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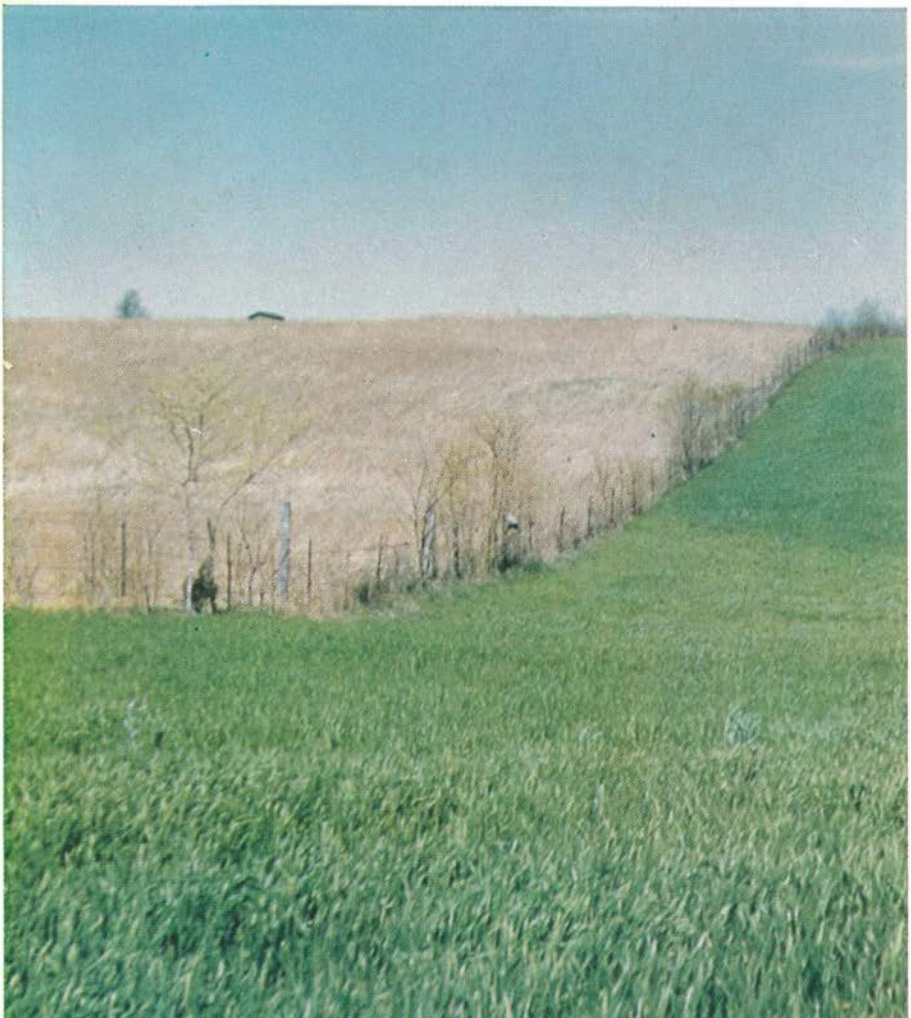
March, 1958 10 Cents



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ON THE COVER . . .

. . . We see a raw, buff colored Indiana slope being converted into a green pasture—the symbol of a new era coming to the unglaciated sandstone area of Southern Indiana.

This unglaciated sandstone area has the lowest gross farm income per acre in the state, though it receives the highest rainfall and has one of the longest frost-free growing periods.

The unprotected silt capped slopes are *very low* in available phosphorus and *low* in potash and calcium.

The hills or knobs are rolling to steep, the sloping soils highly erosive when used for row crops.

In 1949, Purdue University turned the attention of eight departments on the region—Agronomy, Agricultural Economics, Animal Husbandry, Dairy, Biochemistry, Extension, Forestry, and Agricultural Engineering—to find the best land uses for the area.

Working as a team, by 1953 these departments recommended a forage research and demonstration farm for the area. The money to buy the land came from the farmers and businessmen of the southern 41 counties.

Purdue staffmen Maurice Heath and C. J. Kaiser tell the story of this teamwork, starting on page 8.

Progress is necessarily slow—as in all accurate research—but already promising leads are being found on Purdue's 1,016-acre Southern Indiana Forage Farm 3 miles south of Cuzco in northeast Dubois County.

The Forage Farm has become a field laboratory. Various combinations of phosphate and potash for establishing and maintaining high yielding forage stands are being studied.

The search is on for a lengthened grazing season, for the response field-planted hardwoods will give to various soil fertility levels, for better farm pond water, for more plants adapted to the climate and soil, etc.

Better Crops with PLANT FOOD

The Whole Truth
Not Selected Truth

SANTFORD MARTIN, *Editor*

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Vol. XLII WASHINGTON, D. C., MARCH 1958 No. 3

Station men in white have . . .

A NEVER-ENDING QUEST

Jeff McDermid

(Elwood R. McIntyre)

EACH year sees a few more state agricultural experiment stations proudly join the "century of service" class. In only a few decades, all of the 48 state centers of agricultural learning will have spent 100 years belonging to the most remarkable and fruitful system of farm education that the world has ever known.

From its test plots, its feed lots and laboratories has come the agricultural revolution of recent productive years. Whatever troubles and problems arise tomorrow—these, *also,* the "men in white" will solve in time.

Where would we be today had there been no state experiment stations with their diligent, devoted research teams? They work in laboratories and shops to break through local and regional road blocks, which so long kept farmers in primitive bondage to hazards, waste, and toil.

Who is bold enough to guess? Who is keen enough to estimate what might have happened if the Experiment Station Act of 1887 had never been passed?

What do we owe to the foresight of such men as Commissioner Coleman of "The Rural World," Hatch of Missouri, Atherton of Pennsylvania, Willits of Michigan and Lee of Mississippi? They were backed by farmers themselves who longed for better things to know and do, acting through the almost forgotten Association of Agricultural Teachers and the old Society for Promotion of Agricultural Science.

Without the stations' "men in white" would we now have a tight food-sharing dilemma instead of the most lavish larder in the universe?

Would we have more or less impoverished marginal farms run by discouraged incompetents?

Would we have so many large farm estates operated by trained managers with superior working knowledge?

Would our country have its present population?

Would we have plenty of sustenance for so many from so few?

Would we have enough for 170 million well nourished stomachs and jobs to support the growing army of agribusiness workers?

Would we be exporting such an abundance of farm commodities we have to spare?

Without benefit of station zeal would our farmsteads and rural homes be the mecca of foreign observers, with the comfort, cheer, and convenience that millions of these homes enjoy?

Would we have the advantages of good rural churches, schools and roads, supported gladly from net incomes as an investment in spiritual and mental welfare?

Or would we still be stuck in the economic mud, wallowing in a morass of ignorance, exploitation, and improvised schemes, through which no dream of agricultural progress might penetrate the gloomy swamps of despond?

HE WAS NOT SATISFIED WITH THE WEEDY FIELDS . . .

To get some answers, I hark back 50 years to the simple countrified place of my boyhood. There our woefully labor-bound farm folk knew naught of the aid that would soon reach their children, to relieve the bending backs and weary arms. Little did they dream that some 8,500 science folks doing full or part time research at our state ag centers would eventually do so much to lighten the loads of care and worry—even down to these, our present days, of deep portent and serious perplexity.

Back there in the hard times of the 1890's, my uncle Boaz used to venture his convictions as we sat around the kitchen stove on winter nights. My uncle himself was not a learned man, but he belonged to the Grange and took numerous prizes at the county fair.

He pointed to the weedy fields, the rusty wheat, the nubbin corn, the somewhat unthrifty livestock and our nondescript fowls. He was *not satisfied* with it all. He knew the land required lime and more organic residues, a jolt of plant food and better, more timely tillage. Most of the neighbors also spent long hours at meager recompense and no future security, save the "increment of the land." So Uncle Boaz mused:

"Farmers deserve similar treatment to that which the banks and railroads get by public encouragement in various ways. I don't mean dollar doles but state-arranged education for us farmers by institutes and short courses, so we can do a more respectable job. But nobody can learn if there isn't much to teach. Our trouble has been a lack of new facts and better methods. Our small state farm colleges haven't yet discovered much that's useful and beneficial in growing larger yields and making farmers eager to be 'the first by whom the new is tried.' Most of us are afraid we'll fizzle out in adopting what little scientific dope we've been told about. That's natural, because farmers tend to be slow to 'lay the old aside'."

"Unless we conserve our strength and purpose in farming," he would say, "these rich virgin soils we neglect will go back on us badly when we need them most. Our real help must come from ambitious farm boys and girls, and others from cities, learning new ways at college to apply on the farms for better crops and animals."

What a contrast to the voluminous annals of scientific achievement streaming constantly from the state experiment stations! Uncle Boaz would be overwhelmed and confused by the towering body of proof and explanation, as well as the unity of purpose expressed there in behalf of human welfare everywhere—not just for farms and farmers.

Experiment stations have gone beyond farm fences to work with private and other public agencies. We see them play a stellar role in atomic energy, in electronics, in enzymes and hormones, in antibiotics, and in broad research for the armed forces and defense programs.

Taking a cue from the success of experiment stations as a government

. . . OR WITH THE NUBBIN CORN AND RUSTY WHEAT

endeavor—which Uncle Boaz hoped for—our public support has gone into studies of education, conservation, marketing, social security, farm credit, farm management, disease control, regulation and rural electrification.

Unemployment and surplus of goods must finally yield *to sound teamwork between science and industry.* In many ways, industry operates on a profit motive and is not primarily well organized to solve these end results of great efficiency. As one station director said some time ago: "*In a nation where industry has had ample room for extreme competition, it takes considerable faith and courage to promote a program that has education and public welfare, not profit, as its main objective.*"

From this situation and with wise direction, we see how the experiment stations now occupy a spot of high authority. As unbiased, independent investigators, their findings are quoted and their conclusions repeated at meetings and in publications sponsored solely by private enterprises.

We may well wonder what some of the underlying motives and ideals are that give these "men in white" so enviable a position as the nation advances to more complex and challenging times. Space permits only a cursory mention of these things.

The stations are organized so that constant and effective cooperation and coordination exists between the USDA as the federal research agency and the teaching and research projects of the various states. Thus possibility of duplication and waste of human talent, equipment and funds is largely forestalled.

Farmers have deep faith and high regard for these proven agencies of theirs. Through the extension system and otherwise farmers keep in close touch with experiments and pass on fresh suggestions for scientific solution.

Moreover, the idea has existed through the years of experience that first to be served and first to be studied are the state people and the local problems which are peculiar to a given state or region. And why not? The states furnish a major share of the operating funds to run the enterprise.

At the rate we are going, only 10 percent of our manpower will be producing our food and fiber in a few short years. These fewer farmers on larger farms will rely on research in all lines more completely than ever—*if they succeed and we eat well.* This spells for us *protection* research. It calls for more trained recruits to join the "men in white" who man our experiment stations for a never-ending quest.

The lone farmer brooding over his problems and the scientist working like a recluse in his cloister no longer are typical of advancement in agriculture. Group exchange of ideas, teamwork and cooperation are what bring us tested means and methods. That's the way our experiment stations operate. And farmers absorb new ideas in groups and test them out together.

Stations are not often under pressure for hurry-up, superficial research. Most farmers know and appreciate the true scientific approach to dilemmas. They know—*from experience*—that haste makes waste. So they join administrators in seeking sound and lasting results. Inadequate solutions often happen in any human activity, but the "men in blue denim" seldom force it upon the "men in white."

Farmers have learned more about "pure science" in relation to agricultural science. Some of the most basic researches are being conducted in connection with studies aimed at solving certain farm problems. They involve such phenomena as genetics, endrocrinology, colloid chemistry, metabolism, and plant and animal physiology and pathology. *It has been said that one way to attract and hold young scientists of promise is to give them a leader in fundamental research to awaken and inspire them.*

State experiment stations have extended the horizon of the public in regard to science. They have shown that science can be a great instrument to solve the vital problems of humanity. They also hand on the living fire to others young and eager to continue. Most important of all, the basic philosophy of the stations reflect the high ideals and principles of Christianity in creating new helps for the common man. Agricultural research and education provide ways to free the people from the bondage of the land and give them an abundance heretofore unknown.

As we look down the years at the farm toil and fears and the comfort we paid high to borrow, we find that research helps us out of a lurch, with a faith and a hope for tomorrow. Those "profs" are the proofs that we'd surely be goofs if unwisely we thought we could save by pinching down science—*our constant reliance in making bad problems behave!*

FERTILE FACTS

VIA BROCHURES · REPRINTS · HANDBOOKS

The following article reprints on profitable soil and crop management are available on request. Please indicate the reprint code and the number you desire. The address is: American Potash Institute, 1102 16th Street, N. W., Washington 6, D. C.

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O-6-56	Plant Analysis As a Guide to Fertilization of Crops
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FIELD CROPS

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B-1-58	Growing Good Stands of Alfalfa on Low Fertility Soils
C-1-58	Potassium, Its Functions and Availability as a Major Plant Food
D-1-58	Three Periods of Southern Agriculture
E-1-58	Potash Deficiency and Carbohydrate Metabolism

TEAM RESEARCH IN . . .

