sure that what it proclaims is the truth —at least as to whether it will be the truth tomorrow. But if it manages to escape dishonest manipulation for greed or narrow glory, its future service to men of good will should be a credit to the profession.

Some of us have had but humble and obscure parts to play in the upholding of a standard of ethics and nobility for information writing. Many of us have not seen clearly what we were expected to demonstrate or explain. We have all sinned by omission or commission or both. But let's vow to carry forward the ideals and defend those whose daily work has been worthy of the hire. Information is so close to the foundations of our very existence and welfare that he who tinkers with it or attacks it wholesale is quite apt to be anything but a "statesman for the ages."

Seven sailors and a lady, shipwrecked on a desert island, were rescued after five long years.

One of the sailors, upon his return home, was relating his experiences to a very straight-laced and pious old aunt. Finally, after much hemming and hawing, the old lady asked:

"And, my boy, was the lady chaste?"

"From one end of the island to the other," replied the sailor.

* * *

One thing you've got to admit about the little red schoolhouse—it had something in back of it.

* * *

"Darling," a mother reproved her daughter, "you were awfully late last night. I'm afraid I'm dreadfully old-fashioned, but I should like to know where you go."

"Certainly, mummie. I dined with—oh, well you don't know him—and we went to several places I don't suppose you've been to, and finished at a queer little club—I forget its name, but it's in a cellar somewhere in town. It's all right, isn't it, mummie?"

"Of course, darling. It's only that I just like to know."

* * *

A young husband was telling his wife about a couple who had just had twins.

"And just think," he said, "twins happen only once in 13,350 times."

"My," said the young wife, "when did she have time for her housework?"

"Now, children," smiled the Sunday School teacher sweetly, "I want you to be so still you can hear a pin drop."

After silence had reigned for an interminable 30 seconds, a kid in the corner yelled, "Okay. Let 'er drop!"

* * *

"Last night," reported Private Higgins, "I finally persuaded my girl to say yes."

"Congrats," said his buddy. "When's the wedding?"

'Wedding?" said Higgins. "What wedding?"

* * *

The naked hills lie wanton to the breeze,
The fields are nude, the groves unfrocked;
Bare are the shivering limbs of shameless trees.
What wonder is it that the corn is shocked!

* * *

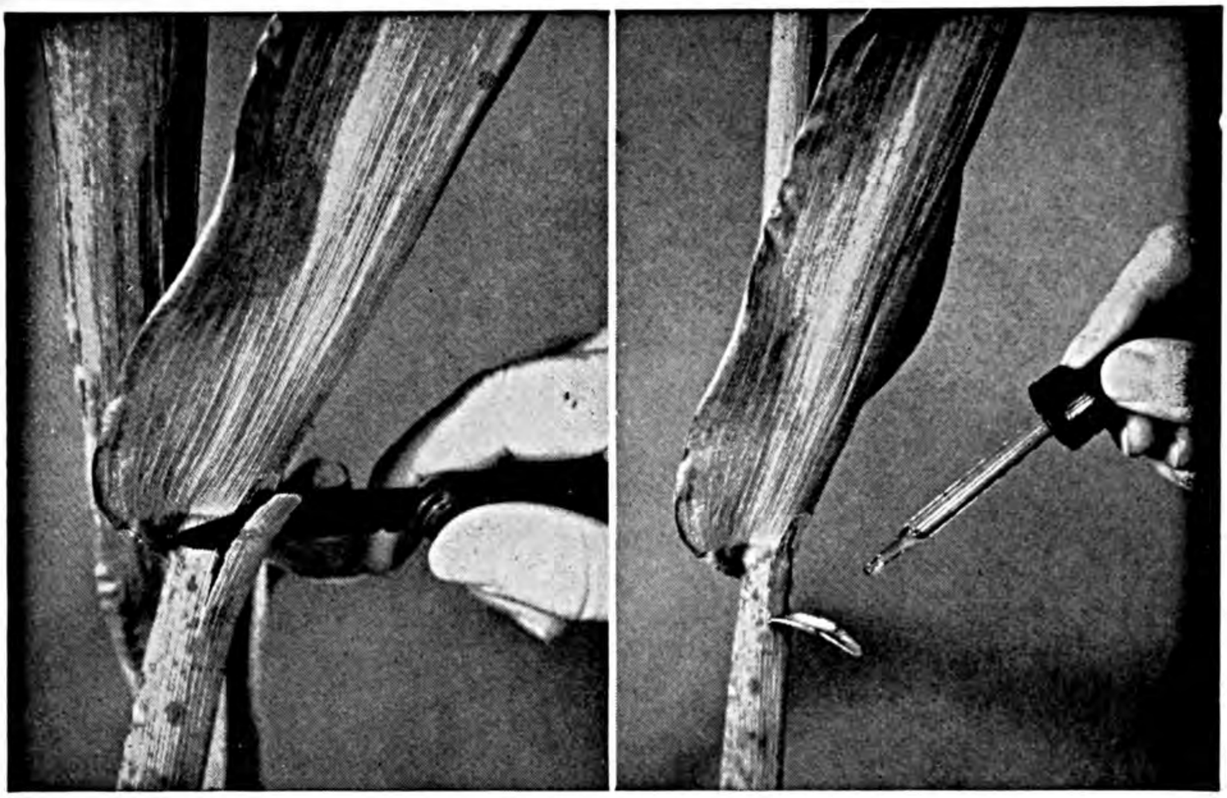
It was in one of those North-South intersectional football games. A Southern halfback was tackled terrifically hard. The impact stunned both boys. When their heads cleared the Southerner said good-naturedly, "You-all sure hit hard."

"You-all, my eye!" retorted the Northern tackler. "I did it all by myself."

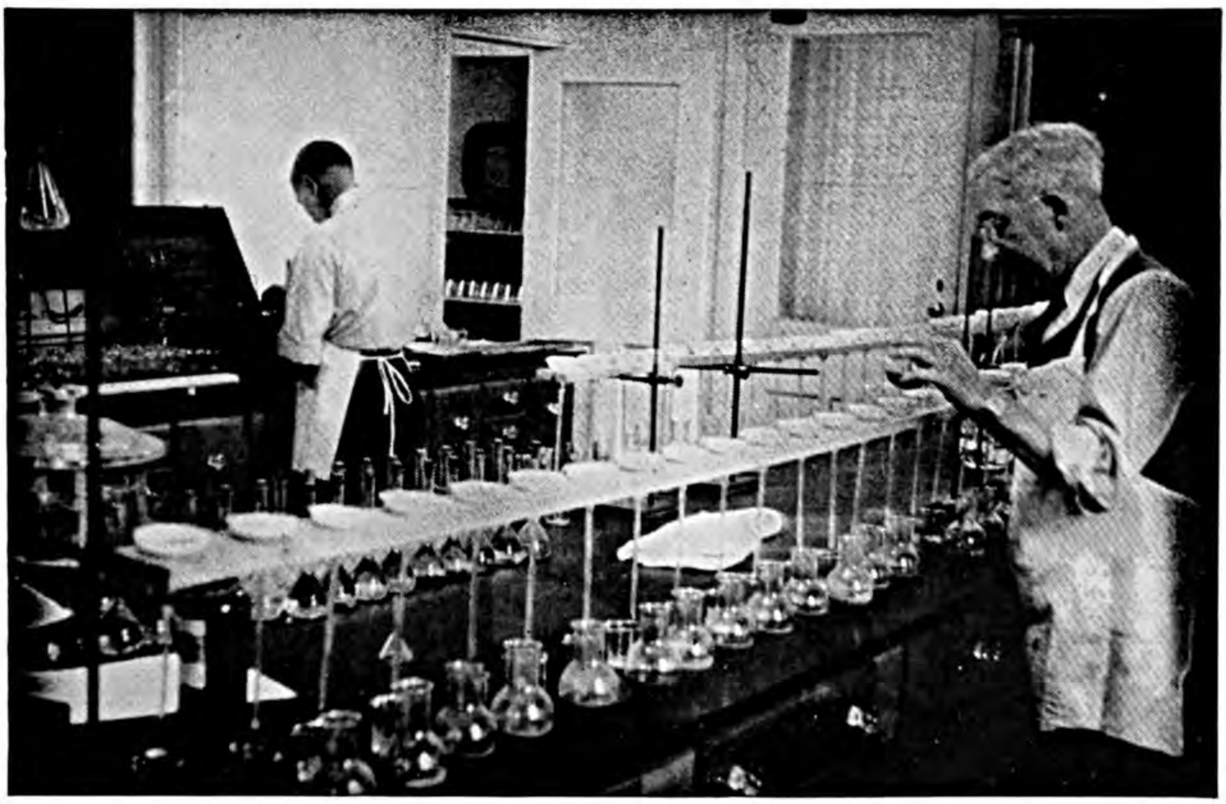
* * *

"Hey, pop!" said the son, "Watcha doin' kissin' the maid?"

"Bring me my glasses, son," said pop. "I thought it was your mother."



Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.

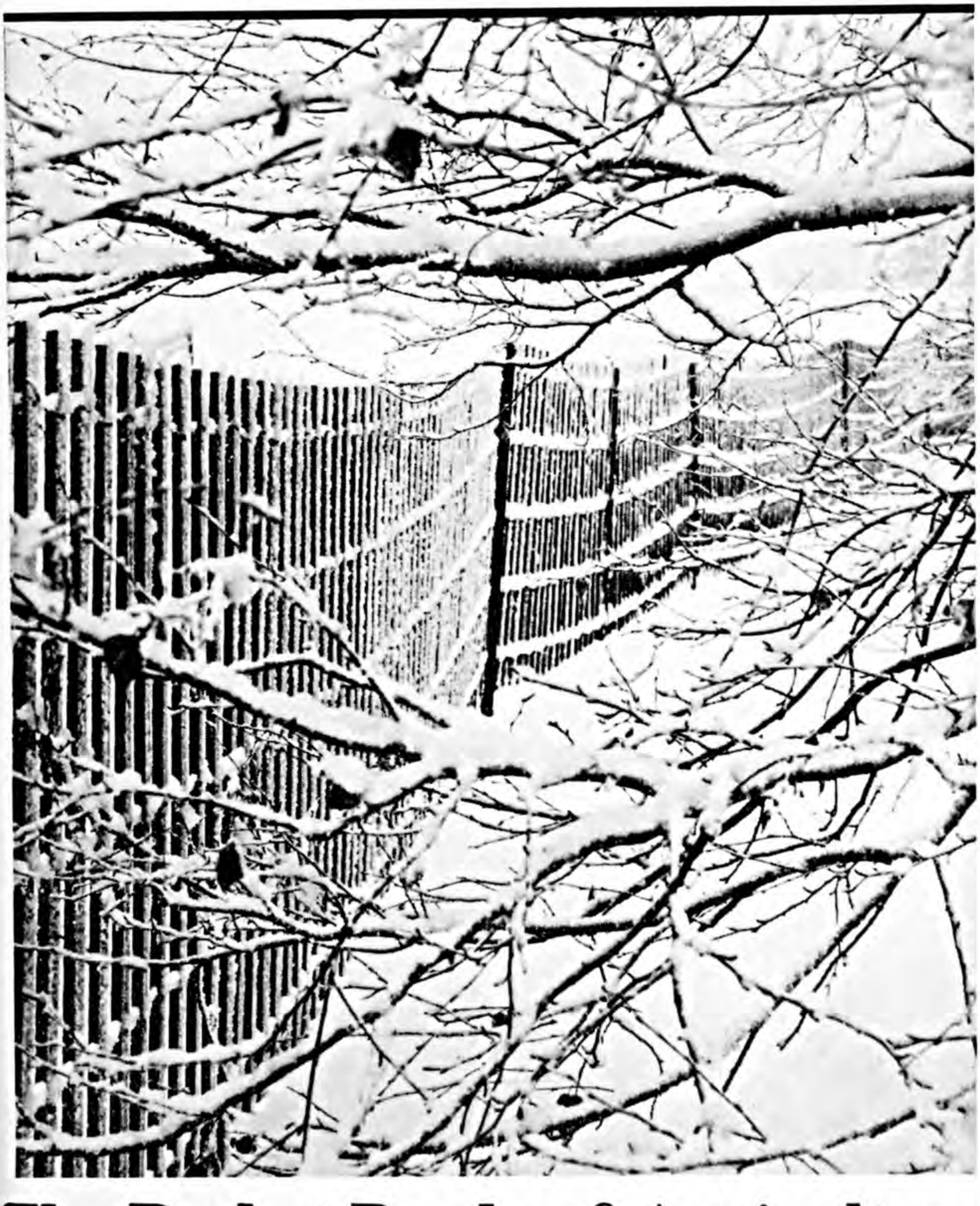


Equipment used in a well-developed laboratory for soil analyses.

Better Crops WITH PLANT FOOD

December 1951

10 Cents



The Pocket Book of Agriculture

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXV NO. 10

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Well-watered Christmas Trees

Better Crops with PLANT FOOD

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Look back, and . . .

You'll Remember Yule

Jeff McDermid

WHEN Christmas comes, it stirs up inside a guy's soul a lot of feelings which are sort of reflections of the bright and dazzling hopes that you had as a kid up there in our old valley. For one thing, it reminds you forcibly that maybe you never made out to do all the good and brave and self-sacrificing deeds that a kid yearns and dreams of doing—not because of any Christmas gifts in the offing—but just because you went to high school and learned a little here and there in a sketchy way about fellows of fact and fiction who went around helping others and lifting the fears and burdens from hungry stomachs and weary hearts.

You remember how we read Ivanhoe, and The Great Stone Face, and the Idylls of the King, and the Dickens books about the child's dream of a star, about Tiny Tim and Bob Cratchett, and that noble man who held the hand of the timid little innocent seamstress on the way to the guillotine in Paris during the Terror—Sidney Carson, who gave his life to make a woman whom he loved happy.

Then there are memories of stories about Friar Tuck and those other mountain monks with their shaggy dogs, who rescued tired travelers amid the Alpine snows. Other boyhood heroes are recalled, such as Sir Launcelot and his high career amid the plumes and his lofty purpose of knighthood in its flower, and Miles, the dashing friend of the "pauper prince" in his tumultuous adventures in the fens of London. And, of course, some of the nicest Bible characters gave you deep reverence for living well and living honorably—like David and Jonathan, Ruth and Boaz, and the Wise Men of the East and the Life they came to usher into a sad and bitter world so that men might find their narrow pathway bright and beautiful.

Yes, and even a few of the mighty men of American history were your lodestars, too. You tried to see yourself as Washington, or Lincoln, or Thomas Edison, Marcus Whitman, or Robert E. Lee. The list also included some members of your own family of past generations who did so much with so very little to ease the cares of neighbors, and raise the orphans, and build little churches and lonely schoolhouses out in the wilderness, so that nobody might say they had not contributed in their brief and rugged lives to the foundation stones of liberty and knowledge and truth and reason.

YOU used to ponder there by yourself near the dancing firelight of mother's kitchen or under the evening hanging-lamp, wondering what manner of man you would finally be and if perchance some happy traits of inheritance or environment might clothe you also with just enough stamina and faith to make you a doer of decent and dutiful things that would leave the community a trifle better for your having lived there awhile in the valley.

You did not in those tender times have the awful sense of quick urgency which haunts you as the middle years start to throw long shadows far behind them. To you of the youthful dream, tomorrow was "tomorrow," and the years ahead a waving stretch of beckoning highways. You seldom stopped to think that life means just one journey, one chance, one search only for the treasure at the rainbow's end, and only one seedtime in which to make a harvest. To you there were no mental reservations about the "gone years," the "now years," and the "maybe years." To your fervid dreams came nothing but the song of the birds and the hue of the flowers—for the time of the locust and the pestilence was yet to be.

One of the best farmers in our valley, who knew that his days were numbered after decades of heavy labor, aroused himself in the last springtime of his life and asked to be taken daily to the edge of the plowlands to see his son and the hired man prepare the soil and seed the crop. He wanted them to be diligent and painstaking, to use the best tested seed, to direct the plowing so as to halt erosion, and mix into the topsoil the right proportions of mineral fertilizer and lime. All summer long he went out to scan the fields and stimulate his hopes; and he must have realized then, as we ourselves do in time, that this was a symbol of the short span of man's normal destiny, in which the task one performed stood as his "grade mark" forever.

NOW if we compare our own achievements with those of other fellows from our valley only on the grounds of bank stock and other tangible property, we probably won't get all the flavor we can out of the Christmas dish. But we should study up what old chums did for community betterment, and use that as a kind of test to find out the butterfat content of our own milk of human kindness. Then when we get to compare the tests carefully, we'll see that certain attitudes and stubborn ideas we held too firmly have stood in our way considerably.

Number 1 stumbling block was our idea that we must never butt into other people's private affairs, leaving that to the civic do-gooders and organized charities and inquisitors. Well, when our valley was first settled they did not carry their rugged individualism quite that far. You were not supposed to tell a man how to vote or whom to marry or how many kids to have or how to raise them—but if anybody down the road a piece got real sick and famished and downtrodden, there was usually some neighbor on hand to "succor the sucker."

Even though we did have a poor farm nigh us, as well as a place to lock up criminals (if they weren't in too big a hurry to get out), our valley folks always pitched in and tried to help unfortunate neighbors and keep them away from trouble and despair as long as possible. None of us were psychological professionals or social science ex-

perts, such as the poor and the lazy find necessary nowadays for their rejuvenation. I know we blundered a lot and did clumsy things in our home-grown charity, but by gracious, we were right in on the scene anyhow and had things first-hand. The real trouble is we pray and perform good words and deeds by proxy these days—and then grumble because the Office of Price Stabilization doesn't put a lower ceiling on the price we must pay for somebody's poverty through the community chest.

There are lots of mixed-up reasons also why we are often slow and reluctant to make personal contacts with the "reliefers." It may be social pride, indifference to others, strict attention to our own cares and business affairs, and the reaction of inflated costs and values on our pivate means and inclinations.

So in this manner the intervening years have hastened by us and found us sadly lacking in many of those ambitious longings and juvenile romanticisms. Of course, we have done a stint or two of devoted service now and then—mostly in between the demanding cares of a none-too-successful family man. We have excused ourselves with the thought that at least the parish has not been obliged to see us through with relief donations and organized charity doles. We take some credit, and rightly so, on our ability to maintain an independence that the government says is part of the American heritage. It is nothing to be dismissed lightly at that, seeing as how no small part of the decadence and poverty all around us is due more or less to laziness, laxity, and bad planning.

WE have prepared ourselves by diligence and study for some sort of contribution to society which keeps us in spending money and self respect. But the thing we most often overlook in casting up the score that way is that some others do not have either good health or a fair share of opportunity. Maybe part of our social obligation here is to give some aid to others whose environment and chances for success and comfort have not been within the average for our country.

I am much heartened by the almost unanimous endorsement of our people today for the various public assistance programs in effect for the aged, the blind, the motherless, and the indigent. They say these dependents on assistance programs—not to be confused with the regular social security insurance deal—are growing in numbers and taking up a larger amount of financial support than ever. Part of this extra cost is traceable to inflation and part to the fast pace we run in American life. The existence of so much dependence in the midst of the highest income level in our history means that we have been ready and willing to enact laws which provide the funds rather than to let vicious anti-democratic elements say that we celebrate Christmas with selfish hearts and pagan indifference.

At this time of the season likewise we often consider the evils that have

(*Turn to page* 49)

Photo by author.

Fig. 1. Turkish shepherd, interpreters, and Mission group in pasture near Eskisehir, Turkey. Shepherd says the pastures aren't as good as they once were.

Grassland Farming in the Mediterranean Area

By Ford S. Prince

Agronomy Department, University of New Hampshire, Durham, New Hampshire

"GRASSLAND farming" in the world received further emphasis last winter when a survey team was selected to study the present status of pasture and fodder crops in the Mediterranean area and make recommendations for their improvement. The survey was limited to those countries that have participated in the Marshall Plan or to segments of those countries which lie within the sphere of the Mediterranean climate. There is no reason why the recommendations that were made would not apply to other countries in the Mediterranean area, such for example, as Spain and Yugoslavia.

