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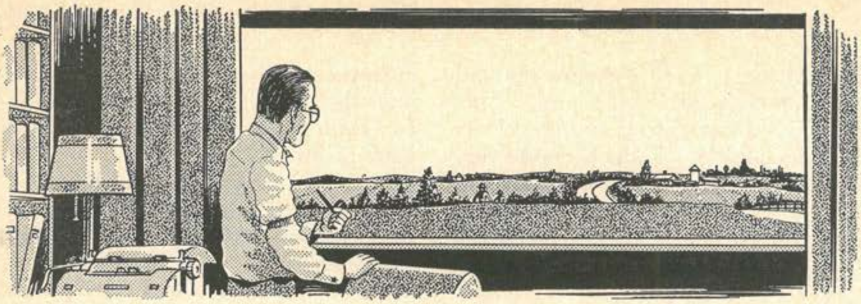
CONTENTS

ON THE COVER

. . . agriculture has come a long way in the past 25 years. Scenes like this were not uncommon when the American Potash Institute was formed in 1935. Today—well, everyone who reads this magazine is well acquainted with the difference. In the quarter century—from 1935 to 1960—the Potash Institute has enjoyed the privilege of cooperating closely with official agriculture in experiencing many of these changes. If you have a few minutes to spare, we have taken a dozen pages or so in the back of this issue to recall some of these experiences. It has been a good quarter century because it has been a cooperative one.



Only one person in eight must

Find the Farm Answer

Jeff McDermid
(ELWOOD R. MC INTYRE)

TODAY we rely on but one person in eight for bigger and better food supplies—and considerable to spare. They may not find the answer to the farm problem, but they surely have first chance to tackle it.

Much as we venerate the struggling lives of our farm pioneers of 75 and more years ago, we ourselves dwell amid dilemmas no less disquieting and challenging.

They never had to take chances with a stalled car, a balky automatic furnace, a dead telephone or a broken tractor gear. They never had to meet such high real and personal taxes and upkeep, or depend upon the stores in town for so much of their ordinary clothing, food and repairs.

They escaped the bogey of integration and the constant need to compete on a dizzy, modern high cost level with other tense commercial farmers. They kept more of their offspring at home in the family circle. They didn't feel called upon to sweeten the kitty for so many drives and public programs—or to belong to so many societies and clubs connected with soils, crops, livestock and community welfare.

Some critics even say the rural spiritual stimulations are not what they used to be. (If this refers to hot and hectic camp meetin's, it may be right because juvenile hot-rodders and night riders have taken their place.)

Yet our thesis can well rest on our faith in the ability of each farm generation to find the workable answer. It may be a compromise with existing tradition and preference, but it will work in the long run when thus supported. Farm folks themselves must do it. Legislators usually fumble the ball. Times were rough and tough enough for our grandparents. But somehow by thrift and cooperation and attention to details, they usually did more than "muddle through."

If the forebears of our present day farm folks met their plight with planning and perseverance, their children's children will assuredly do as well, maybe much better.

As our mutual friend, Phillip Aylesworth, writes so clearly in his Keeping Abreast of Change:

"The massive changes in farming are more than a shift from horse, mule, and human muscle to mechanical or electric power. They are a genetic revolution as well—witness the millions of acres of hybrid corn. They are also a managerial change of the first magnitude. Today's commercial farm is not just a face-lifted traditional farm. The skills required to manage its complexity of technical, biological, and economic factors are of a high order."

Back 85 years ago a supervising teacher in my state undertook a speech that he was asked to give before the State Agricultural Society. He was no Ichabod Crane, but he had lived in rural areas during the years that developed the philosophy of Edward Eggleston's "Hoosier Schoolmaster."

That speech was buried in the proceedings for many years. What comfort and credence it gave to the few farm folks who heard it or read it currently is hard to say. But it rings true in so many ways, with a sort of prophetic angle to it, that we can afford to lift sections of it for your edification:

He started out by saying that the farmer who relies only upon his hands and not also upon his head will be in bondage from the beginning of his career to its end. A liberal education was needed, the teacher said, an education both technical and disciplinary.