ON PURDUE UNIVERSITY'S SOUTHERN INDIANA FORAGE FARM

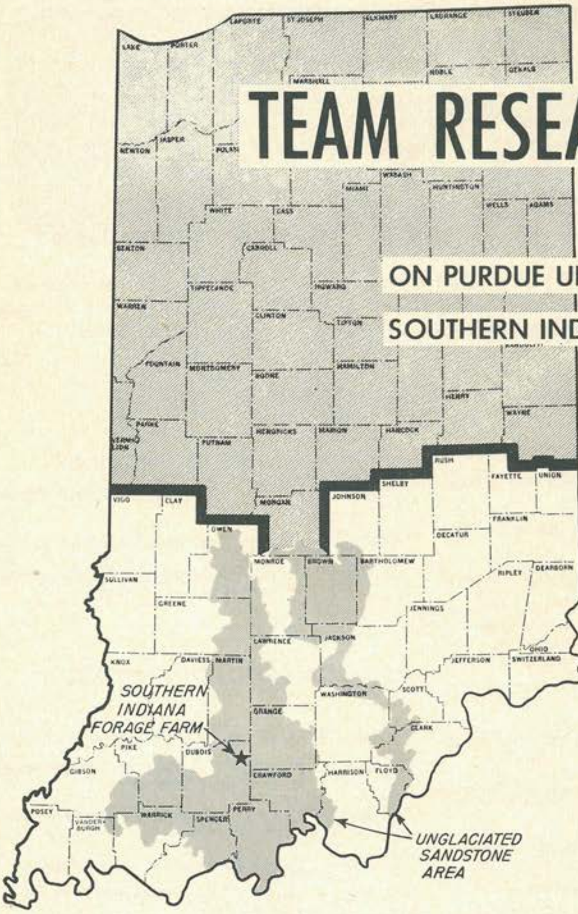

Figure 1. The unglaciated sandstone area represents an area of considerable potential. Farmers and industry of the southern 41 Indiana counties purchased 11 farms or parts of farms that comprise the 1,016 acre Forage Farm.

THE Ohio River Valley has one of the greatest concentrations of industry on earth. Comprising all or parts of 14 states, it has been called the "American Ruhr" and more recently "Atom Valley."

The recent 10-year industrial expansion of the valley is unparalleled at home or abroad. *But what about its agriculture?*

Professor Maurice Heath, Director of the Southern Indiana Forage Farm, has served with USDA Experiment Stations in Iowa, Minnesota, and Illinois. He is coauthor of a textbook on grassland agriculture and recipient of the USDA Superior Award for new grass-legume developments.

It, too, is growing through increased efficiency resulting from the impact of new technology. However, some areas are substandard, are not contributing their share of agricultural products toward the growth of this great valley.

Sandstone Area

One such region is the unglaciated sandstone area in *southern Indiana* extending into more than 15 counties and comprising over 2,225,000 acres (Figure 1).

Although this area has the lowest gross farm income per acre in the

GRASSLAND HUSBANDRY

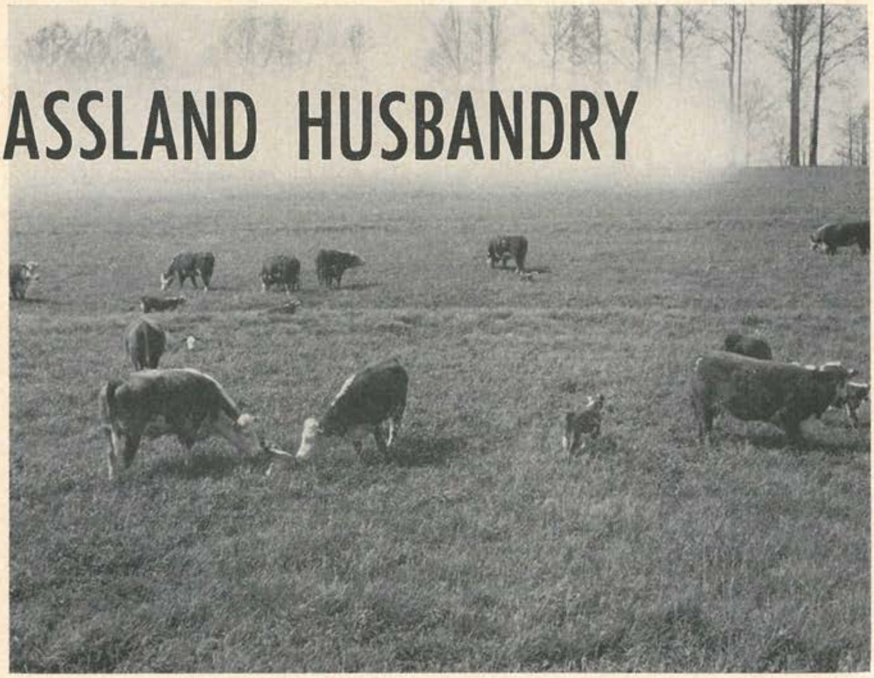

Figure 2. Sod seedling of winter rye in an orchardgrass-ladino clover sod has extended the grazing season 4 weeks in the fall and 3 weeks in the spring.

By Maurice E. Heath and C. J. Kaiser

Indiana Agricultural Experiment Station, Purdue University

state, it receives the highest rainfall and has one of the longest frost-free growing periods.

The hills or "knobs" are rolling to steep. The buff colored sloping soils are extremely erosive when used for row crop culture.

The original hardwood forest that covered the region had some of the finest tulip poplar, walnut, beech, and oak in the entire valley.

The area was settled early in the 1800's and was the scene of many a log rolling festival to clear a little land for cropping. The virgin hillside fields were considered very productive, but soon gullies appeared. History records that commonly a farmer abandoned a gullied field and cleared a new one on which to grow corn and wheat (Figure 3).

Agricultural leaders in the early part of the present century recognized the critical problems of the sandstone area and attempted to bring about improvement. Some of the projects emphasized were *all-weather roads,*

Mr. C. J. Kaiser, Superintendent of the Southern Indiana Forage Farm, earned his B.S. at Purdue, has done advanced work at Indiana University. He has served as a vocational agriculture teacher where he developed an "intense interest in southern agriculture."

A grand experiment to determine how southern Indiana . . .

Fig. 3. This is representative of some of the abandoned land prior to treatment. These soils generally need 2 to 5 tons of lime, are very low in phosphorus and nitrogen, and low in potassium.

improved cropping practices, use of lime and commercial fertilizer, soil conservation, and *improved breeding of livestock.*

The Southern Indiana Forage Farm Is Born

Not until 1953, with the help of farmers in the 41 southern Indiana counties and industry, mainly of Jasper, Indiana, was a comprehensive project started to determine the best land use for the sandstone region.

Progress is expected to be slow but there are *already several promising leads toward increased productivity that have been observed on Purdue University's 1,016 acre Southern Indiana Forage Farm, 3 miles south of Cuzco in northeast Dubois County.*

It all started in 1949 when Dean H. J. Reed (now Dean Emeritus) of the College of Agriculture appointed an interdepartmental committee representing the fields of *Agronomy, Agricultural Economics, Animal Husbandry, Dairy, Biochemistry, Extension* and later *Forestry and Agricultural Engineering.*

They were to study the farming problems of southern Indiana and make recommendations. After two and a half years of deliberation and constant study, the committee strongly urged the development of a forage research and demonstration farm for the area.

The money to buy the land came *from the farmers and industrialists of the southern 41 counties.* This same area, estimates say, may well benefit to

. . . especially the sandstone area can be made more productive.

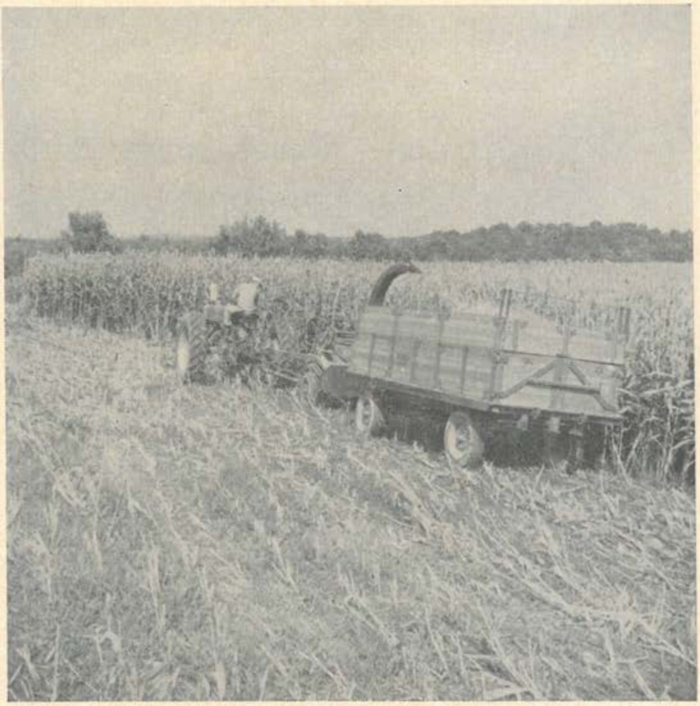

Figure 4. This newly treated field produced 6 tons of winter vetch-cereal silage in the spring followed by 11 tons of Atlas sorgo per acre in the summer. The sorghum was grown in 14 inch rows without cultivation.

the extent of many millions of dollars annually from the research results.

The over-all objective is *improved land use and increased production through an animal agriculture supported by a forage system.*

The research on the forage aspects will be to study the problems of establishment, production and preservation, and utilization. Utilization will be with beef and dairy cattle and ultimately sheep.

Soil and Climate

Two great agricultural resources of southern Indiana are *soil* and *climate*. These differ tremendously from the central and northern part of the state. Southern Indiana has the highest annual rainfall (44-46 inches) and the longest frost-free growing season (180-190 days).

However, drought periods during the summer are common. Weather record analyses show that summer drought periods of nearly a month will usually occur 4 out of 5 years. Mid-summer daily temperatures are usually high with high evaporation.

The topography is rolling to steeply rolling in the unglaciated sandstone area. Thus, *runoff* and *soil erosion* are major problems on the unprotected silt capped slopes. These soils are *very low* in available phosphorus as well as *low* in potash and calcium.

Forage Research

Thus, the Forage Farm becomes a field laboratory to find and test more adapted plants—plants adapted to the climate as well as the soil. The

Will it be more productive if used totally for forest or . . .

Figure 5. Performance of cows and calves in outside overwintering without shelter has been superior to indoor treatments.

forage plants that show the most promise will be studied for their best nutrient and utilization management requirements.

How well adapted is alfalfa? Can a strain be found that is resistant to winter heaving? What are the fertility requirements and how are they best applied to get the greatest fertilizer efficiency?

Work is under way to study the fertilizer requirements of the economic forage plants. *This includes various combinations of phosphate and potash for establishing and maintaining high yielding forage stands.* An evaluation of nitrogen fertilized grasses compared with legume-grass mixtures will be made.

There is currently strain testing of the economic forage grass and legume species. Southern Indiana shows orchardgrass, tall fescue, and timothy well adapted. It is at the southern edge of bromegrass and the northern fringe of bermudagrass areas of adaptation.

Bluegrass is conspicuous by its absence on the low phosphorus soils. Korean lespedeza, red and Ladino clovers show excellent adaptation. Alfalfa has been used to a limited extent by farmers mostly on the well-drained terrace soils.

We're trying to take advantage of the fall, winter, and spring climate by using more productive winter annuals for pasture and silage.

Winter cereals look very promising combined with winter legumes, such as smooth vetch (*Vicia villosa*). Sod seeding of winter cereals into perennial sods has shown promise of extending the grazing season. (Figure

. . . will forage-livestock-woodland be emphasized & practiced?

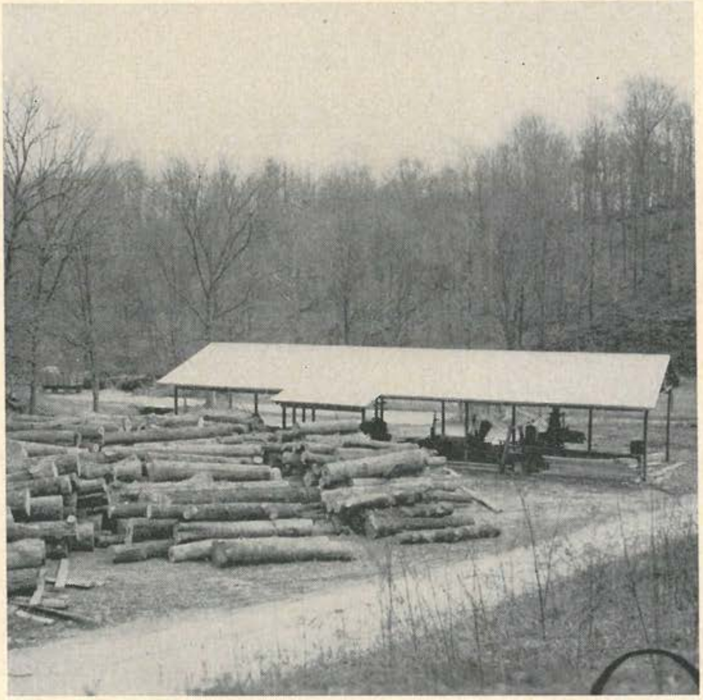

Figure 6. The sawmill is used in processing logs harvested from woods. Logs from defective and slow growing trees, shown here, were cut as part of the woodland improvement program.