The survey was under the immediate supervision of the Marshall Plan countries, which is known in Europe as the Organization for European Economic Cooperation, or OEEC. The Food and Agriculture Division of this organization was responsible for the organization of the project. The expenses of the survey party were borne from counterpart funds belonging to the countries surveyed. Workers from Italy were especially insistent that such a survey should be undertaken.

The survey team which was selected was composed of Dr. O. S. Aamodt, Principal Agronomist of the Division of Forage Crops and Diseases, U. S. Department of Agriculture, whose experience in the States and on similar missions elsewhere proved invaluable to the group; Dr. R. O. Whyte, of England, Editor of the British Grassland Journal, who was chosen by FAO to serve as their representative on the Mission; Mr. C. M. Donald, Principal Research Officer of the Division of Plant Industry of Canberra, Australia, and Dr. John W. Roland, Principal Pasture Research Officer of the South African Department of Agriculture, Pretoria, representing their respective governments. Dr. William Davies, Director of the Grassland Research Station, Stratford-on-Avon, Chairman of the Grassland Working Party for the 16 nations which comprise the OEEC, served on the survey through Italy; and his Assistant Director, Dr. T. Williams, joined the party which surveyed French North Africa and Portugal. The writer was the other member of the Mission, and the second representative of the United States, with Dr. Aamodt, in the group.

We were particularly fortunate in having Mr. Donald and Dr. Rowland on the Mission since their experience had been in climates similar to that of the Mediterranean. Dr. Whyte was a fortunate choice for this group also, since he had made a similar survey of the Island of Cyprus some years ago. Dr. Aamodt has had wide experience and is well acquainted with the "Mediterranean" climate which prevails in southern California, with its peculiar grassland problems. For my part, I had often heard about, but had never seen, the "blue" Mediterranean which is so blue because the sun shines most of the time, so that the climate is actually characterized by a paucity of precipitation. This is especially true of the lowlands of the region.

Actually, the climate of the area is intermediate between the humid climate of northern Europe and the desert conditions of the Sahara to the south. The summer is always characterized by drought, which is more intense at lower elevations, while winter precipitation is more nearly like that of northern Europe with rain-bearing winds from the ocean. At lower altitudes, then, the winters are mild and wet; the summers hot and dry. At higher altitudes, the precipi-

Photo by Dr. Rowland.

Fig. 2. Mediterranean Grasslands Study Mission. Left to right: Dr. J. W. Rowland, South Africa; Mr. C. M. Donald, Australia; Dr. O. S. Aamodt, USDA, Beltsville, Md.; the Author; and Dr. R. O. Whyte, Norfolk, England.

tation is greater; and having cooler temperatures, the rainfall is more effective. "Winter rainfall, summer drought" adequately characterizes this climatic pattern, although the intensity of rain or drought depends largely upon the altitude and the distance from the Mediterranean Sea. The total annual rainfall varies from 8 to 40 inches for the region as a whole.

Outside of the area under irrigation, and there are many actual and proposed irrigation developments, the agriculture is based upon the production of winter annual crops, such as wheat and other small grains. Seedings of crops for fodder and pasture are usually made in the autumn for harvesting in spring or for pasture during the winter and spring months. The production of pasture and fodder for the dry summer, therefore, is as important to the animal husbandry of the region as is the production of winter feed in the northern part of the United States.

Since ancient times, shepherds have pastured their herds and flocks during the winter months on the warm, low-lying plains land, but have taken the animals to the hills or mountains where the weather is cooler and there is more effective rainfall for summer production. This movement still continues in many parts of the area, and the black tents of the Kurds and Nomads are characteristic of many landscapes.

In one respect, at least, and it seemed to me this fact tended to counter-balance the peculiar climatic pattern, the peoples of the Mediterranean are fortunate in that most of their soils are formed from limestone. Furthermore, with the scanty rainfall the soils at lower altitudes are not leached to any extent, except in the marsh lands. The net result is that many soils in the area have a pH value of above 7.0, so that liming is unnecessary. At higher elevations, where there has been much leaching, and especially on soils formed from granite, gneiss, or mica schists, the soils are acid and need lime for high production. Unfortunately, where the soils are acid there are no lime deposits, hence there is a transportation problem if liming is practiced. Soil surveys are not available for most of the countries, and so it would be rash, probably, to guess as to the extent of neutral or alkaline soils. However, in the low and plains land, which is most heavily farmed, it is quite possible that 90 per cent of the soils are alkaline or nearly so, the acid soils lying for the most part at higher elevations and often on sloping land in the hill and mountain areas or in some of the reclaimed marshes.

The Need for Fertilizer

From the standpoint of fertilizer nutrients, the need for phosphoric acid is most acute. All of the fertilizer trials observed by the Mission in Italy, Turkey, and Greece indicated that a deficiency of phosphoric acid was limiting the production of cereal crops to a marked degree. In some instances, on the central Australian plateau in Turkey, as little as 10 pounds per acre of ordinary superphosphate brought a tremendous response in the growth of wheat. With such a deficiency of phosphorus and judging by the response on wheat, it seems almost certain that legumes will respond to phosphorus and that for high fodder or pasture production particular attention should be paid to the use of superphosphate.

Fortunately for the area, there are extensive deposits of phosphate rock in North Africa, and these, coupled with huge sulfur reserves in Sicily, assure the region as a whole that there need be no shortage of phosphate supplies. This is not to say that Turkey and Greece have ready access to either the sulfur or the phosphates, except as they have goods to exchange for them. But the potential supply is there and if the need is as urgent as appears, the demand can and should be met.

The need for potash in the Mediterranean area was said by soils men not to be acute. This was particularly indicated for the soils formed from limestone and those not heavily leached. At higher elevations, however, where more leaching has occurred and especially on soils formed from granite, gneiss, and mica schist, it is very likely that a need for potash will be discovered when experiments are tried in these areas or when attempts are made to produce legumes which have a higher potash requirement than most other field crops.

The potash resources of Europe, such as those in Alsace-Lorraine in France or Stassfurt in Germany, are adequate to supply the needs of the Mediterranean area for some time to come, along with the other demands that are made upon them.

Except for a few minor deposits of potassium nitrate on the arid Central Plateau in South Turkey, there are no natural nitrogen resources in the area. Some ammonia is recovered as a by-product from the coking process and, of course, France and Italy have synthetic nitrogen plants in operation. There is tremendous need for an expansion in the production of synthetic nitrogen to supply the needs of Greece and Turkey, particularly, and perhaps of other Mediterranean countries. The two plants in operation in Italy produce cyanamid, and since this type of nitrogenous fertilizer is better suited to separate application than to use in mixed fertilizers, there could well be an expansion of synthetic nitrogen facilities in that country, especially of plants that use the ammonia process.

Greece is sorely in need of nitrogenous fertilizers, which must now all be imported. A plant in that country that would synthesize air nitrogen would be a boon to the agriculture there. In both Italy and Greece, the pressure on the land because of the density of population is tremendous. Fertilizer nitrogen, reasonably priced and judiciously used, would increase the food supply of these hard-pressed peoples.

The pressure of population on the land in Turkey is not so great as it is in Greece or Italy. Like Greece, there is no synthetic nitrogen plant in Turkey. Some sulphate of ammonia is produced as a by-product and some nitrate of soda is imported. The use of fertilizers in Turkey is really in the beginning stages, and although since the last war such use has increased fivefold, the principal fertilizer so far

Photo by UNH Photo Visual Service.

Fig. 3. A modern ladino clover pasture in New Hampshire. This is introduced to contrast with the Turkish pasture in Fig. 1 which, along with other permanent pastures in the Mediterranean area, has never been subjected to improvement methods.

utilized is superphosphate. Most of the fertilizer used in Turkey is applied to sugar beets and cotton. The use of fertilizer on wheat is just beginning, and so far as pastures and forage crops are concerned none has so far been used.

As a matter of fact, nowhere in the Mediterranean did we find any permanent pastures that had ever been fertilized. Legumes that are produced for hay or silage, which follow wheat, usually, in some rotations, are sometimes fertilized but are more often grown on the residues of plant food from the wheat crop or on that which is available in the soil.

Lack of appreciation of what fertilizers will do on forages is no doubt responsible for this fact. Another hindrance to fertilizer use on forages, and in fact on all other crops, is their high price. In one of the recommendations of the Mission, we stated that fertilizer prices are too high in these countries and that a price policy should be developed to make fertilizer available to farmers at reasonable cost, particularly for use on pasture and fodder crops. This recommendation was directed specifically to pasture and fodder crops since the increase in production of these crops was the primary objective of our mission.

The need for attention to fertilizer prices in the Mediterranean countries has been emphasized also by the report of the Fertilizer Committee of the OEEC.[1] In this report, the average prices of fertilizers to farmers for 15 of the 16 OEEC countries are listed. Greece was listed in this report as having the highest cost of potash and superphosphate. Portugal had the highest cost of nitrogen, was next to Greece in potash prices, but subsidizes the cost of superphoshate to farmers. Italy was third from the highest in fertilizer prices for all three ingredients among the 15 countries. According to the data, nitrogen prices were 60 per cent higher in Italy than in the lowest non-subsidy country, while superphosphate and potash prices were about 50 per cent higher than in the lowest non-subsidy country. Strenuous measures are needed to remedy such a situation, either by subsidies or by the breaking up of monopolies, if such exist, or both.

I made this statement at the final conference which was held in Rome, "The soils of the Mediterranean are not producing the yields of which the environment is capable." High fertilizer costs to the farmer, the lack of appreciation among governments as to the need for fertilizer subsidies to increase food production, the lack of legume production to add to the nitrogen supply on most farms—these are some of the reasons why yields are no higher than they now run.

The Use of Manure

The use and care of manure in Italy, Greece, and Turkey vary widely. In northern Italy, there seemed to be a keen appreciation of the value of manure. Most of the manure on the farms visited there is composted with superphosphate and allowed to stand in well-constructed compost piles for a year before being applied to the soil. Wells to save the liquid portion are commonly found in the area.

Composting manure in this manner is an admission of the shortage of nitrogen since it is well known that strawy manure applied directly to the soil may need to be supplemented with nitrogen to avoid temporary harmful effects. On the other hand, even with superphosphate added, there is much loss of nutrients from composted manure, especially of nitrogen and potash.

In Greece, it appeared that farmers treated their manure supply with some indifference. In many places, piles of manure not in compost heaps were observed on the edges of the fields, but not being utilized for current crop production.

On the Central Plateau in Turkey, manure produced on the farms is care-

[1] Fertilizers in Agricultural Recovery Programmes, OEEC Paris, 1950.

Photo by author.

Fig. 4. An example of farm power on small farms in Turkey. Undersized and poorly nourished cattle speak of the need for more and better fodder crops. Note that these two farmers have brought a "spare" in case one of their animals gets overtired.

fully saved and used as fuel. None of the plant food except that which is in the ashes is returned to the soil. To be used as fuel, the manure is collected, moistened, molded into bricks of varying shapes and sizes (to fit the owners stove, perhaps), and used for cooking or heating. This "Tezek," as the farmers call it, burns with the odor of incense and imparts a very pleasant aroma over the countryside when it is utilized. There is no wood on the Central Plateau and transportation problems are too acute to bring in coal,

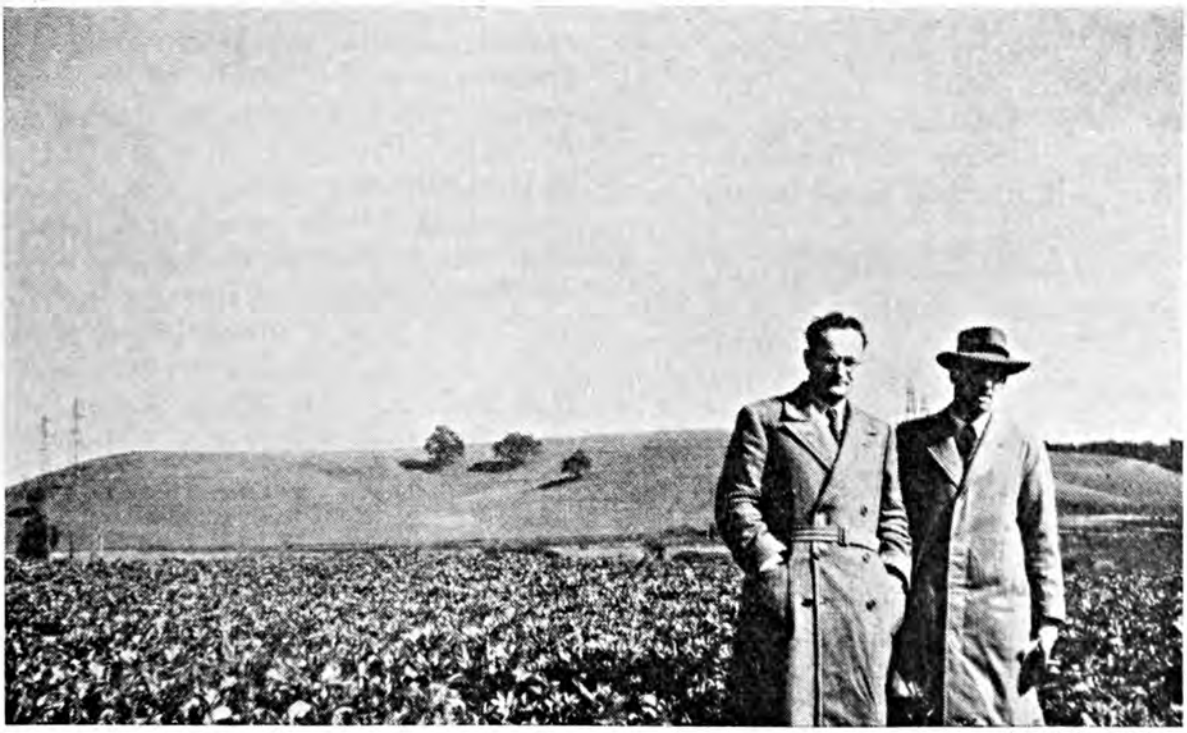

Photo by author.

Fig. 5. Sulla is a promising forage crop in Italy and perhaps will be found to be adapted in other Mediterranean countries. Left to right: Dr. Litt. Scabardi, Italian Ministry of Agriculture, and Mr. Donald of Australia.

hence these villagers are practicing an age-old custom in burning their manure. That this practice creates a special soil-fertility problem in Central Turkey, there can be no doubt. Nor can the farmers there be criticized for burning the manure, since it is the only accessible fuel at their command.

Rotations

Another major point which was strongly emphasized in the report of the Mission was directed specifically toward existing rotations. Many of the rotation practices now in vogue have been handed down from generation to generation without thought of change. Undoubtedly some of these practices are good, but with the pressure on the land as great as it is today, the rotations now need close scrutiny.

Take, for example, the wheat fallow rotation. In this rotation, if one can call it such, wheat is grown one year in two, the land being fallowed in the alternate year. Fallowing such as is done with a wooden plow is of doubtful significance in the conservation of water. That it does have some benefit from causing nutrients to become available is readily admitted. But, as Mr. Donald pointed out at the final conference in Rome, "Fallowing is an exploitive practice, causing loss of fertility nutrients and probably a reduction in structure on all but the most fertile soils."

Mr. Donald asserted also that many countries and regions had eliminated the fallow in favor of growing a legume in the "fallow" year, thus providing feed for livestock as well as nitrogen and organic matter to the soil in the roots and stubble of the legume and in the manure that is produced from it. This change was suggested wherever rainfall would permit.

Then there is the system of wheat monoculture, in which wheat is grown on the same land many years in succession. This program is followed when the rainfall is high enough usually to produce a fairly good crop each year. There is much evidence from experiments in Italy and elsewhere in the area that as much wheat can be produced when the land is in wheat two years in three, with a legume for fodder or pasture the third year, as when wheat is grown each year in the three-year span. More legumes, better livestock, better fertility, and as much or more wheat—thus a beneficent circle is created.

Such a change in the farming program from wheat monoculture to a wheat-wheat-legume rotation entails a basic change in land use, as Dr. Rowland pointed out in the final conference in Rome. At this conference, he stated, "The introduction of pastures and fodder crops into cereal rotations in the Mediterranean is a far more complex task than the mere incorporation of a new cereal." He said, also, that the new cereal-legume rotation must be designed to achieve a steady flow of pasture and fodder for livestock, a continuation or an increase in the over-all production of cereals, particularly for human consumption, and an improvement of soil fertility.

The incorporation of more legumes into these rotations of the Mediterranean countries should cause an improvement in the quality of the livestock as well as to bring an increase in numbers. The cattle, especially where found in the drier areas, are small and undersized for the breeds they represent. Since cattle are everywhere used for draft purposes, an increase in size and vigor would mean better farm power on small farms as well as more milk and meat. The integration of animals, fodder plants, and crops for human consumption should be featured by the prominent use of legumes, which in turn would bring more manure to use on the farm, better soil fertility, and in many areas an expansion of arable land by incorporating some of the so-called permanent pasture land into the farming system.

Unfortunately, in some areas there

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Fig. 1. Nitrogen-treated permanent grass pasture will furnish a week's earlier grazing, two to three times as much feed, a more palatable forage with a higher protein content, and a thicker turf with greater moisture-holding capacity. It will reduce runoff, carry cattle for a longer period into the summer months, and will help to choke weeds. It all adds up to more low-cost, home-grown protein feed, and fits into our national program of soil conservation and a grassland type of farming. Nitrogen backed up with phosphate and potash in a complete fertilizer such as 10-10-10 will maintain high-level production over a period of many years.

Pasture Improvement With 10-10-10 Fertilizer

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wisconsin

PASTURE improvement through the use of 10-10-10, or other high nitrogen fertilizer, looms up on the horizon as a great opportunity for low unit cost milk and meat production on Wisconsin farms. There are thousands of acres of pasture land in Wisconsin where the application of 500 lbs. of 10-10-10 per acre every second or third year (with ammonium nitrate or other nitrogen fertilizer applied during the intervening years) will be found a highly profitable investment. Some agronomists say apply 10-10-10 every year. Why worry, they say, about building up a little reserve of phosphate and potash in these old, depleted permanent pastures.

More abundant pastures will give us cheaper feed and in turn will make possible greater production of low-cost milk and other food products. They fit into our program of grassland farming and all-out production in this critical period.

The average farmer devotes 90 per cent of his time and energy to the production of cultivated crops. He prepares and fertilizes his cropland in the spring, sows his seed, cultivates his crops, then harvests and stores these crops in his barns, silos, and granaries.

