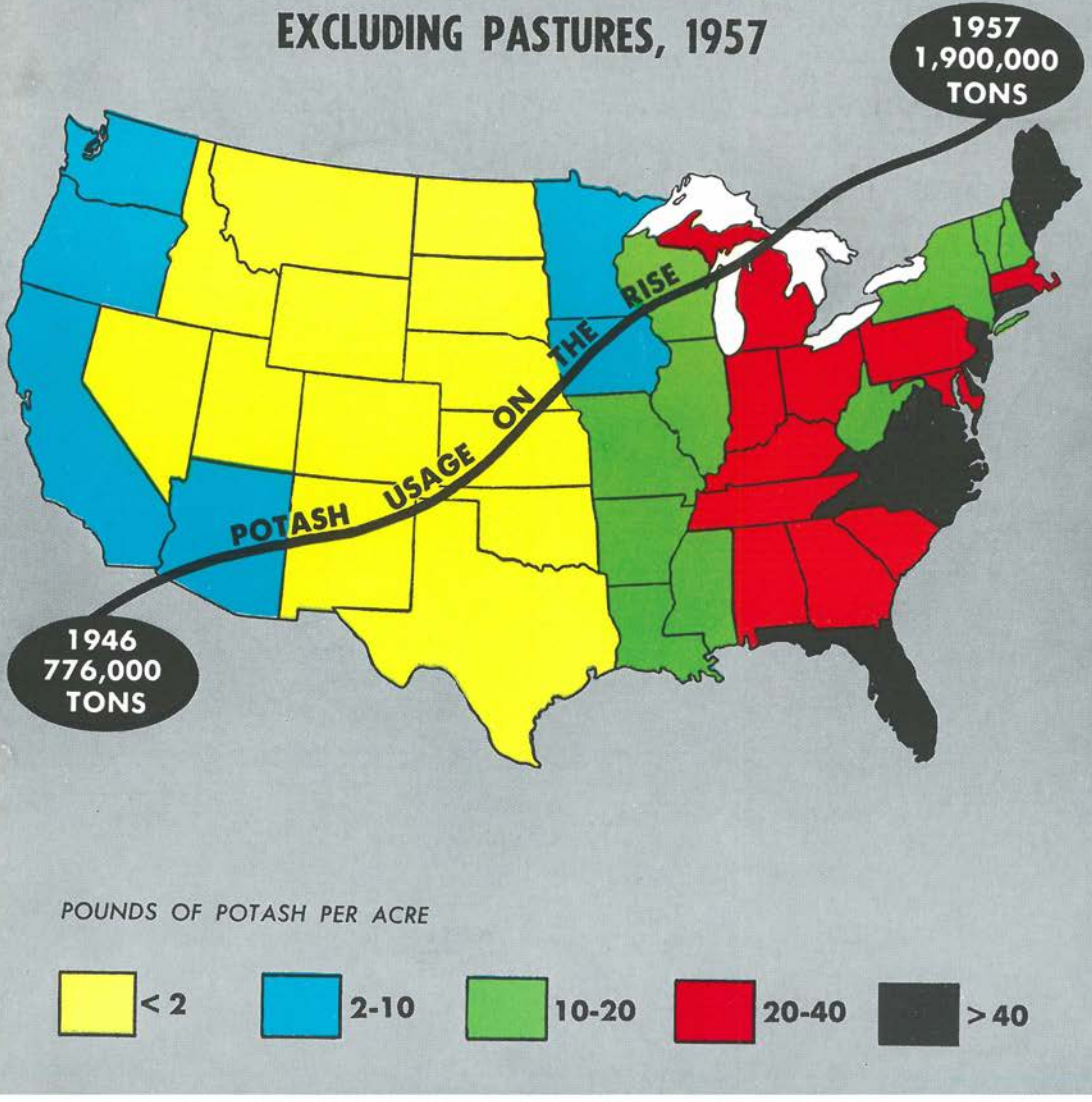
Better Crops

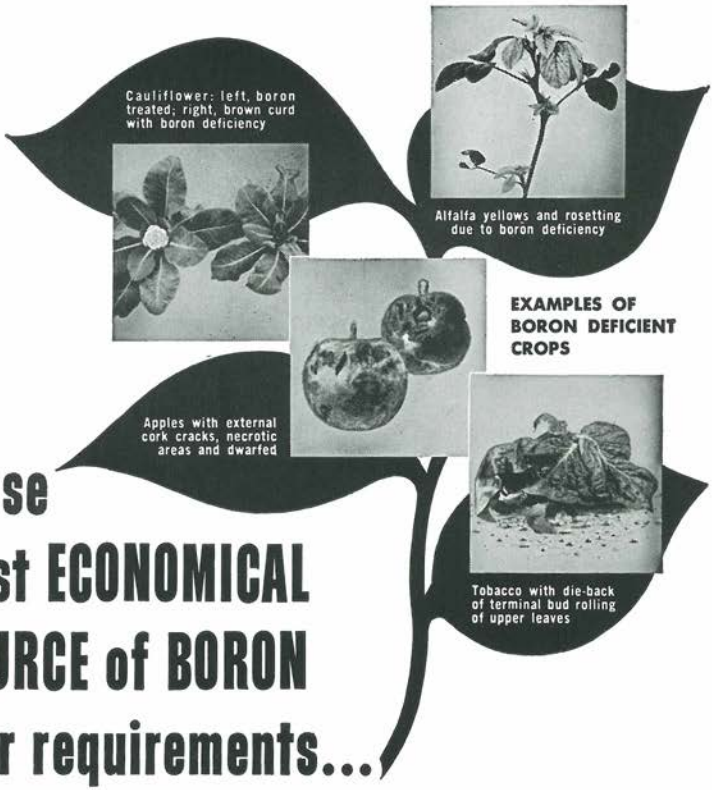
WITH PLANT FOOD

December, 1958

10 Cents

POUNDS OF POTASH APPLIED PER ACRE OF CROPLAND IN THE UNITED STATES, EXCLUDING PASTURES, 1957





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ON THE COVER . . .

. . . we see the average pounds of potash applied per acre of cropland, excluding pastures, in 1957 in the United States.

In his article, starting on page 6, Werner Nelson of Lafayette, Indiana, points out how the wide range of climate, soils, and types of agriculture among the states causes a considerable range in potash requirements.

The Northeast and the South have been climbing in K usage, increasing about 75 and 100 per cent respectively over the past 12 years.

The heavy usage in the 8 states along the Atlantic Seaboard "indicates partly the soil K level but probably more so the special crops grown, such as tobacco and horticultural crops."

Usage in the West is increasing slowly but steadily—in an area where rainfall is generally low, causing less leaching and weathering than in more humid regions. High yields from N and P in some western areas are increasing the need for supplementary potash.

The most spectacular increase has been in the Midwest where usage has increased *4 times*. The Midwest now uses 45 per cent of the total potash consumed in the United States.

The low usage in the Great Plains states indicates the high supply of available K in the soil, as well as the cropping practices. Wheat is an important crop in this area, and a 40-bushel crop of wheat will remove no more than 15 lbs. potash in the grain.

Better Crops WITH PLANT FOOD

The Whole Truth—Not Selected Truth

Santford Martin, Editor
Selma Bushman, Assistant Editor

Editorial Office: 1102 16th Street N.W., Washington 6, D. C.

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NEW SCHEDULE

Beginning in 1959, *Better Crops with Plant Food* will be issued bimonthly—six times a year—in January-February, March-April, May-June, July-August, September-October, November-December.

MERRY CHRISTMAS

Better Crops with PLANT FOOD

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It seems we need at Christmas . . .

MORE LOVE, LESS MYRRH

Jeff McDermid

(ELWOOD R. MCINTYRE)

Would Old Scrooge repent and reform if he lived through our prolonged and hectic Christmas season today? Last month I heard a widowed mother say: "I know it sounds awful, but I dread the coming of all the Christmas rush and scramble at the stores!"

Have the gifts of the Magi—the gold and frankincense and myrrh—almost eclipsed the tender glow of the real Star of Bethlehem? What has happened to the Ghost of Christmas Present in these frenzied, chasing, ding-dong buying days of tinseled, mad confusion?

Whatever has become of those old precious things of Yuletide, recalled by many of us from behind a heap of discarded, ancient calendars? Where and why have we lost the simple loveliness of the Christmas story—"good tidings of great joy, glory to God in the highest, and on earth peace and good will to men."

He who has no gold to give, or sparkling jewels to lavish, often mortgages his security and serenity to fetch myriads of modern myrrh to numerous friends and kinfolk who are already stuffed with more than enough of everything worth having—*except* two things that money can't buy—*good will unlimited* and *love unbounded.*

The Rose of Sharon and the "old rugged cross" are everyday symbols of the finest chapter in the life of man. No need whatever to bargain and beguile the Christmas spirit to make it work like gadgets from a toy shop. For does it not say in First Corinthians:

"Love suffereth long and is kind, love envieth not, vaunteth not itself, is not puffed up, doth not behave unseemly, seeketh not her own, is not easily provoked, thinketh no evil, rejoiceth not in iniquity, but rejoiceth in the truth; beareth all things, believeth all things, hopeth all things, endureth all things. And now abidith faith, hope and love, these three; but the greatest of these is love."

The true value of love is not in showing how much it can splurge at Christmas but how abundantly it can *render help to troubled men throughout the year.*

Even Old Scrooge learned that love's investment lasted far longer than the joys of Christmas Day itself. Among those who believe that love beareth and endureth all things are the intrepid miners of Nova Scotia who will rejoice in the Christmas season as they never did before —for they, too, had faith and hope in their fellow men who rescued them.

There was an ancient old world legend that the animals of stable and fold possess the gift of speech in the quiet, solemn hours before each Christmas dawn. While the rafters crack and snap in the bitter cold, as the hoar frost glitters in the moonlight and children lie dreaming of tomorrow's joys, it is pleasant to imagine now—as we imagined yonder in our boyhood days—that the lowly herds in conversation at this reverent hour might have some words of admonition for the soul's enlightenment.

They speak, if fancy pleases, because of Bethlehem, because of the Star, because of the Majesty that hallowed their manger. Our fancy tells us that their muted Christmas voices sound the talk of brave and gentle lives. Their talk would be about the lot of each in the betterment of some precious place of little world-wide consequence. They would rejoice in the plowing of a straighter furrow, the growing of more bountiful fleeces, the brimming up of flowing milk pails, the abundance of fields and pastures, the comfort of still waters, and the goodness of man.

They would talk about the morning and the evening, the spring time and the fall, the chirp of the chickadee, the sweat and labor of the noonday, the cooling radiant twilight, the sweet scent of hayfields newly mown and the steady light in the homestead door.

Toiling here and erring there, weakness and strength together in touching combination, this livestock communion on Christmas Day perchance holds elements of truth for men, their masters. . . . The charm ceases, the day breaks, humanity awakes again, and the children of the happy farm arouse to clamor joyfully around the lighted tree. We unbar the doors, light the fires, and scrape the frosty panes to see our braes and byres reflect the rising glory of another welcome Christmas morning.

As you sit with your family beside the Christmas hearth bedecked with holly, listening to the neighborhood carolers in the distance, you are not so apt to blame the world for its sins as you are to praise it for its decency.