2.)

Plants are being tested for special uses, such as *gully control, grassed waterways, roadside slope protection,* and *lawn development,* as well as *forage production purposes.*

Grass silage is one of the key practices in animal-agronomy phases. This provides a large degree of safety in feed reserves to bridge the summer drought and winter periods.

The surplus spring and summer crops can be captured and held in readiness for future need. The summer annuals found to be good silage crops are sudangrass and the forage sorghums. (Figure 4.)

Forage Utilization Research With Beef Cattle

A commercial Hereford cow herd of 100 cows has been established. These cattle are being used to indicate the quality of forage produced and to study the effect of the cattle on the pasturage.

Some of the problems now being studied are: *(1) How can we lengthen the grazing season? (2) What is the best summer pasture? (3) What type of grass silage is superior for wintering the cow herd? (4) What is the most successful method of wintering brood cows without barn shelter in southern Indiana when calves are dropped in January and February?* (Figure 5.)

The yearling steers and heifers are being used as the experimental animals on the grazing trials. Twelve treatments are being studied. These include two mixtures (alfalfa-orchardgrass and alfalfa-tall fescue), with and

A program that is unique because 8 Purdue University . . .

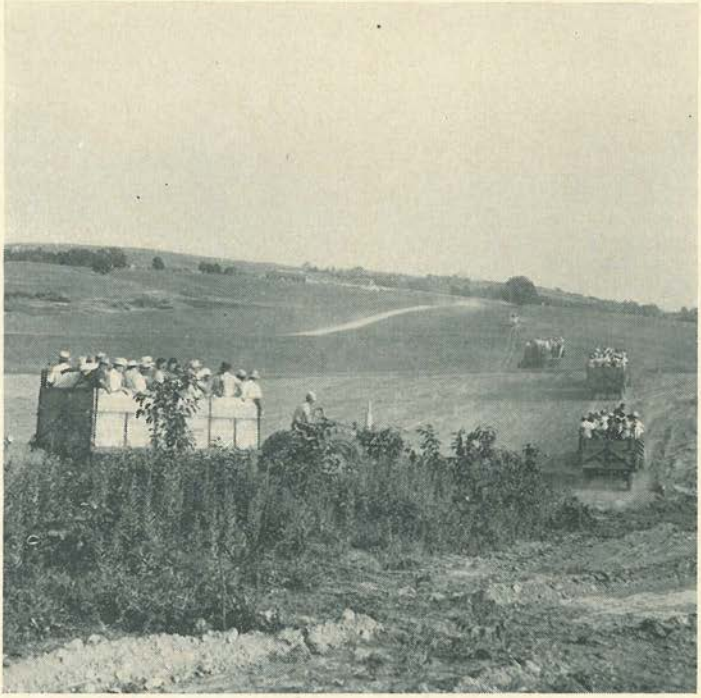

Figure 7. **One of the many groups observing research and demonstrations on the transformation from abandoned land to the production and cultivation of high quality forage.**

without sod-seeded cereals and three levels of nitrogen.

Forage-Dairy Research

In the spring of 1957, 28 counties were sampled for dairy heifers 4 to 8 months of age. Sixty-nine heifers were selected and brought to the Forage Farm. These heifers will become the experimental animals with which to study the forage-dairy problems peculiar to the sandstone area. A new pole-type, loafing shed and dairy barn will be used in milking and caring for the dairy cows.

Woodland Research

Although some counties in southern Indiana are as much as 70 percent forested, the sandstone area of southern Indiana and the Forage Farm are about 40 percent wooded.

The lands devoted to forest crops are usually too rough and rocky to till. On the Forage Farm, recognized woodland management practices are being followed to rehabilitate the forest resource. Cull trees are being girdled and poisoned. Low-value, slow-growing trees are harvested to provide growing space for more vigorous and valuable young growth. Logs are processed at the farm's sawmill. (Figure 6.)

Since all cereals produced are either grazed or harvested as silage, sawdust and slabwood chips from the sawmill are planned for use as part of the bedding requirements for the dairy and beef units.

Studies are currently underway to

determine: *(1) the most economical methods of rehabilitating previously unmanaged woodlands, (2) the growth response that field planted hardwoods can be expected to exhibit at various soil fertility levels, (3) the growth rates of natural hardwood stands, (4) the amount and kind of reproduction that will result following harvesting operations.*

Native lumber, most of which was grown and milled on the Forage Farm, was used in constructing the dairy barn. Nail-glued, hardwood trusses developed at Purdue University were used in framing the roof.

This type of truss has increased the flexibility of the barn by eliminating the usual interior rows of roof supporting poles.

Developing Water Resources

Underground water is generally scarce in the sandstone area. To overcome the water shortage, extensive use has been made of farm ponds for livestock water and fish production. All but one of the 17 fields have a source of pond water for livestock purposes.

Little difficulty from pond seepage has been experienced on the Wellston and Zanesville silt loam soils. It is extremely important to make test borings prior to construction to avoid locating a pond on sandstone strata with the hazard of water seepage.

A study is now underway to determine how pond water can be made suitable for domestic use. Several treatment systems are being compared in cooperation with the State Board of Health.

Wells in the sandstone area usually have a very low yield and are not dependable in supplying increased water needs for home and farm use. If research results are favorable an enlarged system will be installed to use pond water for all purposes in the dairy unit.

Fish Reproduction

Research is being conducted by Indiana University on several ponds relative to fish reproduction. We hope to determine the mortality rate of fish populations in different age classes.

Such information will be useful in the future in determining stocking rates and management practices for increased yields.

SEARCH FOR HOLELESS BAGS

PROF. Max E. Brunk, marketing specialist at the New York State College of Agriculture, is testing five different kinds of plastics searching for a holeless bag that can hold certain fruits and vegetables without spoilage.

The holes are necessary now because the fruit must have room to breathe. Without the holes, carbon dioxide given off by the fruit would accumulate in the bag and cause the fruit to spoil.

But Professor Brunk is working with some plastics that are permeable to gases so the fruit's breathing is retarded just enough to hold its quality and maintain crispness.

"The possibilities look good," he said, "but it will take several more years of testing before we can be sure. So much depends on the growing conditions.

"But it appears now that we will be able to get rid of the holes," he said. "This will result in higher quality produce—and will allow homemakers to use the bags again."

POTASSIUM CONTENT AND FORAGE YIELD AS AFFECTED BY FERTILIZATION

When Alabama Polytechnic Institute scientists recently studied the relationship between potash content and relative yield of 20 forage crops, they found . . .

- That these crops vary widely in uptake of potassium.
- That increasing the available potassium may have a different effect on various crops.
- That the potassium level at which the yield or adaptability of a wide range of plant species can be compared is relatively narrow.
- That when selecting forage mixtures it is important to consider their reaction to available potassium level.

THROUGHOUT the history of scientific research in crop production, there has been interest in relating the *mineral composition* of plants to *yield*.

Most studies have shown that the plant content of potassium is related to both potash availability in the soil and crop yield; however, exceptions have been reported.

Present information supports the conclusion that if other nutrients are not limiting, increasing the level of available potassium may affect the yield and the potassium composition of the plant in four ways: *(1) increase yield without an increase in potassium content, (2) increase both yield and potassium content, (3) increase potassium content without an increase in*

Dr. R. D. Rouse, head of Soil Testing Research at Alabama Polytechnic Institute, earned his B.S. and M.S. at the University of Georgia, his Ph.D. at Purdue University. He is author and co-author of 18 research publications.

By

C. L. Parks & R. D. Rouse

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Department of Agronomy

Alabama Polytechnic Institute

yield, (4) increase potassium content while yield decreases.

The effect found in a given situation depends on the level of potassium in the soil and the amount by which the available potassium is increased. Critical levels vary with the crop and such factors as climate and stage of growth.

Potassium fertilization of forage crops requires considerations not applicable to many other crops: *(1) when harvested for hay, large amounts of potassium may be removed; (2) differences in potassium requirements may favor one species over another in mixtures; (3) loss of stand may be the first indication that the soil has been severely depleted of available potassium.*

These factors, along with the large number of species considered as possible forage crops, indicate the need for special criteria by which potassium requirements of such crops may be anticipated.

To obtain a measure of the variation in potassium requirements that could be expected among forage crops, 20 different species were grown in the greenhouse over a wide range of available potash. A very potash-deficient Norfolk Loamy Sand was selected to ensure a response to potassium.

Lime and fertilizer, including minor elements, were added in amounts that would be expected to result in satisfactory growth. This soil was then potted and rates of potash added. The rates selected were 0, 10, 20, 40, 80, 160, 320, 640, and 1,280 pounds of K_2O per 2,000,000 pounds of soil.

Mr. C. L. Parks, Soil Scientist with USDA, works with the Agricultural Research Service on a regional lime project at Marianna, Arkansas. He earned his B.S. from Tennessee Polytechnic, his M.S. from Alabama Polytechnic Institute.

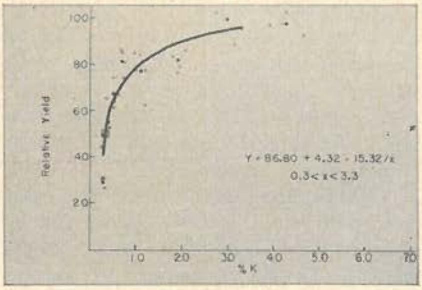

Figure 1. The relationship between potassium content and relative yield of millet.

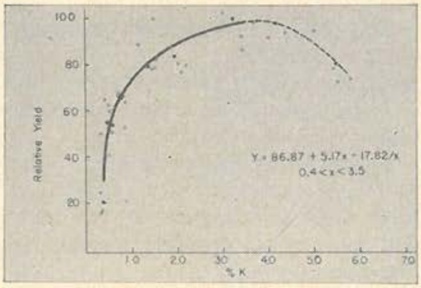

Figure 2. The relationship between potassium content and relative yield of ryegrass.

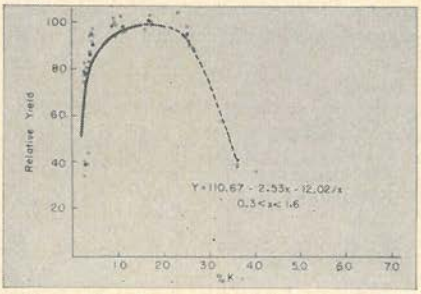

Figure 3. The relationship between potassium content and relative yield of Bahiagrass.

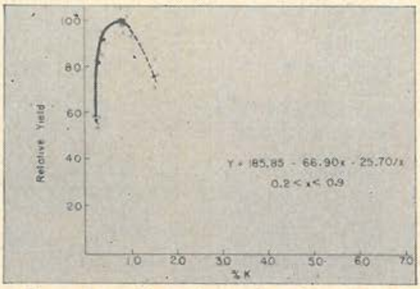

Figure 4. The relationship between potassium content and relative yield of lespedeza.

The various crops were planted at the time of year that should result in favorable growth. Clippings were made at the stage of growth at which they would normally be harvested for hay. Yield of forage and potassium content were determined.

To compare the various crops, relative yield was plotted against potassium content and curves were calculated. There appeared to be 4 general type curves. Examples of each are shown in Figures 1, 2, 3, and 4.

The solid line represents the calculated equation that best fits the data up to the highest relative yield. The dotted line shows yield decreases from higher rates of potash.

Figure 1 is typical of group 1. With each increase in level of soil potassium, there was an increase in the yield without any appreciable increase in potassium content of the plant until the yield was 50 to 60 per cent of maximum. From this point, there was an increase in both the yield and potassium content of the plant with further increases in the level of soil potassium. A gradual increase continued throughout the range studied.

Crops that exhibited this type response were Coastal Bermudagrass, millet, Sudangrass, and Birdsfoot trefoil. For all of these except trefoil, the highest rate reported was 1,280 pounds K_2O. All trefoil plants died at the 1,280-pound rate.

The response curves for the crops in group 2, as illustrated in Figure 2, were similar to those in group 1 up to maximum yield. However, after maximum yield was obtained, further increases in potassium level in the soil resulted in a decrease in the yield, although the potassium content continued to increase. Crops included in this group are orchardgrass, ryegrass, oats, vetch, crimson clover, and white clover.