Then he listed the qualifications a true farmer needs, as follows:

"To know all the circumstances best adapted to the growing of grain, grass, trees and shrubs; to study and forecast the markets of the world like a successful merchant; to know what crops will pay him best; to keep his accounts with accuracy and fullness, like that same merchant.

"To know the cost and profit of every crop he grows, every animal he raises and sells, every investment he makes; to have the wisdom and courage to cut off needless expense; to know how to plan for the future as well as to act effectively in the present.

"To know best how to husband his resources in stocks, in machinery and buildings, wisely providing against accidents; to make the labor of his brain limit the minimum labor of his hands, by carefully planning in his leisure the work of his busy days.

"To have a taste for the beautiful in nature and art, so that he may invest his home with those delights and comforts, which need for their creation not so much a well filled purse as a cultivated eye and brain.

"To have a taste for reading, so that his leisure may be partly given to that recreation which combines instruction with pleasure; and last, though not the least, to make a home for his children which shall be worthy of the name and of them—a home full of attractions and delights, which shall be hard for them to leave and hard for them to ever forget."

And finally he insisted that farming would one day become a learned profession. "I think the day has already come when true success in agriculture and horticulture is the result only of intelligence and skill."

I am convinced that truly effective and inspirational extension work has been done by rural teachers of maturity and vision, as well as by so many capable county school superintendents. My own state's early extension campaigns were run by the overworked county superintendents.

The great A. B. Graham of Ohio and national fame in rural youth leadership is one, and the late O. J. Kern, superintendent in Winnebago county, Illinois, is another. Both are mentioned in Dr. True's ready reference work on the History of Agricultural Extension, Miscellaneous Publication No. 15, USDA.

Graham was alert, active, interesting as a speaker only as recently as 1957, when he talked to our farm paper editors in Chicago. But I go to the files for excerpts from a talk made by Mr. Kern at our farmers' institutes fully 60 years ago.

"The difference between a period of settling a country and a period of settling down is the difference between adventure and development . . . It is expressed in many ways—intensive farming instead of extensive; building better homes instead of seeking others elsewhere; in doing the jobs we have in hand better instead of looking for other jobs to do."

Kern was an apostle of consolidated schools—in a period when that was a bitter topic. He worked for and secured the first centralized school in Illinois, when three districts joined together in Seward township, Winnebago county.

"We must put the country child in sympathy with his environment," he said, "and improve country life by a course of training that will be more practical and yet possess high cultural value."

He added the hope that the consolidated schools would become a local experiment station working under the direction of expert investigators from the land-grant colleges.

Lastly, we go to the memoirs of a talented and distinguished rural school teacher and county superintendent. He served also as dairy and food commissioner in my state—Hon. J. Q. Emery, who said:

"In consequence of the Morrill, Hatch and Adams Acts, great agricultural college and experiment stations have been established and maintained, where the fundamental purpose is to bring us new knowledge. As a result great scholars have devoted their time and energy—not in what the Greeks and Romans knew, but in learning how to read God's thoughts in the great book of nature; and how mankind is to gain dominion over the earth, including the nature of milk and its products, the laws of reproduction, the best environment for the dairy cow, the balanced ration, the mode of manufacture and preservation of dairy products, and soil conservation. We face, with the help of science, a revolution in agriculture." **THE END**

RESEARCH BY 1970 MAY TAKE $27 BILLION

"Theme of 1960's: More Research," was a New York Times headline on an article by Richard Rutter. The writer said:

"Research, of course, has been an integral part of industrial activity for years. But that part has been growing at a phenomenal rate. Here are two examples:

"1. In 1920 there were about 290 industrial laboratories in this country. Today, there are more than 5,000.

"2. In the fiscal year ended June 30, 1954, research and development expenditures by all sources were about $5,150,000,000. In the present fiscal year, they will come to more than $12,000,000,000. This covers spending by Federal Government agencies, industry, colleges and universities and non-profit organizations such as private foundations and research institutes. Some forecasts put the figure for 1970 at $27,000,000,000 or more.