Most of us who gather around the family fireside have little power to cope with the forces of a worldwide scope, but we have aspirations for the time when the humble and the worthy of the earth may be sure of peace and plenty and a fair share of life's leisure to rest, to dream, and to play. Parents and children living in a realm of joy and plenty must not forget to give a helping hand to those who never had such privileges. By doing so, we overcome discordant and unworthy schemes and shibboleths that mar the Christmas hours.

In the North, the snow falls and icebergs form on street and rooftops. In the South, the palm trees wave and the bonny breath of summer lingers. *But among all of us alike a spirit moves which neither soils nor frosts nor race nor creed can overcome.* Thus, once a year, at least, we all are one and speak a common language, with the password at love's portal "Merry Christmas!"

GREEN ROADBANKS TAKE PLENTY OF PLANT FOOD

Green roadbanks are admittedly pleasant for the traveler—but they're not always so easy to establish.

The problem of steep roadside cuts has been under investigation in Virginia and Dr. R. E. Blaser, agronomist at Virginia Agricultural Experiment Station, recently reported that some progress is being made.

In the Virginia tests, conducted cooperatively with the Virginia Department of Highways, various grass and legume species, with different fertilizer treatments, have been tried for sodding roadside cuts and fills.

The results showed decided differences in the species adapted for southeastern and mountainous Virginia, although Kentucky 31 fescue is the best adapted species for steep cuts and difficult soil environments in all sections of Virginia.

A mixture of Kentucky 31 fescue with some redtop, Bermudagrass, and white clover, is a suitable mixture for the southeastern area of Virginia. Kentucky 31 fescue with some redtop is recommended for some of the difficult spots in southwestern Virginia. Mixtures may be of bluegrass and fine-leafed fescues. These mixtures may be used for shallow slopes, shady slopes, and slopes that have some topsoil.

Dr. Blaser said fertilizers high in nitrogen and phosphorus are essential to establish sod rapidly. A 10-20-10 fertilizer at the rate of 1,000 pounds per acre has given excellent results. Half this amount has not been satisfactory.

Rates of fertilizers at a ton per acre have caused burning of seedlings in some cases, but the growth of the surviving plants was excellent. Work is also underway to test the value of urea forms of nitrogen.

It is important, Dr. Blaser said, *to keep up fertilizer applications to maintain dense sods that resist erosion.* Maintenance applications of 500 to 1,000 pounds of a *10-20-10 or a 14-14-14* fertilizer have been found satisfactory.

Seedlings made in early spring and late summer have been best. Light applications of asphalt-straw mulch have improved germination and rate of seedling growth.

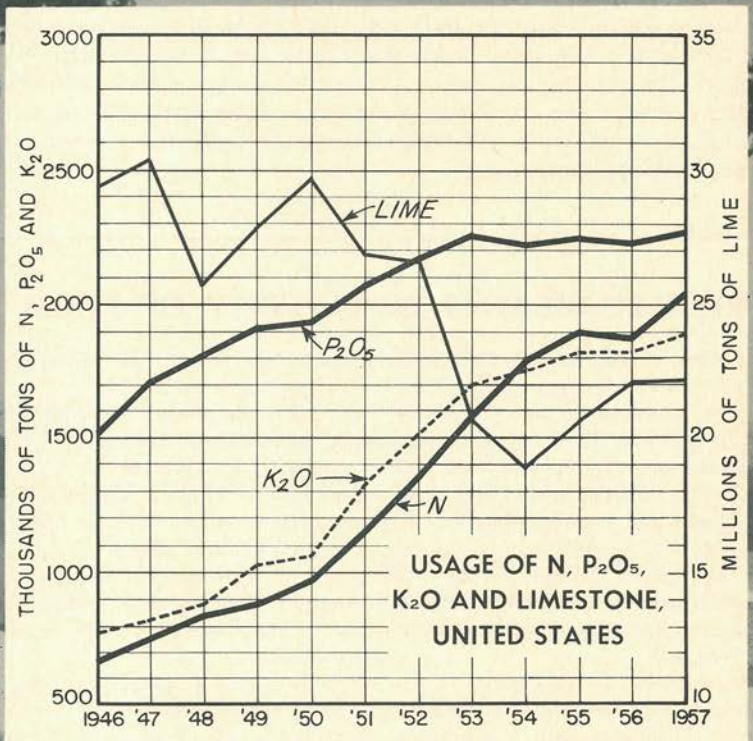


Figure 2.—The usage of N, P_2O_5, and K_2O has increased sharply in the decade of 1946-57. The general trend for lime was downward to 1954.

DEVELOPMENT OF POTASSIUM

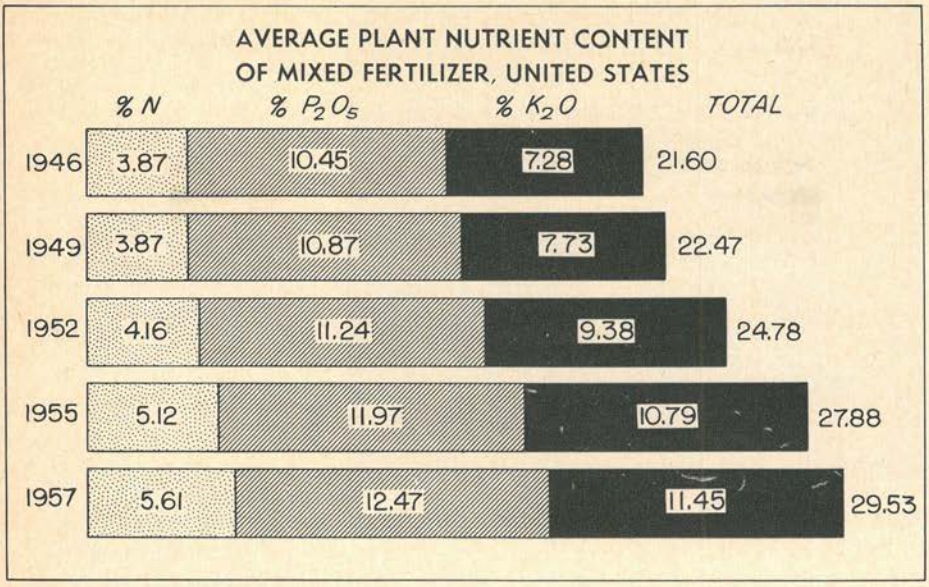


Figure 1. The total nutrient content is increasing with the greatest share of the gain being due to K_2O.

By Werner L. Nelson **Lafayette, Indiana**

One of the outstanding developments in crop production practice in the United States during the past few years has been the greatly increased use of nitrogen, phosphorus, and potash.

There has been a growing realization of the need for correcting deficiencies and replacing plant nutrients removed.

The early, continuing work of research and extension workers laid the foundation for wise use of plant nutrients. And information from these leaders is being placed in the hands of the farmer and fertilizer industry.

1946-1957, increased 50% (Figure 1)*. In the same period, usage of K increased about 250%, and N about 300%. In 1954, N tonnage first exceeded that of K.

One of the critical aspects of plant nutrient use has to do with lime. Limestone tonnage in 1957 was about 75% of the peak usage in 1947. Returns from fertilizer usage are greatly reduced if lime requirements are not met. Yet, every year we are falling further behind in meeting lime needs. The upturn since 1954 is encouraging.

USE AND FUTURE POSSIBILITIES

Use of P still greatly exceeds that of N or K, and in the 12-year period,

The total nutrient content of mixed fertilizers has increased steadily since

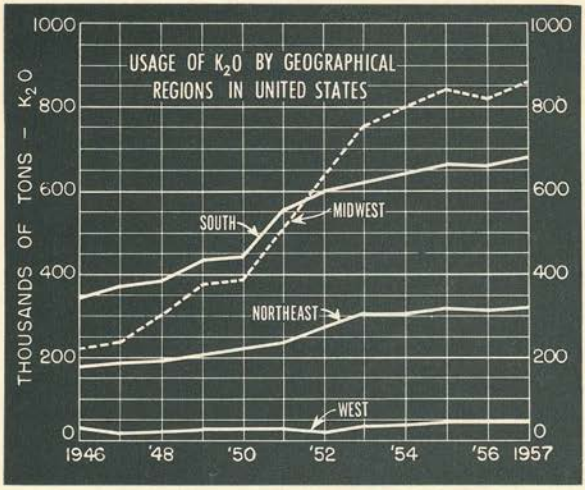


Figure 3. The usage of K_2O in the South and the Northeast has been climbing, but the most spectacular increase has been in the Midwest.

1946—from a total of 21.6% in 1946 to 29.53% in 1957 (Figure 2). While a part of this is due to the increase in N and P_2O_5, the greatest share of the gain is due to the increased K_2O content—for example, from 7.28% to 11.45%. Wisconsin leads the nation in average K_2O content of mixed fertilizers—*19.48%*.

Of course there has been a continued procession of fertilizer grade changes. As late as 1949, 2-12-6 and 5-10-5 were the leading grades. In 1957, 5-10-10 and 4-12-12 were leading, with grades such as 5-20-20 and 12-12-12 increasing rapidly in popularity.

K Use by Areas

The wide range in climate, soils, and types of agriculture among the states causes a considerable range in K requirements. The Northeast and the South have been climbing in K usage, with increases of about 75 and 100 per cent respectively in the past 12 years (Figure 3). The most spectacular increase has been in the Midwest, where usage has increased four times. The Midwest now uses 45 per cent of the total U.S. consumption.

Usage in the West is increasing slowly. This is generally a low rainfall region with less leaching and weathering than in the more humid areas. Thus, the majority of western soils were originally well supplied with K, and many still are. In some areas, however, the high yields resulting from N and P applications are increasing the need for supplementary additions of K.

A somewhat more realistic view of K usage is obtained when we consider the acreage of cropland along with total usage by states (Cover). This shows the pounds of potash applied per acre of cropland, excluding pastures, in 1957. The heavy usage in the eight states along the Atlantic Seaboard indicates partly the soil K level but probably more so the special crops grown, such as tobacco and horticultural crops. Florida leads with an average application of 189 lbs. per acre of K_2O. The low usage in the Great Plains states indicates the high supply of available K in the soil, as well as the cropping practices. Wheat is an important crop in this area, and a 40-bushel crop of wheat will remove no more than 15 lbs. potash in the grain.

It is interesting to compare the K usage in eastern U. S. with the average annual water surplus map (Figure 4). Surplus water leaches

through or runs off the soil. Generally speaking, in areas where there is little or no surplus water the available K supply in the soil is quite good. Hence, in the 0-3″ water surplus area the need for additional K will be limited. Of course, sands or soils derived from parent material low in K, or special crops which require very high amounts of K, will alter requirements locally. The 3-8″ area in Florida and eastern Georgia and South Carolina is an example of a sandy soil area low in K with specialized crops requiring high amounts of potash.

Dr. Werner L. Nelson is Midwest Director of the American Potash Institute. He earned his B.S. and M.S. from the University of Illinois, his Ph.D. from Ohio State. A member of Soil Science Society of America, American Society of Agronomy, and American Association for Advancement of Science, he was formerly a member of the N. C. State College faculty and has worked in many areas of fertilizer and lime requirements.

Sources of K

Potassium chloride supplies most of the K, with sulfate sources being used for certain specialized crops. A list of sources follows:

	K_2O Content	Per Cent of Usage in U. S.
Potassium chloride	50–62%	93
Potassium sulfate	50%	7
Sulfate of potash-magnesia	22% (19% MgO)	
Manure salts	22–27%	Trace
Nitrate of soda and potash	15% (15% N)	Trace
Potassium nitrate	44% (13% N)	Trace
Potassium phosphates	30–50% (32–53% P_2O_5)	—
Potassium metaphosphate	35% (55% P_2O_5)	—

In 1946, potassium chloride supplied 88%, sulfate and sulfate of potash-magnesia 8%, and manure salts 3% of the total.