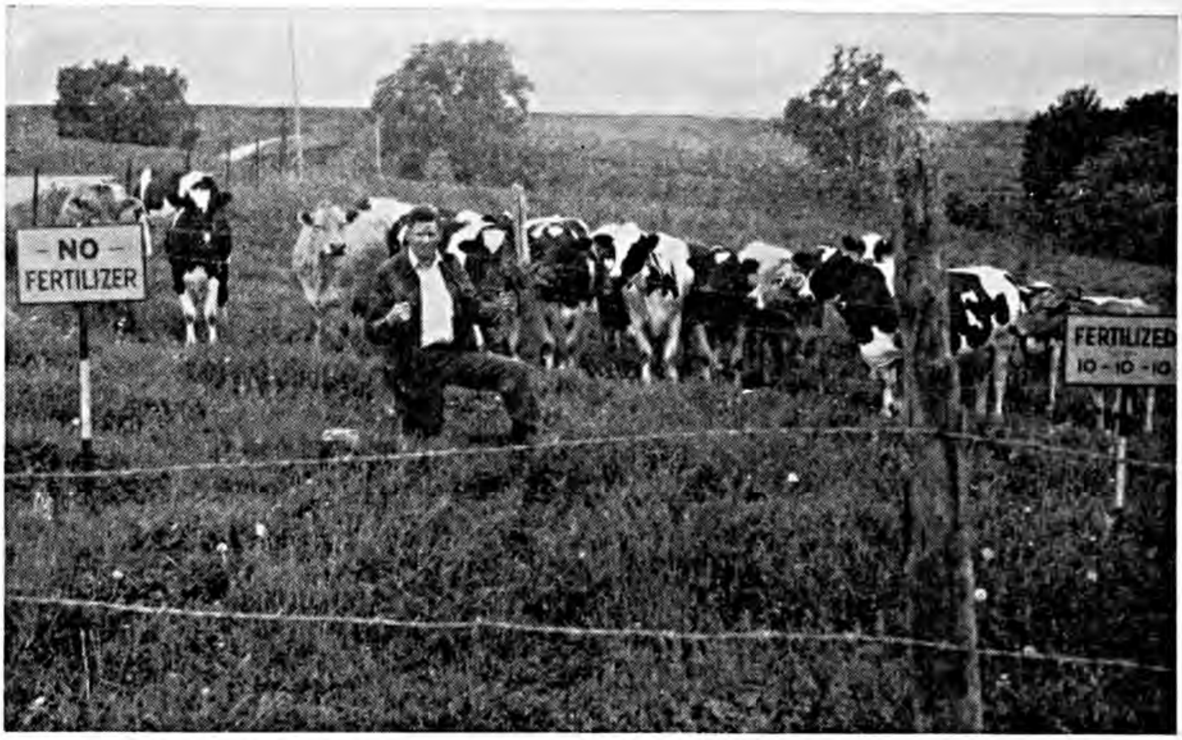

Fig. 2. Here is one of the 213 acre scale 10–10–10 pasture demonstrations set up on as many farms scattered over 45 Wisconsin counties in 1951. This photo, taken on the Oscar Schaller farm at Wonewoc, shows Fred Field, Juneau County Agent, holding handfuls of grass from fertilized and unfertilized areas. The day this picture was taken Mr. Schaller's cows were spectators, but on another day in early June more than 100 farmers turned out to see this demonstration.

Yields: (Dry weight—total of 3 clippings)

10–10–10 at 500 lbs. per acre	**= 4,162 lbs.**
No fertilizer	**= 1,912 lbs.**
Increase	**2,250 lbs.**

Figuring this extra 2,250 lbs. of protein-rich and palatable forage equivalent in feeding value to a 16% dairy feed (which sold in Wisconsin last spring at about $65 per ton) we arrive at a figure of $73.13. The cost of 500 lbs. of 10–10–10 fertilizer last spring was $18, and there will be a residual benefit from the extra phosphate and potash left in the soil which will benefit both legumes and grasses next spring.

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 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. But even where pastures are renovated, they eventually "peter out" with June-bromegrass and timothy again taking over.

The lack of nitrogen is the bottleneck that is more responsible for poor pastures than is the lack of any other element. There are thousands of acres of poor, thin, yellow, sparse permanent grassland pastures that are starving for nitrogen. It is true, the native white clover and other legumes do supply some nitrogen to native grasses, but white clover is not too dependable. In fact, it is fickle, a here-this-year and gone-the-next type of legume.

Where straight nitrogen fertilizer is applied year after year, the increased growth of grasses uses up the supplies of readily available phosphate, potash, and lime in our soils, and it soon becomes necessary to apply mineral fertilizers on these pastures. 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

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Soil Fertility and Pastures

By Firman E. Bear

Soils Department, Rutgers University, New Brunswick, New Jersey

IN the October 1950 issue of Successful Farming there was an excellent story about Ben Moy, a Buffalo County, Wisconsin, farmer who threw away his plow and sowed his hilly, eroded, 240-acre farm down to bromegrass and alfalfa. His present equipment is confined to that required to lime, fertilize, seed, grow, and harvest grass-legume forage. Life on his farm is not as full of trouble as it used to be.

A great many other intelligent dairy farmers on hilly land have come to realize that plowing and cultivating are enemies of the soil. They have found that corn on a dairy farm is parasitic on the grass-legume forage crops that are needed in much greater quantity and in much higher quality for economic milk production.

My first experience in improving grassland was in West Virginia some 35 years ago. In those days, W. D. Zinn, a prominent farmer, institute speaker, and part-time county agent, was advocating the use of limestone and superphosphate as a means of increasing the productivity of permanent bluegrass pastures. Where the topography of the land permitted, disking and reseeding with grasses and clovers were recommended. The effects were often phenomenal.

But the rate at which his suggestions were applied never attained any great momentum. Most of the pastures in West Virginia were being used for the production of beef cattle on which the profit margin was relatively small. Also, it was soon found that more than limestone, superphosphate, and reseeding were required to get and keep a stand of clover.

In Europe, carefully-saved manure and basic slag have long been used to excellent effect on permanent pastures. The manure serves primarily as a source of nitrogen and potassium and the basic slag supplies lime and phosphorus. Both materials are important sources also of the minor elements that are missing over large areas of pasture land.

It was not until the end of the first World War, when the produce of the tremendous nitrogen-fixing factories of Germany and England was diverted from explosives to agriculture, that really intensive systems of pasture management came into being. One such system, which added heavy use of nitrogen fertilizers and rotational grazing to the program, had been started at Hohenheim, Germany, in 1917. This system, fostered by the Stickstoff Syndikat in Berlin and by Imperial Chemical Industries in London, began to receive serious consideration in this country about 25 years ago. The first experimental project of this type in the United States was put into operation at the Dairy Research Farm at Sussex, New Jersey, by Bender (5) in 1927, where it has been in effect ever since.

Program Brought Results

Notwithstanding the known values of lime, complete fertilizers, improved strains of grasses and legumes, and rotational grazing, progress in pasture improvement and management had been distressingly slow. But the "Green Pasture" program, which is being fostered by the Extension Services of the several Northeastern States, has resulted in getting large numbers of farmers alerted to the possibilities for profit in improved grasslands.

In New Jersey, stress is laid on having uniformly good grazing from early April to late November, a period of more than 200 days. The program includes the use of winter grains for early spring and late fall pasture, rotational grazing of bluegrass-white clover swards, and the growing of orchard grass-ladino clover, sudan grass-soybean, and bromegrass-alfalfa mixtures for in-between grazing and hay purposes. Various other forage plants, such as Reed's canary grass, sweet clover, and birdsfoot trefoil are also used.

In dealing with these pasture-management programs, I have reached certain conclusions. Some of these are supported by exact experimentation of my associates and myself, some are based on studies of scientific developments in related fields of research, some are the result of field surveys, and some have come from conversations with pasture specialists in this country and abroad.

Concerning Bluegrass

Recently there has been considerable discussion of bluegrass as a weed that should be replaced by improved grasses and clovers on dairy farms. But bluegrass is seldom given an opportunity to demonstrate its real value, being usually grazed continuously from early spring to late fall. Furthermore, the native white clover, which grows here and there and comes and goes from one year to the next, is expected to supply all the nitrogen the grass requires.

The falsity of the concept that the clover will supply the necessary nitrogen to the associated bluegrass is readily apparent following an application of a nitrogen fertilizer. If one wants really good bluegrass pastures that start off early in the spring, extend well into the summer, and come on again with luxuriant growth in the fall, he should, in our experience, give them the equivalent of 500 pounds 10-10-10 fertilizer an acre every year. A second application of 50 pounds of nitrogen after the first grazing will aid in extending the grazing further into the summer and bringing it back earlier in the fall. The protein and mineral content of such pastures leaves little to be desired.

If bluegrass-white clover fertilized pastures are grazed as they should be, which means close grazing followed by a resting period and clipping with a mower, clover stands can be maintained at as high levels as they would have been if no nitrogen had been applied. If available, a 5-ton-an-acre application of manure, supplemented by 50 pounds each of phosphoric acid and potash, will accomplish the same purpose and increase the stand of clover. After such manuring at our Dairy Research Farm, the white clover coverage was 25, 44, 41, and 54 per cent for four successive years.

There is abundant evidence that poor bluegrass pastures can be greatly improved by the use of some of the more modern implements that stir up the old sod without turning it upside down. The efficiency of such machinery has been greatly increased. Poor hillside pastures of any type can be very quickly improved by this process when accompanied by liming to pH 6.0 to 6.5, fertilizing with 500 pounds of 10-10-10, and reseeding to grass-legume mixtures. The nitrogen is usually needed to overcome the competition of the soil micro-organisms that work on the old sod.

Our orchard grass-ladino clover lowland pastures have produced at the rate of 5,500 pounds dry matter an acre, following the regular use of lime and the annual application of 250 pounds 0-20-20. Better results would have been obtained by doubling the potash, and that is our recommendation.

Yields can be stepped up still higher by the application of larger amounts of fertilizer or by the supplemental use of manure. The potentialities of dry-matter production in grass-alfalfa mixtures at New Brunswick were found to be nearly 10,000 pounds dry matter an acre annually over a 2-year period following seeding. This was on well-limed soil that received the equivalent of 1,000 pounds 0-12-12 fertilizer and 25 pounds borax an acre annually.

Quality of produce tends to deteriorate with increasingly high yields above a reasonable level. This is due in part to the higher proportion of stems to leaves. Quality also tends to be lowered from one year to the next. This is because of the soil's dwindling capacity to deliver enough of both the major and minor mineral elements to the forage plants to meet the needs of the animals that consume them. As the pH value of the soil begins to drop, beginning with the first year after seeding, the availability of all the minor elements, except molybdenum, tends to increase. The manganese content of alfalfa was higher each year over a 3-year period (2). But the cobalt content fell successively from 0.12 to 0.08 and 0.07 parts per million dry matter, and zinc from 0.58 to 0.33 parts per million by the second year.

The Potassium Problem

Special attention is called to the potassium problem. The soils of most permanent pastures have been badly robbed of this element over the years. When it is finally added, a large part of that applied is often fixed by the soil. This fixed potassium is held much more tightly than that adsorbed in the exchange complex. In other words, to get the effect desired, very heavy applications may be required until the potassium level of the soil has been materially raised.

Orchard grass was found to contain one per cent more potassium than the legumes that are associated with it. Similar findings have been reported (3) with bluegrass and bromegrass. Crabgrass, dandelions, shepherd's purse, and dock have very high potassium-accumulating powers, often containing from two to three times as much of this element as the alfalfa associated with them. One of the most important causes of the disappearance of white clover in bluegrass pastures is the competition for potassium that is provided by the grass and weeds. Similar troubles are experienced in grass-legume hay mixtures.

Time of Application

It is generally assumed that fertilizers can be applied to pastures to equally good effect at any convenient season of the year. It is too bad this is not true, since we need to distribute farm and factory labor over a larger part of the year. And, it is much easier to get over the land in summer and fall than in early spring. But in a 5-year test of nitrate of soda and sulfate of ammonia on permanent pastures at New Brunswick, the yields were 36 per cent greater on the average from March applications than from those in October. In similar comparisons of a phosphate-potash mixture, the yields were 22 per cent higher from the March applications.

At reawakening time among the soil microorganisms each spring, there is need for extra nitrogen and phosphorus, elements that are found in very high percentages in their cells. Some bacteria have been found to contain over 10 per cent nitrogen and 2 per cent phosphorus. Such microorganisms offer serious competition against grass and clover for these and other elements in early spring.

Use of the airplane (4) for distributing fertilizers will aid greatly on the rougher lands. It appears likely that anhydrous ammonia, applied by the use of a combination tillage implement and gas applicator, may enter the picture. Certainly both practices will be given extensive trials on the more rolling pasture lands in the northeastern part of the United States and they may well spread over large grazing areas farther west.

The general tendency to assume that weeds have negative value in pastures is of doubtful validity. It is well known that they add variety to the diet in terms of both mineral and digestible nutrients. Fertilized weeds of many species make good grazing, and cows mow them down with the grass and clover. The essential point is to keep them growing luxuriantly. The answer to the problem of tall-growing and coarse weeds, as well as clumps of tall grass around dung heaps and urine spots, lies in the regular use of a mower. Interestingly enough, such mowings are often readily consumed by animals, until such time as they become moldy from rain or dew.

One does not care to advocate sowing weed seed. Instead, it appears desirable that more attention be given to introducing a greater number and variety of species of plants into our forage-crop mixtures. Certainly the chances of providing the cow with everything she requires is greatly improved by having variety in the diet. Some plants have much greater capacity to accumulate minor elements from the soil than others. One of the important reasons for having legumes in the mixture lies in their generally high content of cobalt. Bluegrass also is high in cobalt. Timothy and orchard grass are usually very low in this element.

A number of cases of X-disease of cattle have developed on farms that have been very liberally limed and phosphated. These practices reduce the availability of most of the minor elements, notably of zinc. The zinc content of bluegrass and ladino clover from X-disease farms in New Jersey was found to range between 15 and 25 parts per million dry matter, in comparison with 34 to 92 parts per million in the same forage crops on nearby farms where no X-disease occurred. The evidence on this point, however, needs more confirmation.

Something should be said about manure. Our well-fed 1,300-pound Holsteins produce manure at the rate of 21 tons annually per cow, not including the bedding (1). Of this, 75 per cent is feces and 25 per cent urine. This manure contains about 9½ pounds nitrogen, 3 pounds phosphoric acid (P_2O_5), and 8 pounds potash (K_2O) per ton. The annual output of fertilizer constituents in the manure of such a cow is estimated to be equivalent to one ton of 10-3-8 fertilizer. It would seem that such an amount of plant nutrients, no matter whether they were dropped directly on the soil by the cow or were hauled out from the barn, should go a long way toward maintaining the fertility of the land required to produce enough feed for that cow.

In theory, there should be little need for anything but lime and superphosphate to supplement the manure on a dairy farm, assuming that legumes were grown in the hay and pasture mixtures. In proportion as grain feeds are purchased and fed, the picture looks better still. But we have found that fertility levels on the pasture soils of many dairy farms are very low. Evidently much of the value of the manure contributed by cows is lost in drainage water. It would pay dairy farmers to explore means by which such losses can be lowered. Ammonia losses can be kept down by adding superphosphate to the manure as it is applied. If the urine is collected separately from the dung, air-tight containers with oil seals are required to prevent escape of ammonia.

It would not be becoming to a believer in soil conservation to omit mention of the healing properties of grass on eroded soil. The roots of the grasses sew the soil to the earth. In proportion as more grass is grown on more acres of land, the best interests of the Nation are served. That applies today, but it applies much more to tomorrow.

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Fig. 1. Spreading poultry manure on pastures is a regular farm job in Bethel Community. Seen here on the tractor hauling a load of manure is Elmer Truelove, with one of his brothers, Oscar.

Bethel Community Hits Its Stride

By T. S. Buie

Soil Conservation Service, Spartanburg, South Carolina

"I JUST tell you, the steering wheel of a tractor naturally fits a man's hands better than plow lines. Then, too, paydays come closer together when you sell milk every day and chickens 3 or 4 times a year. You know, when you grow only cotton, you get only one payday in a whole year."

The speaker was Elmer Truelove, one of the five Truelove boys in the Bethel Community, 15 miles north of Gainesville, Ga., an area which has become famous as a production center for broilers. Elmer and his brother Roy served in the armed forces during the last war. All five brothers are now working on the old home farm or other farms nearby. They were encouraged because of the things Elmer mentioned to stay on the farm instead of seeking jobs in town.

You need only to drive through this community, as I did not long ago, to see the remarkable changes that have taken place within a few years—changes brought about by families like the Trueloves and their neighbors. One of the most striking is that on hillsides which were cleared of trees and planted for generations to cotton and other row crops, grass is appearing. There are sound reasons, too, for this change.

Rudolph Clark, one of the supervisors of the Upper Chattahoochee Soil Con-

Fig. 2. Rudolph Clark, right, puts more fertilizer on his pastures than he used to put on his cotton, and it pays better, he says. Last spring he sold $1,000 worth of seed from this 4½-acre fescue-ladino pasture that he and District Conservationist T. O. Galloway are examining with Mr. Clark's young son, Ted.

servation District, in which the Bethel Community is located, inherited his farm 17 years ago. For some years, he and another man worked the farm together and each averaged about $500 or $600 a year on the crops—mostly cotton and corn.

"You just can't make a living up in this country growing row crops like cotton and corn," said Mr. Clark, standing at the door of his neat, well-equipped homestead. "I have found out," he continued, as he indicated a 4½-acre pasture of Kentucky-31 fescue and ladino clover, "that fertilizer pays better on my pasture than anywhere else.

"There are 4½ acres in that field," he said, "and I grazed 14 calves all winter before last, and then 8 sows, a boar, and 46 pigs until August 20. The army worms got in there then and ate it down to the ground. But you know those plants have deep roots, and the worms only ate the tops. I put on 400 pounds of superphosphate and 400 pounds of 4-8-6 fertilizer to the acre, drilled it in, and harrowed twice. Then in early October I added 100 pounds of nitrate of soda. That is more fertilizer than I used to put on my cotton, but it pays better, as I just said."

As we walked across the pasture, Mr. Clark went on to say, "I forgot to tell you that I sold $1,000 worth of seed from this same field last spring and then the grass and clover got so far ahead of the hogs in the summer that I cut 250 bales of hay." Considering such excellent returns, I can easily see why he has such a high regard for his pasture.

Nearing one of the chicken houses, from which he sells 33,000 chickens each year, Mr. Clark continued the conversation, "Chickens and grass just naturally go together. The manure is fine on the grass and by keeping the ground covered the year around there is not much washing."

He did not tell me just how much his current net income is, but I know it is far more than it was when he first began farming, and before he planted so much of his land to pasture and other feed crops. He doesn't have to divide what he makes on the farm with anyone else, for he and his 12-year-old son operate the farm. They do have a hired man to care for the

Fig. 3. Bethel Community farmers believe in regular application of fertilizer. Harold Rail, Navy veteran, is using the hand method of applying fertilizer on a small patch of Kentucky-31 fescue in front of his house.

chickens and he helps them out occasionally if they get too far behind and in too much of a rush.

"Let's drive around a little; I want you to see this Bethel Community and what we are doing here now," Mr. Clark suggested.

As we drove for several miles, in and out of the community which centers around the Bethel schoolhouse and church, built in 1882, he told me about the 50 farmers who make up this community.

"The average-size farm is about 100 acres, with two-thirds to three-fourths of it open land. Up to 5 or 6 years ago our principal crops were planted in the row each year, cotton and corn mostly," he related. "But our land was too steep for row crops. Now we concentrate on chickens and cattle. What we like is kudzu on the steepest slopes and sericea on those not quite so steep. Kentucky-31 and ladino clover make the ideal combination for grazing, especially when planted on the level areas near streams. Then, too, we grow a lot of annual lespedeza. Most of our farmers are following these practices, and eliminating row crops."

On the crest of a small hill we stopped to look down across a beautiful pasture along a small creek bottom. Just beyond the fescue-ladino clover mixture, which was as pretty as any pasture could be, we saw a portion of the bottom land which was grown up in alders and other brush.

"Just look at that land on the next farm. It isn't paying that man anything. It could be made like this," said Mr. Clark. "He is beyond our community and hasn't come under the influence of our group as yet."

These 50 farmers who constitute the Bethel Community are interested not only in their crop lands and pastures, but in every piece and parcel of land as well. I saw sericea that had been planted along the road after the banks were smoothed and leveled. As we looked across the sloping hills we saw a beautiful picture of land use, occasionally cultivated fields, but with every hillside covered with green crops. All were fitted perfectly to the contours of the hills. On every side there was evidence of new pastures, land being prepared, and fertilizer and lime being distributed.

"We have tried to get everybody to cooperate with our soil conservation district and to take advantage of the P&MA payments," Mr. Clark said. "It has been only 5 years since all this land was very sorry looking. The trouble was farmers were planting cotton on land where no row crops should be expected to grow. The chicken business has built it up. It and conservation farming go together. We sell more from the land now every year than the land itself would have brought a few years ago."