"Industry spending for research and development constitutes, by far, the largest portion of all such activity—about 75 per cent. But the Federal Government continues to be the main supplier of research funds, though its proportionate share is expected to dwindle."

Rutter mentioned Esso research with 1,000 projects, 7,000 patents, 3,000 employees and $54 million a year; DuPont, spending $90 million for research, creating 16,000 new jobs since World War II; Bell Telephone Laboratories with 11,000 employees, General Motors and several others.

"In 7,500 research groups around the world, 800,000 men and women are shaping the World of Tomorrow. Their work cannot be overestimated," he concluded.

By C. M. Woodruff

J. L. McIntosh J. D. Mikulcik H. Sinha

Department of Soils

Missouri Agricultural Experiment Station

HOW POTASSIUM CAUSED BORON DEFICIENCY IN SOYBEANS . . .

THE frequent association of boron deficiency with over-liming has received considerably more attention than has the association of boron deficiency with the use of potash fertilizers.

Purvis and Hanna (3) observed in 1938, "Response to potash fertilization is prevented by the retardation of plant growth due to a boron deficiency in an Elkton soil." However, they did not develop further this aspect of the subject.

Using sand cultures, Reeve and Shive (4) demonstrated in 1944 the relation both between potassium and boron and between calcium and boron. In each case symptoms of boron deficiency were induced in tomatoes by increasing potassium or calcium.

White-Stevens (5) noted a deficiency of boron in the presence of excess potassium.

The basic principle of the potassium-boron relation as set forth by the reports of these investigators *seldom is considered in the field of applied agriculture.*

Soil and plant tissue tests for potassium and the development of symptoms of deficiency of potassium are used as guides for fertilizing with potassium. Potash fertilizer is usually applied with no thought of the possible impact such a treatment might have on the boron nutrition of plants.

But since "alfalfa yellows" following potassium top dressings have frequently been corrected by boron, alfalfa fertilizers containing boron have been formulated in some states.

Occasionally depressed alfalfa

Contribution from Department of Soils, Missouri Agr. Exp. Sta., Journal Series No. 2031. Approved by Director.