For the crops in group 3, illustrated by Figure 3, the yield increased with each increase in the level of soil potassium without any appreciable increase in the potassium content of the plant until the yield was 80 to 90 per cent

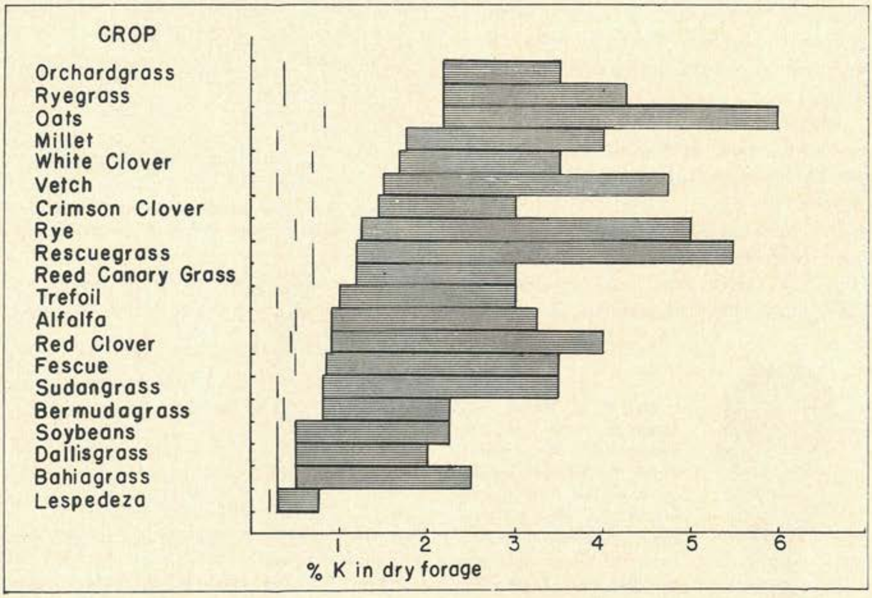

Figure 5. Range in potassium content of plants with yields above 90 per cent of maximum.

of the maximum.

This is in contrast to the gradual increase of yield and potassium content of the plants observed in groups 1 and 2. At 80 to 90 per cent of maximum yield, the yields tended to level off while the potassium content of the plant increased with increasing levels of soil potassium. However, there was a decrease in yield when potassium content of the plant reached a sufficiently high level. Crops with this type response curve are rye, fescue, rescuegrass, reed canarygrass, Dallisgrass, Bahiagrass, alfalfa, and red clover.

An example of group 4 is shown in Figure 4. The yield increased with each increase in the level of soil potassium without any appreciable increase in the potassium content of the plant. However, the yield did not level off as in group 3, but decreased with further increases in the level of soil potassium and potassium content of the plant. Soybeans and lespedeza were the only crops studied that exhibited this type of response.

In addition to differences in the response curves for the various crops, there was considerable difference between crops in potassium content at selected points on the response curve. Figure 5 shows the range of the potassium content of the plant when the yield was above 90 per cent of maximum. The minimum amount required for survival of the crop is indicated by the vertical line to the left of the bar for the respective crop. This figure shows that forage species vary widely both in minimum K content, K content necessary for maximum growth, and absorption of K in excess of that needed for maximum growth.

In answer to the question of whether one soil potassium level can be selected that would give favorable growth of all species, these data are plotted according to potassium treatment levels in Figure 6. This indicates that about 160 pounds K_2O per acre in this pot experiment produced near maximum yields. However, the range in available potash where all 20 crops

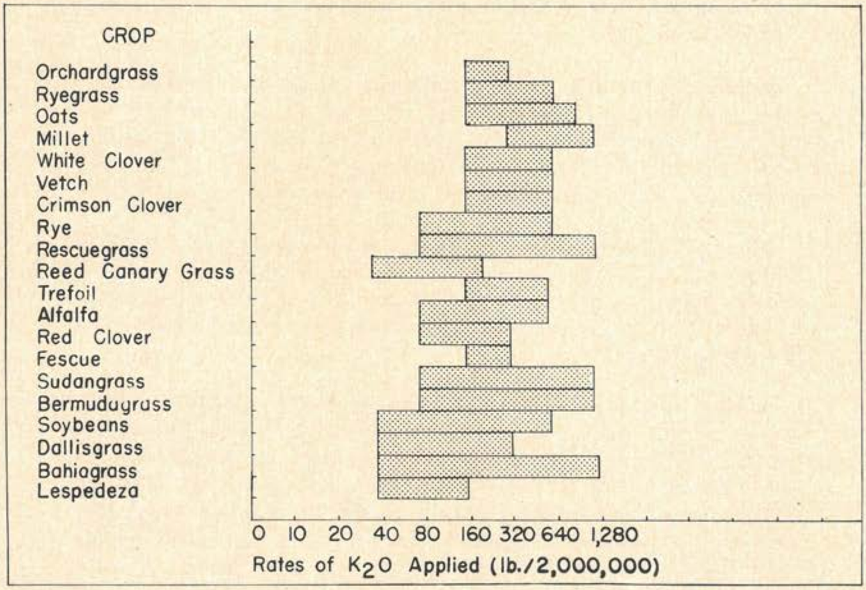

Figure 6. Range in potassium applications resulting in yield above 90 per cent of maximum. (From where 90 per cent of maximum yield was obtained to where yields decreased to less than 90 per cent of maximum as a result of excessive applications, or to the maximum rate used.)

could be compared is very narrow.

For example, it appears that this amount might be inadequate for millet and barely adequate for eight other plants, whereas more than this would be expected to decrease yields of such crops as lespedeza and reed canary-grass.

The reason for the decreased yield of some plants at high rate could not be determined from this study. However, the fact that such wide variation was observed indicated that when comparing different species, the response of each crop to potash on the soil where the study is to be made should be known. It suggests also that species in some forage mixtures might be able to compete favorably only if timely applications of potassium fertilizer are made.

Results of a study to determine the relationship between potash content and relative yield of 20 forage crops reveals that these crops vary widely in uptake of potassium and that increasing the available potassium may have a different effect on various crops.

The potassium level at which the yield or adaptability of a wide range of plant species can be compared is relatively narrow. This study shows that when selecting forage mixtures it is important to consider their reaction to available potassium level.

POTASH IMPORTANT TO GRASSLAND FARMING

In grassland agriculture where hay makes up a large part of the winter ration for cattle, the amount of potash taken in by animals is greater than when grain and corn fodder make up a large part of the ration.

Research work at the Ohio Agricultural Experiment Station indicates that the experiments showed 78 to 92 per cent of the potash in feed is excreted in manure, nearly all the potash being soluble. When the potash intake of different crops is compared, the need for potash conservation in grassland farming becomes more apparent.

The tests revealed that a four-ton crop of alfalfa removes about 200 pounds of potash from the soil and a four-top crop of an alfalfa-timothy mixture removes about 170 pounds. Rate of consumption by corn, oats and wheat is less than half the consumption by grass in varying degrees.

Another reason why grassland farmers should give special attention to potash fertilization is that legumes are "luxury feeders" of potash. When excesive quantities of potash are present in the soil, legumes are apt to take in more than they need. Therefore, in efficient grassland farming, potash should be applied in smaller amounts but at more frequent intervals, the Ohio experimenters recommend. Soil tests are the best way to keep posted on both phosphate and potash needs. —*Good Farming Quarterly*

In both yield and quality

NPK BOOSTS PECAN CROP

Soil Conservation District Supervisor Paul Sparks, above, living east of Wetumka, Oklahoma, believes that commercial fertilizers have increased both the yield and the quality of his pecan crop.

In 1956, Mr. Sparks cleared all the brush and timber from his bottomland pecan tract, leaving only the 7-year-old pecan trees.

He used 40 pounds of 10-20-10 fertilizer per tree, spreading it as far out as the branches reached and then working it well into the soil to make it available to all feeder roots.

The 1957 crop yielded an average of 60 pounds of pecans per tree. Mr. Sparks says that was a *higher yield* than other pecan trees on the farm, and the *fill of the nuts* was much better.

He plans to continue the practice.

—*Bernice DeShong*

Abstracts

FROM THE AMERICAN POTASH INSTITUTE LIBRARY SERVICES

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Through its library, the American Potash Institute summarizes the important findings on the role of potash in good soil management and balanced soil fertility. This program abstracts the important potash information from each article that is summarized. These abstracts are available on request to professional agricultural workers of the United States and Canada. Each issue *Better Crops* features a small portion of the abstracts available in current issues. If you are interested in receiving this summary service regularly in complete issues, please write the above address.

K Deficiency Contributes to Blackening of Potatoes

Mulder, E. G.

Effect of the mineral nutrition of potato plants on the biochemistry and the physiology of the tubers. Netherlands J. agric. Sci. 4, 333-356. 1956. Abs. Soils & Ferts. 20(1):334. Feb. 1957.

The composition of the free amino acids is not correlated with the amino-acid composition of the protein and, unlike the latter, may be considerably affected by mineral nutrition. Tubers from very K-deficient plants are rich in tyrosine and show stem-end blackening after rough handling. Less severe K deficiency results in the blackening of tubers after boiling. Potassium deficiency increases the respiration rate of the tubers.

Common Cause of Low Quality Tobacco—Low Potash

Bortner, C. E., Atkinson, W. O., and Hunt, R. A.

Fertilizing burley tobacco. Ky. Agr. Ext. Serv. Cir. 545, p. 6-7, 10-14. Rev. April 1957.

Lack of K is a common cause of low quality tobacco. A deficiency of this element produces characteristic symptoms in tobacco plants. Symptoms are described. A good supply of K imparts general vigor to plants and improves burning quality and finish of the leaf. Whenever the burley plant shows K deficiency the quality of the plant has already been lowered. Apply K to burley tobacco unless it is known that the crop will not respond. Amount to apply will vary with past cropping and fertilizer practices. A soil test is very useful for determining amount of K a soil needs. Additions may not increase yields but may increase the value of the tobacco by many dollars per acre owing to improved quality.

Potash Affects Corn Lodging, Yield, and Composition

Boswell, F. C. and Parks, W. L.

The effect of soil potassium levels on yield, lodging, and mineral composition of corn. Soil Sci. Soc. Amer. Proc. 21(3): 301-305. May-June 1957.

Five corn hybrids were grown on a soil low in exchangeable K. Four K fertility levels were used. Calcium, K, Mg and P were determined on leaf samples collected periodically thru the growing season. Root lodging and stalk breakage were also determined periodically. A significant yield increase from the first increment of K_2O was obtained, but no further increase was obtained from additional increments. Significant yield differences among corn hybrids were obtained. Potassium fertilization significantly decreased both root lodging and stalk breakage.

Increasing Potash Efficiency on Ladino Clover

Brown, B. A.

Potassium fertilization of Ladino Clover. Agronomy Jour. 49(9):477-480. Sept. 1957.

In a 6-year experiment on ladino clover and orchardgrass on K-deficient Paxton very fine sandy loam, the stands of clover and the yields of dry matter were maintained much better by relatively small annual application of KCl, than by less frequent heavier dosages. Even greater efficiency of fertilizer K was obtained by adding ¼ of the annual amount after each of the four cuttings per season. The chief reason for this was reduction in luxury consumption of K, which was influenced little by heavy applications of dolomitic limestone. The Mg content of the forage varied inversely with the amounts of K applied. The contents of N, P, and Ca were not influenced appreciably by the K treatments except that N decreased markedly when very poor stands of ladino resulted from K starvation.

High Sweet Potato Yields Require High Potash
Lin, K. C. and Wen, H. P.

A report on the optimum nitrogen-phosphorus-potassium fertilizer ratio for sweet potato. Agric. Res. Taiwan 6, 1-14. 1956. Abs. Soils & Ferts. 20(2):710. April 1957.

With 5 different rates of N, P, and K application ranging from 0-120 kg/ha N, 0-100 kg/ha P_2O_5 and 0-200 kg/ha K_2O at 8 different localities, the average rates for optimum tuber yields were 50, 35 and 170 kg/ha respectively. Customary application rates are generally somewhat high for N and P and too low for K. K appears to increase tuber yields most.

Long-Term Sugar Beet Experiment
Shustova, E. N.

Certain characteristics of sugar beet nutrition under conditions of long-term fertilizer application in a rotation. Pitanie Rast., 194-208. 1955. R. Zh. (Biol.) 1956. (76309). Abs. Soils & Ferts. 20(1):339. Feb. 1957.

In a 13-year experiment on slightly leached chernozem with sugar beet grown in a 5-course rotation including grasses, the following amounts of fertilizers were applied during 1 rotation: N 180, P_2O_5 240 and K_2O kg per ha. The effectiveness of K increased with time. Nitrogen markedly increased the effectiveness of K. The most constant yield increases were obtained from K. Symptoms of K deficiency (following NP) and high effectiveness of K are due not to a lack of soil K, but to reduce K uptake by plants under conditions of increased P supply.

Nation-Wide Soybean Studies
Calland, J. W.

Soybean fertility.
Soybean Digest 17(3):6-8. Jan. 1957.

Summary of reports from several different states given at the 7th annual meeting of the National Soybean Crop Improvement Council. John Pesek reporting for Iowa states, that several studies have been conducted in North Carolina over the past 15 years on the use of fertilizers and lime for soybeans. In nine experiments on coastal plain soils it was found that the application of lime and 40 lbs. of P_2O_5 and 80 lbs. of K_2O per acre gave an average increase of 12.4 bushels of soybeans.