Except for certain specialized crops, one carrier is as effective as another.

The quality of tobacco, and in some instances potatoes, is affected adversely by excessive amounts of chlorides. These crops may require from 100 to 300 pounds or more K_2O per acre annually. In such instances, sulfate of potash may furnish a portion or all of the K.

It is interesting, however, that in Holland muriate of potash is broadcast in the fall preceding the spring planting of potatoes. Presumably this method allows for leaching of the chloride by fall and winter rains. Chloride is and will continue to be much the cheapest from standpoint of cost per unit of K_2O, which favors

Table 1. Estimated removal of K_2O by major crops in Minnesota (1957 yields)

	Total Production	Yield per Acre	K_2O removal
	Bu.	Bu.	Tons
Corn	327,192,000	56.5	40,900
Soybeans	54,805,000	21.5	37,700
Oats	167,832,000	42.0	15,900
Wheat	15,780,000	22.5	3,000
Hay	7,387,000 (T)	2.0 (T)	166,200
Barley	20,475,000	25.0	3,100
K_2O removed			266,800
K_2O applied in fertilizer in 1956–57			54,980

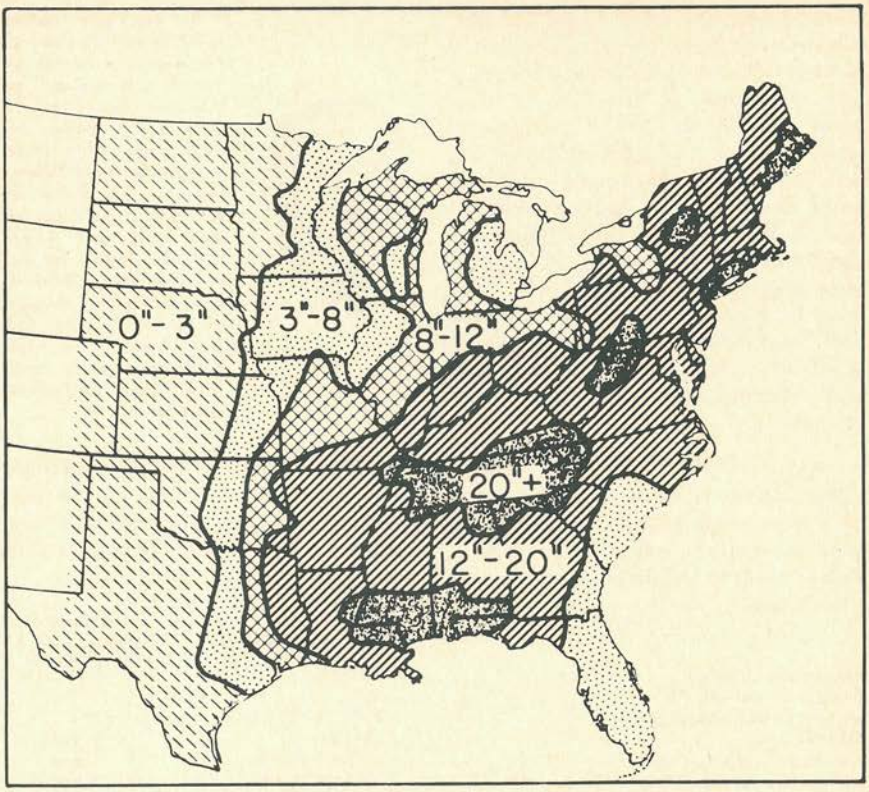


Figure 4. Average annual water surplus in inches in eastern U.S. This is the amount left after the water evaporated is subtracted from total rainfall. The surplus runs off or percolates down through the soil. (Nelson and Uland, 1955).

the continued major use of this form.

Trends in Application Methods

Eighty-seven per cent of all the K_2O was applied as a mixed fertilizer in 1956-57. While part of this is broadcast on forages or for other crops, most of it is applied at planting. It is well known that soluble N and K salts in close proximity to the seed may harm germinating seed and young plant. Even so, most farmers are still using the split-boot applicator for field row crops, such as corn, putting the fertilizer dangerously close to the seed. Placement in a band about two inches to the side and two inches below the seed has been found to be a safe and excellent method. Machinery to do this is now available.

Due to higher analyses, the placement problem has become more acute. For example, in the Midwest in 1949, 2-12-6 was the popular grade for row fertilization of corn. In 1957 5-20-20 led. The 2-12-6 has a total of 8 units of N plus K_2O, while the 5-20-20 has 25. In addition, most farmers are applying larger amounts now than in 1949.

The trend toward higher analyses and rates is desirable and will continue, but it emphasizes the importance of using improved placement methods. In some instances, use of higher rates of plant nutrients is avoided because of the possibility of fertilizer injury. Some states indicate

Table 2. Soil samples tested increased markedly from 1950 to 1954 in the four major regions (Fitts and Nelson, 1956)

	1950		1954		
	Samples Tested	One Soil Sample for Each*	Samples Tested	One Soil Sample for Each*	Increase %
Midwest	880,000	260 acres	1,205,000	190 acres	37
Northeast	85,000	390 acres	105,000	310 acres	24
South	255,000	1,000 acres	500,000	510 acres	96
West	13,700	3,050 acres	20,100	2,080 acres	46
	1,233,700		1,830,100		48

*Crops and Pasture.

that two to three times the fertilizer now recommended could be safely applied at planting if proper placement was used.

There is a distinct trend for applying K as straight material (Figure 5). In some states, such as Illinois, 44 per cent is applied as material—in Indiana 22 per cent. Most of the potash applied as material is used as (1) maintenance applications once or twice in the rotation or (2) corrective applications where soil is extremely low in potassium.

Although K_2O in mixed fertilizer has increased much more than N, the total usage of N exceeds K_2O. This means the use of straight N materials is increasing much faster than the use of straight K materials.

Factors Affecting Future K Usage

Many factors directly or indirectly affect potash usage. Of course, any practice raising the production ceiling will point toward increased need.

Farm Income. Some years ago fertilizer consumption closely paralleled farm income. In the past five years, there has been an apparent departure from this relationship, since fertilizer consumption has increased while income has declined. Realizing how fertilizers help reduce unit cost of production, the farmer is now re-

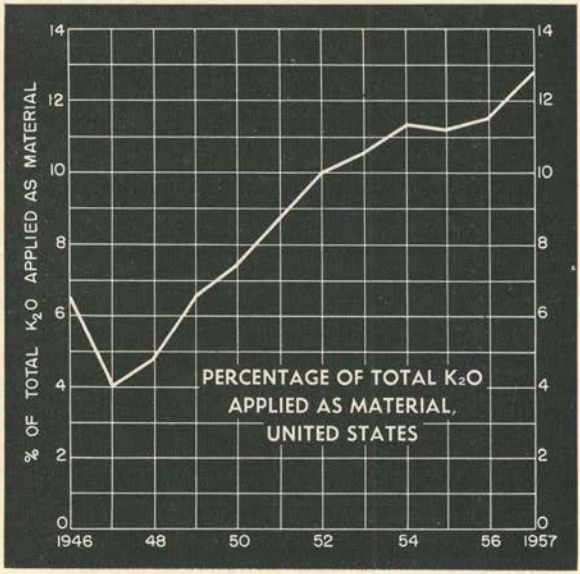


Figure 5. There is a trend toward more use of K as straight material.

luctant to cut fertilizer usage as income declines. However, in the final analysis, it must be recognized that fertilizer usage will be influenced greatly by farm income.

RECOMMENDATIONS. If Experiment Station recommendations were followed, potassium usage would increase greatly. For example, in North Carolina and Georgia, states which are already using much K, estimates indicate that consumption would more than double if farmers applied what the experiment station workers feel is a profitable application. Similar calculations have been made for Wisconsin. Iowa workers state soil test summaries indicate 10 times the present usage could be used.

Another important point is that recommendations tend to increase gradually. This is a normal development as the level of other management practices improves. Prime among these are the development of new varieties and new pest control measures and higher stands. So, the top rate in 1958 may not be the top rate 5 years later.

In all states, official agricultural leaders are increasing their efforts to educate the growers on the value of fertilizers. The increased emphasis on cost per unit and profit per acre encourages more adequate use of all nutrients, including K. Much effort

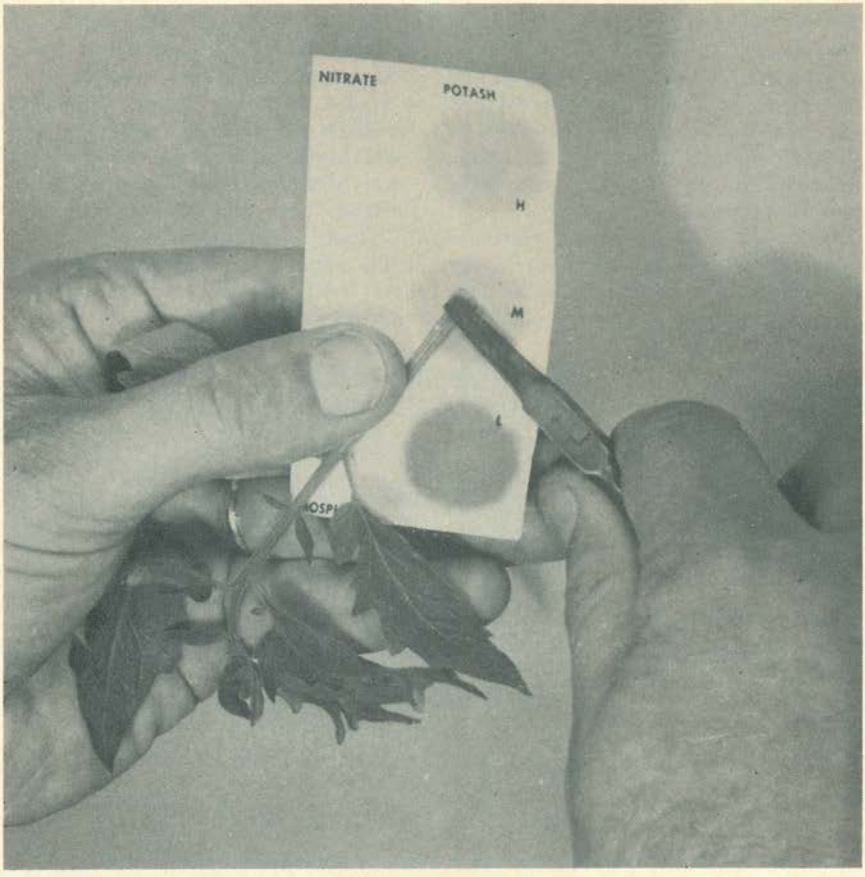


Figure 6. Tests on the growing plant are helpful in determining K needs. (Photo by G. A. Wickstrom).

is being devoted to show that fertilizers are an investment and not an expenditure.