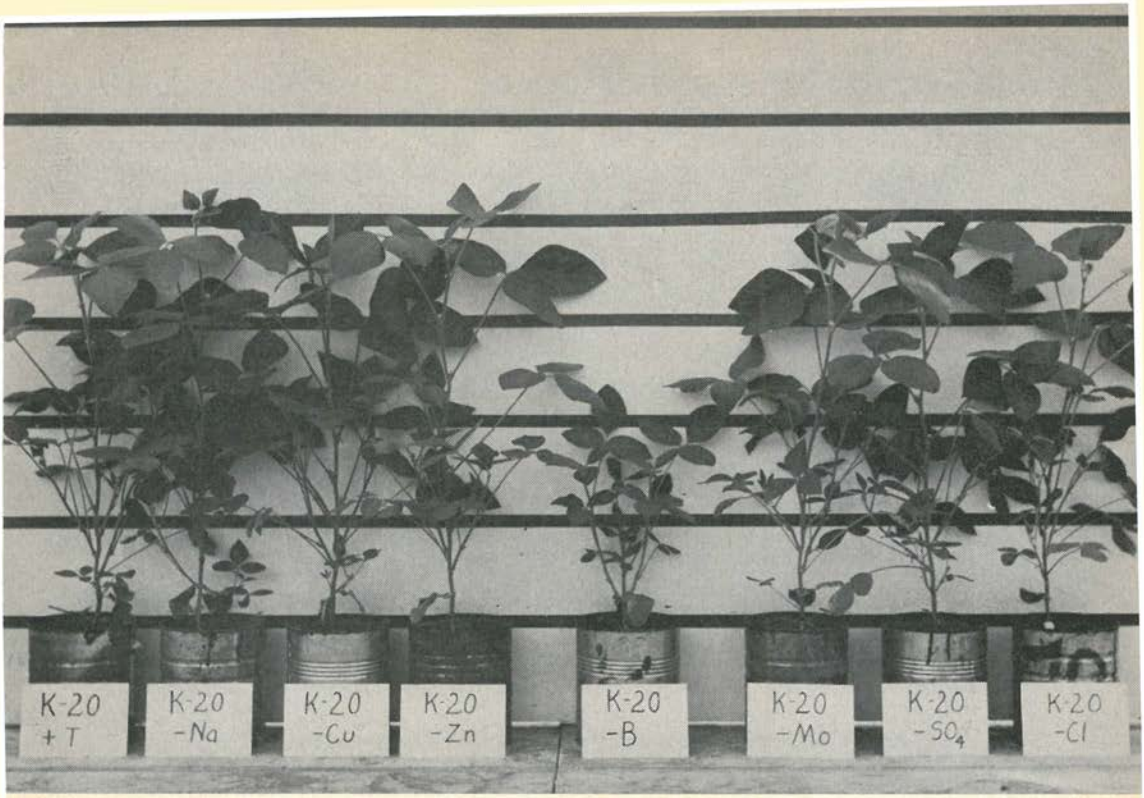


Figure 1—Boron was the limiting factor in growth of soybeans on this soil. Soil at extreme left contained all seven elements. Only the omission of boron restricted the growth in soils with 20% of exchange complex occupied by potassium.

yields are reported from rather heavy treatments of potassium. This has caused smaller and *more frequent applications* to be advocated.

Some evidence exists of depressions in the yield of small grain with broadcast applications of only 40 pounds per acre of K_2O. Such evidence is difficult to interpret when in Missouri, applications of K_2O at rates of 400 pounds per acre have produced no adverse effects.

DEPRESSED YIELDS

The significance of the potassium-boron relation in plant nutrition became apparent in a preliminary investigation of the cationic balances of soils.

An acid-leached soil was used to prepare a series of pots of soils containing various combinations of potassium, magnesium, and calcium with a final pH of 6.1 to 6.4. Soybean plants were grown to maturity.

The most important effect was a rapid increase in the yields of beans with an increase in the percentage saturation of the soil by potassium up to a level of 2% (equivalent to adding 280 pounds K_2O per acre).

There was a constant and rapid decrease in yield to nearly zero with further increases in saturation by potassium up to 20% of the exchange complex. The standard-free energy for the replacement of potassium by calcium and magnesium at the 20% level of saturation by potas-

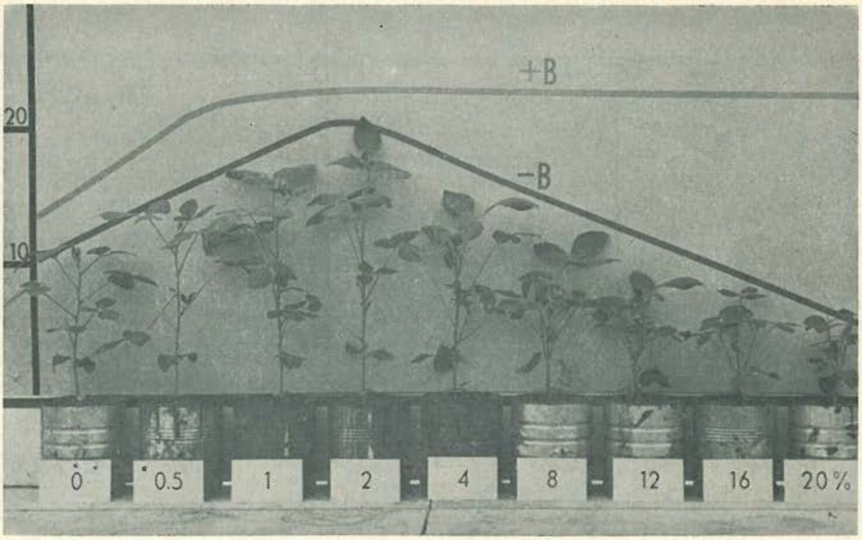


Figure 2—With no boron added, soybean yields decreased when K content of this soil was increased beyond 2% saturation—280 lbs. K_2O per acre.

sium compared to that of the nutrient solutions commonly used by other investigators.