We stopped and talked with a number of his neighbors; one of them was a Navy veteran, Harold Rail. I was particularly impressed by the things he talked about: Coastal Bermuda, Kentucky-31 fescue, the pH value of the soil, sericea, importance of proteins in crops, reseeding crimson clover; these and other expressions were as commonly used by him and his neighbors as lay-by time, pulling fodder, sweet potatoes, and turnip greens were a few years ago.

Mr. Clark swung his 3-year-old son Ted up in his arms and looked across at Wauka Mountain in the distance. Then his eyes rested on the land closer home, on a field which had been in corn last year.

"You know, I planted only 2½ acres of corn last year," he recalled, "but I don't expect to plant any this year. I can buy what little we need easier and cheaper than I can raise it. I don't have any livestock to feed it to for I don't see the idea in keeping mules just to raise corn to feed them on during the winter. I had rather put my efforts in doing something that will pay me better," he added, with a note of conviction in his voice.

Around his house, like all others in the community, is a well-kept yard in which grass is growing, with shrubs properly placed against the house. Grass grows to the doors in most places for these people who have made an ally of grass in their fields, and now are willing to see it grow in their yards. Incidentally, this eliminates the arduous task of yard-sweeping every Saturday.

The people of Bethel Community take a great interest in their community activities, and the schoolhouse

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Fig. 4. Grassland farming has brought comfortable living to farmers in the Bethel Community. Here's Ted Clark getting the mail out of the box in front of the Rudolph Clark home.

Potassium in Animal Nutrition

By J. W. Turrentine

Washington, D. C.

IN our absorption with the scientific use of potassium (potash) as a plant food we have in general overlooked its equally essential role as food for man and beasts.

This absorption with the plant-food role of potash is evidenced in many ways. Our agricultural literature with its innumerable articles relating to crop feeding with potash based on research, experiment, and demonstration by a host of Federal and State scientists is eloquent testimony to that interest extending now over many years and, in fact, dating back to the days of Liebig. And the soundness of their conclusions and advice to the farmer based thereon is strikingly illustrated by the fact that the agriculture of North America currently consumes some 2,500,000 tons of potash salts, equivalent to 1,400,000 tons of K_2O per annum.

Plants of commercial importance have been analyzed to determine their potash content in desirable or optimum concentration and observations recorded when that concentration falls below the minimum requirement. These potash-deficiency symptoms have been widely publicized through verbal description and photography. Thus, the potash content of the major crops has been shown to vary among them, from 30 lbs. K_2O per acre for wheat (30 bu. grain and 1.25 tons straw) to 165 lbs. per acre for sweet clover (5 tons). When soil tests indicate a lack of potash in available form in the soil, the farmer is advised to add more from commercial sources.

But no such researches of such dimension have been conducted to determine the potash requirements of man and animals. In fact, little recognition has been given to potash as an essential food for man and animals. Accordingly, we have no colored pictures illustrating "potash deficiency" in that large biological category and are not likely to have so long as our present basic foods containing potash are so abundantly available. Furthermore, as recent research has shown, the animal system has perfected the device whereby potassium is stored up in the body cells and maintained there in optimum supply, released under certain cell excitations but restored from the blood when those excitations end. The blood supply has its origin in the food we eat, and the excess over what is needed to maintain the cellular content is eliminated along with body wastes.

In the Human System

Thus, in the human system the total potassium supply is stated to be some 175 grams of K. Most of this supply is within the body cells. In the blood plasma surrounding the cells there are .3 grams, while in the whole blood there are 8 grams potassium. Against a "daily starvation loss" of .6 grams, there is a daily intake of 3 grams which can be increased to 20 grams per day without harm. Obviously the daily intake must vary widely depending on dietary habits. Raw vegetables would appear to be a more abundant source, but after they have been boiled, for example, their potash content is greatly reduced.

What we are discussing here is the potassium cation, the form that element invariably takes in dilute aqueous solution. This is without regard to its origin, whether that origin is the slightly soluble silicates such as feldspar, leucite, or greensand, or the soil colloids by which it is absorbed in replaceable form from the soil solution, or decaying vegetable matter released from "green-manuring crops" and compost, or is the freely soluble potash salts such as potassium chloride and sulfate so extensively used in agriculture. Once it is released in its ionic form, it assumes all of its characteristic properties and it is in this form that it enters the plant roots and thence into the circulating plant sap, thereby reaching the plant cells. Therefore, its origin has no bearing whatever on its biological functions.

Three Ions

While we speak here of the potassium atom and ion in the singular we are aware of the fact there are three potassium ions that so far as we know are always found together in definite ratios, which means that their physical, chemical, and biological properties are practically identical, with the exception of slight variations in atomic weights, they being respectively 39 (K-39), 40 (K-40) and 41 (K-41), and the fact that K-40 is radioactive. Thus potassium has the distinction of being the lightest radioactive element of the periodic system of chemical elements, but little can be made of that distinction since the ratio of K-40 is only .01 per cent while that of K-39 is 93.38 per cent. Nevertheless, this radioactivity has been the inspiration for much experimentation and speculation as possibly offering an explanation of the obviously essential role of potassium in life processes, as a source of energy, perhaps; but the amount of energy so released is so slight as to make it difficult to assign any great importance to it.

This brief discussion of the three potassium isotopes is introduced with some reluctance as further complicating a subject which is already complicated enough in the physiologist's efforts to understand and explain the functions of potassium in the living cell. For the sake of simplification it is more useful to consider the potassium cation in aqueous solution as a single entity and let it go at that.

Twofold Mystery

The mystery that excites the curiosity of the research scientists in the complicated chemical, physical, and biological systems involved are twofold:

1. How does the potassium ion get into the living cell from the blood to the virtual exclusion of the closely related and similar sodium cation and once in, stays in, and

2. Just what is its function within the cell that makes it essential to life.

This mystery is deepened by the fact that experimental evidence is lacking to show that the potassium ion enters into chemical combination with any other elements in either plant or animal, although theory implies that it must.

That these problems are increasingly engaging the informed attention of physiologists is strikingly illustrated by the article, "New Developments in Potassium and Cell Physiology: 1940-50" by C. W. Sheppard, of the Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee, which appears in the issue of "Science" of July 27, 1951. Therein the author reviews the contributions of the workers in this field for the decade indicated in the title, providing a bibliography of 96 references. While the reader of this article may not find therein the solution to the two aforementioned mysteries, he is made aware of the nature of those mysteries and the vast complication of the sciences and techniques that are being brought to bear in their study.

Among these references recommended for the layman is the highly informative article, "Potassium," by Wallace O. Fenn, Professor of Physiology at the University of Rochester School of Medicine, which appeared in the "Scientific American" issue of August 1949, pp. 16-19, from which excerpts are quoted in the following paragraphs. As a subtitle the following appears: "The 19th element of the periodic table has fascinating physical and biological eccentricities. Its behavior in cells is one of the fundamental characteristics of life." This indicates the nature of the discussion wherein a wealth of fact and theory is presented and the statement made that, "potassium is coming to be recognized by biologists as one of the most interesting and significant among all the 92 natural elements."

Importance to Life

The question immediately arises in the mind of the inquisitive—just why did life at the time of its origin pick out this element and assign it such an important place in its life processes, a constituent of the cell which is the basis of all life? That line of inquiry, of course, leads us back to the beginning of life and to speculation as to the nature of the environment in which life had its origin. The sea is generally accepted as that environment, but the sea of that far distant time probably had little resemblance in composition to that of more recent eras.

The geologists in their turn ascribe to potassium a much more active role in the shaping of the earth than it occupies today. They give prominence to the energy liberated by the radioactivity of potassium now practically exhausted and reduced to insignificant power. They even theorize that this energy was sufficient to maintain the earth in its early molten state, a state substantiated by the igneous rocks with which we are familiar. In this connection they point out the great abundance of potassium in the earth's crust, while at the same time calling attention to the fact that this potassium is to be found in the sedimentaries in percentages comparable to those of the older rocks.

This leads to the logical conclusion that potassium was in relatively higher concentration in the sea in those earlier eras than today and that its reduction in concentration resulted from its elimination through absorption on the soil colloids from which the sedimentaries were formed and even, as some believe, from the living organisms that took the element into their cells and dying and sinking to the bottom of the sea deposited that potassium as a constituent of the sedimentaries.

Thus, according to theory we find life originating in a medium high in concentration in the potassium ion, tieing in its life processes with an element which it made use of through choice or necessity, possibly utilizing its radioactivity as a source of energy when that source amounted to more than it does today, relying thereon instead of the solar radiant energy, life's dependence of the present era.

Another Theory

Then there is the other theory or possibly a phase of the same theory, that there came about the growing concentration in the sea of the sodium ion with many physical properties similar to those of the potassium ion, accompanied by the reduction in the concentration of the latter. It is obvious from present-day demonstration that the body cell does not accept the sodium ion as a substitute for the potassium ion as is abundantly proven by the fact that it has provided itself with a shielding membrane that admits the one from the blood plasma while excluding the other.

A similar phenomenon is to be observed today in the case of certain sea plants. Reference is made particularly to that so-called giant kelp, *Macrocystis pyrifera,* growing in huge tonnages off the coast of southern California, which received so much attention as a source of fertilizer and chemical potash during the World War I period of alarming deficiency in potash supply, and

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Agronomists Recommend Fertilizer Grades

By J. S. Owens

Plant Science Department, University of Connecticut, Storrs, Connecticut

ONLY moderately good fertilizer supplies are in prospect for the 1952 season. The best information at present indicates a 10% or greater reduction in phosphorus-carrying materials, and possibly a little more nitrogen and potash than was used in 1951. However, an increased demand of 5% to 15% also appears certain and that would mean around 20% less phosphorus than farmers wish to use.

To aid in making the best use of the fertilizers available, the New England Agronomists met in Boston on September 28 to revise the recommendations they made last January. The proportions of phosphorus (phosphoric acid) were reduced in grades which are used chiefly on soils that have been heavily fertilized with high phosphorus fertilizers for a period of years. The need for this change has been becoming increasingly evident with continued research. It is therefore believed that the reductions required will not reduce crop yields or quality.

The largest tonnage of mixed fertilizers used in southern New England has a 1-2-2 or similar ratio of plant nutrients. The grades are chiefly the 5-10-10 (5% nitrogen, 10% phosphoric acid, 10% potash, or a 1-2-2 proportion) and the 5-8-7. The new recommendation is to use an 8-8-8 grade (1-1-1 ratio) or a 6-8-8.

This change will be easy to make if the amount of nitrogen required per acre is used as a starting point. For example, a vegetable crop has been receiving 2,000 lbs. of a 5-10-10 per acre or 100 lbs. of nitrogen. By substituting an 8-8-8 only 1,250 lbs. (100 ÷ .08 = pounds fertilizer) will be needed. This will reduce the phosphoric acid from 200 lbs. (10% of 2,000 lbs.) to 100 lbs. (8% of 1,250 lbs.). While this is a 50% reduction in phosphorus, it is certain to be ample for nearly all conditions. Should the crop be one which requires a larger amount of potash, a 6-9-12 could be used (1,650 lbs. to secure 100 lbs. of nitrogen) and still conserve over 50 lbs. of phosphoric acid per acre as compared with the 5-10-10 grade.

Another feature of the new list is fewer grades and ratios. This will further simplify selection, and facilitate and reduce costs in manufacture.

The ratios, minimum grades (the lowest analysis for each grade), and other probable grades of the same or similar ratios recommended are as follows:

Ratios	Minimum Grades	Other Probable Grades
0–1–2	0–10–20	0–12–24
		0–15–30
1–1–1	8–8–8	10–10–10
3–4–4	6–8–8	8–10–10
2–3–4	6–9–12	5–8–10
2–1–2	6–3–6 (Tobacco)	
1–1–3	5–5–15 (Tobacco)	

The ratios eliminated from the January recommendations are 0-1-1, 1-2-1, 1-2-2, and the 2-3-3. Common grades of these in the same order are 0-14-14,

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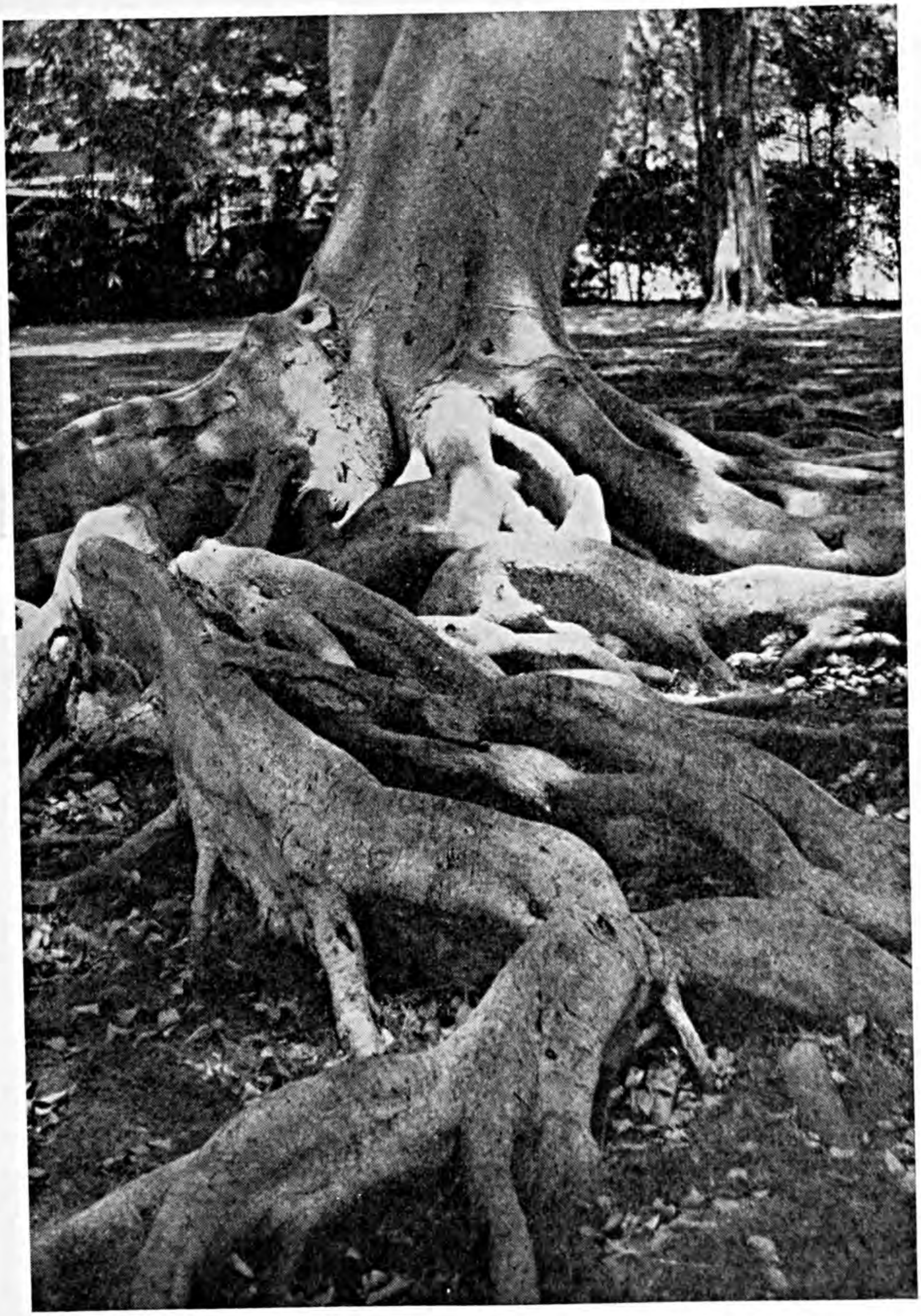
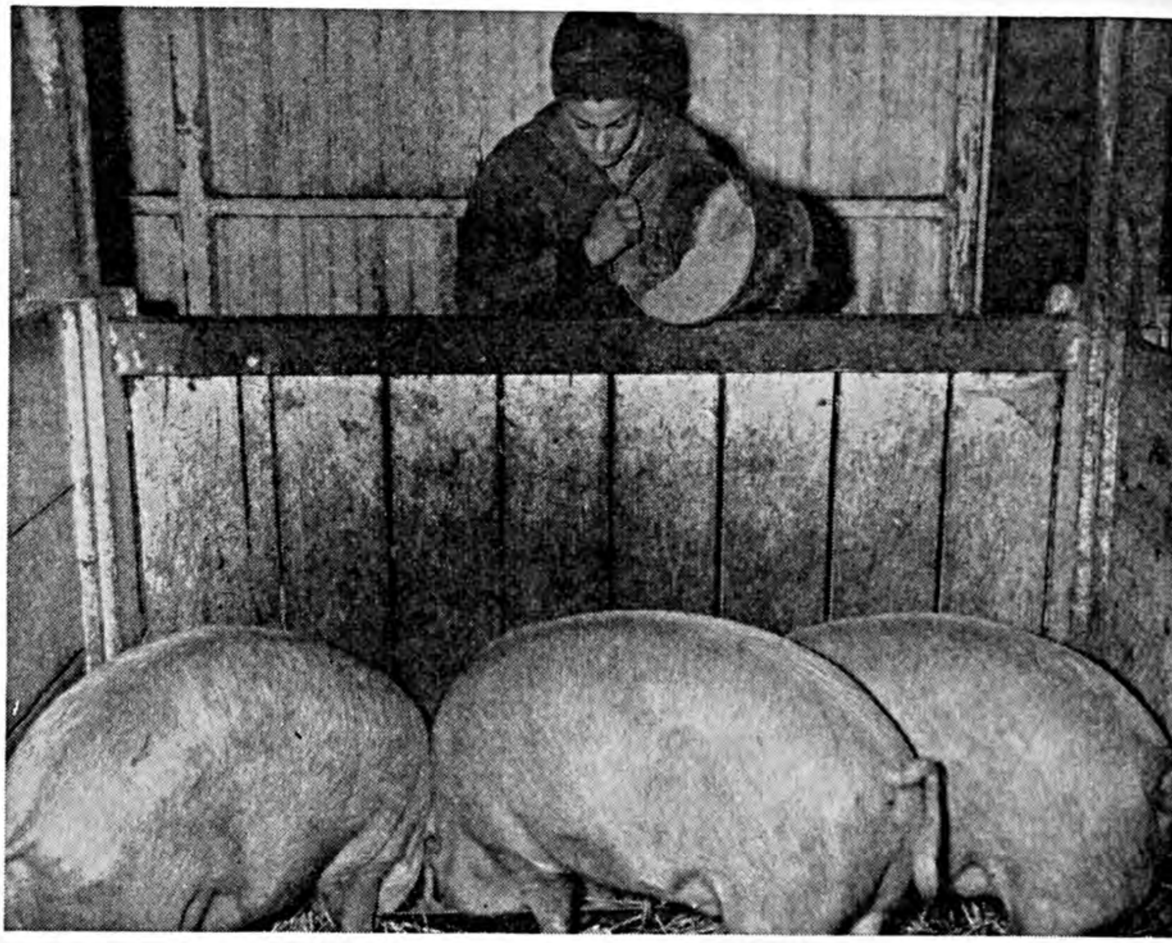
PICTORIAL