NUTRIENT REMOVAL. Each year, new yield records on a state-wide basis are set somewhere in the United States. Yields of most of our crops have been increasing considerably over the past 10 years. Hence, greater quantities of plant nutrients are being removed. *Except for a small acreage of specialized crops, almost the entire crop acreage in the United States is on a depletion basis as far as K is concerned.*

A study made by the Soil Conservation Service in 1952 indicated that nutrients supplied by fertilizers and manures for the United States as a whole total 16% of the N removed by harvested crops and erosion, 20.3% of the P, and *only 2.1% of the K.*

It is enlightening to contrast crop removals with fertilizer additions on a state-wide basis. An example of such a calculation for Minnesota is shown in Table 1. This is based on 1957 yields, and does not include pastures. While Minnesota is a state in which K usage is increasing rather rapidly, the estimate indicates the speed with which the soils are being depleted.

A more specific example might be cited in a corn-soybean-wheat-hay rotation in which the approximate removal by good yields is as follows:

	Yield	Removal of K_2O lbs. per acre
Corn (grain)	100 bu.	25
Soybeans (grain)	40 "	55
Wheat (grain)	40 "	15
Hay	4 tons	180
		275 lbs. of K_2O removed from each acre every 4 years or 69 lbs. annually.

In a livestock system, part of the K is returned but usually not more than 50% because of leaching losses from the manure. So, with corn and hay fed, removal would be about 170 lbs. of K_2O per rotation—or 42 lbs. per acre.

Calculations on removal are only approximate since the soil will release some K and some of it will be leached or lost by erosion. There are great differences among soils in rate of release. Some soils are already at

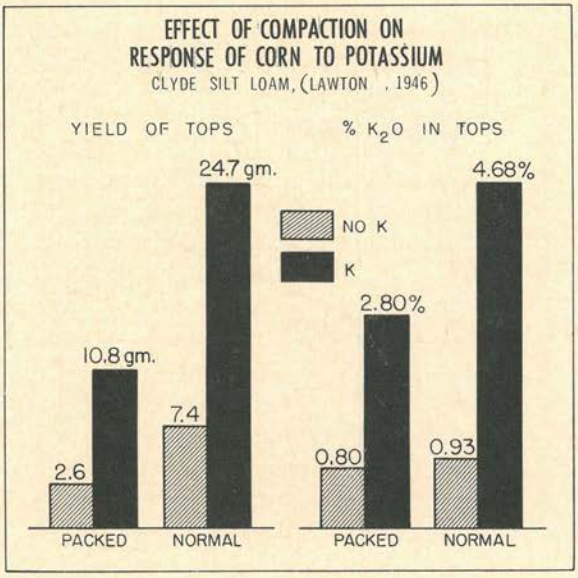


Figure 7. Compaction decreases the response of corn to K.

a critical level, some have a moderate supply, while others still have a large amount of potassium in reserve. But the calculations do show how the storehouse of K is being depleted.

When soils are depleted in potash, ordinary application rates may not be sufficient to produce top yields. This may be due partly to fixation or to distribution in the soil. An experience on fruit in California is a good example. Trees in low-K soils failed to respond to ordinary applications. Heavy applications of 10 to 25 lbs. K_2O *per tree* were tried, gave responses, and are now in common use.

It would appear, then, that on low-potash soils somewhat more than crop removal should be applied to build up the soil. Later applications, after one or two rotation periods, can then be governed by soil tests.

SOIL TESTING. It is important to test soils so that K is applied where most needed. Interest in soil testing is growing each year. In the period 1950 to 1954, the number of soil tests increased 48% (Table 2). The greatest percentage increase occurred in the South (96%), while the greatest intensity of sampling is in the Midwest.

Summaries of soil tests on a state, county, or soil area basis point out general needs rather effectively. A summary in Alabama shows that 8% of the soils need fertilizer ratios high in P and low in K, 75% even in P and K, and 17% low in P and high in K.

TISSUE TESTS. The expanded use of tests on the growing plant helps point out K as well as N and P levels in the plant. Such tests help the search for limiting factors, and supplement soil tests very well.

In a survey of 125 corn fields in Montgomery County, Missouri, tissue tests checked very well with past treatment. Where the corn had received only part of the fertilizer recommended on the basis of soil tests, or none at all, tissue tests showed the plants to be low.

Several types of tissue testing kits have been assembled. A more recent development has been the *dipicrylamine filter paper test for K* in plant tissues. Two of its advantages are *rapidity* and *simplicity*. The plant sap is squeezed on each of the three

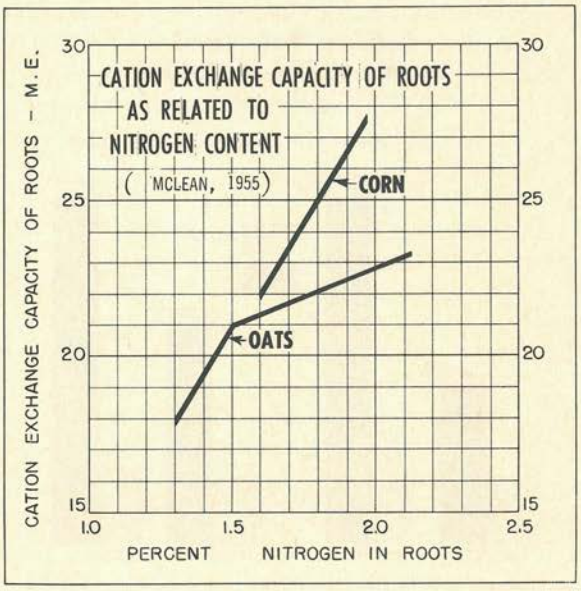


Figure 8. Cation exchange capacity of roots tends to increase with increasing N content. With increasing exchange capacity, plants have less ability to absorb K.

Table 3. Added P increased uptake of K by soybeans (Howell, 1956)

P in solution mg/1	K content		
	Seed	Stems & hulls	Roots
	%	%	%
2	2.0	2.5	2.3
10	2.4	2.9	3.8

dipicrylamine dots and after washing with dilute acid the general level of K in the sap is evaluated (Figure 6)°. N and P are also determined on the same paper.

TILLAGE PRACTICES. Soil aeration is a factor that affects response of crops to nutrients. Since our farmers are striving for higher yields, soil compaction may become a limiting factor. Anyone who has tried to insert a soil probe between corn rows where the normal management practices have been followed knows that extensive compaction does occur.

° *Kits are available from Urbana Laboratories, Urbana, Illinois, and the Denham Laboratory, Denham Springs, Louisiana.*

The effect of compaction on response of corn to K is illustrated in Figure 7. Normal treatment resulted in much higher yields, either with or without potassium. The same general trend was true for per cent of K in the tops.

Minimum tillage points to less compaction. The net effect on usage of K and other nutrients should be an increase. Nutrient removal will be larger because of increased yields, and conditions will be more favorable to obtain more profitable returns from added nutrients.

Effect of Other Nutrients on K Needs

The increased yields resulting from heavier applications of N, P, and lime

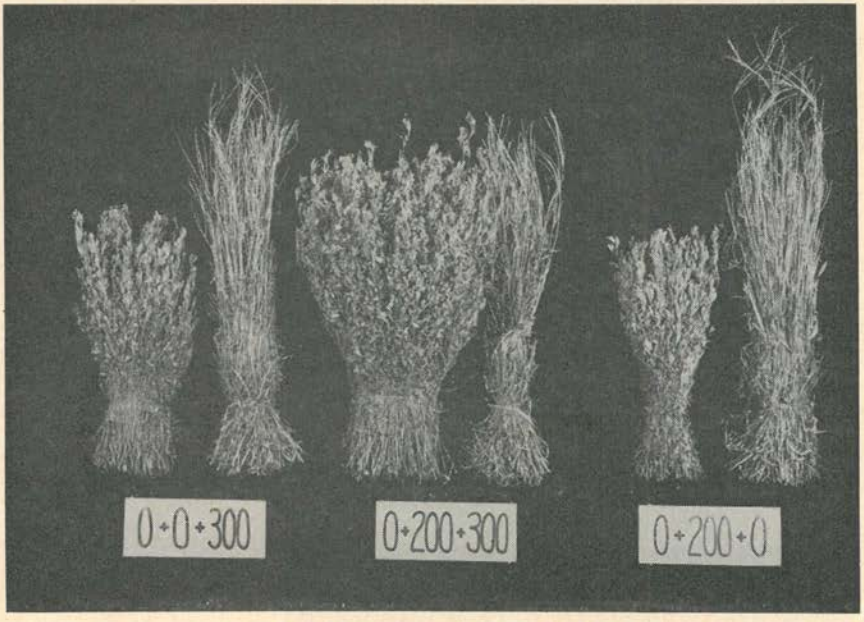


Figure 9. Omitting K (right) or P (left) gave a lower yield of alfalfa and more grass and weeds. This affects protein and palatability. *(Photo by H. L. Garrard).*

will, of course, cause greater removal of K. In addition there are other effects.

NITROGEN. There is some indication that as the N content of the plant increases, it has a decreased ability to absorb K. As the N content of the roots increases, the cation exchange capacity of the root also increases (Figure 8). This enhances the competitive ability of the roots for divalent cations such as Ca and Mg but decreases the ability to take up monovalent cations such as K.

Work in Iowa indicates that ammoniacal N tends to block the release of non-exchangeable K when soils are dried. The ammoniacal N may be adsorbed in exchange spots comparable to those taking up K. Too, these two ions may behave competitively for entrance into the plant, since they are both monovalent cations, and absorption of K by the plant may be depressed by absorption of ammonium ions. This does not mean that ammoniacal nitrogen is an undesirable source, but it does emphasize the need for adequate supplies of K.

PHOSPHORUS. P affects the uptake and distribution within the plant of other nutrient elements. For example, in soybeans an increased P supply causes increased K uptake (Table 3). Such plants should be capable of higher yields, and greater removal will increase needs.

LIME. The effects of lime on potash needs are rather complex. On some soils, liming favors release from non-exchangeable forms in the soil. In the plants, cation balance comes into

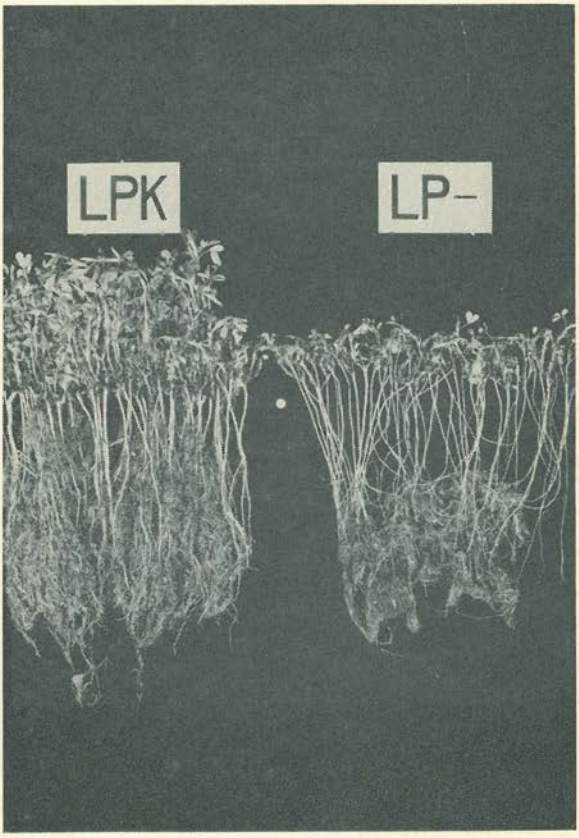


Figure 10. Omitting potassium on this low K soil decreased root and top growth and resulted in considerable heaving of alfalfa. ***(Photo by H. L. Garrard).***

play and as greater quantities of calcium and magnesium are absorbed there is room for less K. If the soil is low in K, this decreased absorption may be so marked that the plant will suffer from K deficiency. This has been noted on high-lime soils.