Also a variation of the calcium content in the exchange complex of the soil between 20% and 60% as the content of magnesium varied reciprocally (between 60% and 20%) produced no observable differences in the characteristics of the plants.

It was apparent that the depression in the yields of the soybean plants at the high levels of saturation of the soil with potassium was associated with an interaction between potassium and some element other than calcium or magnesium.

The death of the growing tip of the plant, the prolific development of shoots at the axils of the leaves, and the brittle character of the leaf tissue suggested a *deficiency of boron.*

A further suggestion that some other element might be responsible for the depression in yields at high levels of soil potassium was offered by the results of an investigation reported by Parks and Rouse (2). They showed a serious depression in the yields of lespedeza at a potassium content of the plants of only 1.5%.

C. E. Marshall (1) grew lespedeza at levels of potassium in the soil that produced hay containing 2% of potassium with no suggestion of a depression in yield. Such great differences in the composition of a plant species and in the response of the species to high levels of soil potassium suggested that some other element must have been responsible for the differences in behavior.

BORON WITH POTASH

To determine which element might be responsible for the poor

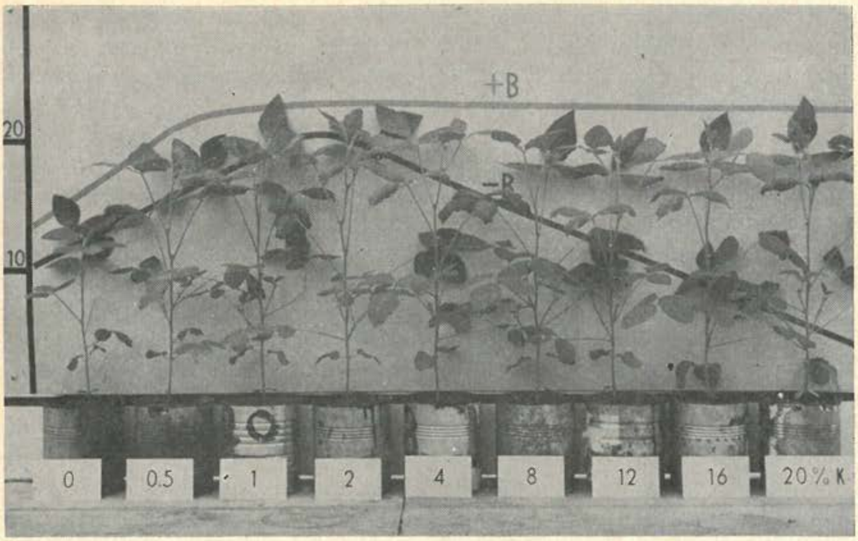


Figure 3—With boron added (2 lbs. per acre), soybean yields increased at all levels of soil potassium.

growth of soybeans at high levels of potassium in the soil, (20% saturation), a mixture containing seven additional elements and separate mixtures with one of each of the seven elements omitted was incorporated into the soils.

Three rates and three replications were used.

The soybean plants grew perfectly in all cases except where boron was *not* added (Fig. 1). Each of the nine pots of soil that had not been treated with boron produced soybean plants with characteristics identical to those of the plants in the original experiment where high levels of potassium had been used.

The rates of application of boron that grew satisfactory plants were 1, 2, and 4 pounds per two million pounds of soil. All three rates were equally effective in growing normal healthy plants.

The original experiment with nine levels of potassium, ranging from zero to 20% of the exchangeable cations as potassium, was repeated without boron and also with 2 pounds of boron per two million pounds of soil.

The amount of magnesium in the soil was kept constant at 24% of the exchange capacity while the amounts of calcium were varied from 56% at the high level of potassium to 76% at the low level of potassium.

Single plants of the Clark variety of soybeans were grown in 3200 grams of soil in No. 10 cans. Each of the nine levels of potassium, both with and without boron, was replicated three times. Photographs of the two series of plants one month after planting are presented in Figures 2 and 3.

With no more than 2% of the exchange complex of the soil occupied by potassium, the boron content of the soil to which no boron had been added, was sufficient to produce a normal, healthy-appearing plant.