Potash Affects Respiration
Fujiwara, A. and Ilda, S.

Biochemical and nutritional studies on potassium 1. Effect of potassium on the respiration of higher plants. J. Sci. Soil Tokyo 27, 100-104. 1956. Abs. Soils & Ferts. 20(1):233. Feb. 1957.

In culture solutions, the respiration of K-deficient barley seedlings increased with K; glucose increased respiration and also K absorption; as respiration decreased some K was excreted. Since respiration of tomato seedling was not increased by Fe applications, it is thought that K has no activating effect on Fe. Sodium had no direct effect on the respiration of rice seedlings. It appears that respiration is directly regulated by K.

How Fertilizer Influences Clovers
Brown, B. A. and Musell, R. I.

Clovers in permanent grassland as influenced by fertilization. Conn. Agr. Exp. Sta. (Storrs) Bul. 329, 35 p. Oct. 1956.

Stands of native clover on over 200 plots on Paxton very fine sandy loam were studied each year from 1931-1953. Effects of different surface-applied treatments on prevalence of the clovers are summarized. Good stands of clovers prevailed only when enough dolomitic limestone was applied to maintain pH of surface 3-4 inches of soil at pH 6 or above; plus superphosphate to supply equivalent of 60-70 lb. P_2O_5 per acre per year, with applications not over three years apart; and KCl every year to furnish 120 lb. K_2O per acre. These better stands averaged 47% clover from 1945-1953, in contrast to 9% under less effective treatments. With liberal lime and K, very large applications of superphosphate depressed clovers. After a few years of liberal LPK treatments, omission of K decreased clovers first, superphosphate second, and Ca last. Chemical compositions of clovers and grasses were influenced appreciably by different fertilizers. Nitrogen content was least, and K content, most affected by fertilization. In most cases, K content of clovers rose sharply, while Ca and Mg decreased with increasing amounts of fertilizer K. The reverse occurred when K was not added. The K content of clovers was greater than associated grasses excepting where K had not been applied for several years. Both clovers and grasses contained more Ca when either K or P was added more liberally.

Ottawa Study on Flue-Cured Tobacco
MacRae, N. A.

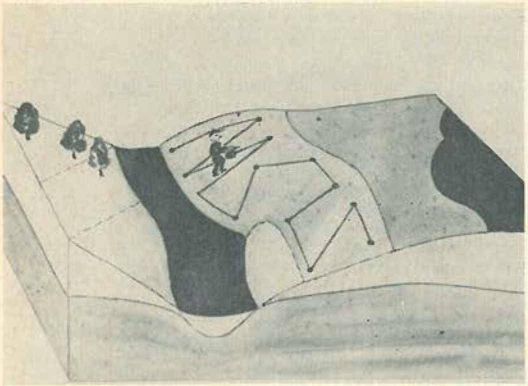
Sulphate and chloride affect yield of flue-cured tobacco. Canada Dept. Agr. Exptl. Farms Serv. Ann. Rept. 1955-56, p. 30. Jan. 1957.

The differential response of flue-cured tobacco to the sulphate and chloride sources of K in sand culture was studied at Ottawa. The lowest dry weight yields were produced when all the K was supplied as K_2SO_4 and the highest yield when the K was supplied half as K_2SO_4 and half as KCl. The all-chlorine source of K resulted in the highest water content of the leaves at harvest time. The chlorine content of the leaves increased directly with chlorine supply and increased with leaf position from the bottom to the top of the plant.

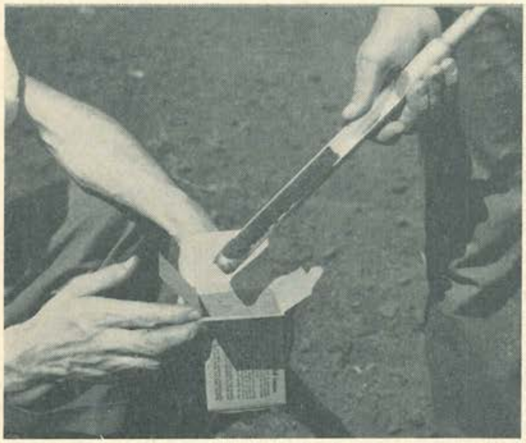
Sugar Beets Need Potash
Dona Dalle Rose, A.

Availability of soil potassium and production of sugar beets. Potassium Symp. 1955, 511-525. 1955. Abs. Soils & Ferts. 20(3): 1133. June 1957.

A beet yield of 30 tons/ha requires 150-175 kg exchangeable K and removes from the soil 75 kg K_2O. In mature beets the ratio of Na/K generally amount to 1:2 and that of Mg/K to 1:3-1:4. K promotes carbohydrate production and regulates the uptake of Na by the cell. K fertilizing and deficiencies of sugar beet are briefly discussed.



In a non-uniform area, as above, a sample would consist of 15 to 20 borings taken from level upland, from a sloping area, and from bottomland.



After the 15 or 20 borings have been carefully mixed in a clean pail, a sample is transferred to a pint carton, above, and labeled by field and owner's name.

If a soil tube or soil auger is not available, a sample can be taken by spade, as above—a ½ inch slice of earth 6 inches deep.

Don't guess

TEST Your Soils

As he tries to meet today's cost-price squeeze, the modern farmer well knows how unit cost of production is related directly to yield—the *higher* the yield the *lower* the cost per unit and the better the net income.

A major factor in high yields, according to agricultural scientists, is *proper fertilization.* And to fertilize properly, of course, takes some knowledge of what your soils need.

Such knowledge is gained through soil tests. And one of the most important steps toward an accurate *soil test* is the right kind of *soil sample.*

Soils vary from field to field—even from place to place in the same field. A good soil sample should contain a mixture of 15 to 20 sub-samples taken from uniform areas within a field.

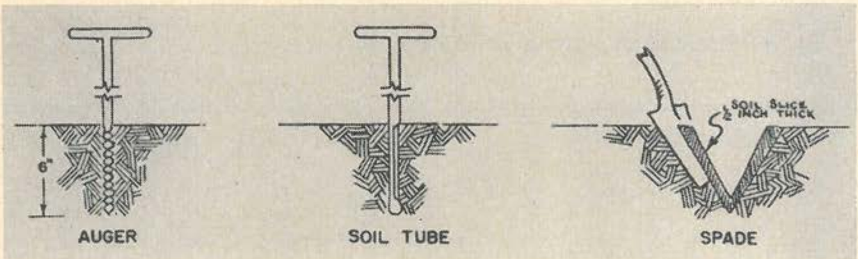
If your field is not uniform, divide it into its natural divisions—upland, slopes, bottomland—and sample each area carefully.

Avoid low spots, old straw piles, fence rows, roadways, fertilizer bands, manure piles, urine spots, or areas where fertilizer and lime have been spilled.

To take your sample, scrape away surface litter. Take a core from the surface soil to a depth of 6 inches. (In permanent pastures or lawns sample only 2 inches deep.) Then put this in a clean pail.

If you use a spade, dig a V-shaped hole 6 inches down, remove a ½-inch slice from one edge, and take a section 1-inch wide from this slice.

Repeat this procedure in 15 or so



This shows method and depth of taking a sample with soil auger, soil tube, and spade.

places and then mix your combined samples thoroughly in your clean pail, breaking up any clods or lumps before they dry out. Fairly wet samples can be spread out to dry at room temperature on a clean sheet of wax paper. Don't dry samples on a stove or refrigerator.

Fill your container (usually one pint) from this sample and *label your name and the field number* so you will know where the sample was taken. The sample is then ready for your nearest official soil testing laboratory.

One of the most complete studies on taking soil samples was made by the Soil Test Work Group of the National Soil and Fertilizer Research Committee, composed of soil scientists representing the USDA, the Agricultural Experiment Stations, and the fertilizer industry.

This study was interpreted in an article by J. F. Reed, a committee member and southern manager of the Potash Institute. The article is now in pamphlet form on *Sampling Soils for Chemical Tests.* It gives specific instructions for taking soil samples and major steps in preparing to sample a field for soil analysis. Such steps as . . .

(1) The area to select for soil sampling—what size area to sample, whether to subdivide the field into smaller fields.

(2) The number of borings, their distribution and relations to the size of the area to be sampled.

(3) The sampling tools to be used.

(4) Depth of sampling.

(5) Size of the final composite sample (one pint usually) and whether this should result from subdivision of a larger sample.

(6) Moisture status of the area—too wet or too dry?

Copies of this booklet are free in reasonable quantities from the American Potash Institute.

This Booklet Is For Your Use

FREE

Write American Potash Institute

The Soil Test Work Group developing this booklet were J. W. Fitts, J. J. Hanway, L. T. Kardos, W. T. McGeorge, L. A. Doan, and J. F. Reed. It is available on request.

In Minnesota, they asked . . .

1 Can alfalfa yields be profitably increased and maintained by phosphate fertilization?

2 Is potash essential in the fertility program?

3 Are commercial nitrogen applications of practical benefit to alfalfa yields?

4 Are applications of trace elements essential?

5 How much fertilizer should be applied at one time, and is topdressing more valuable than initial application?

6 Should alfalfa be fertilized annually, biennially, or at time of seeding only?

7 Is fall fertilization equally as effective as spring application?

8 Does fertilizer affect plant composition?

9 Do fertilization and higher yields measurably affect soil pH, absorbed phosphorus, and exchangeable potassium?

10 Is moisture a limiting factor in alfalfa production in Minnesota?

PHOSPHATE-POTASH MAINTAIN ALFALFA

ALFALFA is an important hay crop in Minnesota, since approximately 2 million acres are grown there.

Phosphate fertilization of alfalfa has long been regarded as essential to good legume hay yields. On many of the sandier lands in the state—of which Minnesota has some 5 million acres—the addition of potash for legumes is often *more critical* than the need for phosphate, since the initial potash supply is relatively low in soils of coarse texture.

Dr. John M. MacGregor, Professor of Soils at the University of Minnesota, was born on a Michigan farm. He is a graduate of the Universities of Alberta and Minnesota—and has specialized in soil fertility at Minnesota since 1943.

However, during recent years, it has become apparent that phosphate fertilization of many finer textured soils is likewise not sufficient for good alfalfa yields, especially if more than one cutting a year is desired. Most of the earlier fertility investigations conducted over the state on alfalfa consisted of applying different fertilizers to small grains and then determining

. . . and they learned

1. That Port Byron silt loam is a productive alfalfa soil, but fertilization is profitable.
2. That potash is essential for good alfalfa yields and stand maintenance.
3. That commercial nitrogen is of little value in alfalfa production.
4. That addition of boron alone, or in combination with copper, zinc, manganese, and iron did not increase alfalfa yields *on this soil*.
5. That moderate use of starter fertilizer and annual topdressing is desirable.
6. That annual fertilization of alfalfa is more desirable than fertilization every other year.
7. That there is little difference in alfalfa yields between fertilization in the spring and in the fall.
8. That the addition of phosphate or phosphate-potash affects plant composition.
9. That heavy fertilizer treatments reduced soil pH and increased both absorbed phosphorus and exchangeable potash after five years.
10. That heavily fertilized alfalfa severely depleted available soil moisture to a depth of 5 to 7 feet.

STAND WITH PROFITABLE HAY YIELD

the residual effects on alfalfa yields for either one or two years. Generally, such short-term studies indicated phosphate alone to be the fertility nutrient most needed for increased alfalfa production.

The soils of several million acres in southeastern Minnesota are of wind-laid origin, silty, with considerable slope, and very susceptible to water erosion. Limestone underlays a large part of the loessal area, but at a considerable depth. The zone of root development is usually acid in reaction (pH 5.0 to 5.5). Grasses grow luxuriantly, and, with additions of lime and fertilizer, legumes are very productive.

Since both grasses and legumes are excellent natural soil stabilizers, maintaining considerable acreages of these is an important contribution to soil conservation of the area.

By

J. M. MacGregor

J. R. Brownell, W. W. Nelson

Agricultural Experiment Station
University of Minnesota

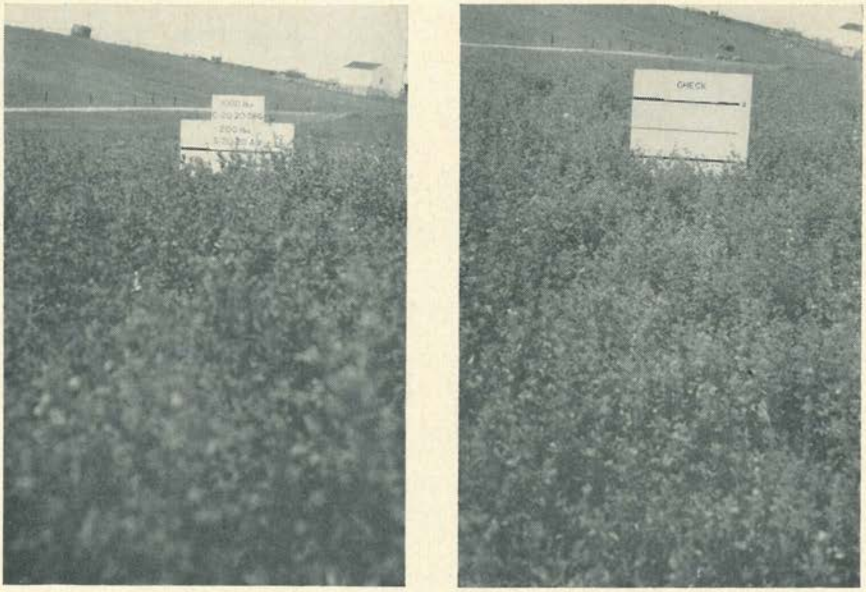


Figure 1. Fertilization of alfalfa on this Port Byron silt loam increased yields 1½ tons per acre annually. Port Byron silt loam is a productive soil, but fertilization is profitable.