Some Effects of K on Plants

In addition to direct effects of K on yield, there are indirect effects on plants which will be considered more carefully in the future. Such consideration should encourage increased use.

QUALITY. In these days of heavy competition for markets, quality of the produce is very important. The effect of adequate nutrition on crop quality is well known, and several of the nutrients enter in. K definitely affects the quality of such crops as corn, tomatoes, grapes, peaches, potatoes, soybeans, and wheat. Quality of forage from alfalfa-grass mixtures is closely correlated with mineral nutrition. A deficiency of K allows grasses and weeds to take over, with the protein and palatability of the forage dropping accordingly (Figure 9).

MATURITY. On a K-deficient soil, the maturity of crops is hastened by adding K. Iowa reports that 15 and 30 lbs. of K_2O in the fertilizer at planting hastened corn maturity 10 days on a deficient soil. On soils rating medium or above there was little effect.

DISEASE. Potash deficiency increases the severity of many diseases or may predispose plants to infections by fungi, bacteria, and virus. Just why K deficiency encourages diseases is not completely understood. But with a deficiency, there is an accumulation of sugars and inorganic nitrogen which may make conditions more favorable for the invading organism. Also, cell walls are thinner in some instances. Potash is said to have alleviated damage from more diseases than any other nutritional element (McNew, 1956). Examples are fusarium wilt on cotton, wildfire on tobacco, and leaf rust on small grain.

ROOT DEVELOPMENT. The effect of nutrition on root development is rather striking. This is important in many respects and, of course, influences livability. This effect may be due to such factors as more disease resistance or less winterkilling of crops, such as wheat or alfalfa. The effect of potash in reducing heaving of alfalfa is shown in Figure 10.

The effect of K on standability of crops has long been known. On soils low in K, additions of KCl decrease both root lodging and stalk breakage of corn. Similar effects occur on small grain.

** Consumption data based on U.S.D.A. reports.*

FERTILEGRAMS

Why settle for less than 100 bushels of corn per acre?

That's the timely question posed by VPI agronomists who point out that it costs just as much to plow, harvest, plant, and cultivate to grow 30 bushels per acre as it does to grow 100.

On a typical farm, labor, tractor and machine use, seed cost, plus land rent, will total about $35 for each acre. If the yield of the field is only 40 bushels per acre, the cost per bushel is $1.10.

But by applying $20 to $25 worth of *fertilizer,* most producers can grow 100 bushels of corn per acre in a good season. This reduces the cost per bushel to 55 to 62 cents, with variations because of soils, previous treatment, etc.

The agronomists say to choose fertile, well-drained soil, test it to determine lime needs, and prepare a good seedbed. The amount and analysis of fertilizer to apply will depend largely on that used on other crops in the rotation, the amount and quality of manure used, whether or not a legume crop immediately preceded and was turned under before corn, and the fertility level of the soil.

However, you can't expect high yields unless the soil has plenty of plant food.

Plant a corn hybrid adapted to the locality, about 10 days or two weeks after the average date of the last killing frost. Plant thick—at the rate of 14,000 to 16,000 kernels per acre for a full-season hybrid; or 16,000 to 18,000 kernels per acre for an early variety.

It isn't always wasteful to fertilize rich soil, says the USDA; tests show that land which yielded 138 bushels of corn without fertilizer yielded 159 bushels when plant food was added.

~

Nitrogen returns the biggest profits to the farmer *when his soil is well supplied with the other plant food nutrients*—phosphate, potash, and lime—reports Dr. A. C. Caldwell, University of Minnesota soils specialist.

Caldwell points out soils can vary in their need for individual nutrients.

"In tests with corn on land low in potash, for example, adding high-potash fertilizer gave a big yield increase," he says.

"In a second set of experiments, phosphate was the most needed nutrient and in still another trial, nitrogen was the limiting plant food nutrient.

"Yet in all these tests, a *balanced fertilizer* containing nitrogen, phosphate, and potash gave *the best corn yields.*"

~

Use of more machinery and fertilizer and less manpower and horsepower is helping Oregon farmers hold the line against rising costs, according to extension agricultural economist, Elvera Horrell, at Oregon State College.

Although last year's farm output was a third larger than in 1940, it was produced on the *same acreage* of cropland by *fewer farmworkers* and

from Across the Land

FOR BETTER SOILS • FOR BETTER CROPS

on *fewer but larger farms*, economist Horrell noted.

Farmers have learned more about how to use commercial fertilizers in recent years, the economist points out, and these fertilizers have become cheaper in relation to land and other costs of production.

Fertilizer costs have gone up only about 6 per cent in the last 10 years, while land values have risen about 40 per cent, other production costs from 20 to 25 per cent.

~

Applying potash to a hay crop at Lexington, Kentucky, produced about $6 worth of hay at a cost of *only* $3 in extra fertilizer. About 60 pounds of potash per acre meant the difference.

~

Recent studies of aluminum in Florida soils have uncovered another good reason for liming soil used for producing agricultural crops, according to a University of Florida specialist.

Dr. J. G. A. Fiskell, associate biochemist with the Florida Agricultural Experiment Stations, says the study of aluminum in Florida soils was started about a year ago, and has led to some findings that every farmer and grower should understand.

He says all soil contains rather large amounts of aluminum, which can be toxic to growing crops. Plant roots encounter aluminum in the soil as they feed on fertilizer and other nutrients. If the aluminum level is too high, reduced crop yields will result.

However, there is a way to prevent aluminum toxicity to crops, Dr. Fiskell says. Phosphate acts to reduce the trouble, but the most economical remedy is the use of lime, which has long been recognized as necessary for the control of soil acidity. Lime contacts most of the topsoil where crops grow, and it changes the aluminum to forms less actively available to the plant roots.

A good soil fertility program and proper liming will maintain good yields, Dr. Fiskell says.

~

"Is your alfalfa hungry?" asks William Mitchell, extension agronomist at the University of Delaware.

You should be getting *400 pounds of 0-15-30, plus borax,* on your alfalfa during the year, Mitchell says.

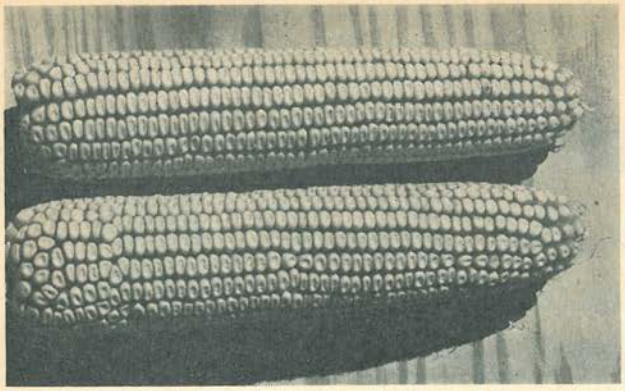
It is best in *two servings* to keep the alfalfa from gorging itself on potash, which is a bad habit of alfalfa.

A spring course of 200 pounds and another 200 pounds after the second cutting is a good distribution to get the most efficient use of potash.

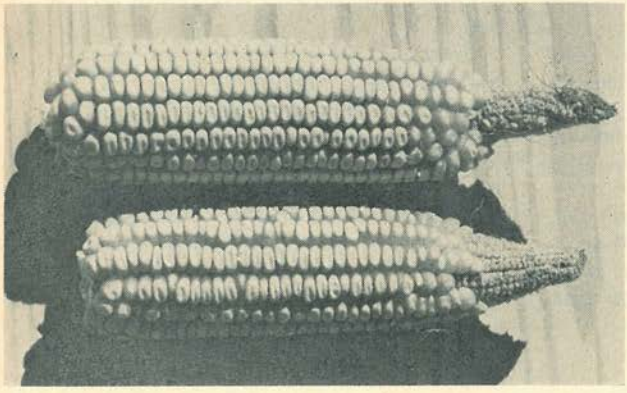
Mitchell says even if you forego the fertilizer on your alfalfa, be certain to apply the *borax*.

Alfalfa absolutely requires *16 to 20 pounds of borax per year* on most Delaware soil.

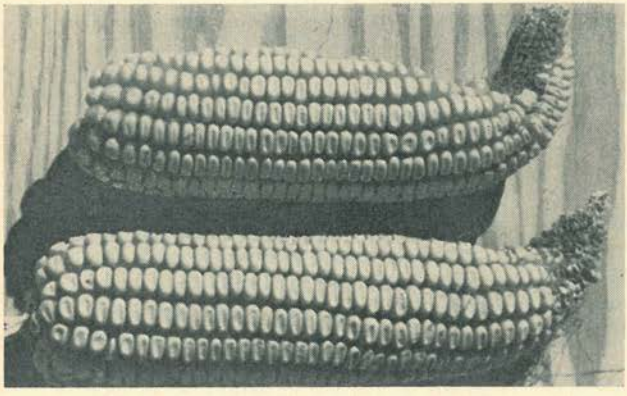
It is carried in the 0-15-30 at a rate of 80 pounds per ton, which means you will meet the requirements of 16 pounds per year if you apply *400 pounds of the complete fertilizer.*



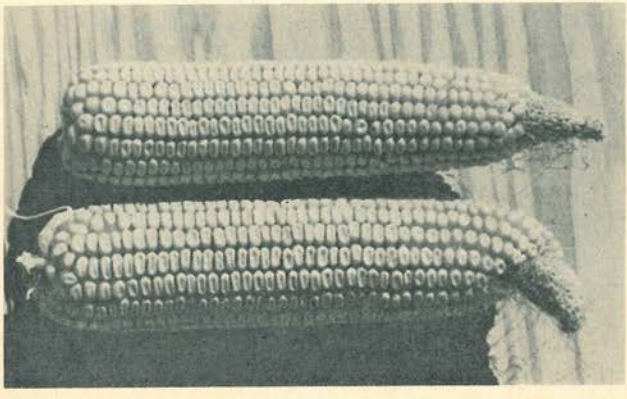
WELL-FILLED EARS of corn indicate a crop has received a good food supply from a soil well stocked with all essential nutrients.



NITROGEN shortages result in ears with unfilled tips sharply pinched off. Normal-sized kernels have a bright, polished luster.



PHOSPHORUS deficiencies often are responsible for crooked and missing rows of kernels in twisted and small ears.



POTASSIUM shortages can cause chaffy nubbins, kernels that are loose on the cob and dull in color, and unfilled tips.

EARS OF CORN CAN TELL A STORY

The time corn growers spend examining their crop may reveal a lot of secrets that could be worth many dollars in future years, says Marshall Christy, University of Missouri extension soils specialist.

Many factors must operate in harmony to produce a good corn crop, he points out, and some one factor may be limiting yields and income. Correcting the limiting factor will likely mean more profitable yields and a higher interest return on the money invested in corn production.

Ears can point out a great deal about the fertility of soils and the kind of nutrition plants were able to get. The ears are the final evidence of the kind of food supply the plants had throughout the growing season. They reflect whether the food supply was adequate or limited in some respect, Christy notes.

Frequent observations throughout the growing season, including tissue tests, as well as the final yield and quality of the crop can provide a great deal of useful information about soil fertility. This information, along with soil tests, is the most useful guide for 1959 soil treatments to correct fertility conditions that act as a barrier to better quality and yields.