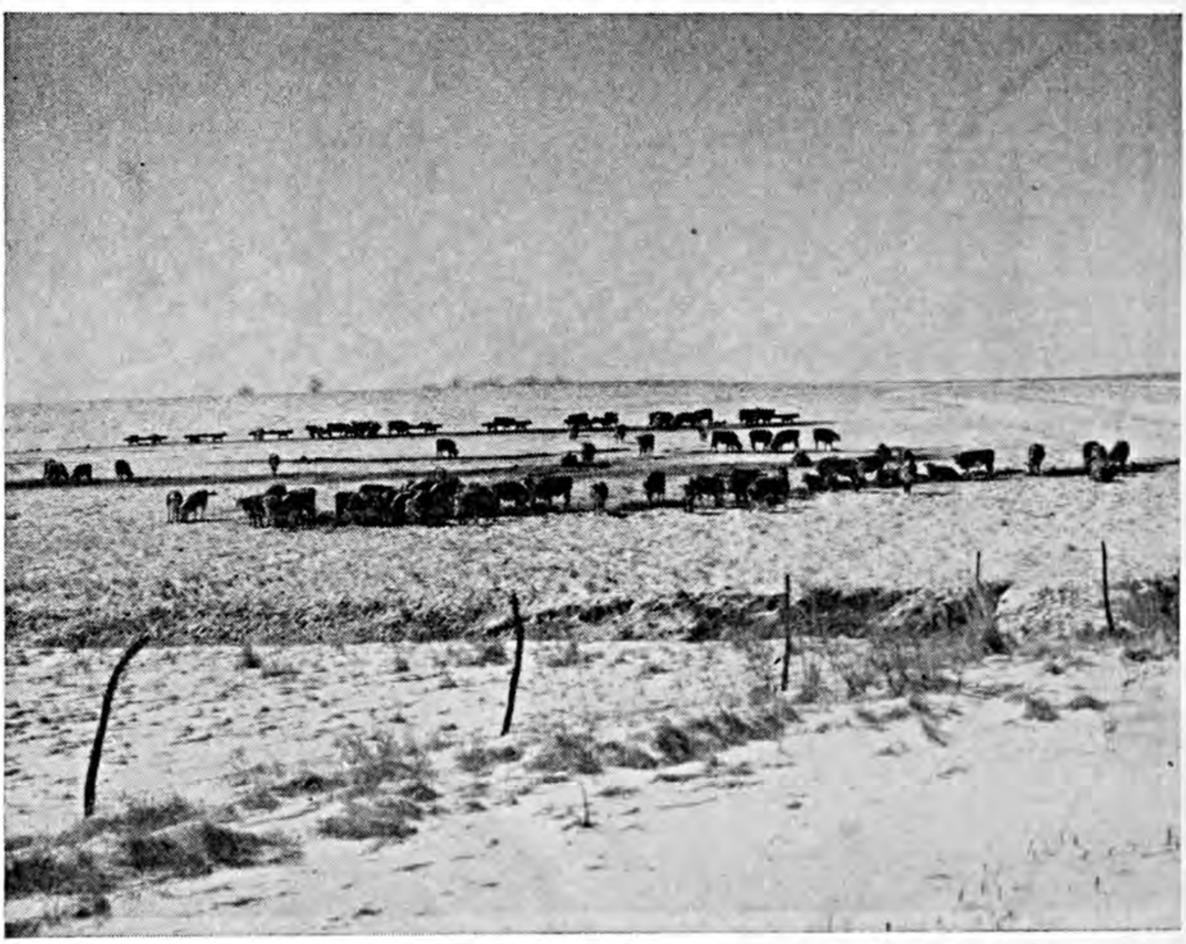


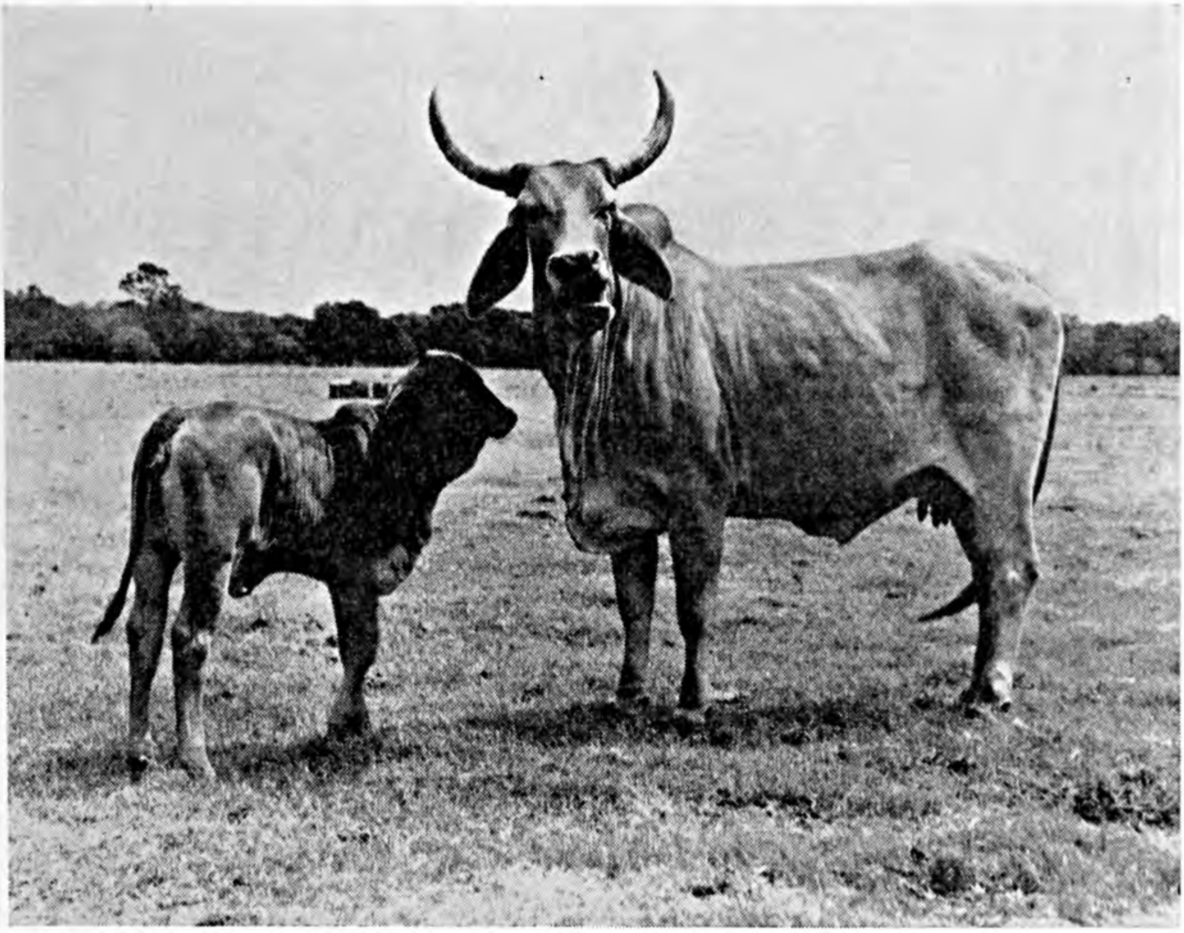
Weeping Fig Tree Roots, Foster Gardens, Honolulu



Above: **Well-housed and well-fed.**

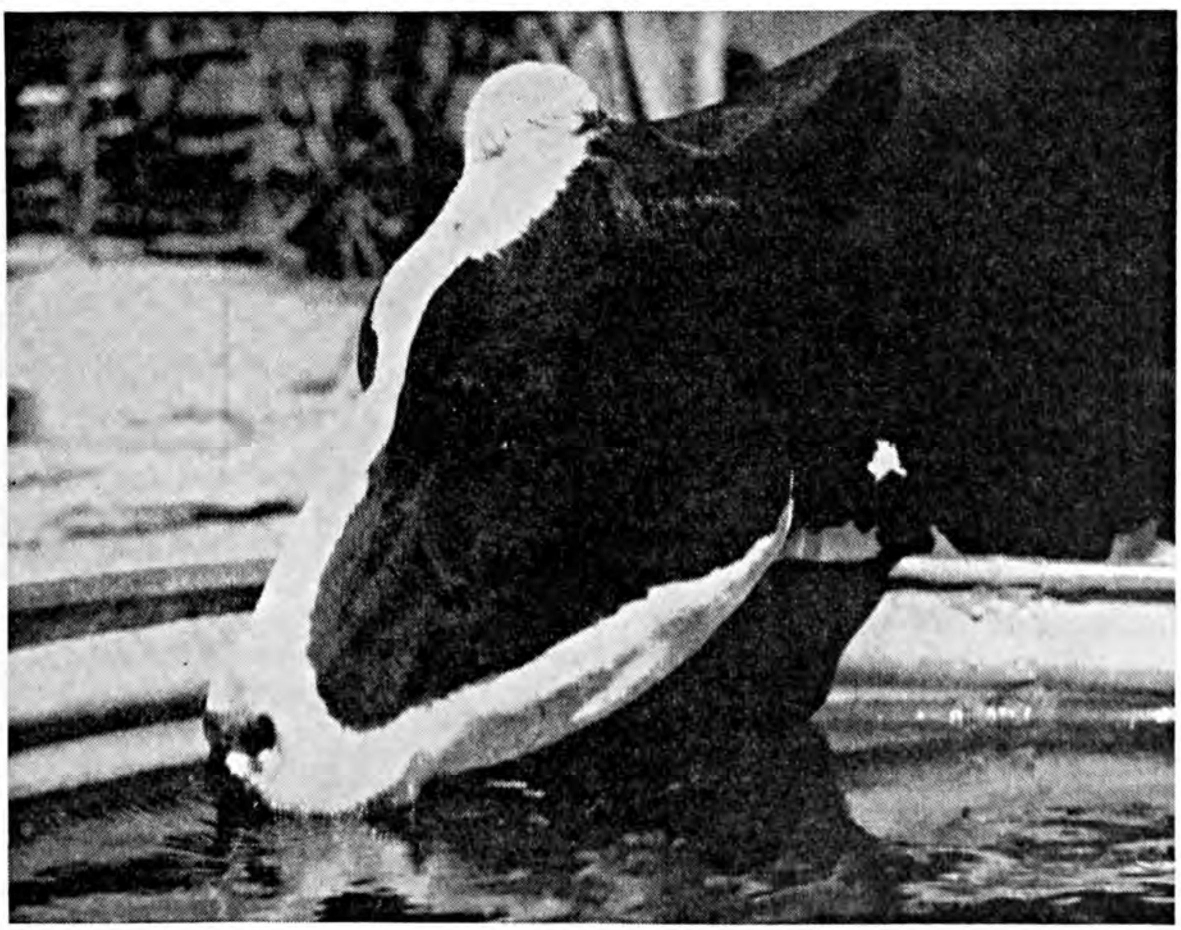
Below: **Herefords on winter range.**

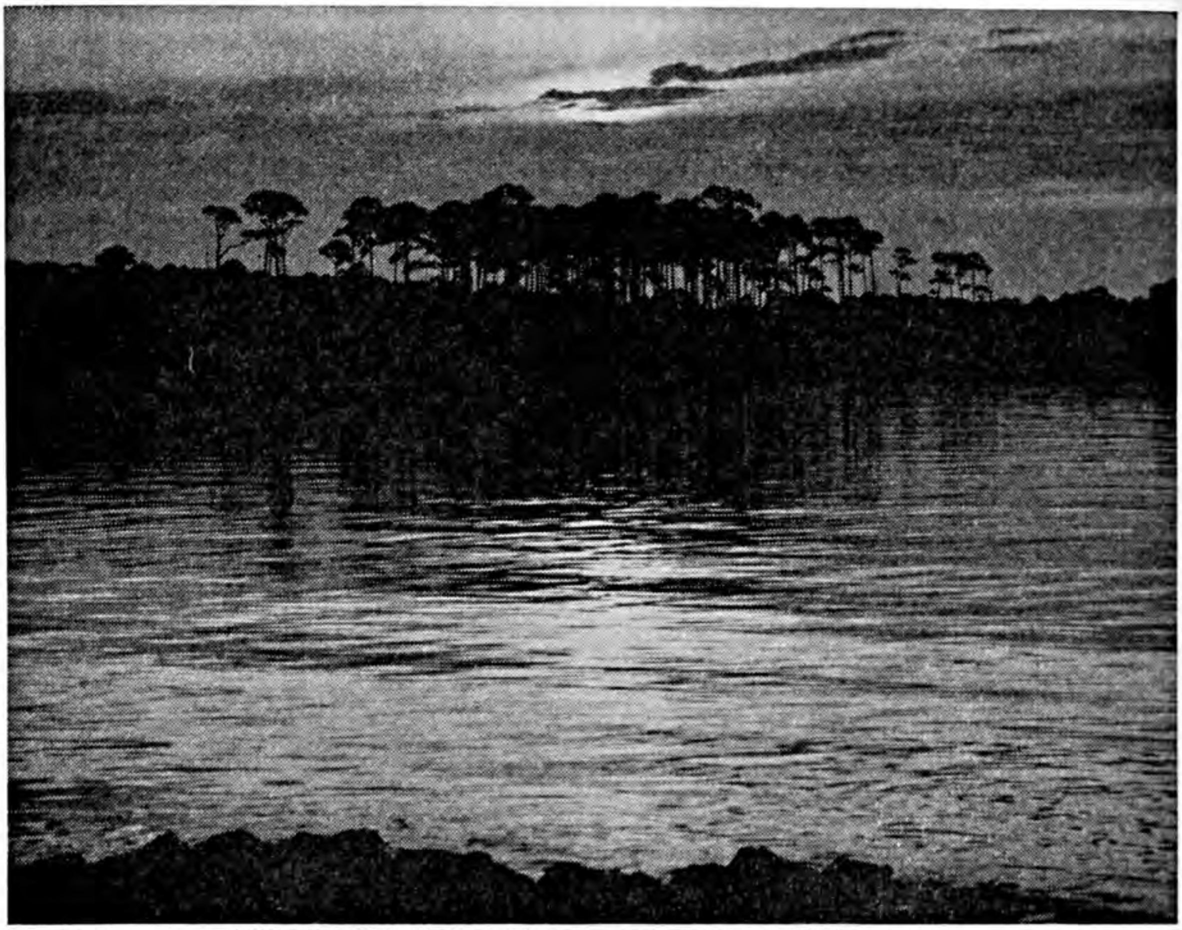


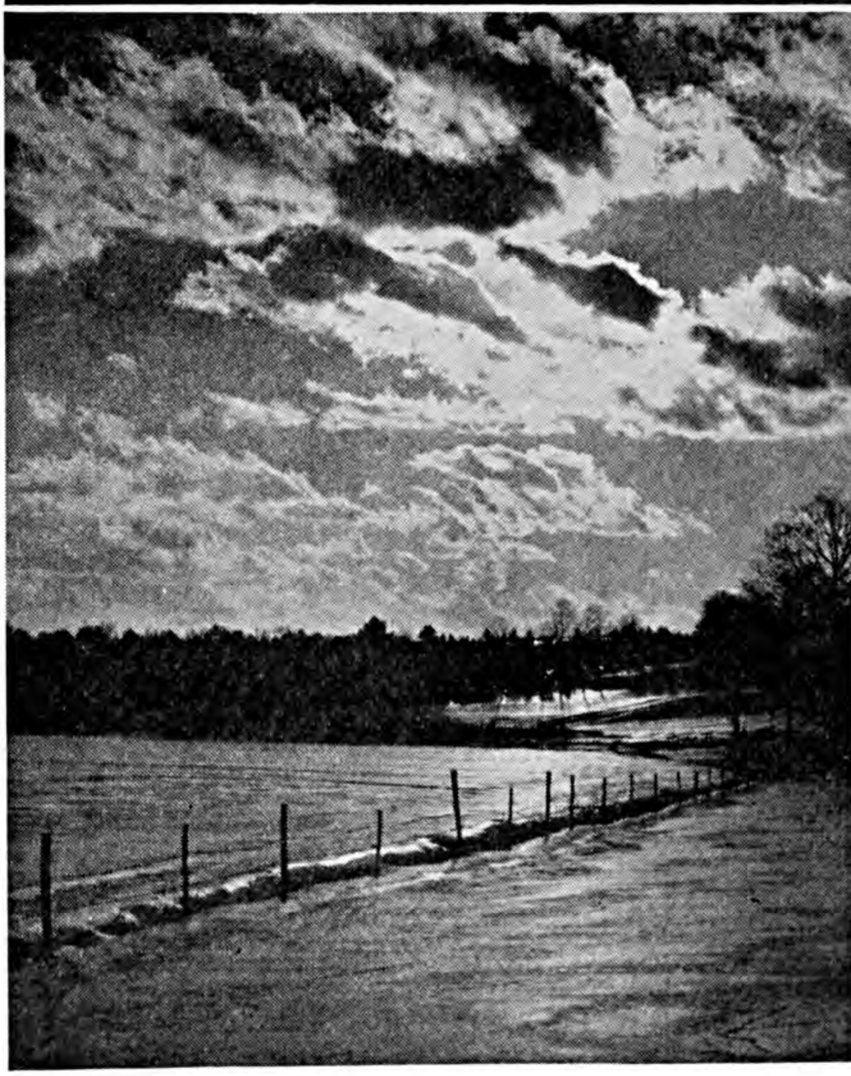


Above: **Pastured in the sunny South.**

Below: **An ice-cold Northern drink.**







Winter Sunsets South and North

The Editors Talk

Grasslands and Bloat

According to J. Kendall McClarren, Bureau of Animal Industry, U. S. Department of Agriculture, in USDA Farm Paper Letter, December 10, bloat, an old livestock problem, is taking on new implications. The drive for a grassland agriculture has brought improved pastures and growing numbers of forage-eating livestock, and with them an increasing incidence of bloat. Serious losses occur in three ways: (1) About 10 per cent of all animals affected with acute bloat die; (2) dairy animals surviving acute bloat drop in production for several days; and (3) many good pastures are not fully utilized because of fear after bloat trouble once occurs.

These and many other points concerning bloat were discussed at a special meeting held in Chicago during the week of the International Livestock Exposition. Scientists from all parts of the country and representing several fields of research took part in the informal discussions arranged by the Agricultural Research Administration of the U. S. Department of Agriculture. A plan for a coordinated research attack was made.

Two broad generalizations can be made as a result of the meeting, reports Henry Marston, Livestock Coordinator for ARA, who served as general chairman.

First, we have no experimental evidence of the real cause of death from acute bloat, nor is much known about the relationship of the many factors that predispose bloat. It is not known whether bloat is a cause or an effect, whether a poison is the cause of death, or whether gas pressures in the rumen may cause mechanical failures in either the cardio-vascular or respiratory systems.

Second, despite the increase in bloat, improved pastures are returning far greater dividends in the form of more meat, milk, and other needed animal products than any losses attributable to this condition. Legumes in improved pastures, which take the major blame for bloat, are also important to the soil conservation program.

Several State experiment stations already are working on the problem and several management suggestions came out at the meeting that would help in preventing acute bloat. One such suggestion was that mixed pastures of grasses and legumes should contain 50 per cent or more grasses. To maintain this kind of grass-legume relationship, however, requires different practices in different sections of the country, under regional recommendations.

Some States also reported less bloat when animals had access to succulent, non-leguminous feed other than alfalfa or clover. There also was general agreement that animals should not be turned out to graze alfalfa or clovers if they have been without feed for some time.

The discussion, and later the plan for research, was divided into five subject-matter panels, each with a discussion leader specializing in that particular field. The panel on physiology was led by Dr. R. W. Dougherty, Cornell University; agronomy, Dr. W. K. Kennedy, Cornell University; microbiology, Dr. W. D.

Pounden, Ohio State University; and management, by Dr. H. H. Cole, University of California.

The importance of this meeting which resulted in a plan for research is seen in the increasing interest and widespread use of legumes, particularly ladino clover, in the large pasture management program under way over most of the country. Ladino clover is one of the big problem plants of bloat trouble. A relatively new plant in pasture use, its popularity has been tremendous because of the many excellent qualities it has from the viewpoint of assuring a large volume of high-quality forage throughout most of the season.

When numerous cases of bloat injury began to be reported, especially from those pastures where ladino clover was predominant, great concern was felt among those working on the grassland program. In many cases, the trouble seemed to be worse where the most intensive methods of pasture improvement were being employed. At one time it looked as though it might undermine the entire program. Remedial measures, such as avoidance of straight ladino stands and management of the cattle on pasture appear to help considerably in overcoming this trouble, but do not seem to be the entire answer.