Greater amounts of potassium induced boron deficiency in the plants which increased in severity with increasing amounts of potassium (Fig. 2).

The addition of boron at a rate of 2 pounds per two million pounds of soil provided sufficient boron for the normal growth of the soybean plants at all levels of potassium in the soils.

It is interesting that boron also improved the vigor of the plants below the 2% level of saturation by potassium (Fig. 3).

BORON ON PLANT COMPOSITION

There appears to be no suitable explanation for the relation between potassium and boron based upon their chemical properties in the soil. The relationship must be associated with the physiology of the elements in the plant.

At the low levels of boron in the soils that were not treated with boron, the plants contained acceptable amounts of boron when 2% and less of the exchange capacity of the soil was occupied by potassium, Table 1. Greater amounts of potassium reduced the boron in the plants where none had been added to the soil. The reduction was not great where boron had been added.

The potassium content of the plants varied according to the amounts of potassium in the soils in much the same manner irrespective of whether or not boron had been added.

With no boron, the calcium and magnesium contents of the plants were depressed markedly, from 1.5% to 0.3% for each, as the percentage saturation of the soil with potassium was increased from zero to twenty.

With boron, only small depressions, from 1.5% to approximately 1%, were noted. It would appear that the adverse effects upon plant growth and the uptake of calcium and magnesium when large amounts of potassium were added, must be associated with the absence of suitable amounts of boron in the plant system.

A casual examination of the amounts of potassium used in the soil and the energies of replacement of the potassium that were associated with them might suggest that the amounts of potassium were somewhat excessive. However, the energies of replacemnt of potassium from the nutrient solutions that are used by many investigators range from 1500 to 2000 calories. Most of the adverse effects of adding potassium to soils have been associated with topdressings of alfalfa or placement techniques that create localized zones of very high concentrations of potassium in soils. When viewed in this light, the conditions of the experiment were not so unusual.

Contrasted with the essential needs of plants for boron are the toxic effects of excess boron to which soybeans, in particular, are very sensitive. Also boron is one of the essential elements which must be distributed through the soil rather than concentrated in localized zones.

Therefore, boron should not be included in fertilizers to be drilled with the seed. Its proper use is in fertilizers that are broadcast and mixed with the soil.

CONTINUED ON PAGE 11

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CONTINUED FROM PAGE 8

Table 1. Composition of the soybean leaf* as affected by potassium and boron treatments of the soils.

Composition of soil with respect to K		Composition of plant leaves—dry basis							
		Untreated				With boron			
Saturation	ΔF	B	K	Ca	Mg	B	K	Ca	Mg
%	Calories	ppm.	%	%	%	ppm.	%	%	%
0	3920	11	0.4	1.4	1.5	75	0.4	1.6	1.4
0.5	3930	42	0.5	1.2	1.1	78	0.3	1.7	1.2
1.0	3740	24	0.8	1.1	0.7	47	1.2	1.4	0.9
2.0	3370	34	1.0	0.8	0.6	54	1.5	1.4	0.8
4.0	2920	11	2.1	0.7	0.4	50	1.6	1.1	0.7
8.0	2310	6	2.1	0.6	0.3	49	2.7	1.3	0.7
12	1980	6	2.2	0.6	0.4	39	2.6	1.3	0.8
16	1720	12	2.2	0.4	0.4	43	3.0	1.1	0.6
20	1580	Tr.	3.1	0.3	0.4	—	3.0	1.0	0.8

*Second trifoliate leaf removed after fifth trifoliate leaf had developed.

CONCLUSIONS

1. The reason for depression of growth of soybeans by large amounts of potassium on a low boron soil is complex. It is related in part to a depression of the uptake of boron by the plant and also the subsequent depression of the uptake of calcium and magnesium. With adequate amounts of boron in the soil, large amounts of potassium produced no such adverse effects.

2. The tendency of potassium to depress the concentrations of calcium and of magnesium in plants, sometimes leading to symptoms of deficiencies of these elements, may in many cases indicate only that the soils in question lack sufficient boron.

3. It would appear that where soils are low in boron, the evaluation of the effects of potash fertilizer by field plot tests should be made only in conjunction with applications of boron—or after ascertaining by means of soil tests that adequate amounts of boron are present.