In any diagnosis, the soils specialist suggests that corn growers try to examine stalks, leaves, and roots as well as ears. Insect and disease damage might be responsible for some of the apparent nutrition deficiencies.

And severe limitations of one nutrient may result in multiple deficiency symptoms showing up. *For example, phosphorus or nitrogen deficiencies may be caused by a "poor" lime situation of the soil.*

So don't jump to conclusions too fast but rather look at all the angles, he says.

Nitrogen Hunger

1 *A lack of nitrogen* causes ears to form that are small and sharply pinched off on the tip as pollinated kernels fail to fill. Filled kernels have good luster and polish.

Nitrogen is an essential nutrient all through the growing season. However, *it's needed in far greater amounts during the last half of the growth period and is especially useful when silking and tasseling starts.*

Limited nitrogen causes firing, or yellowing, starting at the leaf tips and proceeding along the midribs of the leaves. First leaves to show the deficiency symptom are the oldest ones on the lower part of the corn stalk.

Phosphorus Hunger

2 Phosphorus shortages interfere with pollination. Ears are small and are often twisted with part or entire rows of kernels missing. Rows of kernels are often crooked, and the tips of ears aren't usually filled.

Purplish-tinted leaves and stalks may indicate phosphorus limitations in young corn plants, although some varieties have this color characteristic. A small, weak, spindly stalk that produced a small twisted ear, or no ear at all, is the most typical symptom. Reddish leaves at or near maturity aren't a symptom of phosphorus deficiency.

Potash Hunger

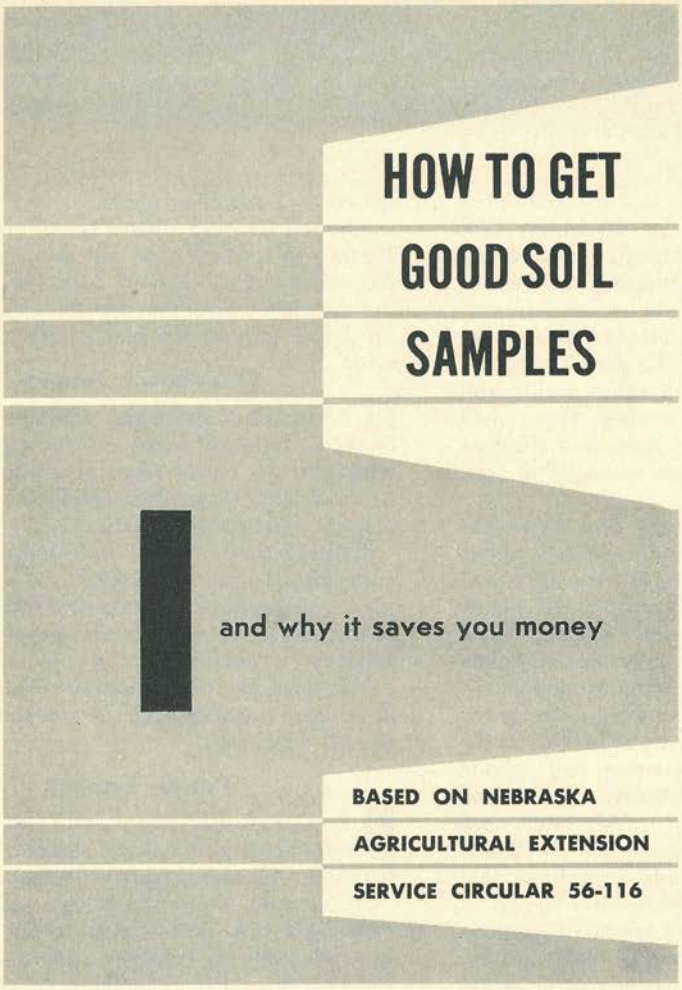
3 Potassium starvation results in chaffy-like nubbins with dull-colored kernels. Tips of ears don't fill and kernels are loose on the cob.

When split, the nodes of the stalk are often discolored and dark brown when potassium isn't available in sufficient quantities through the growth period. Potassium deficiency is indicated by corn leaves that fire and turn brown along the edges starting at the tip.

If most of the ears in a field are exceedingly large, yields could likely be improved by using a thicker planting rate. On the other hand, if most ears are too small, it indicates limited fertility, limited moisture, or too thick a stand, Christy notes.

Remember, many factors are involved during the growing season that will affect the yield and quality of a corn crop, the Missouri extension worker continues. A diagnosis of many nutritional limitations can be made through observation, tissue tests, and soil tests.

These are steps that can be taken to strengthen soil improvement programs. The payoff comes with more profitable operations and greater satisfaction for good yields of high quality year after year, Christy points out.



Several thousand soil samples are taken by farmers each year. The soil test results—and the accompanying letter of recommendation—tell you several facts about your soil.

The tests show whether your soil needs (a) lime, (b) phosphorus, or (c) potassium. The recommendations tell you how much of each you should apply, when to apply it, and for which crops. Recommendations are also made for nitrogen fertilizer use. Special tests are made, when necessary, for excess lime and soluble salts. Information on how these affect your yields is included in the recommendation.

By
Delno Knudsen

University
of
Nebraska
Extension

Delno Knudsen is in charge of soil testing at the University of Nebraska. Raised in the Nebraska Sandhills, Knudsen earned his B.S. in agronomy at Iowa State, his M.S. from Purdue. He is now Assistant Extension Agronomist at Nebraska.

SEE YOUR AGRICULTURAL LEADER

SELECT THE TOOLS YOU NEED

DIVIDE YOUR FIELD

WATCH DEPTH OF SAMPLE

KNOW WHAT A SAMPLE IS

USE A SPADE

BREAK CLODS-MIX

POUR IN MAILING CARTON

LABEL THE CARTON

SKETCH YOUR FIELD

FILL OUT INFORMATION SHEET

WRAP SAMPLES WELL

TAKE OR SEND

Now, a soil test can't be any more accurate than the sample from which it is made. Poor samples can result in tests which are misleading. This in turn can lead to inaccurate recommendations which can cause you to lose money through (1) low yields, (2) using the wrong fertilizer, or (3) using fertilizer you don't need.

Good samples yield good tests and good recommendations which can make you money. This circular tells you how to get good soil samples on your farm.

FOLLOW THESE STEPS TO GET GOOD SOIL SAMPLES . . .

1

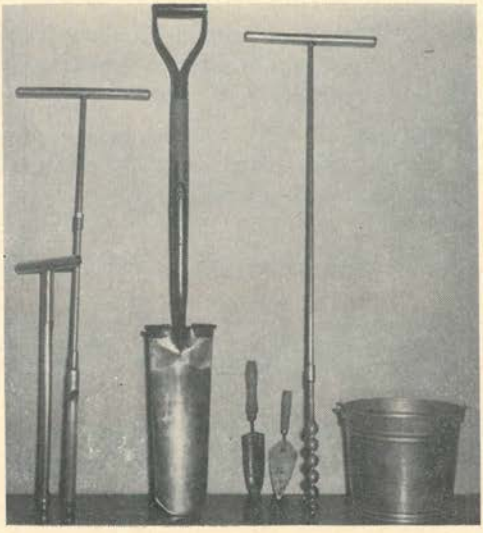
SEE YOUR AGRICULTURAL LEADER

He has information sheets and mailing boxes. He can answer your questions about soil testing.

2

SELECT THE TOOLS YOU NEED

A clean bucket, spade, and knife or a soil probe or auger.



DIVIDE YOUR FIELD

Different soil conditions exist on your farm. Some of them are illustrated in the map on the right. Remember—don't mix different soils.

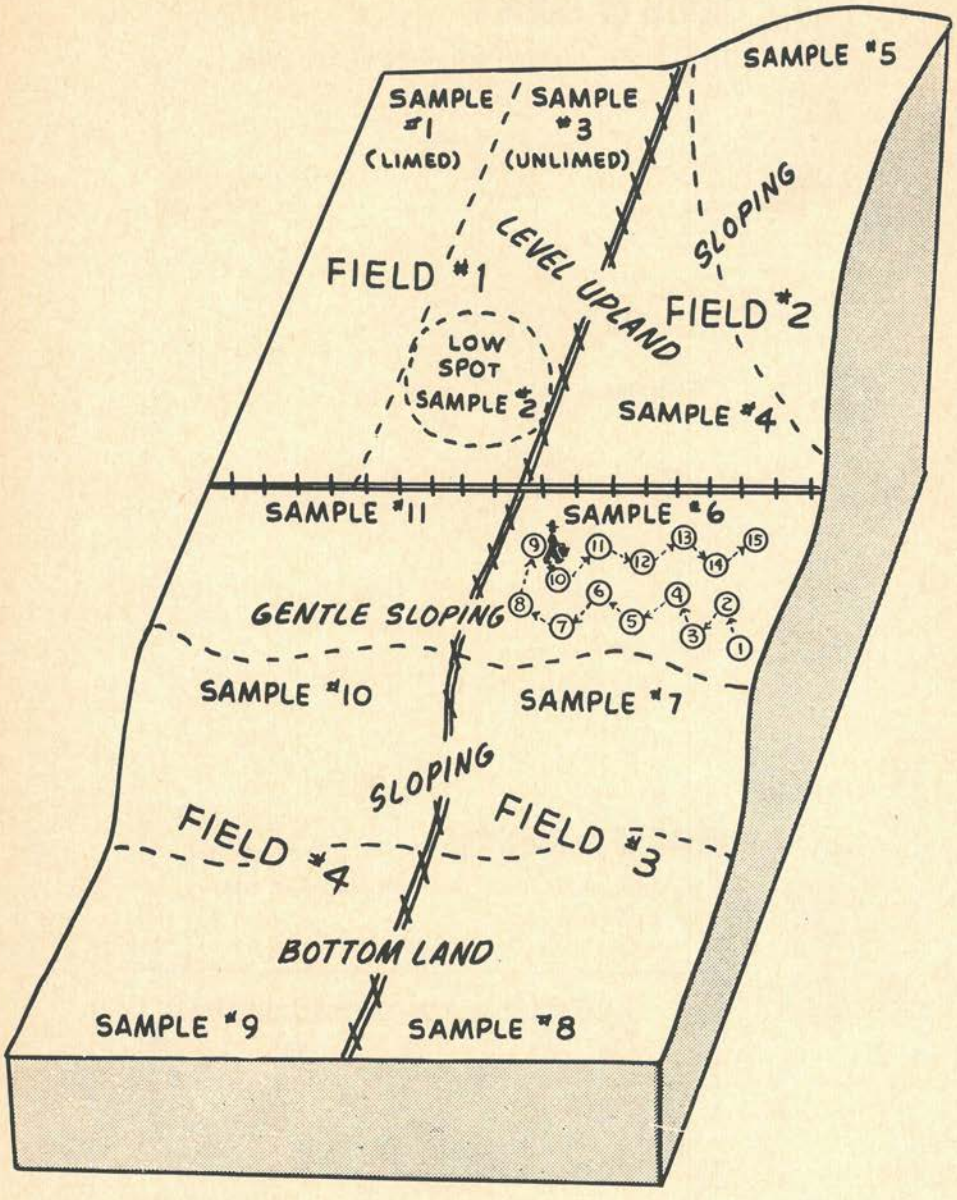
Here are some conditions which may result in different soil test results.