Alfalfa acreage is gradually increasing, but corn and soybean acreage is proportionately more rapid. One reason for this lag in alfalfa acreage increase is that the average per acre alfalfa yield in Minnesota is only 2.25 tons. Heavier yields would further stimulate the growing of the higher protein alfalfa in this dairying area.

In fall 1949, a long-term alfalfa fertility experiment was initiated on the Soils Unit of the Rosemount Experiment Station (some 20 miles south of Minneapolis—St. Paul) to answer such questions as the following:

1. *Could alfalfa yields be profitably increased and maintained by phosphate fertilization?*
2. *Was potash essential in the fertility program?*
3. *Would commercial nitrogen applications be of practical benefit to alfalfa yields?*
4. *Were applications of trace elements essential?*
5. *How much fertilizer should be applied at one time, and was topdressing more valuable than initial application?*
6. *Should alfalfa be fertilized annually, biennially, or at time of seeding only?*
7. *Was fall fertilization equally effective as spring application?*
8. *Did fertilizer affect plant composition?*
9. *Did fertilization and higher yields measurably affect soil pH, adsorbed phosphorus, and exchangeable potassium?*
10. *Was moisture a limiting factor in alfalfa production in Minnesota?*

Experimental

The soil of the experimental area, Port Byron silt loam, was known to be acid and the entire area was limed at the rate of six tons per acre in fall 1949.

Three years later, in fall 1952, the soil pH varied from 7.0 to 7.7. The

Figure 2. Potash is important for alfalfa. On this soil low in potassium 200 lbs. of 0-20-20 topdressed annually gave a net return from fertilizer of $15.00 per acre. Phosphate alone gave a return of $7.38.

unfertilized soil then contained six pounds of adsorbed phosphorus and 117 pounds of exchangeable potassium per acre surface six inches, *a relatively low available supply of each element.*

Seven replications of 30 fertilizer treatments were studied, some of which were applied late in 1949, some just before seeding the Ranger alfalfa in the spring of 1950, with later treatments commencing in 1951. Three hay cuttings have been removed annually, a total of 18 cuttings by fall 1956. All yields are reported on a 15% moisture basis. Some observations should be of value after six years of cropping, although the experiment will be continued for at least several more years. (All photographs were taken in July, 1956, just prior to the second cutting.)

Observation 1. *The Port Byron silt loam is a productive alfalfa soil, but fertilization is profitable.*

Table 1.
The effect of fertilizing Ranger alfalfa on Port Byron silt loam.

Fertilizer applied per acre	None	1000# 0-20-20 at seeding 200# 5-20-20 annually
1951 yield per acre	3.10 tons	4.34 tons
1956 yield per acre	2.99 tons	4.50 tons
1951-56 yield per acre	19.03 tons	27.89 tons
Average annual increase for fertilizer		1.49 tons
Annual value of increase over check [1]		$29.80
Annual fertilizer cost per acre [2]		$12.96
Net return from fertilizer		$16.84

[1] Hay valued at $20.00 per ton.

[2] Based on 1956 consumer fertilizer cost. Other additional production costs not included.

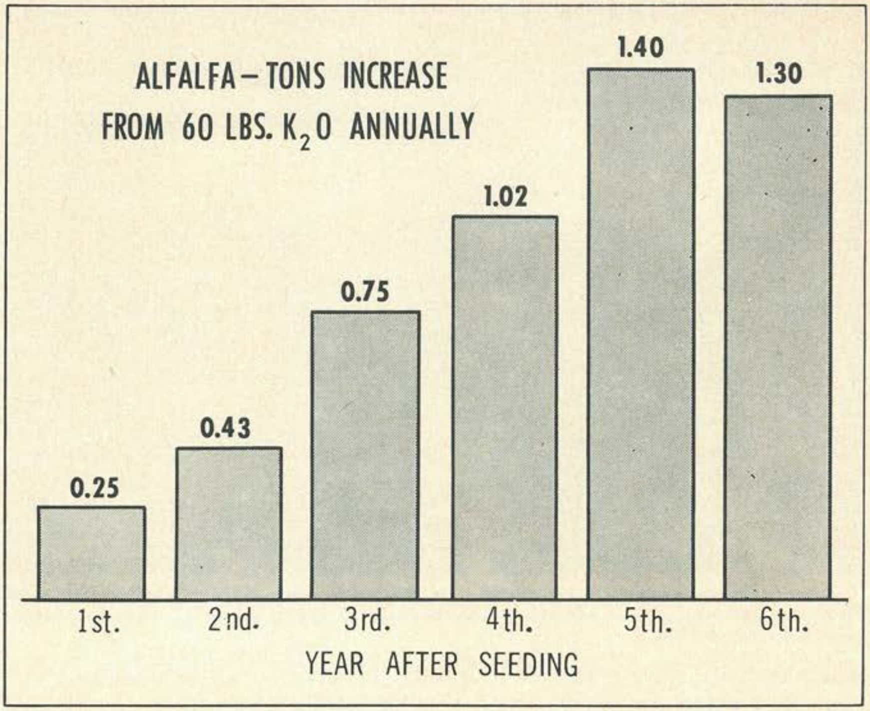


Figure 3. This illustrates the increasing return from 60 lbs. K_2O topdressed annually on alfalfa after the first cutting (Port Byron silt loam, limed before seeding and 200 lbs. P_2O_5 applied, 117 lbs. exchangeable potassium). The annual cost of K_2O is about $2.40 per acre.

In the sixth year, the unfertilized soil is still producing a good alfalfa hay yield of some 1500 pounds above the state average. However, grasses have invaded the unfertilized areas and *lowered the overall protein content of the hay,* although this invasion is not noticeable in Figure 1. The fertilizer treatment shown in Table 1 was the most productive of the thirty studied, but was not the most efficient per fertilizer dollar.

Observation 2. *Potash is essential for good alfalfa yields and stand maintenance.*

Table 2.
Phosphate versus phosphate-potash with a heavy rate at seeding plus annual topdressings.

Fertilizer applied per acre	1000# at seeding + 200# annual topdressing of:	
	0-20-0	0-20-20
1951 yield per acre	4.04 tons	4.42 tons
1956 yield per acre	3.55 tons	4.30 tons
1951-56 yield per acre	22.72 tons	26.93 tons
Average annual increase over check	0.62 tons	1.32 tons
Annual value of increase per acre	$12.40	$26.40
Annual fertilizer cost per acre	$ 6.28	$11.00
Net return from fertilizer	$ 6.12	$15.40

Including potash with the phosphate *produces and maintains heavier alfalfa yields and gives two and one-half times the annual net return.* The effect is more strikingly shown if the before-seeding fertilization rate is decreased or eliminated altogether. (Tables 2, 3 and 4).

Table 3.

Phosphate versus phosphate-potash with a light rate at seeding plus annual topdressing.

Fertilizer per acre	300# at seeding+200# annually of:	
	0-20-0	0-20-20
1951 yield per acre	3.77 tons	3.96 tons
1956 yield per acre	3.79 tons	4.80 tons
1951-56 yield per acre	22.71 tons	27.61 tons
Average annual increase over check	0.61 tons	1.43 tons
Annual value of increase per acre	$12.20	$28.60
Annual fertilizer cost per acre	$ 4.42	$ 7.50
Net return from fertilizer	$ 7.78	$21.10

Table 4.

Phosphate versus phosphate-potash as a topdressing.

Fertilizer per acre	200# annual topdressing only of:	
	0-20-0	0-20-20
1951 yield per acre	3.64 tons	3.25 tons
1956 yield per acre	3.42 tons	4.48 tons
1951-56 yield per acre	22.29 tons	25.33 tons
Average annual increase over check	0.54 tons	1.05 tons
Annual value of increase per acre	$10.80	$21.00
Annual fertilizer cost per acre	$ 3.42	$ 6.00
Net return from fertilizer	$ 7.38	$15.00

The value of including potash is thus strongly evident in greater alfalfa yields in both the heavier and lighter applications of fertilizer.

Potash also can be effectively applied after the first alfalfa cutting, if ample amounts of available phosphate are present in the soil. Table 5 illustrates this point. The increasing return from topdressed potash over the 6-year period is shown in Figure 3.

The annual application of potash after the first cutting was highly profitable. Although the yield was less than that shown in the 0-20-20 treatment of Table 2, *there was a greater net return.*

Observation 3. *Commercial nitrogen is of little value in alfalfa production.*

Although nitrogen application with phosphate-potash resulted in the highest yielding alfalfa of the experiment, the increase in yield for 20 pounds of nitrogen applied annually was not financially justified.

Observation 4. *The addition of boron alone or in combination with copper, zinc, manganese, and iron did not increase alfalfa yields on this soil.*

Table 5.

Effect of annual potash topdressing after the first cutting.

Fertilizer per acre	1000# of 0-20-0 spring before seeding plus:	
	no potash	100# 0-0-60 annually
1951 yield per acre	4.01 tons	4.26 tons
1956 yield per acre	2.86 tons	4.16 tons
1951-56 yield per acre	20.52 tons	25.67 tons
Average annual increase over check	0.25 tons	1.11 tons
Annual value of increase per acre	$ 5.00	$22.20
Annual fertilizer cost per acre	$ 2.85	$ 5.25
Net return from fertilizer	$ 2.15	$16.95

Observation 5. *Moderate use of starter fertilizer and annual topdressing is desirable.*

Table 6.

Effect of all fertilizers at seeding versus annual topdressing.

Fertilizer per acre	0-20-20		
	1000# at seeding	300# at seeding & 200# annually	200# annually only
1951 yield per acre	4.09 tons	3.90 tons	3.25 tons
1956 yield per acre	3.40 tons	4.80 tons	4.48 tons
1951-56 yield per acre	22.53 tons	27.61 tons	25.33 tons
Average annual increase over check	0.58 tons	1.43 tons	1.05 tons
Annual value of increase	$11.60	$28.60	$21.00
Annual fertilizer cost	$ 5.00	$ 7.50	$ 6.00
Net return from fertilizer	$ 6.60	$21.10	$15.00

Applying 0-20-20 at the rate of 1000# per acre at seeding, with no further treatments obviously produced the lowest total alfalfa yield for the six year period, although initially this treatment gave largest increase. Applying 300 pounds per acre at seeding and topdressing with 200 pounds each spring increased annual fertilizer cost *but further increased alfalfa yields.* The moderate application of fertilizer before seedings plus annual topdressings was *more productive and profitable than annual topdressings alone.* (Table 6)

Observation 6. *Annual fertilization of alfalfa is more desirable than fertilization every other year.*

Annual fertilization resulted in a greater return per acre over the six year period than where applied every second year. (Table 7)

Observation 7. *There is little difference in alfalfa yields between fertilization in the spring and in the fall.*

Initially, fall application of fertilizer was at least equally effective to that applied in the spring, but during the last three years there has been a trend toward increased alfalfa yields on the alfalfa receiving fertilizer in the spring.

Table 7.

Effect of annual and biennial fertilization.

Fertilizer per acre	300# of 0-20-20 at seeding and:	
	200# annually spring	200# biennially spring
1951 yield per acre	3.96 tons	3.79 tons
1956 yield per acre	4.80 tons	4.02 tons
1951-56 yield per acre	27.61 tons	24.37 tons
Average annual increase over check	1.43 tons	0.89 tons
Annual value of increase	$28.60	$17.80
Annual fertilizer cost per acre	$ 7.50	$ 4.50
Net return from fertilizer	$21.10	$13.30

Observation 8. *The addition of phosphate or phosphate-potash affects plant composition.*

Table 8.

Crude protein, phosphorus, and potassium content of Ranger alfalfa grown with different fertilization on Port Byron silt loam.

(Average of three 1951 cuttings—O. D. basis)

Fertilizer per acre 1950-56	Crude Protein %	Crude Protein lbs/A	Phosphorus %	Phosphorus lbs/A	Potassium %	Potassium lbs/A
None	21.2	1032	0.24	11.8	1.62	76.4
300# 0-20-0 initially 200# annually	21.9	1187	0.32	17.1	1.37	74.2
300# 0-20-20 initially 200# annually	21.1	1395	0.30	19.2	1.91	113.1
1000# 0-20-0 initially 200# annually	22.3	1019	0.36	16.8	1.37	63.1
1000# 0-20-20 initially 200# annually	21.4	1295	0.36	21.9	1.88	116.4

Applying phosphate fertilizer to alfalfa increased the percentage of crude protein and the total production of alfalfa per acre, increased phosphorus concentration in plants and the total removal of phosphorus per acre. At the same time it depressed the potassium content of the alfalfa probably because of depletion. (Table 8)

The inclusion of potash with the phosphate tended to produce a slight depression in the crude protein concentration of the hay, *but increased the total protein production by substantially increasing the total hay yield.* Potash had little effect on phosphorus content of alfalfa but increased total removal from the soil and greatly increased the concentration of potassium in plants and the removal of this element from the soil.