Our pasture improvement program is so vitally important to the over-all agricultural program that nothing should be spared in bringing to bear all of the resources of agricultural research in its furtherance. It is fortunate that this group is attacking this problem and there is every reason to believe that information obtained from it will eventually show how bloat can be avoided.

The Golden Era

The present era of prosperity being enjoyed by the farmers in this country has been labeled "The Golden Age for American Agriculture" by Cornell University's widely known economists—W. I. Myers, F. A. Pearson, and H. F. DeGraff. According to these authorities, there have been few, if any, eras which even approximate in prosperity that of the last five years. To be sure it has not touched every farm family equally, but looking at the broader panorama, these years have brought opportunity, dignity, and a heightened self-respect to rural America.

This era has been characterized by rising prices, larger production per unit of labor, a phenomenal increase in crop yields, mechanization of farm operations, application of proved practices based on research, expansion of commercialization and specialization, and last but not least, the remarkable improvement in the farmer's physical plant and standard of living.

These economists maintain that never before has there been such a vast application of power to agriculture nor such a rapid advance in knowledge and its almost immediate acceptance. The measure of a man's greatness is his knowledge and the greatness of agriculture is its power.

Many of the recent developments in agriculture may have had their parallels in history, but never before has there been such an auspicious combination of favorable prices, good weather, rising yields, and increasing efficiency of labor occurring at the same time. The farmers of America, with requisite land, capital, and management, have at last grasped that mythical pot of gold at the end of the rainbow.

As the year closes, let us hope that we can add many more five-year periods to a continuation of this Golden Era. In other words, let us make our greetings this year—"BEST WISHES FOR MERRY CHRISTMASES AND HAPPY AND PROSPEROUS NEW YEARS."

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
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	78.0	51.8	96.2	8.74	19.51	....
1938...........	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939...........	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940...........	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941...........	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942...........	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943...........	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944...........	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945...........	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946...........	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947...........	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948...........	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949...........	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January......	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.......	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April........	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May.........	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June.........	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July..........	39.11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....
August......	34.60	47.7	117.0	273.0	165.0	205.0	15.65	69.10	....
September...	33.73	52.4	123.0	287.0	165.0	207.0	16.55	66.10	....
October......	36.21	57.7	139.0	271.0	164.0	210.0	17.15	69.90	....
November....	41.00	50.0	174.0	280.0	162.0	219.0	18.35	72.70	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
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	89	81	109	74	87	110
1938...........	69	196	80	79	76	64	57	97	88
1939...........	73	154	100	84	88	78	67	94	91
1940...........	80	160	78	97	96	77	64	96	111
1941...........	137	264	116	105	117	107	82	211	129
1942...........	153	369	168	134	143	124	91	202	163
1943...........	160	405	188	235	174	154	125	231	245
1944...........	167	420	214	216	170	160	139	234	212
1945...........	181	366	205	232	198	170	127	227	207
1946...........	263	382	178	248	212	209	141	319	182
1947...........	257	380	232	248	336	259	148	381	226
1948...........	245	482	222	253	201	226	155	298	214
1949...........	231	463	184	244	210	210	139	192	201
1950									
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.......	345	266	154	236	249	240	155	457	265
April........	348	253	161	231	252	242	155	457	225
May.........	342	398	156	238	255	239	153	448	239
June.........	339	490	155	239	252	235	142	424	189
July.........	315	495	169	249	254	232	130	346	204
August......	279	477	168	311	257	232	132	306	181
September...	272	524	176	327	257	234	139	293	161
October......	292	577	188	309	255	238	144	310	171
November....	331	500	250	319	252	248	155	322	249

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	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
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	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12.37	10.06	8.68	8.56
August	3.13	2.07	11.94	10.41	8.66	8.66
September	3.13	2.07	11.50	10.78	9.26	9.26
October	3.13	2.07	12.85	11.28	10.56	10.32
November	3.34	2.07	13.93	11.28	10.39	10.25
Index Numbers (1910-14 = 100)						
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	112	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	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243
August	117	73	341	295	257	246
September	117	73	329	305	275	263
October	117	73	365	320	313	293
November	125	73	398	320	308	291

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[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
1925	.600	2.44	6.16	.584	.860	23.72	.483
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
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	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
December	.798	3.98	5.47	.420	.796	16.00	.210
1951							
January	.810	3.98	5.47	.420	.796	16.00	.210
February	.810	3.98	5.47	.420	.796	16.00	.210
March	.810	3.98	5.47	.420	.796	16.00	.210
April	.810	3.98	5.47	.420	.796	16.00	210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193
August	.810	3.98	5.47	.389	.768	14.72	.193
September	.810	3.98	5.47	.386	.768	14.72	.193
October	.820	3.98	5.47	.386	.768	14.72	.193
November	.820	3.98	5.47	.386	.768	14.72	.193

Index Numbers (1910-14 = 100)

	Super-phosphate	Florida land pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash in bags	Sulphate of potash magnesia	Manure salts
1925	110	68	126	82	90	98	74
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	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
December	149	110	112	75	84	66	85
1951							
January	151	110	112	75	84	66	85
February	151	110	112	75	84	66	85
March	151	110	112	75	84	66	85
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	82
August	151	110	112	70	81	61	82
September	151	110	112	70	81	61	82
October	153	110	112	70	81	61	82
November	153	110	112	70	81	61	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**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	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	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78
March	311	272	269	142	91	357	151	78
April	309	273	268	141	91	353	151	78
May	305	272	266	139	91	334	151	78
June	301	272	265	134	91	311	151	69
July	294	271	261	135	93	297	151	74
August	292	271	258	135	94	294	151	74
September	291	271	258	135	94	300	151	73
October	296	272	259	140	94	335	153	73
November	301	274	259	143	98	343	153	73

* U. S. D. A. figures, revised January 1950. 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 Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

2 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 is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 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

"Inspection of Commercial Fertilizers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 370, June 1951.

"Fertilizer Recommendations for Kansas," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Cir. 264, Sept. 1950, H. E. Myers and F. W. Smith.

"Effects of Certain Cropping and Management Practices on Soil Nitrogen Content," Bul. 561, Mar. 1951, P. E. Karraker; "Nitrogen and Phosphorus Relationships in Strawberries," Bul. 562, June 1951, C. S. Waltman; Agr. Exp. Sta., Univ. of Ky., Lexington, Ky.

"Rate, Placement and Source of Nitrogen for Potatoes in Maine," Agr. Exp. Sta., Univ. of Me., Orono, Me., Bul. 490, Apr. 1951, G. L. Terman, A. Hawkins, C. E. Cunningham, and R. A. Struchtemeyer.

"A Preliminary Report on Spraying Nitrogen Fertilizer on Cotton," Agr. Exp. Sta., N. Mex., A & M College, State College, N. Mex., Press Bul. 1048, Dec. 1950, G. Staten.

"Fertilizer Sales in Ohio, January 1 to June 30, 1951," Dept. of Agronomy, Ohio State Univ., Columbus, Ohio.

"Fertilizer Report for the Year 1950," Dept. of Agr., Harrisburg, Pa., Gen. Bul. 635, Vol. 34, No. 2, Mar.-Apr. 1951.

"Fertilizer Requirements for Rice Following Improved and Unimproved Pastures," P. R. 1335, Mar. 5, 1951, R. H. Wyche, R. L. Cheaney, R. M. Weihing, and J. B. Moncrief; "Barnyard Manure and Cotton Burs as a Dryland Fertilizer for Cotton," P. R. 1379, June 13, 1951, D. L. Jones; Agr. Exp. Sta., Texas A & M College, College Station, Texas.

"Six Long Strides to Better Sandy Soils 3. Apply Potash and Phosphate," Ext. Serv., Univ. of Wis., Madison, Wis., Spec. Cir., Feb. 1951, A. R. Albert.

"Fertilizer Use and Crop Yields in the United States," Natl. Soil and Fert. Res. Comm., USDA, Wash., D. C., Rpt. No. 5, Oct. 1951.

Soils

"Soil Fertility Investigations at Columbus Experiment Field, 1924-49," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Bul. 343, Sept. 1950, F. E. Davidson and F. W. Smith.

"Safeguarding Our Soil and Water Resources 1937-1951," Soil Conser. Comm., Univ. of Md., College Park, Md.

"Build Your Own Terraces," Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Fldr. 159, June 1951, H. E. Jones and D. M. Ryan.

"The Land Use Pattern Scale Method of Land and Farm Classification," Agr. Exp. Sta., Miss. State College, State College, Miss., Tech. Bul. 32, July 1951, O. T. Osgood.

"Soils Investigations on the Tucumcari, New Mexico, Irrigation Project," Agr. Exp. Sta., N. Mex. A & M College, State College, N. Mex., Press Bul. 1054, June 1951, M. Fireman, C. W. Chang, and L. W. Healton.

"Progress Report, 1951 Soil and Water Conservation Research at the Red Plains Conservation Experiment Station, Guthrie, Oklahoma," Mimeo. Cir. M-219, Apr. 1951; "Progress Report, 1951 Soil and Water Conservation Research at the Wheatland Conservation Experiment Station, Cherokee, Oklahoma," Mimeo. Cir. M-223, May 1951, Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., H. A. Daniel, H. M. Elwell, and M. B. Cox.

"Soil Management in Pennsylvania Orchards," Ext. Serv., Pa. State College, State College, Pa., Cir. 381, May 1951, C. S. Bittner.

"Six Long Strides to Better Sandy Soils: 4. Reduce Wind Erosion Damage," Spec. Cir., Feb. 1951; "5. Increase Soil Organic Matter," Spec. Cir., Mar. 1951; "6. Don't Overwork the Land," Spec. Cir., Mar. 1951; Ext. Serv., Univ. of Wis., Madison, Wis., A. R. Albert.

"Soil Survey Manual," Agr. Res. Admin., USDA, Wash., D. C., USDA Handbook No. 18, Aug. 1951.

"Soil Survey: Stockton Area California," Agr. Res. Admin., USDA, Wash., D. C. Series 1939, No. 10, May 1951.

"Release of Native and Fixed Nonexchangeable Potassium of Soils Containing Hydrous Mica," Agr. Res. Admin., USDA, Wash., D. C., Res. Rpt. No. 224, June 26, 1951, R. F. Reitemeier, I. C. Brown, and R. S. Holmes.

Crops

"Cotton Production Practices in the Limestone Valley Areas of Alabama," Agr. Exp. Sta., Ala. Poly. Inst., Auburn, Ala., Cir. No. 100, June 1951, R. W. Robinson.

"Golden Rain Oats for Alaska," Cir. 15, Apr. 1951; Edda Barley for Alaska," Cir. 16, Apr. 1951; Agr. Exp. Sta., Palmer, Alaska, S. C. Litzenberger and B. M. Bensin.

"1950 Arkansas Cotton Variety Tests," Mimeo. Series No. 5, Mar. 1951; "Preliminary Report on Alfalfa Research in Eastern Arkansas," Mimeo. Series No. 6, Apr. 1951, W. C. White; Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark.

"Farm Life in Ontario," Dept. of Agr., Parliament Bldgs., Toronto, Ont., Can.

"Garden with a Purpose," Ext. Serv., Univ. of Ga., Athens, Ga., Cir. 364, Apr. 1951, E. Ragsdale.

"1950 Varietal Trials of Cut Flowers," Agr. Exp. Sta., Univ. of Hawaii, Honolulu, T. H., Progress Notes No. 63, Feb. 1951, H. Kamemoto, H. Nakasone.

"Sunflowers as a Seed and Oil Crop for Illinois," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Cir. 681, May 1951, R. O. Weibel.

"Tomatoes in Maine," Agr. Exp. Sta., Univ. of Me., Orono, Me., Bul. 489, Mar. 1951, E. F. Murphy and M. R. Covell.

"63rd Annual Report Agricultural Progress through Research," Agr. Exp. Sta., Univ. of Md., College Park, Md., Sta. Bul. A-62, July 1, 1949-June 30, 1950.

"1950 Extension Work in Maryland," Ext. Serv., Univ. of Md., College Park, Md., 36th A. R.

"Growing Sweet Corn for Canning," Ext. Bul. 139, Mar. 1951, F. C. Stark and I. C. Haut; "Vegetable Gardens," Ext. Bul. 141, Apr. 1951, E. K. Bender and R. F. Stevens; Ext. Serv., Univ. of Md., College Park, Md.

"How to Cultivate Tomatoes," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 29, May 1951, E. K. Bender and F. C. Stark.

"Crop Varieties for Michigan," Ext. Serv., Mich. State College, East Lansing, Mich., Ext. Fldr. F-157, Apr. 1951.

"House Plants and Their Care," Ext. Serv., Univ. of Neb., Lincoln, Neb., E. C. 5-131 (Rev.) C. C. Wiggans.

"Progressive Development and Seasonal Variations of the Corn Crop," Agr. Exp. Sta., Univ. of Neb., Lincoln, Neb., Res. Bul. 166, Dec. 1950, T. A. Kiesselbach.

"Research on the College Ranch," Agr. Exp. Sta., N. Mex. A & M College, State College, N. Mex., Bul. 359, Feb. 1951, J. H. Knox, W. E. Watkins, M. Koger, and K. A. Valentine.

"1517C, A High Yielding Strain of 1517 Cotton," Press Bul. 1049, Jan. 1951, G. N. Stroman; "Corn Varieties and Hybrids in Southern New Mexico," Press Bul. 1053, Apr. 1951, J. R. Spencer; "Tomato Varieties for the Middle Rio Grande Area," Press Bul. 1056, July 1951, H. Jones; Agr. Exp. Sta., N. Mex. A & M College, State College, N. Mex.

"Summer Care of the Garden," Ext. Serv., Cornell Univ., Ithaca, N. Y., Bul. 832, June 1951, C. B. Raymond.

"Early Vegetable Plants," Ext. Serv., N. C. State College, Raleigh, N. C., (Revised) Ext. Cir. No. 231, Apr. 1951, G. O. Randall.

"The Salt of the Earth, Oklahoma 1950 Annual Report," Ext. Serv., Okla. A & M College, Stillwater, Okla.

"Castor Bean Production," Ext. Serv., Okla. A & M College, Stillwater, Okla., Cir. 552, W. Chaffin.

"Hybrid Corn Strains Recommended for 1951 Based on Results of the Oklahoma Corn Performance Tests 1946-1950," Mimeo. Cir. M-210, Jan. 1951, J. S. Brooks and H. Pass; "Progress Report for 1951, Oklahoma Vegetable Research Station at Bixby, Oklahoma," Mimeo. Cir. M-225, June 28, 1951; Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla.

"Science for the Farmer, The Sixty-fourth Annual Report," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 540, July 1951.

"Science for the Farmer, Supplement No. 3 to Bulletin 529, The 63rd Annual Report," Agr. Exp. Sta., Pa. State College, State College, Pa., June 1951, H. L. Carnahan and H. L. Fortmann.

"Growing Tree Fruits for Home Use," Ext. Serv., Pa. State College, State College, Pa., Cir. 380, May 1951, J. U. Ruef.

"Performance of Varieties of Grass and Legume Species in Pennsylvania—1950," Agr. Exp. Sta., Pa. State College, State College, Pa., P. R. No. 53, May 1951, H. R. Fortmann and H. L. Carnahan.

"Small Grain Variety Tests in the Rolling Plains Area of Texas," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., P. R. 1373, May 23, 1951, I. M. Atkins.

"Tomato Production Guide," Ext. Serv., Univ. of Fla., Gainesville, Fla., Cir. 98, Dec. 1950.

"Cabbage Culture in Wisconsin," Ext. Serv., Univ. of Wis., Madison, Wis., Sten. Cir. 184, Nov. 1936 (Revised Mar. 1951), J. G. Moore.

"Cultural Studies on Carrot Stecklings in Relation to Seed Production," Cir. No. 877, Aug. 1951, L. R. Hawthorn; "Alfalfa for the Yuma Mesa," Cir. No. 879, Aug. 1951, C. D. Converse; "The Cardinal, Calmeria, and Blackrose Grapes for Vinifera Regions," Cir. No. 882, Aug. 1951, E. Snyder and F. N. Harmon; USDA, Wash., D. C.

"Grass Seed Production on Irrigated Land," Soil Conservation Serv., USDA, Wash., D. C., Leaf. No. 300, May 1951, H. F. Oman and R. H. Stark.

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Potassium in Animal Nutrition . . .

(*From page* 25)

becoming the second most important source of that essential commodity during that emergency.

Here is a vine-shaped plant, 30 or more feet in length, attached to rocks on the ocean's floor but suspended upward with air-filled floats at the base of each leaf. It is completely submerged in the ocean brine which contains 1.07 per cent of the sodium ion but only .039 per cent of the potassium ion, a ratio of 27:1. Yet from that dilute concentration in the potassium and high concentration in the sodium ion, the kelp plant takes up some 14 per cent dry weight of the potassium, but only some 4 per cent of the sodium ion. From analogy with what we now know of the accumulation of potassium in the animal cell we can assume also that the high potassium content of the kelp plant results from the occlusion of the potassium within the plant cell while the sodium remains within the plant sap.

Here is a relatively simple organism that would appear to warrant the closer scrutiny of the physiologists. The entire plant is submerged in one unchanging environment, ocean brine, of constant concentration and fairly constant temperature. It is uncomplicated by root systems as a source of nutrients, evaporation, and, quite possibly, translocation that characterize land plants, all of these functions apparently being performed by the leaves and stems.

What induced the animals to crawl out of the environment of their supposed origin, ocean brine, is a matter of speculation, of course. It has been suggested that the increasing sodium concentration made that an uncomfortable medium in which to live. That theory, however, is not entirely supported by the fact that when they emerged to take up their abode on dry-land, they provided themselves with an envelope wherein they continued to remain immersed in brine of approximately the same saline concentration as ocean brine. What is meant, of course, is our blood. As expressed by Dr. Fenn, "If the blood had no potassium at all, the heart would be just as much incapacitated as with too much potassium. For its normal beat the heart requires in the blood plasma about 100 parts of sodium to four parts of potassium and two parts of calcium. These are approximately the relative concentrations of the three substances in the ocean. In spite of the great changes in living forms wrought by evolution, the basic living cells apparently still feel the need of a salty environment like that in which life presumably began."

Abnormal Release

In discussing the pathological phases of the potassium concentration of the blood and the importance of a proper ratio of potassium and sodium therein, Dr. Fenn cites conditions inducing the abnormal release of potassium from the cell, thus increasing the blood concentration to an unfavorable level, or on the other hand decreasing it to too low a level resulting from its elimination from the blood through excretory processes. He states, "Physicians now realize the dangers of too low a level of potassium in the blood. There is a hereditary syndrome called familial periodic paralysis in which the muscles become paralyzed, although fortunately it does not affect the muscle of the heart, at least for a time. The disorder can be treated by giving potassium by mouth. A potassium deficiency also sometimes occurs in patients who are given fluids intravenously in large amounts. If these contain no potassium and if the patient is not able to take a regular diet containing a supply of potassium, there may be so large a loss of potassium through the kidneys that the deficiency is felt; muscles become weak and death may result. Persistent diarrhea in infants likewise may deplete the body potassium, for all the intestinal secretions contain considerable amounts of potassium—three or more times as much as the blood plasma. Ordinarily this potassium is reabsorbed into the body, but when the intestines are not functioning properly it is lost. A dose of potassium at a critical time may often relieve a paralysis and save a life."

He adds, "A method for quickly analyzing the potassium in body fluids has recently been developed and is rapidly making its appearance in hospitals. The instrument, called the flame photometer, makes it possible to find out quickly whether a potassium deficiency is threatening." And, "By the use of such an instrument, John S. Lockwood and his staff in the general surgical service at the Columbia University Medical Center believe that they have been able in the last 18 months to save the lives of 10 patients who would otherwise have died."