1. Past lime, fertilizer or manure treatment. (Field 1)
2. Low spot. (Field 1)
3. Slope and degree of erosion.
4. Cropping history.
5. Bottomland and upland differ. (Sample Nos. 7 and 8)
6. Soil texture (sandy, loamy, or heavy).
7. Organic matter content.
8. Different colors mean different soils.

Here are some places to avoid.

1. Unusual areas. If sampled, do them separately.
2. Turn rows, dead furrows, snow fences, stack bottoms, strips near trees, rocked roads, etc.

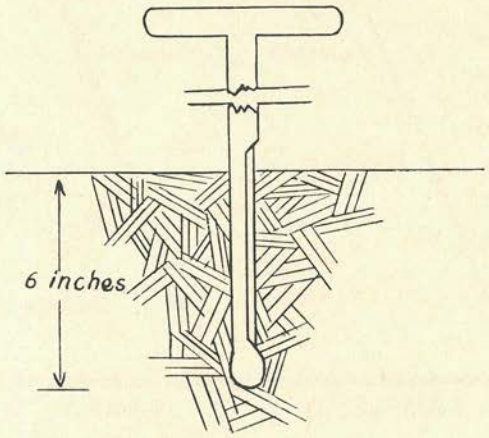
Terrace channels should be sampled separately. For alkali spots ask your agricultural leader's advice.


SAMPLE #5
SAMPLE #1 (LIMED)
SAMPLE #3 (UNLIMED)
LEVEL UPLAND
SLOPING
FIELD #1
FIELD #2
LOW SPOT SAMPLE #2
SAMPLE #4
SAMPLE #11
SAMPLE #6
GENTLE SLOPING
SAMPLE #10
SAMPLE #7
SLOPING
FIELD #4
FIELD #3
BOTTOM LAND
SAMPLE #9
SAMPLE #8

4

DEPTH OF SAMPLE

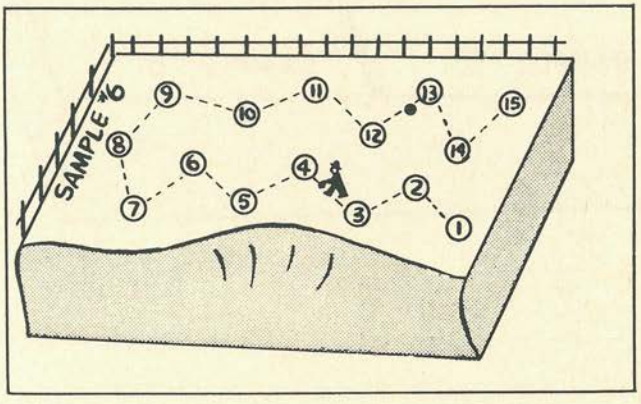
Only 6 to 7 inches—the same as you plow.



5

WHAT IS A SAMPLE?

A sample is soil from 10 to 20 places in the same soil area.

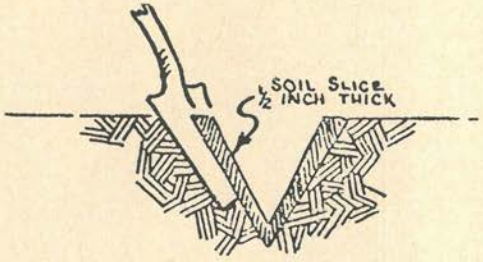


6

USING A SPADE

If you don't have a probe or auger, use a spade.

1. Dig a V-shaped hole 6-8 inches deep. Then take a half-inch slice from the smooth side—like this:

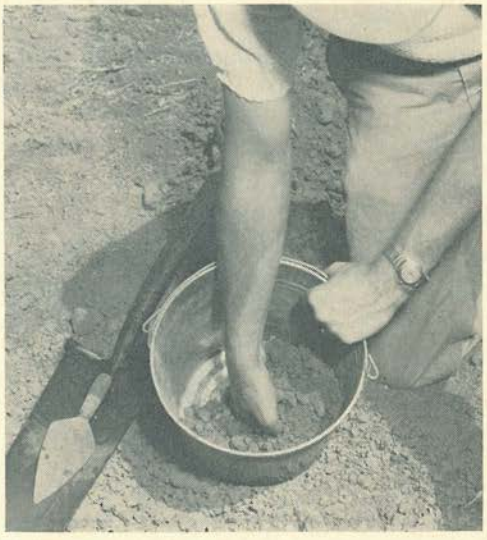


SPADE

2. Then trim sides leaving a one-inch strip like this—and then dump this strip into a clean bucket.
   Repeat in 10 to 20 places for each soil sample.

7

BREAK CLODS—MIX THOROUGHLY



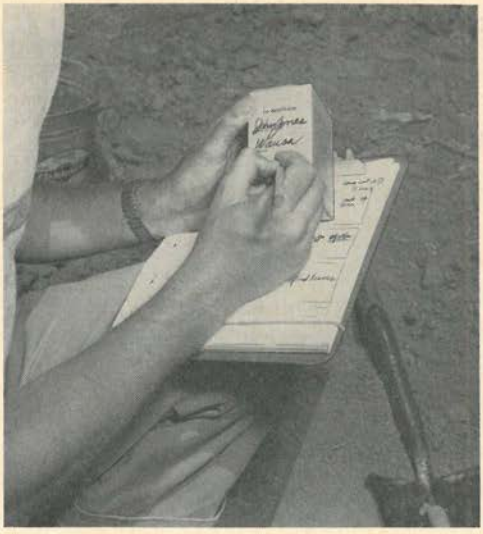
8

POUR IN MAILING CARTON

9

LABEL THE CARTON

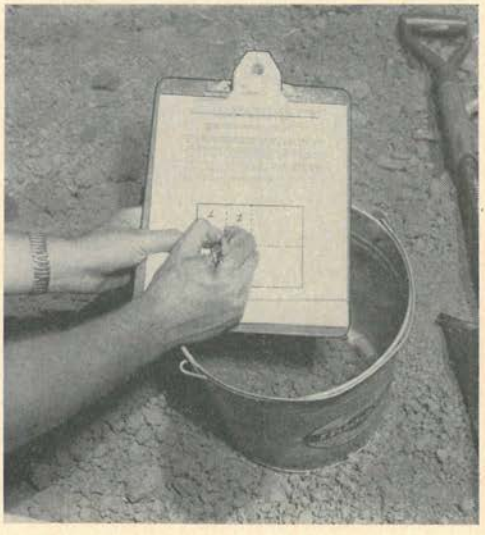
With your name, address, and the sample number.



10

SKETCH YOUR FIELD

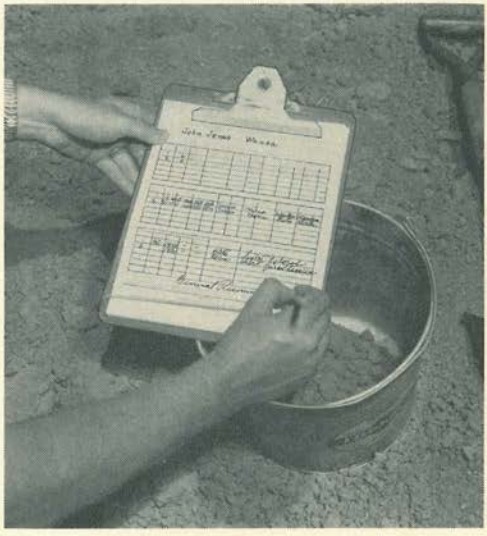
Diagram it the way you sampled it. Be sure sampled areas are labeled the same as soil sample cartons.



11

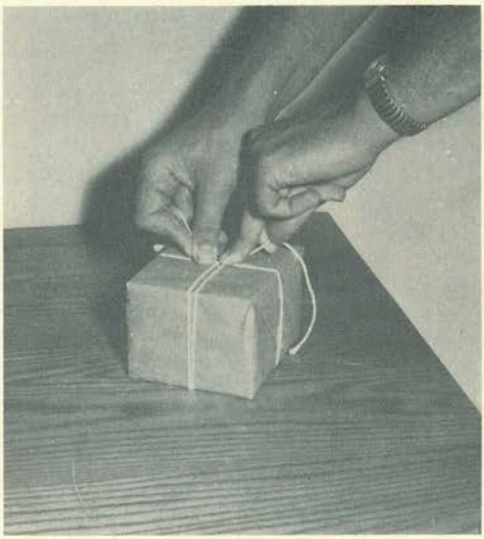
FILL OUT INFORMATION SHEET

The more information you give the better your recommendation will be.



12

WRAP SAMPLES SECURELY



13

TAKE IT TO YOUR AGRICULTURAL LEADER

Who will be glad to mail it for you.

OR

Mail it yourself to the Soil Testing Laboratory.

14

DEPENDABLE AND ACCURATE

If you have done your part well, you can be sure that the soil tests are accurate and dependable, if the tests are backed up by many years of field and laboratory research. The recommendations for lime and fertilizer use must be based on thorough and extensive field experiments throughout the state, including your area.

15

FOR FURTHER READING

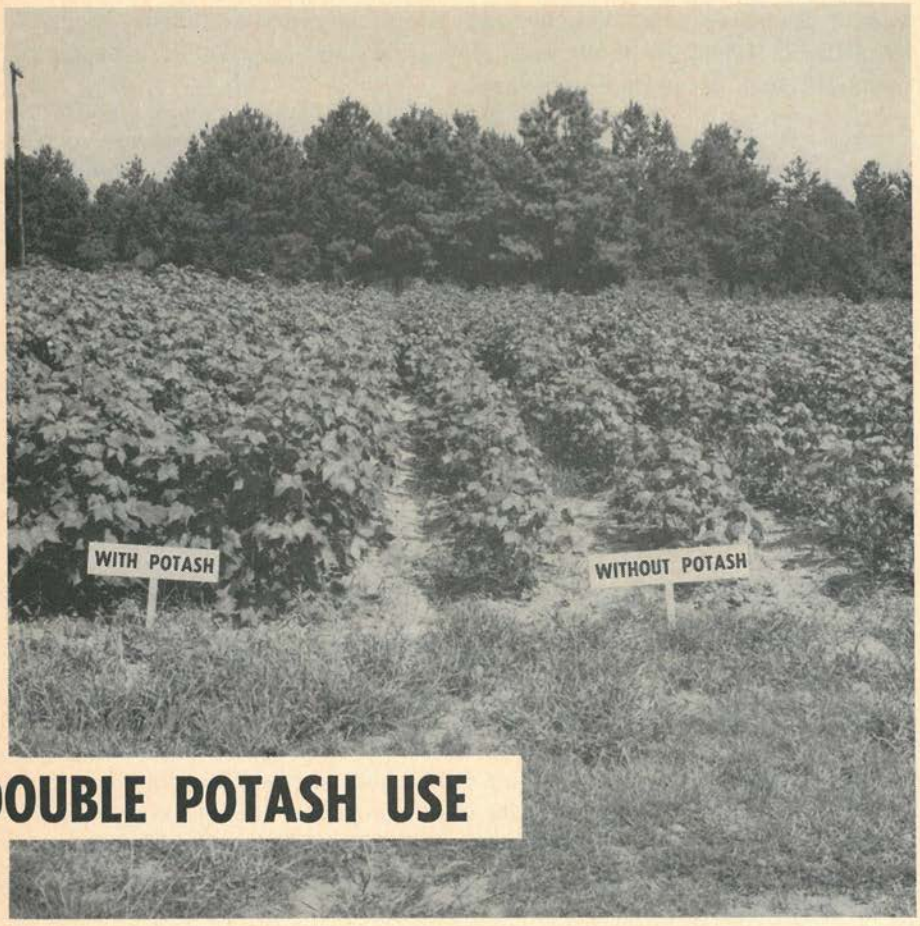
When you receive your soil sample test results, University publications may help you understand the condition of your soil and what you can do about it. Ask your official agricultural leader for appropriate circulars.