Observation 9. *Heavy fertilizer treatments reduced soil pH and increased both adsorbed phosphorus and exchangeable potash after five years.*

The decline in the soil pH on the two lower fertilizer treatments is not readily explainable, but the higher yields may have extracted more basic cations from the soil subsequent with replacement by hydrogen. The heavier applications of phosphate-potash have increased the relative concentrations of phosphorus considerably and potassium only slightly.

Table 9.

Effect of fertilization of Ranger alfalfa on pH, adsorbed phosphorus, and exchangeable potash of Port Byron silt loam (1955 Analyses).

Fertilizer per acre	Tons alfalfa/A 1951-55	pH	Adsorbed P.(lbs/A)	Exch. K. (lbs/A)
None	16.04	7.3	6	77
300# 0-20-0 initially 200 annually	18.92	7.6	7	67
300# 0-20-20 initially 200 annually	22.81	7.5	7	95
1000# 0-20-0 initially 200 annually	19.17	6.9	26	74
1000# 0-20-20 initially 200 annually	22.63	6.9	19	85

Observation 10. *Heavily fertilized alfalfa severely depleted available soil moisture to a depth of 5 to 7 feet.*

The annual precipitation on the experimental area is approximately 27 inches. July and August, 1954, were the driest growing season months of the six year period. Soil samples to a ten foot depth were obtained at that time to determine if available soil moisture was more depleted under the higher yielding alfalfa plots in the fourth cropping year. (Table 10.)

Table 10.

The percentage available soil moisture under differentially fertilized alfalfa (August 1954).

Fertilizer per acre	Tons alf. per acre 1951-54	Available soil moisture in percentages at varying depths in feet (1 to 10)									
		1	2	3	4	5	6	7	8	9	10
None	13.07	3.0	3.7	2.4	3.1	6.4	3.9	4.0	4.4	5.8	4.1
300# 0-20-0 initially	13.49	2.1	0.9	0.1	2.0	2.7	2.7	4.1	3.9	4.6	4.3
300# 0-20-20 initially	15.14	4.0	3.3	2.9	2.7	3.3	3.3	3.9	4.3	4.1	4.7
1000# 0-20-20+ 200# 0-20-20 annually	18.38	0.4	<2.0	<1.3	<0.8	<0.5	1.1	1.7	3.0	2.1	4.4
1000# 0-20-20 initially 200# 5-20-20 annually	19.04	1.1	1.9	0.5	0.1	0.5	1.5	2.6	3.3	4.1	4.9

In the driest period of the six years, the two highest yielding plots of the five treatments studied for soil moisture content showed available moisture to be seriously depleted to the five to seven feet soil depth. However, considering that these heavily fertilized plots have produced *five to six more tons of alfalfa than the unfertilized or lightly fertilized soil areas,* the difference in available soil moisture is interesting because it suggests adequate fertilization of the soil causes more efficient utilization of water.

We can assume that alfalfa yields are not high on the unfertilized plots largely because of insufficient available soil nutrients rather than lack of soil moisture.

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FERTILEGRAMS

CORNELL agronomists indicate a need for considerably more fertilizer than is being used on field crops in New York. They point out the following conditions where an increase in fertilizer consumption is most needed:

(1) Complete fertilizers for spring oats and barley. They point out that less than 25% of the farmers are applying as much 1:2:1 and 1:2:2 ratio fertilizers as is recommended.

(2) A moderate application of a complete fertilizer on corn. "Surprising as it may be, many farmers still apply superphosphate or 1:2:1 ratio fertilizers and use only low rates. Fertilizer for corn at planting should be a 1:1:1 or a 1:2:2 ratio."

(3) Extra nitrogen for corn on low-fertility soils.

(4) Potash topdressing on good stands of legumes. "Alfalfa, ladino clover, and perhaps birdsfoot trefoil *need a lot of potassium.*"

(5) Extra nitrogen for grass, meadows, and pastures.

(6) Nitrogen topdressing for wheat in the spring.

(7) More superphosphate in the stable.

The use of *200 pounds per acre of potash* at Prairie View, Texas, in 1956 resulted in a *17 percent increase* in the yield of marketable Charleston Gray watermelons over the yield from control plots where no potash was used.

This report comes from a project conducted by O. E. Smith, agronomist with Prairie View A & M College, and D. R. Paterson, horticulturist with Texas Agricultural Experiment Station.

There also was a highly significant increase in the yield in 1957 from 100 pounds per acre of potash, and again as the potash rate was increased from 100 to 200 pounds.

The use of 40 pounds per acre of phosphoric acid resulted in a highly significant increase in the yield of marketable watermelons in 1957, and in the yield of early watermelons in both 1956 and 1957.

The University of California has found that lack of potash in the vines of Russet Burbank potatoes is responsible for black spotting. This problem, which has beset the Salinas and Santa Maria valleys by causing an internal stem-end spotting or bruising, has also been found in the Bakersfield region.

The blackening has been found to occur only after handling, and mature potatoes are the most seriously affected. In all cases, however, the trouble has been traced to potassium nutrition. In tests, John Oswald and Oscar Lorenz of the University's staff found potatoes coming from fields high in potash and little or no spotting was found in machine-dug potatoes nor were they susceptible to black spot even when artificially bruised in a barrel seed-treater. In other fields where the potash was low, severe black-spot-

from Across the Land

FOR BETTER SOILS • FOR BETTER CROPS

ting occurred. When potash fertilizer was added to these fields, black-spotting disappeared or was reduced drastically.

It is thought that although there is potash available for vine growth and yields in many fields, there isn't sufficient potash for proper tuber growth.

Only about four per cent of Wisconsin's hay and pasture land is fertilized, reports John T. Murdock, University of Wisconsin soils specialist.

The state average yield for alfalfa is 2.4 tons per acre, yet numerous fields have yielded *four to five tons with fertilizer*. The average farmer is producing *about one-half his potential* yield of forage.

"Adequate pasture fertilization must be considered as a practice to help stabilize a livestock farmer's income," L. H. Hileman, junior agronomist with the University of Arkansas' Agricultural Experiment Station, says.

Summarizing a three-year study of permanent pasture fertilization, he reported, "Total forage production on unfertilized plots varied widely between seasons, while yields of adequately fertilized pastures remained *more constant in spite of variable seasonal conditions.*"

The outstanding fertilizer treatment returned $72 an *acre above cost of fertilizer* when forage yield of fertilized plots was compared with unfertilized plots.

This gain was obtained in Lafayette county with a per acre application of 500 pounds ammonium nitrate, 300 pounds of 20 percent superphosphate, and *100 pounds of 60 percent muriate of potash.*

Before a farmer invests in supplemental irrigation—a practice that can help greatly to increase crop yields—he should be willing and able to use *high rates of fertilizer*.

Research done recently by the U. S. Department of Agriculture shows that crop response to water management through irrigation or drainage is closely associated *with soil fertility management*.

Scientists of USDA's Agricultural Research Service point out that no single soil and water management practice, by itself, will insure high crop yields. Such practices—including supplemental irrigation—must be integrated into the farming system for maximum benefit, they say.

Perhaps the greatest change in fertilizer use in Wisconsin has been the trend toward higher analysis fertilizer, says K. C. Berger of the University of Wisconsin Soils Department.

Along with more nearly adequate fertilization for crops has come the use of granulated fertilizers. For the next ten years, fertilizer usage should *more than double, using higher analysis, more soluble plant foods* to give farmers greater profitable yields per acre, the Wisconsin scientist contends.

Attempts to increase corn yields through heavy planting rates may prove unsuccessful unless the soil contains an abundance of plant nutrients. Further, experimental tests have shown that ample amounts of plant food, especially nitrogen, are needed to cause a high protein content in corn.

MORE FERTILIZER HIGHER YIELDS

MORE and more bushels to the acre . . . higher yields of corn, wheat, oats . . . with yields of potatoes, cotton, and tobacco climbing faster than those of the cereal grains.

What has caused the phenomenal jump in acre yields during the past few years? Let us examine some of the possible causes.

Moving to new land

In this country in earlier periods, declining yields and impoverished soils forced farmers to abandon worn out land and bring new soils under cultivation.

This was effective for a time, but for several decades now comparatively little new acreage has been added. In fact, highly productive land is being taken out of cultivation for growing cities and towns, for parks and recreational areas, for highways, for airfields and military use much more rapidly than new areas can be readied for farming.

There is no good way to measure or compare the productive capacity of land taken out of cultivation with that of new areas. With a yearly grain harvest of 200 million acres, either a large, highly-productive area would need to be added or extremely high yields obtained on new land in order to cause an appreciable increase in national average yields.

It is unlikely that much, if any, increase in the overall acre yield of crops

Providing liberal amounts of plant food has greatly stepped up yields of small grains as well as those of corn. This Wisconsin field indicates the value dairy farmers place on oats as a crop for feed and bedding.

By

William B. Nevens

Professor Emeritus

University of Illinois

in recent years can be attributed to bringing new land into cultivation.

However, it is probable that large areas of unproductive land will be irrigated and made to produce great quantities of foodstuffs if sufficiently cheap sources of power (perhaps atomic energy) can be found.

Further, with cheap power for irrigation, the yields of millions of acres presently under cultivation can be markedly stepped up.

Livestock farming

Good procedures on livestock farms have helped to increase yields. Feeding crops by return of manure to the soil, practicing crop rotations, and growing legume forages have built up many farms to higher productivity than under grain systems of farming.

Growing legume forage crops is recognized as an excellent way of obtaining nitrogen as well as good feed. The rise of alfalfa acreage, some 12 million acres in the 1930's to more than 25 million acres in 1955, attests to that.

Dr. W. B. Nevens, professor emeritus of Dairy Cattle Feeding at the University of Illinois, earned his B.S. at Wisconsin, his M.S. and Ph.D. at Illinois. He has published many reports on improving silage, hay, and pasture. He has authored two books in the field.

Table I.—CROP YIELDS, UNITED STATES, 1870–1955 [1]

Crop	1870-1879	1880-1889	1890-1899	1900-1909	1910-1919	1920-1929	1930-1939	1940-1949	1950-1954	1955
Corn, bu.	26.6	25.9	25.9	27.3	26.0	26.8	23.5	33.8	38.2	39.8
Per cent [2]	100	97	97	102	98	101	88	127	144	150
Wheat, bu.	12.5	13.1	13.7	14.4	14.1	14.0	13.3	17.0	17.2	19.9
Per cent	100	105	109	115	112	112	106	136	138	159
Oats, bu.	26.1	27.9	27.2	28.9	30.9	29.7	27.3	33.1	34.0	38.5
Per cent	100	107	104	111	118	113	105	127	130	148
Barley, bu.	21.0	23.4	24.0	24.1	22.3	22.7	20.6	24.5	27.6	27.4
Per cent	100	101	114	115	106	108	98	117	131	131
Rye, bu.	10.8	12.1	12.7	13.3	12.7	12.5	11.2	12.1	12.7	14.1
Per cent	100	112	118	123	118	116	104	112	118	131
Cotton, lb.	174	172	192	185	184	163	205	266	307	416
Per cent	100	99	110	106	106	93	118	153	176	239
Potatoes, bu.	84	83	82	94	97	111	113	168	249	271
Per cent	100	99	98	113	116	132	134	201	297	323
Sw. Potat., bu.	78.6	78.2	83.8	93.9	95.9	92.9	83.0	92.4	93.2	107.5
Per cent	100	100	107	120	122	118	106	118	119	137
Tobacco, lb.	749	711	754	825	811	772	832	1100	1291	1494
Per cent	100	95	101	110	108	104	111	147	172	200
Soybeans, bu.						12.7 [3]	16.1	18.9	20.4	20.0
Per cent						100	127	149	161	158
Sorghum gr., bu.						17.1	12.7	17.5	19.0	18.5
Per cent						100	74	102	111	108

[1] Averages of 10-year periods except for 1950–1954 (5 years) and 1955 (1 yr.).
[2] In percentage of first 10-year average yield.
[3] For 1922–1929.

Source: Crops and Markets, U. S. Department of Agriculture.

Although much alfalfa is in commercial production—grown in nonlivestock areas for sale as hay or meal—the acreage has risen more rapidly in livestock states.

For example, alfalfa hay acreage in a midwest area comprising seven states (Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, and Ohio) *in 1955 was three times that of the 1930's.* These seven states, in fact, grew nearly 40 percent of the nation's crop in 1955.

Though livestock farming has helped boost acre yields of grains and other field crops, it accounts for only a part of the remarkable yield increases experienced in the past 15 years. Equally great increases have also occurred on nonlivestock farms where grains, potatoes, cotton, and tobacco were grown.