From the foregoing it would appear that the physiological chemists studying the role of potassium in biological processes are using some of the same techniques, whether working with man or plants, and that both are deriving conclusions not only as to the essentiality of potassium to life but also as to its optimum levels of concentration. Thus we find the plant technologist testing the plant juices for their potassium content, "tissue tests," and the hospital technologists doing the same with human "juices." And the flame photometer is a familiar piece of apparatus to the plant chemist.

But it is the latter who is more generally concerned with the problem of the adequacy of the potash supply. The plant has to depend on the soil solution for its supply and only that portion of the soil solution in which the root system is immersed. If this source is not adequate, the plant cannot efficiently perform the functions for which it is grown, whatever they may be, the potassium entering into all of the metabolic processes of the plant in its essential roles.

Once this is accomplished with adequate fertilization in optimum ratios with other plant foods it would appear that man and beast consuming these crops as a diversified diet would be assured of an adequate supply of potassium for his biological processes, in the absence of pathological conditions. As we have seen, he has been provided by nature with a most efficient combination of mechanisms to guard against a deficiency of supply. For both groups of physiological chemists in their research in the field of metabolic processes, in both animal and plant, there remains the solution of the mystery of the vital role of the potassium ion within the cell. When that mystery is solved we shall be much closer to our understanding of the very basis of life—metabolism.

Grassland Farming . . .

(*From page* 12)

is a land-use regulation forbidding the plowing of permanent pastures and putting the land to cultivated crops. Such a regulation stems from centuries of livestock husbandry and the use of the land by shepherds, some of whom may belong to the nomadic tribes. With increasing populations and with the deterioration of the permanent pastures to a much lower carrying capacity, such a regulation is definitely outmoded and should be abandoned.

A step forward and away from such a regulation was noted in Greece where seeded pastures were being demonstrated by Mr. Landerman of the Staff of the American Mission to Greece. This consisted of reseeding worn-out pastures to species that should give a higher yield and at the same time required the cooperative effort of many land-owners of the village in a system of "block" cultivation. This effort was being applied also to one very large area of alfalfa, the land for which was owned by many farmers, and to erosion control by means of contour farming and terracing on multiple-owned land.

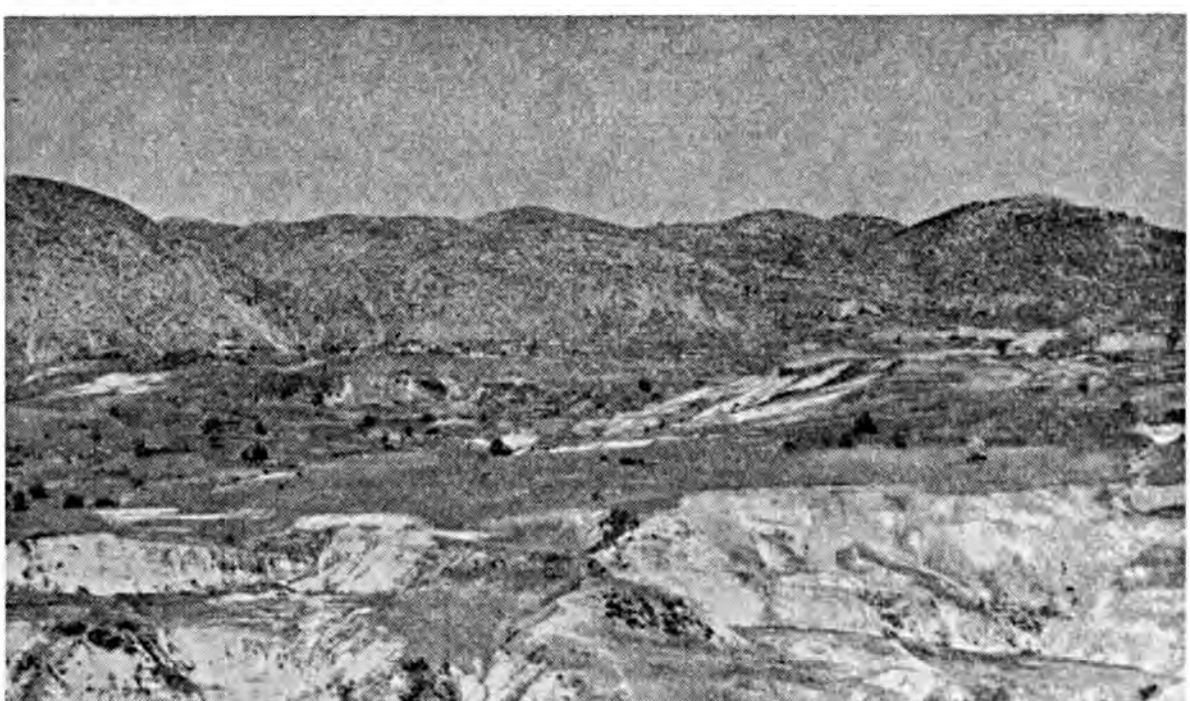

Photo by author.

Fig. 6. Because of overgrazing and deforestation, the Mediterranean countries are plagued by erosion. Photo taken near Serros, in northern Greece, shows an extreme example of soil deterioration by erosion.

The mountain areas of these countries came in for special treatment. When it is known that a country like Greece is 80 per cent mountain and hill land, and that there are many, many villages in these mountains that depend upon the soil for their livelihood, it is easy to realize that here, indeed, is a problem of special importance. Nor is the problem confined to Greece, for all these countries have their hill and mountain populations and problems.

Overgrazing, particularly by goats, deforestation because of the acute need for fuel and timber, and indiscriminate cutting of timber by hostile peoples during wartime—these are some of the causes of the present conditions of the mountain areas. Dr. Whyte called attention to this at the Rome conference, calling it mountain sickness. He described the erosion there, and the bare, rocky slopes, and called attention to the rapid runoff immediately following winter rains which not only caused soil depletion on the slopes but filled up valleys and even the irrigation channels of the level lands below with sand, gravel, and rubble.

Grazing Districts

Dr. Whyte advocated the establishment of grazing districts, such as the one being formed on Mount Olympus in Greece, in which definite areas would be set aside for grazing under reasonable control. Other areas unsuited to grazing would be reforested under this plan. He advocated the setting up of a Department of Mountain Resources to handle land-use problems in mountain areas, such a department to be staffed not only by foresters, but by animal husbandrymen and other interested lines of endeavor.

All the Mediterranean area is rich in species of native flora, it having been the home of many of our better forage legumes and grasses. It appeared to me to abound particularly in legumes some of which none of us had ever seen. Medicagos and vetches were particularly abundant. Dr. Aamodt called attention to this in one of his talks at the final conference and pointed out that one of the major recommendations of the Mission had suggested the collection and testing of these native species. This is not to say that no work along this line had been or is being done, but that a complete assessment of the value of these indigenous forms had not been made in any of the countries.

The value of a survey of this kind by men from outside the area, and going from country to country, can best be illustrated by the example of Sulla, a very large acreage of which was found growing in Italy. Sulla *(Hedysarium Coronarium)* was not found growing on a commercial scale anywhere except in Italy. Yet, it appeared to have a peculiar adaptation to the Mediterranean climate and will, in future, undoubtedly be used in the other countries. Sulla is a legume, sweet enough apparently to be ensiled without a preservative. It makes wonderful pasture or excellent hay and seems to prosper particularly on heavy, alkaline soils such as are found in the Mediterranean area.

Because none of the other countries were using this crop, it appeared particularly pertinent to the Mission that a Mediterranean Grassland Committee be set up for the exchange of ideas. To further this idea, too, it was recommended that a Grassland Journal be instituted, dealing particularly with the fodder and pasture problems of the area.

These are some of the major points covered in the recommendations of the Mission. In all, 28 recommendations which applied generally to all the countries were made. In addition, each country was written up separately and in that discussion certain recommendations which applied specifically to that particular country were made.

Many of the recommendations had a long-range aspect, while others were such that they could be taken up by the agricultural officials, such as the

Extension Services and used immediately in an educational program.

To me (and I am certain other members of the Mission would agree) it was a wonderful experience. All the officials of Ministries of Agriculture, of Educational Institutions, and of Extension Services placed the information we required before us if it was available and were most cooperative. The same can be said also of farmers of high or low estate. Nowhere were we met by any one who was not willing to answer the questions which we proposed to them to help us reach a reasonable conclusion as to how the grasslands of the area could be improved. The wonderful hospitality to which we were everywhere treated will always be remembered.

The establishment of better pastures and the production of more livestock fodder will not solve all the problems of the Mediterranean countries. They are things which are needed, however, and strike at the root of one of the difficulties these countries now face. With the increase in populations, such as is now occurring in Italy, particularly southern Italy, and Greece, many other improvement measures will be required. The land cannot continue to absorb the burden of these heavy populations. Industries of a varied character will be required along with the improvement in agriculture. Some of the most needed industries should manufacture moldboard plows and particularly small tools to replace the heavy mattocks that are now used by both women and men in the fields. Food-processing plants to assure the people an adequate year-round diet should be established also. There are, no doubt, many other needed industries that would give profitable employment to the workers, but these are the ones most apparent to me as a result of my service on the Mission.

The recent history of most of these countries is too well known to recount here. It may be sufficient to say that they are making good strides toward recovery and that what is needed now to go forward to better living, is a cessation from war and strife.

Bethel Community . . .

(*From page* 22)

and church grounds are well kept. The boys can gather around the fish ponds which Mr. Clark and his neighbors have built in almost every hollow. Home life is pleasant and up-to-date, for most of his neighbors, like Mr. Clark, have television sets, and all of the other things which go to make living pleasant and home life comfortable. On the neat and well-kept lawns are chairs, now that the people have time to use them. They don't have to spend all of their time working in the field as they used to.

Much has been written and more said in recent years about the changing agriculture of the Southeast, and as we drove away from this splendid community I realized that here I had seen taking place a tremendous revolution in land use. For the first time since the old hickory and other hardwood trees were cleared from these steep hillsides, a permanent system of agriculture is being developed.

This permanent agriculture embraces a system of land use which will provide a place where soldiers returning from the wars and others who attain maturity can build for themselves lasting homes in an area where just a few years ago deep gullies were commonplace and considered as inevitable.

In an entire afternoon's drive covering at least 25 or 30 miles, I saw only one evidence of active erosion, and that was in a newly planted sericea field where a heavy rain came before the new crop was established. This typifies the change which has come about with such rapidity in Georgia and other Southern states.

New Uses for Sweet Potatoes

By C. B. Sherman

Washington, D. C.

HOW to raise large crops and good crops of sweet potatoes is now pretty well understood. The problem of storage, keeping, and transportation, which plagued farmers, shippers, and merchants for many years has seemed fairly well solved. But research still goes on to prevent waste. Recent experiments showed that much of the difference in keeping quality can be attributed to different implements and procedures used at harvest time. Seemingly superficial injury then may mean considerable deterioration later. An ordinary turning plow and gentle handling, and placing into storage crates as soon as practicable, make a combination that means small damage, then or later.

With these storage and quality problems somewhere near licked, sweet potatoes are now on markets far from their southern fields during virtually all of the year. Yet expanded outlets are needed. In fact for nearly 30 years there has been a steady decline in the consumption per person in spite of the wider and longer distribution. The increase in population has been taking up most of the difference and there has been some dehydration and canning of the crop.

With a view to widening the outlets, the Agricultural Experiment Station of the Alabama Polytechnic Institute has been experimenting with at least three new products, all named most appropriately. Federal-State funds under the Research and Marketing Act have been used for some of the work and the Federal Bureau of Agricultural Economics has aided in the later stages when consumer acceptance tests became the obvious next step.

These consumer tests were scientifically planned and carried through. The analyzed details as to how they were made, who took part, and the replies are covered in comprehensive reports put out by Alabama. Only the conclusions are outlined here as they relate to the three products chosen to be tested.

Alayam breakfast food, ready-to-eat, is made from sweet potatoes and wheat bran. It has a toasted, golden color and keeps very crisp as long as it is in its cellophane container. The sample of consumers in the test represented a fairly large segment of the nation's consumers. More than a third of those who tried the product said they would buy it if it were placed on the market. Nearly a fourth said they liked it as well as, or better than, the ready-to-eat breakfast food they normally use. The most favorable reaction came from those who lived in the South, although only a very few of these or any of those in the panel identified sweet potato as the dominant flavor. Consumers in low-income groups and those who lived in rural areas were included among the groups that were generally more favorable, and more women liked this breakfast food than men.

Alayam snack, made from sweet potato puree, finely ground coconut, and sugar, has a golden-brown tinge, comes in irregular strip-like pieces a few inches long and is brittle. It has an exceptionally long shelf life but doesn't retain its crispness very well after the package is opened. This new snack appears to be acceptable to a large proportion of our consumers, according to the test, for more than a third of the testing individuals said they would buy it if it were placed on the market. And nearly a fourth of those in the test indicated that they liked the Alayam snack as well as, or better than, the snack that they normally preferred. Again, consumers from the South, and those with lower incomes, and those living in rural areas were among the groups generally more favorable toward the product, and women generally liked it better than men. Older people liked it better than the younger ones.

Alayam candy is made from the same ingredients as the snack. In the consumer test it stood up best in comparison with brittles and hard candies. But in comparison with all candies, more than 40 per cent of the nation's consumers who took part in the test indicated that they liked this new candy as well as, or better than, the candies they are currently buying or eating. More than a third of those in the test indicated that they would buy it if it were placed on the market. An additional 11 per cent were undecided or failed to give an opinion. A little more than 50 per cent said they would not buy it. More than half, on the other hand, liked the texture or quality, and about a half liked its flavor or taste. By the way, flavors of both the candy and the snack can be varied by blending in other fruits, or by substituting other fruits for the coconut.

Next question is: How attractive will the proposition to make and market these products—one or all—be to manufacturers? Many inquiries have come to the Alabama Station in the short time since the reports were published. They concern the methods of manufacture, availability of the products, and possible recipes. Both trades people and individuals are among the inquirers. Meanwhile, physical research is going forward aimed at overcoming the phases that were criticized by some of the testing consumers. That ought to help a lot.

Pasture Improvement . . .

(*From page* 14)

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.

Our recommendation of nitrogen every year with the suggested treatment of minerals (0-20-20) every third or fourth year just didn't seem to click. Farmers kept right on using nitrogen until their pastures were all "petered out" and then complained that the use of nitrogen fertilizer seemed to have exhausted their soils and that it no longer gave good results. So we said to ourselves last spring, "Why not combine the nitrogen with phosphate and potash in a mixed fertilizer like 10-10-10?"

During the winter of 1950-51, we blazed the State with a publicity program via radio and farm press. The fertilizer industry in turn put on a selling program both through printed leaflets and local dealer publicity. As a net result of all this educational effort and publicity, the fertilizer industry sold an estimated 10,000 tons of 10-10-10 in Wisconsin this past spring. This was enough fertilizer to cover 40,000 acres of pasture with a net increase of at least an extra 50,000 tons of an 18 per cent protein feed (worth a good three million dollars).

To promote an even greater interest in 10-10-10 for pastures, we set in motion the biggest program of field demonstrations with 10-10-10 ever attempted. A total of 213 acre scale plots was set up on farms in some 45 Wisconsin counties. The 10-10-10 was applied at the rate of about 500 lbs. per acre. Small areas of about six square rods each of the fertilized and unfertilized were fenced out and we thus "preserved the evidence." These enclosed areas were used for field demonstration meetings. Thousands of farmers saw the amazing results at these meetings. Many county agents made good use of these pasture plots for stops on conducted tours which were held in their counties in early summer. And these fenced-out areas also furnished us with yield data. Square-yard harvests were made and total yields calculated to the dry-matter basis. Increases of a ton per acre were common. There were many plots where yields were doubled or trebled and a few where increases were in the ratio of five to one.

Fertilized grass in the June period, we have found, runs as high as 20 per cent in crude protein on the dry-matter basis. The average increase for all plots harvested has figured out to about one ton per acre. Assuming this extra forage to be the equivalent in feeding value of a 16 per cent dairy feed, we show an average return of $65 worth of feed at a cost of $18, or about $3.50 returned for each $1 invested in fertilizer. And, of course, there will be a substantial residual carry-over of the phosphate and potash from these 500-lb. applications of 10-10-10 which should stimulate the growth of legumes next year.

The program has just barely gotten under way. We expect to see Wisconsin farmers buy and apply at least 25,000 tons of 10-10-10 on their pastures this coming spring.

Soil Fertility and Pastures . . .

(*From page* 18)

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Agronomists Recommend . . .

(*From page* 26)

5-10-5, 5-10-10, and the 6-9-9. Doubtless, there is a place for some of these when phosphorus supplies are normal. The 0-1-1 (0-14-14 and 0-20-20) are excellent to increase phosphorus reserves before seeding legumes for instance. However, manure supplemented with superphosphate will serve the same purpose. The 0-1-2 (0-10-20 grade) should supply ample phosphorus as a topdressing if the rate of application is high enough to furnish the amount of potash needed.

Limited supplies of the "discarded" grades will be available, as manufacturers have already started mixing for next season. Of course, some farmers may demand the old high phosphorus grades to the embarrassment of the manufacturer who is doing his best to supply all of his customers with ample fertilizer. Fair play will help everyone and injure none. If the "build-up" of phosphorus is not known, a sample of soil from each area should be carefully secured and tested by the Agricultural College. Tests for phosphorus are now highly dependable.

There is still a need for the use of much more phosphorus on dairy farms. It is recommended that every effort be made to avoid a reduction in the supply of superphosphate, especially for use in stables. However, it appears certain that reductions in dairy farm use are inevitable unless savings are made in the extravagant use of phosphorus on the intensively grown potato and vegetable crops.

The amount of phosphorus used for tobacco is small, about 1% of the total for New England, and it is secured chiefly from organic materials which are not used for other crops. No reduction seems necessary even though some soils are abundantly supplied; therefore, tobacco fertilization has been excluded from this analysis.

Following the Agronomists' analysis of the current fertilizer problems, they presented their recommendations to representatives of the fertilizer industry for further examination. There were practical problems of manufacture and distribution which had to be considered. In all of this, the industry showed a most cooperative and sympathetic attitude. They too are determined to do their utmost in giving the farmer the best that present supplies permit. They only ask that farmers accept the situation with understanding and make the most efficient use of fertilizer in 1952.

The possibility that many new problems in the manufacture of materials and in transportation might develop overnight cannot be overlooked. The fertilizer industry is closely associated with defense operations and will not be free from seemingly unsurmountable difficulties so long as military demands are high. Such matters as early buying, selection of grades to economize phosphorus, and wise use of all fertilizers are not arbitrary impositions by the industry or by Agronomists, rather, they are a part of National defense.

New U-3 Bermuda Grass Is Crabgrass Competitor

U-3 Bermuda grass, a highly successful turf grass selected at Savannah, Georgia, 13 years ago, can compete successfully with crabgrass in lawns. U-3 could understandably have been named because of its unusual combination of three very desirable characteristics—fine blades, hardiness, and wide adaptability. But the name "U-3" was really only the identifying number used by scientists of the U. S. Department of Agriculture and the U. S. Golf Association. The grass was sent in for identification in 1938 by D. L. Hall, Superintendent of the Savannah Golf Club.

U-3 must have a sunny location to do well, but its resistance to cold has resulted in good turf at Washington, D. C., at State College, Pennsylvania, Cleveland, Ohio, and St. Louis, Missouri, all places well outside the recognized Bermuda belt. The men who have been testing this strain expect it to have its greatest usefulness for lawns, athletic fields, playgrounds, and golf courses in the crabgrass area, for what crabgrass likes, U-3 likes also—lots of sunshine and hot humid weather. In 13 years of observation, insects and diseases have not caught up with it, if well fertilized. The density of its growth keeps down weeds.

Dr. Fred V. Grau describes U-3 as "a lawn grass for the man who cares." It must be mowed and fertilized regularly. It presents other difficulties. It produces no seed, and must be grown from stolons, sprigs, or plugs of sod. However, it can be established without destroying the existing turf. It becomes dormant and brown after the first killing frost, but cool-season grasses seeded into the turf can mask the brown until U-3 is green again.