Where no potash was applied to corn, the yield was 30.9 bushels per acre. When potash was applied to the corn, yield jumped to 107.1 bushels per acre.

ALABAMA NEEDS TO TEST FIELDS SHOW

Are you using the right amount of potash under your crops? This question might draw an answer like this, "I don't know," or another, "I guess so," or still another, "I'm using as much as I can afford."

But will any one of these answer the question? Certainly not. The only way to know whether you're using the right amount of potash is



DOUBLE POTASH USE

R. D. Rouse
Soil Testing Research

Alabama Polytechnic Institute

Seed cotton yielded only 250 pounds per acre where no potash was applied. Where 120 lbs. potash per acre was applied, the yield jumped to 1,680 lbs. seed cotton per acre.

to have your soil tested. Recommendations based on soil samples properly taken to represent each of your fields will show you the exact amount of lime and fertilizer, including potash, needed to make the most return for your labor and investment.

In all the fertilizer used annually in Alabama, there are only 86,000

tons of potash (K_2O). This includes potash in mixed fertilizers—such as 4-12-12, 4-8-16, 0-10-20, and others—as well as that in straight materials, such as muriate of potash.

Research shows that twice this amount should be used annually on the present total acreage and crops if farmers are to get the highest production from their land—assuming, of course, that the recommended amounts of lime, nitrogen, and phosphate are also used.

The importance of controlled fertilization of crops may not be appreciated in field plantings because a comparison is not available here. However, in these pictures from experiments conducted at the Alabama Polytechnic Institute Agricultural Experiment Station, the effect of potash on crops can be seen because adjoining plots with and without potash were used. With each crop, both plots were managed identically and received the same lime and fertilizer, based on a soil test, except for potash, which was not applied to one plot in order to show its importance.

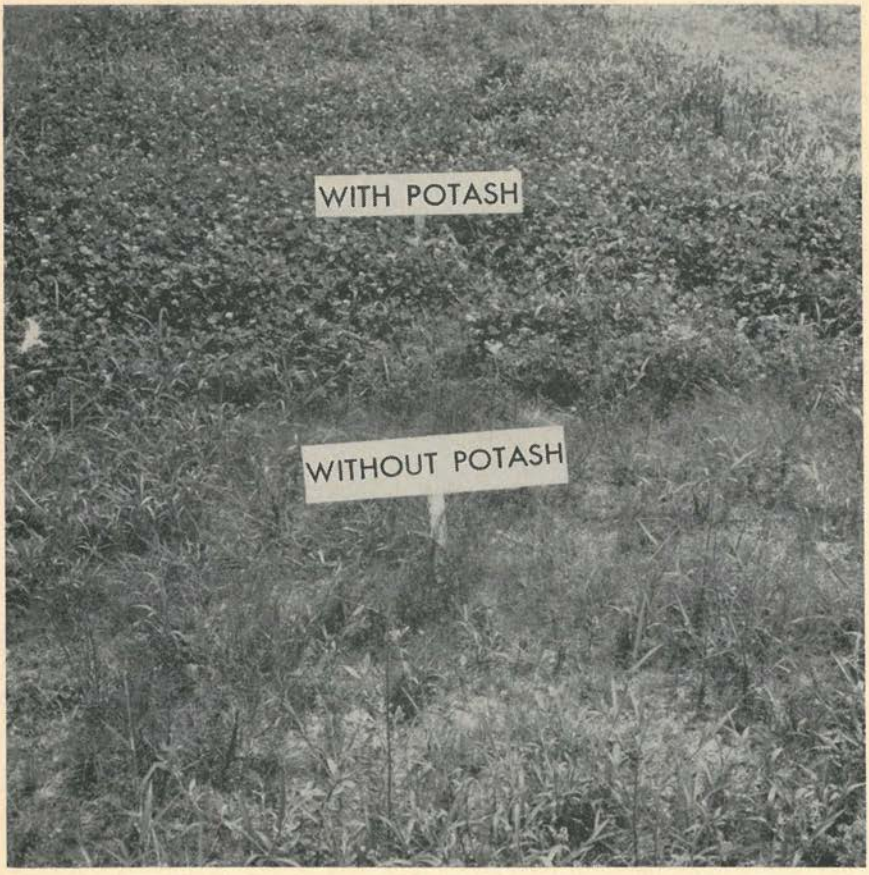
The corn showed a much greater difference to the eye than it does in the picture because the lower leaves of the no-potash plots were yellow and dying around the edges. This difference was reflected in yield last year. Where no potash was applied, the yield was 30.9 bushels per acre; with potash the yield was 101.7 bushels per acre.

The cotton plots were located on a field where hay had been harvested for three years without potash applications, and a soil test showed potash to be extremely low. The yield was only 250 pounds of seed cotton per acre where no potash was used, and where over 120 pounds of potash was applied the yield was 1,680 pounds of seed cotton per acre.

The yield of clover on the first two cuttings amounted to only 375 pounds of dry matter per acre where no potash was applied, compared to 1,875 pounds with potash.

Pinpointing these differences, you can see that *potash was directly responsible for over three times as much corn, more than six times as much cotton, and five times as much clover per acre.*

Of course, these are extreme conditions, but you may be farming anywhere between these extremes without knowing why yields are not as good as you might expect from your land. You can find out if your yield on certain fields is limited by fertilizer simply by taking soil samples, according to instructions that can be obtained from your county adviser, and sending them to the Soil Testing Laboratory at Auburn.



Where no potash was applied to white clover, the yield on the first two cuttings amounted to only 375 lbs. dry matter per acre. Where potash was applied, the clover yield jumped to 1,875 lbs. dry matter per acre.

Frequently a farmer finds that on some fields he has been applying more of certain elements than are needed, but less of others. By shifting to a grade of fertilizer that best fits the need of each particular field and crop, he may actually be able to use fewer tons of fertilizer and make higher yields.

Lime and fertilizer recommendations made by soil and crop scientists at the laboratory are based on many years of experience in field research. You can be sure they are the most reliable recommendations available.

(From *This Month In Rural Alabama*)

LIME PAYS BIG DIVIDENDS

LIME PAYS BIG DIVIDENDS. Ed Wiggins, county agent in Henry County, points out the difference lime has made on the growth of soybeans on a farm in his county.

Soybeans, like other crops, produce larger and more profitable yields when the plants can get adequate nutrients from the soil, says C. M. Christy, extension soils specialist at the University of Missouri.

Limestone supplies important nutrients and helps others to be more effective.

Experimental work at the University has shown that soybean yields can be increased five to eight bushels an acre when limestone is added to a soil in need of calcium.

Calcium and magnesium are the basic plant nutrients supplied by limestone. However, all nutrients, especially phosphorous, are more effective when the lime situation of the soil is good.

The fall season is an excellent time to apply limestone. Trucks can usually get over most fields better in the fall when the soil is firm and dry, Christy says.

Also, limestone is most effective when applied before plowing and growing crops interfere least with spreading operations in the fall.

Soil testing is the best way to determine whether a soil needs lime as well as how much it needs. Missouri county agents can supply information on how to get soil samples tested, Christy says.

THE EDITORS TALK

Of A Corn Champion

A 12-year-old girl is the 1958 corn champion of Louisiana, producing a crop five times greater than the average yield of corn per acre for the state.

Linda Carol Teer of Dixie, Louisiana, grew 149.9 bushels of corn on one acre, the highest yield reported in the state-wide contest sponsored by Louisiana State Agricultural Extension Service and the Chilean Nitrate Educational Bureau.

To win:

(1) She flat broke and subsoiled her corn land about Feb. 1 and on the 10th applied about 150 pounds of nitrogen to the acre, with applicator nozzles placing the nitrogen about 14 inches deep in furrows about 16 inches apart.

(2) She broadcast 275 pounds of potash and phosphate to the acre about a week later and disked the land.

(3) She then harrowed her corn patch and planted her Coker 811 corn seed with a 4-row planter.

(4) She cultivated her corn with a rotary hoe as soon as it made a stand, hoed again a short time later, plowed on May 7, and hoed a third time on May 13.

(5) She sidedressed 30 more pounds of nitrogen to the acre when the crop was about 20 inches high.

(6) She plowed her crop only once after it was sidedressed.

(7) She laid by her crop on May 16, when the corn was about 36 inches high.

(8) She enjoyed a favorable growing season but had to delay her harvesting because of September rains.

(9) She finally got her crop in, with a picker-sheller machine, and sold it to a Shreveport grain elevator.

(10) She figures her profit at about $156—which she has banked toward a college education some day.

What this country needs is a special encyclopedia with blank pages for the guys who know everything.

Dora: I don't think that story we heard about Flora is so bad.

Cora: Give it time, dear, give it time.

"I can't make them out," said the woman over the back fence. "They have no car, no television, and she hasn't any jewelry or furs."

"Perhaps," said her neighbor, "they just have money."

An elderly man with a shy young girl entered a doctor's office, announced they needed blood tests for a marriage license.

The doctor eyed them, then asked, "How old are you?"

"I'm 87," the old man replied. "She's 17."

"What!" screamed the doctor. "Don't you realize that much difference in age could be fatal?"

"Oh, well," shrugged the old gentleman, "if she dies, she dies!"

People will believe anything if you whisper it.

"This is the very last word, madam," the salesman assured the woman shopper as he held up a royal blue Italian silk smoking-jacket. "Just the thing for the man-about-town."

"It certainly is," the lady agreed. "But what do you have for the mouse-around-the-house?"

Extract from a letter to a doctor—"Since taking your tablets I am another woman. My husband is delighted."

Female voice over telephone: "Is this the Fidelity Insurance Company?"

"Yes, Ma'am."

"Well, I want to find out about having my husband's fidelity insured."

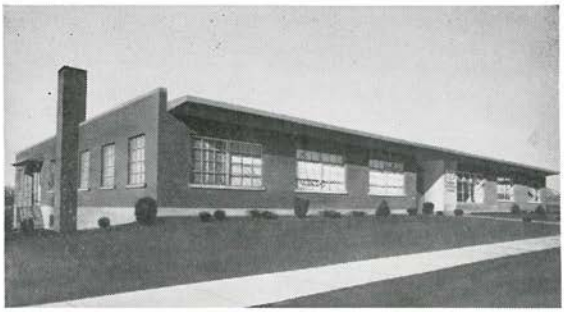
"I wouldn't have known you from your picture. Albert said you were so pretty."

"No-o-o . . . I'm not pretty, so I try to be nice. You should try it sometime."

Stopping at a wayside service station in Arizona, the lady motorist inquired: "Do you have a rest room?"

"Nope," returned the attendant. "When any of us gets tired, we just sits on one of those oil drums."

YOU DON'T SAY?! A turtle only makes progress when his neck is out.



Funk's-G Research Center at Bloomington, Ill., from which nationwide corn breeding program is directed. Near Bloomington is world famous Research Acres Central Field Laboratory where many firsts in hybrid corn breeding took place.

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Nationwide field trials are backed by careful laboratory analysis, such as this test for kernel oil content—another reason livestock feeders make more money feeding Funk's-G.