Control of plant pests

The discovery of new, improved methods of controlling plant pests has been a great boon to grain growers, as well as producers of vegetable, fruit, and tree crops. Before the 1930's, sprays, dusts, and sterilization of plant beds were employed in the production of vegetables, fruits, cotton, and to-

Table II.—PRODUCTION OF FEED AND FOOD GRAINS IN THE UNITED STATES

Period	Kind of Grain	Size of Crop Acres [1]	Yield of Crop Tons [2]	Yield per Acre Pounds	Percentage of 1909–1911 Av. Per cent
1909–1911	Feed [3]	145,257	93,808	1292	100
	Food [4]	50,452	20,999	832	100
1919–1921	Feed	156,861	107,111	1366	106
	Food	74,314	29,323	790	95
1929–1931	Feed	160,734	94,363	1174	91
	Food	66,012	28,740	870	105
1939–1941	Feed	145,028	101,062	1394	108
	Food	62,430	27,630	884	106
1949–1951	Feed	140,175	118,503	1690	131
	Food	70,062	33,741	964	116
1955	Feed	147,732	130,284	1764	136
1955	Food	51,227	31,682	1236	149

[1] In thousands of acres.
[2] In thousands of tons.
[3] Corn, oats, barley and sorghum grain.
[4] Wheat, rye, buckwheat and rice.

Source: Crops and Markets, U. S. Department of Agriculture.

bacco. But these practices had comparatively little place in the production of cereal grains. Need for some method of combating the European corn borer and other new insect and disease pests led to the development of many new chemicals for fighting these intruders.

Further far-reaching advances in field production are the new chemical controls for weeds.

Control of plant pests, no doubt, has contributed greatly to yield increases of grain crops as well as other crops. But there is still a long way to go in this direction.

Charles F. Brannan, writing in the 1952 Yearbook of Agriculture, stated that insects cause a loss of about 4 billion dollars annually to the nation's farmers.

Ezra Taft Benson reported that the United States suffers an annual loss of about 3 billion dollars from plant diseases.

Improved varieties

Improved varieties and hybrids have played a big part in bringing higher yields to the acre.

The first comprehensive yield records of the U. S. Department of Agriculture were begun around 1870. The yield of corn for the 1870-1879 period (10-year average) was 26.6 bushels to the acre (Table I). The next two 10-year averages were 25.9 and 25.9 bushels while the figure for the 1900-1909 period was 27.3 bushels.

Then followed two 10-year stretches with average yields of 26.0 and 26.8 bushels. During the 1930-1939 period, however, there were several drought years and the figure fell to 23.5 bushels.

The story for other grains, including wheat, oats, barley, and rye is much the same as it is for corn—that is little or no increase in acre yields over a period of about 70 years.

During those seven decades when

agriculture was making great advances on all fronts, the introduction of many new grain varieties failed to effect an increase in *national average* yields. It is likely, however, that the use of new, improved varieties did help *to maintain* yields and *to offset* the effects of soil depletion.

A study of the combined yields of grain crops leads to the same conclusions as those obtained from a survey of the individual grains. The U. S. Department of Agriculture reports the yields of four feed crops (corn, oats, barley, and grain sorghums) and four food grains (wheat, rye, buckwheat, and rice) in Table II.

Prior to 1919, grain sorghums were not included. The yields of both feed and food groups showed seasonal fluctuations but no substantial increases until after 1940. Since that time, there have been marked advances which correspond closely with those for the grains as reported singly.

In the 1930's the impact of hybrid corn on increased yields was beginning to be noted and foreshadowed revolutionary advances in corn production. There can be little doubt that the development of hybrid corn has been a potent factor in bringing higher yields of this crop.

It is highly improbable, however, that the hybrid feature alone is responsible because yield increases in wheat and oats since 1940 have been about as large on a percentage basis as those in corn. At the same time startling upward trends were experienced in yields of potatoes, cotton, and tobacco.

Furthermore, it must be kept in mind that even the best hybrid or variety cannot reach its full yield capacity without an abundant supply of plant nutrients.

Fertilizer use

The close parallel between *yield increases* and *fertilizer consumption* is dramatic. From 1900 to 1940, there was a substantial growth in fertilizer use—the amount rising from about 2 million tons yearly to more than 8 million tons in 1940. This was an increase of about 6 million tons.

Since 1940, annual fertilizer consumption has increased more than 12 million tons. The 1955 figure was *1770 per cent* of the amount sold in 1880.

A considerable portion of the fertilizer consumed was used for fruit and vegetable crops, with fertilizer application on field crops becoming more widespread in recent years. This is shown in the sales of fertilizers by regions.

In 1954, fertilizer sales in the east north central and western states were double those of 1945.

In 1945, only 25 per cent of the total fertilizer consumed in the United States occurred in the north central and western states, but in 1955-56 the consumption in these areas accounted for *38 per cent of the total.*

In terms of tons, the amount used yearly in the north central and western regions in the 1955-56 season was more than 4 million tons above that consumed in 1945.

A comparison of figures for fertilizer consumption over the years is somewhat misleading because of a marked rise in the amount of plant nutrients per ton of fertilizer.

Estimates place the nutrient content of fertilizers sold in 1939 at 20.3 per cent and that of the 1955-56 products at slightly under 29 per cent. This is an increase of about two fifths.

If the 1955-56 tonnage were calculated on the same nutrient basis as the 1939 consumption, then the amount would be about 28 million instead of just under 20 million tons.

The trend in fertilizer use has been westward. For decades, farmers in the eastern and southeastern sections of the country have recognized the need for fertilization in the production of vegetables, cotton, peanuts, and tobacco as well as grain crops.

However, farther west fertilizer use is a newer, less widely used practice.

For years, the agricultural experiment stations of the central and western states have reported increases in yields resulting from fertilizer application, but acceptance of these findings by grain and livestock farmers in those regions has been slow.

The advent of hybrid corn has done much to stimulate fertilizer use. Because of stronger stalks, greater resistance to lodging and to disease, maturity before frost, and ability to adjust to heavy planting rates, the new corn hybrids have higher yield potentials than the open-pollinated strains and hybrids of an earlier day. And have opened up new horizons in corn production.

A few years ago a yield of 100 bushels to the acre caused much comment. Today yields of 100 to 150 bushels are commonplace. But no matter what kind of seed is planted, the yield is definitely limited by the amount of available plant food. Farmers using the new hybrids have found the use of fertilizer necessary and distinctly advantageous in obtaining maximum yields.

Without fertilizer application, it is extremely doubtful if the high yields of the recent past could have been attained. In other words, *hybrids with plant food* and *not hybrids alone* have been chiefly responsible for the boost in corn yields.

The greatest single incentive for greater fertilizer use, of course, has been *the profit factor*. An improved marketing situation for farm products brought about by Federal price support programs, as well as other influences, has assured a good return for money invested in fertilizer in normal crop seasons.

In fact, higher costs of labor, seed, machinery, fuel, taxes, and other production inputs have necessitated higher crop yields to the acre in order to obtain a profit. The wider application and use of larger amounts of fertilizer in most cases have been the simplest, most effective ways of attaining this objective.

REVIEWS

March, 1958

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TOPDRESSING ALFALFA

THREE and four tons per acre of high quality alfalfa hay, or its equivalent in silage, are successfully produced in all areas of Missouri. This kind of roughage production is practical for nearly every farm.

The deep rooting ability of alfalfa kept it alive and producing during the past drouth years in most cases.

Adequate mineral treatments well distributed deeply in the soil, to correct deficiencies determined by soil testing, have opened the door to a greatly expanded alfalfa acreage. Liberal use of limestone, phosphate, and potash is usually required on most soils for successful establishment of a productive stand.

It is one thing to establish alfalfa with corrective soil fertility treatments and *another thing* to hold the stand at *top performance.* If you grow alfalfa, keep in mind that this crop takes *more calcium, phosphorus,* and *potassium* from the soil *than any other crop.* A yield of four tons per acre removes as much effective calcium as available in one-fourth ton of pure calcite limestone, 48 lbs. of phosphate, and 180 lbs. of potash.

Using adequate soil fertility treatments before seeding will not long maintain a top producing stand. When any one of the essential minerals is exhausted to a point of deficiency, the alfalfa plants weaken and die out, permitting weeds and grasses to gain a foothold. In this weakened condition, the alfalfa stand ceases to produce and is soon ready to plow up. Soil tests of failing stands indicate potassium deficiency usually appears first, followed by phosphorus and lime deficiency symptoms.

Regular annual applications of potash and phosphate are the key to a thick, vigorous stand. More liberal use of potash is required since this crop is a heavy user of this plant food. Phosphate is essential but in smaller amounts. Phosphate helps in quicker new growth after cutting.

An annual potash application of 120 lbs. per acre is desirable. It can be furnished with 200 lbs. of 0-0-60 or its equivalent in combination with phosphate. Annually topdressing alfalfa that first received ample rock phosphate as a basic treatment can be done with 400 lbs. per acre of 0-9-27 or 0-10-30, or any other materials that will supply an equivalent amount of phosphorus and potassium.

If only processed phosphate is used in the original preparation of the field for alfalfa, it is effective to topdress 600 lbs. of 0-20-20 per acre, or similar materials *to get enough phosphate and*

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Extension Soils Specialist
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potash to push production yields up.

Boron deficiencies have been occurring more frequently as observed in short, stunted growth with yellowing leaves at the tip of the plants. Applying 25 to 30 lbs. of borax per acre annually is good insurance. This can be purchased already mixed in the phosphate and potash fertilizer at the rate of 5 to 7½%, or as straight material. Borax can be applied with a cyclone seeder. However, the easiest way is to purchase it already mixed with the other fertilizer and make one spreading trip do the job.

After establishing a stand, the first topdressing job normally follows the first cutting in May. In other words, fields seeded in August and September should be topdressed the following spring. It is preferable to apply the phosphate-potash-borax topdressings immediately after the first cutting each year or, at least, to do the job sometime during the season rather than omit it.

The topdressing job can be done with a disc drill or fertilizer distributor. For a thick, vigorous productive stand of alfalfa that will serve your balanced farming operations long and usefully, remember adequate lime, phosphate, and potash must be *readily available* for the plants.

The topdressing of old established fields of alfalfa with mixtures such as 0-10-30N, 0-12-36 or whatever combination of phosphate and potash, (with or without boron) as soil tests indicate, has been recommended practice over many years.

Farmers who have followed out this program of topdressing their old alfalfa fields—in fact new seedings of alfalfa, clover, and timothy—have been richly rewarded with substantial increases in yields the following year. *(C. J. Chapman, University of Wisconsin)*

No other perennial forage crop produces as high yields and is as tolerant of drought as alfalfa. It is no longer thought of as a hay crop alone but is used for silage and grazing as well. *(Circular 685, V.P.I.)*

Alfalfa, the queen of forage crops, produces higher yields than any other perennial forage crop. The high nutritive value of alfalfa makes it a highly desirable crop in a system of production where some form of harvested forage is essential. *(Bulletin 72, Kentucky Univ.)*

Alfalfa is a heavy feeder on fertilizer elements, particularly potash and calcium. Liberal amounts of fertilizer and lime need to be applied to maintain stands. Alfalfa cannot grow in soils that are acid. Some of the factors that cause farmers to fail to maintain stands include inadequate amounts of lime . . . spotty applications . . . failure to work the lime deeply into the soil. *(P. J. Bergeaux, Georgia Agricultural Extension Service.)*

A Few Whinnies

Psychiatrist: "What did you say?"

Patient: "I said that for some strange reason, people don't like me . . . pay attention, fathead!"

~

When we were kids, ten cents was big money. How dimes have changed.

~

John Ruskin: "There is hardly anything in the world that somebody cannot make a little worse and sell a little cheaper, and the people who consider price only are this person's lawful prey."

~

To judge from the names of perfumes, virtue doesn't make scents.—Grundy Register.

~

Going on a diet is simply the triumph of mind over platter.

~

When all is said and done, there's generally more said than done.

~

It's foolish to worry about confused, miserable teenagers. Give them a few years and they'll turn out to be confused, miserable adults.

~

"I just heard about your husband being in the hospital," said the neighbor sympathetically. "What happened?"

"It's his knee," said the wife. "I found a blonde on it."

~

PERMANENT HONEYMOON

Sweet young wife: "Now over in this corner, we'll have a loveseat—over there, we'll have a loveseat, and here by the fireplace, we'll have another loveseat."

Decorator: "My word, do you call this a living room?"

Young wife: "Why of course—if that isn't living, I don't know what is!"

~

"Why the gloom, Osmon'd? Girl not coming to the dance?"

"Oh, she's coming all right, but she can't even send a telegram without saying 'stop' after every sentence."

~

Lou—"You should see my new girl. Beautiful as a mirage."

Mac—"That's the wrong simile. A mirage is something you can see but can't put your hands on."

Lou—"That's my girl."

~

Fast Line Larry: "O come with me my love deep into yonder woods where we'll list to the voice of the nightingale?"

Faster Line Mary: "Get this car started and let's get out of here. I can tell a lark from a nightingale."

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