U-3 grass is now available commercially, but neither the U. S. Department of Agriculture nor the U. S. Golf Association has sprigs for distribution. Either, however, will furnish a list of sprig sellers.

Up-to-date Family Runs Efficient Farm

HIGHER production from family farms of a size to take full advantage of mechanization is one of the most promising possibilities of the years immediately ahead. This prospect emerges in a study of how U. S. agriculture can expand output to meet the national emergency.

In this survey the Bureau of Agricultural Economics is cooperating with the Land-Grant Colleges and other agencies to analyze what happened to make possible increased production during World War II, and how still higher production can be brought about. In the technical journal, Agricultural Economics Research, Jackson V. McElveen reports results of part of the study based on classifying farms by size. Some of the highlights are:

Large farms are now producing nearer to total capacity than most family farms. They are up-to-date, use more advanced technology, and are more nearly balanced. Therefore, these show few opportunities for further increases in efficiency.

During the war an enormous shift took place from small to larger family farms. This shift enabled the larger family farms to take advantage of gains from mechanization.

Recent technological advances, the study shows, have opened amazing possibilities for increased production on family farms that take advantage of new methods. Increased production since World War II is an indication, says McElveen, that many are adopting new methods. Others do not know about them or are not yet convinced that they can afford them.

Increases in production on small and medium family farms during the war, though striking, leave room for improvement. Production levels are lower than on larger farms.

There is doubt, however, that large farm efficiencies continue beyond the point at which the farm gains full advantage of mechanization. Beyond the size of the fully mechanized and up-to-date family farm the problems of hired labor intervene. There is great promise for increasing production on larger family farms making the most effective use of the full possibilities of the family working as an up-to-date productive unit.

Dairy Cow Harvests Her Own

THE dairy cow is a first-class food-processing plant on four legs. This is a fact a farmer may well consider in making plans for treating his productive acres more kindly by a shift to grassland farming, say the U. S. Department of Agriculture.

Dairy scientists have compared the feed requirements of animals in providing the equivalent of a day's food for a man—2,600 calories. The cow and the hog place fairly close with the hog a little ahead in using slightly fewer feed units to supply 2,600 calories of pork products. But the hog requires a diet almost entirely of concentrated feeds—grain and meals. The main item, corn, calls for work in getting it ready for the pork factory—and corn cropping promotes erosion. Only about one-tenth of a hog's diet comes from roughages. The cow in contrast gets three-fourths of her feed units from roughage—pasture, hay, and silage. A cow does much of her own harvesting—and of crops that hold the soil.

Looked at another way, the cow processes into human food, crops that man can not eat. The hog competes with man for grain units that man can use directly.

You'll Remember Yule . . .

(*From page* 5)

grown among us, the greed and the loss of honor and probity in both public and private life. To the careless, the thoughtless, and the selfish ones, such dismal careers suggest adoption of similar ways to get ahead. To such people these unfortunate digressions from decency only spell a desire to imitate and be callous to the shame and unfairness and degenerate motives involved. If one man steals and cheats and gets away with it, why not forget to be honest and decent yourself?

Of course, in everyday life the real answer to all that kind of drivel is the very fact that you associate with so many upstanding and honorable persons, the ones who do the major share of the routine tasks in little stores, service shops, eating-houses, railways and buses, and big institutions.

By and large, these "little people" maintain a rare and very comforting resistance to the cheap and sordid blandishments of all manner of bribery and corruption. Day by day they go to work in rain and shine, often ill and cold and unhappy, but usually doing their duty with pride and nobility of purpose. They are the ones who make ordinary humdrum life run smoothly, who furnish the fuel and the energy, the know-how and the regularity with which a community maintains its poise and completes its tasks. Yes, even if most of them hire out to private firms and corporations, the result is just about the same—"service with a smile."

Right in this connection we also glean good will and cheer from the knowledge that these small fry who really do the world's work in America are accepted as essential and come in for benefits and insurance and pension plans, and get full credit in a public way for their vital importance. The day of throwing away old-age discards and piling up heaps of human wreckage in the wake of industry have gone forever—if we see the trend correctly. Today a new dignity invests the humble servants and laborers in our midst. If the price we pay for inflation is connected with better wages and finer working conditions, then we should pay it and be thankful it is not enforced tithes paid to a despotic overlord. Remember the angels came to announce the first Yuletide when Herod and his nasty minions ruled the universe.

So this is the time of year when we pay devoted homage to the humble people of earth, among them being those old householders and nature's partners who resided up in our old valley. In periods like the present one, when the globe rocks and reverberates with venom and suspicion, it is good to escape mentally from the uproar and the tension to regale ourselves in memory amid those fine old traditions.

How the eagerness to know simple truths and find solace in the everyday things around us makes sharp contrast with the immoral indifference which "high society" in cities often disport themselves at the holiday season! Both they and the valley dwellers afar in the open country are alike aware of the sacrifice and suffering some of our boys undergo in waging this "diplomatic war" abroad—yet one group revels and wastes its substance, while the other in the valley continues to stand firmly for the values and ideals for which our sons have been willing to die.

To refresh our memory, then, let us see if we can remember many of the typical surroundings in those homes in the valley that we shall never behold again—at least not with the ardor and the enthusiasm of lost youth and vanished yesterdays. To do it right, let's pretend we have returned again from our first job away from home, and we stamp off the snow and wipe our overshoes on the welcome mat, bearing some bundles for Mother when she opens the homestead door.

After the greetings are over and tears of reunion are shed, we glance around to spot the old, familiar evidences of home craft and family comforts gracing that valley haven. The old ingrain carpet is still there, a bit worn and scuffed in spots, stretched tight to the base boards and tacked firmly. Above it, the walls are decked with mail-order paper you helped hang, roses and vines and curlycues long since outmoded. Pictures in walnut frames, deep-set and embellished, look down upon you as of yore—grandsires and grandmothers, aunts and uncles, family groups, and historic views, and maybe that ever-present horse-fair by Rosa Bonheur. That old chromo depicting the surrender of Cornwallis at Yorktown, and the Currier & Ives print of the farm home at Christmas, recall your first beliefs that art was grand and imperishable.

In the room's center is the reading and sewing table, above which is suspended the rose-tinted hanging-lamp whose vivid reflections on the winter walls delighted you when evening came. Reposing on the table are Mother's workbasket and an unfinished pair of woolen socks hitched to the knobby ball of yarn. Beside it are the Bible and a few weekly newspapers and favorite novels.

Just at the side of the room not far from the chairs drawn up to the center table is the sitting-room stove, manufactured, you recall, by a noted iron works at Manitoba. Memories of the cozy warmth it gave to the narrow room are offset a little by equally strong recollections of the bruising job of lifting and tugging it in and out, across shifting layers of newspapers which Mother spread to catch the stray soot gobs knocked from blackened lengths of pipe. And beneath the stove the "zinc" must still repose, with a basket of kindling and a few oak chunks at the rear edge, to keep the home fires burning.

Over there is the narrow doorway leading upstairs, and the next to it at the right is the open door to the aromatic kitchen. To the left inside the kitchen door is a big armchair beneath the clockshelf. The cat usually appropriated that because it held a goose-feather cushion. The family clock is still there, with the big brass key tucked under it. Its yellow face is marred a little by so much time-pointing and ruthless winding. Its "tock" is measured and solemn, in rhythm with the gilt pendulum swinging behind the scrollwork. Its trilly alarm is seldom required now, since Dad is sleeping later than his wont, and the hour you rise to seek your job no longer ever concerns it. But the whizz and buzz that ushers in the hourly striking bell still shows that the old clock suffers from some form of respiratory obstruction of an obscure but not serious kind. It always brings back Mother's recitations of the Longfellow poem, "The Clock on the Stairs." But the echoing words of "Never, Forever" hit you harder than before. For after all, none of our ancient household gods and family altars can compete with the Connecticut clock as harbinger of jolly hours a-coming or reluctant moments of parting too soon to come. In sickness or in health, when infants were imminent or deaths impending, that old unfailing timepiece carried on.

Snapping and cracking with glee at your return, there is the old and ever-hungry kitchen range. Your frequent bouts with it on frosty mornings and the ruddy glow of its grates when its surface got hot enough for battercakes to cook upon are reminders of days before your appetite got jaded with packaged substitutes. You do not pause to enter the current squabble of nutritionists whose modern skills and scientific lore insist that Mother fed you badly with unbalanced diets from that rural laboratory. It's no time to worry about thiamine or riboflavin, calcium or calories. Everyone is entitled to a binge at Christmas, even though it's just wishful thinking about hungry kids and wishbones and jelly tarts and pumpkin pie. Avaunt, you decriers of homely meals! Haven't I survived and remained stout enough to dream back yonder with keen nostrils and gormandizing gusto?

Walls behind the range are streaked with runny creosote which seeped below the collar fitted to the chimney hole. The corner has a big sink for dishwashing, with a gurgling and wheezy cistern pump on a platform at the end. Near it stood Mother's culinary cabinet and its laden shelves. Here you filched dried apples and brown sugar, and made up that bubbly summer drink of well water, sugar, vinegar, and a dash of soda to make it fizz. Flanking all sides of the kitchen was a four-foot wainscoting, and the eastern outer door had glass at the top, where you drew pictures in the frost on winter mornings.

But why persist in further meanderings, which would lead you to your boyhood bedroom under the eaves, and the catch-all storeroom over the kitchen, and the wide porches toward the front road and the fields? You have passed the test by this time—even to reading old titles of dog-eared books kept in reserve, and labels on the preserves in the cellar closet.

So whistle for your dog again, put on your leggings and arctics, wrap that scarf snugly around your ulster, and wade right out there in the ermine fields—go right back there and feel the nip and the tingle and the zest of it. Then come back and lay it all away again, be alert to make the most of things as they are or boost for things as they should be. Old times and holiday pastorals are like believing in religion. Unless you make them come true today in spirit, their inward value is lost and useless.

And again to all and sundry, may we leave 1952 as we enter it—in peace and in hope, based on the things we have loved and the dreams we have had for future progress and Christian fortitude.

FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)
The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)
The Plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)
The Plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)
Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)
Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)
Potash Production in America (Silent, running time 40 min. on 400-ft. reels.)
In the Clover (Sound, running time 25 min. on 800-ft. reel.)

OTHER 16 MM. COLOR FILMS AVAILABLE ONLY FOR TERRITORIES INDICATED

South: Potash in Southern Agriculture (Sound, running time 20 min. on 800-ft. reel.)
Midwest: New Soils From Old (Silent, 800-ft. edition running time 25 min.; 1200-ft. edition running time 45 min. on 400-ft. reels.)
West: Machine Placement of Fertilizers (Silent, running time 20 min. on 400-ft. reel.)
Ladino Clover Pastures (Silent, running time 25 min. on 400-ft. reels.)
Potash From Soil to Plant (Silent, running time 20 min. on 400-ft. reel.)
Potash Deficiency in Grapes and Prunes (Silent, running time 20 min. on 400-ft. reel.)
Bringing Citrus Quality to Market (Silent, running time 25 min. on 800-ft. reel.)
Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
In the Clover

DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.
Southeast: Vocational Film Library, Department of Agricultural Education, North Carolina State College, Raleigh, North Carolina.
Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.
Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.
West: Department of Visual Education, University of California, Berkeley 4, California.
Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.
Department of Visual Instruction, Oregon State College, Corvallis, Oregon.
Bureau of Visual Teaching, State College of Washington, Pullman, Washington.
Canada: National Film Board, Ottawa, Ontario, Canada.

IMPORTANT

Request should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternate dates if possible), and period of loan.

Request bookings from your nearest distributor

A Few Whinnies

One cold, snowy morning an old man was seen, dressed in his nightshirt, vigorously chopping kindling.

His neighbor, amazed at the brevity of the old man's clothing in such severe weather, asked, "How come?"

The old man never missed a lick in his chopping as he replied: "For the last 70 years I have always dressed by a fire, and I'll be dad gummed if I'm gonna stop now."

* * *

Mrs. Young: "Nora, was the butcher boy impudent again when you telephoned your order this morning?"

Nora: "Sure, but I fixed him this time. I sez, 'who the hell do youse think y're talking to? This is Mrs. Young.' "

* * *

In a recent court session a man came before the judge for nonsupport.

Judge—"Have you lived with your wife since July?"

Man—"Naw, suh."

Judge—"Have you contributed to her support since that time?"

Man—"Naw, suh."

Judge—"Well, why haven't you?"

Man—"Well, suh, I'll tell you. I've been married to this woman five years, and last July her conduct got so miscellaneous that I don't think I was eligible to support her any longer."

One night a young Kentucky mountaineer was standing guard at an Army post, when an officer, nearly 7 feet tall, approached.

"Halt!" challenged the Kentuckian. "Who goes there?"

"Major Whate," the officer replied.

"Advance and be recognized."

The major approached. The sentry stood at port arms. Suddenly the major's huge arm lashed out and jerked the rifle from the soldier.

"You're one devil of a soldier," the major barked. "Here you are—rendered completely helpless."

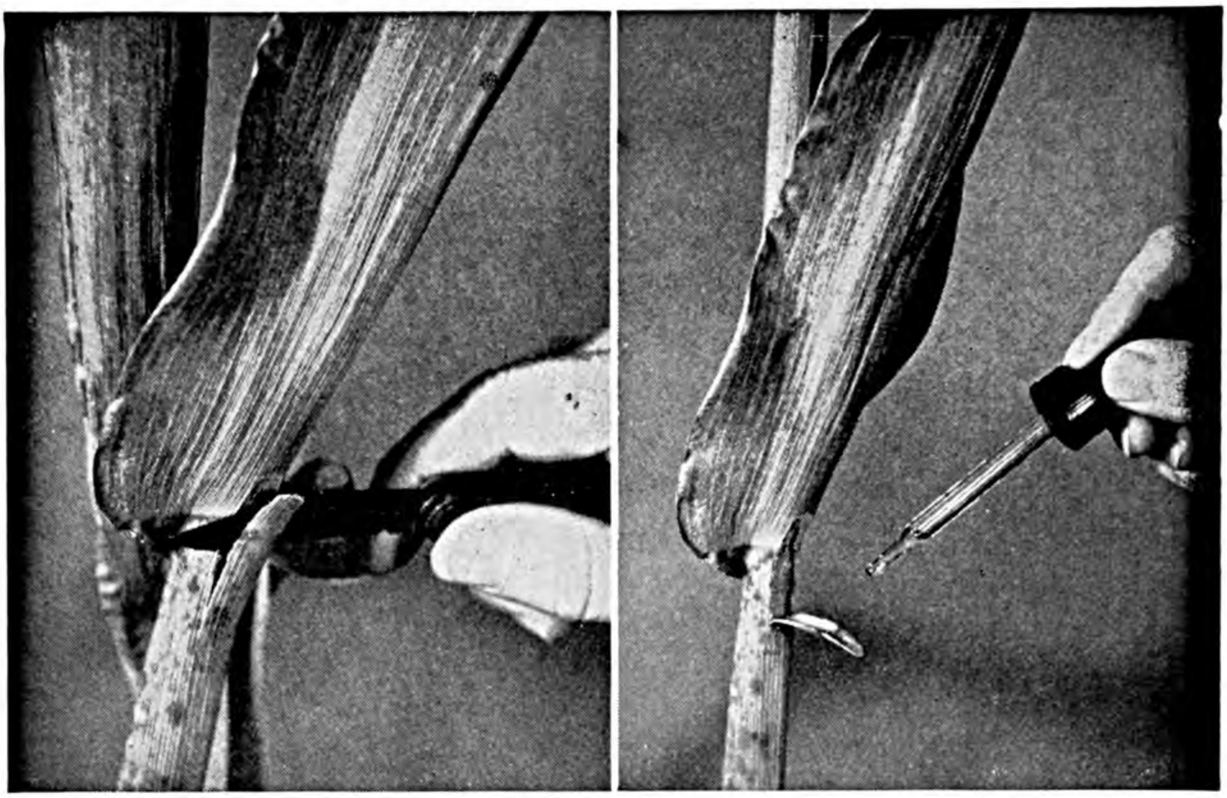
"Ah don't know about that," the young mountaineer retorted, and the major found himself looking down the barrel of a .38 revolver which had unaccountably appeared from the soldier's shirt. "All ah kin say, Maj, is that you'd better hand over that rifle. It ain't loaded—but this pistol is."

* * *

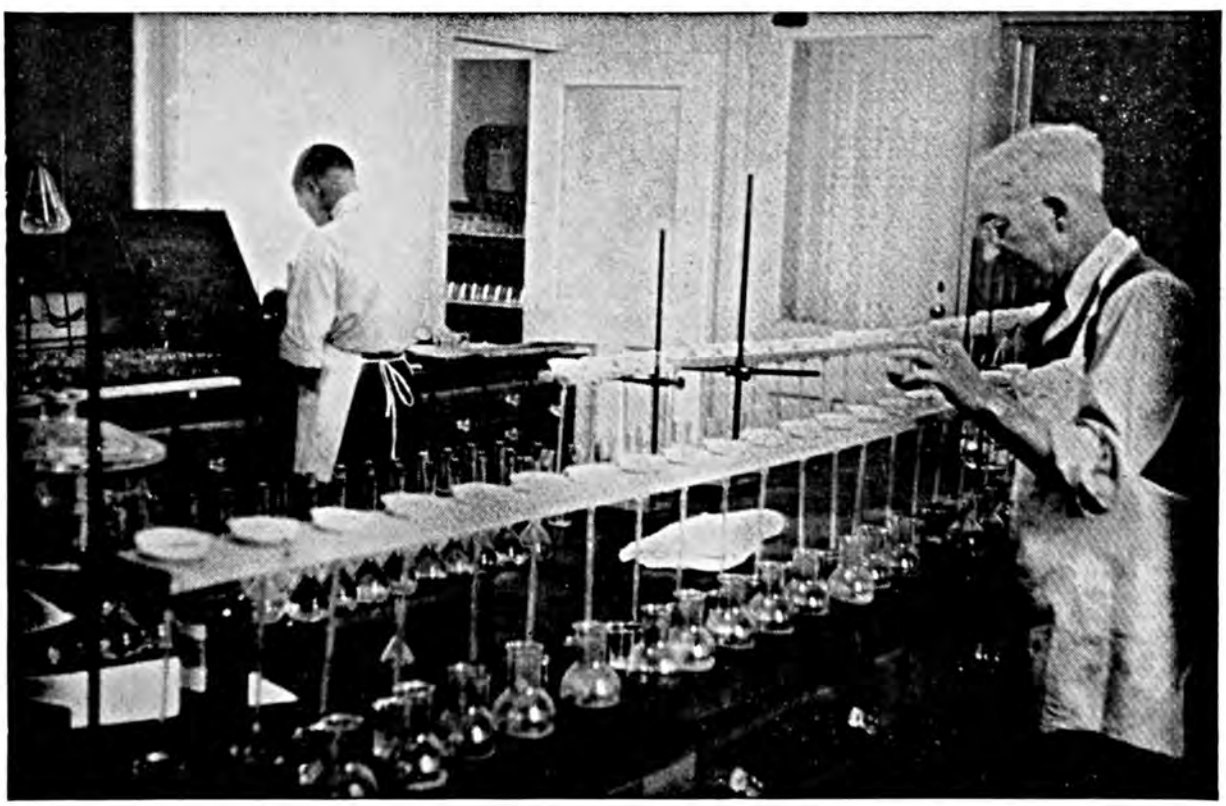
We asked the youngster who lives on our street how he was getting along with the new puppy he acquired a couple of weeks ago, and he replied, "He is getting along swell, but he makes puddles on the floor."

"What does your mother do about it?" we inquired.

His reply was startling, "She goes to the bathroom."



Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



Equipment used in a well-developed laboratory for soil analyses.