4. If the results of soil tests are to provide reliable guides for the fertilization of soils, especially in regions where soils may need boron, then soil testing laboratories should be equipped to make a test for boron. A knowledge of the potassium-boron relationship should aid in establishing suitable standards for such tests.

NO LIME OR FERTILIZER

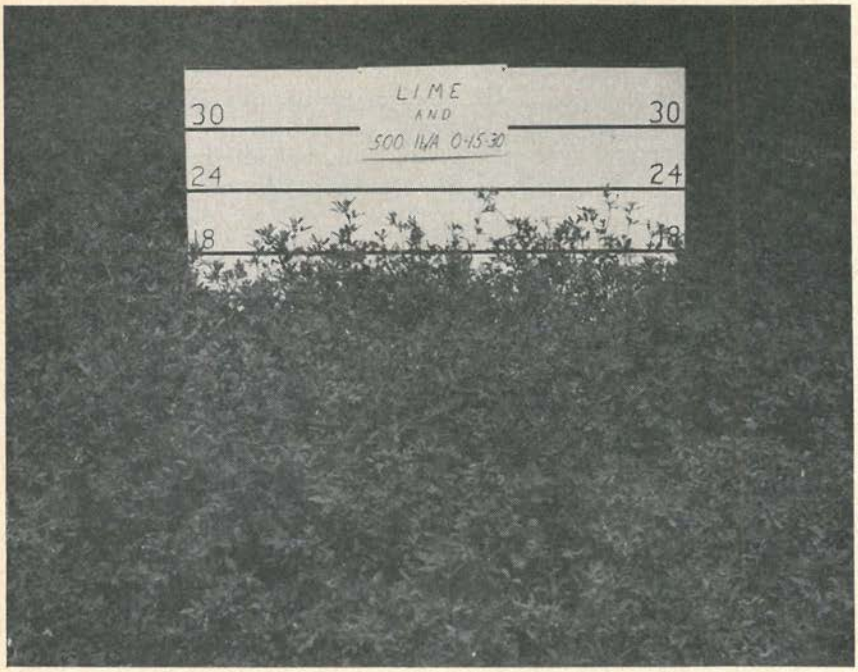
Alfalfa receiving no lime and no fertilizer is only about a foot tall at the time of second cutting of hay. Dr. James Miller, University of Maryland Extension Soils specialist, points that out here.

ARE YOU GETTING TOP YIELDS

ARE YOU getting top yields from your alfalfa?

Dr. James Miller of the University of Maryland Agronomy Department points out that yields of alfalfa are often reduced because adequate amounts of fertilizer and lime are not applied. Fertilizer and lime test plots with alfalfa have shown that yields are often increased on Maryland farms by 1.5 to 2 tons per acre with the use of fertilizer and lime.

Best way to determine the amount of fertilizer and lime needed to grow alfalfa successfully on your farm, Dr. Miller says, is to have your soil tested. The University of Maryland Soil Testing Laboratory at College Park will make the tests free. Your county agent can supply you with soil sample cartons and information on how to have your soil tested.



Alfalfa plot receiving lime and fertilizer—*as needed according to soil test results*—is well over a foot and a half tall. It yielded an extra ton of hay per acre from the first two cuttings.

WITH LIME AND FERTILIZER

FROM YOUR ALFALFA?

To show the importance of fertilizer and lime in profitable alfalfa production, the Agronomy Department in cooperation with County Extension Offices established demonstration test plots in a number of counties. The American Potash Institute has helped support the project through a grant of funds. The fertilizer and lime was applied to the plots according to soil test results. The response to fertilizer and lime has been very good at many of the plots. For example, yields obtained for the first two cuttings of alfalfa in a Howard County test plot this year are as follows: No lime and No fertilizer—1.66 tons per acre; 500 pounds per acre of 0-15-30—2.10 tons per acre; 500 pounds per acre of 0-15-30 and 1 ton per acre of limestone—2.64 tons per acre.

The above results show the importance of both lime and fertilizer in profitable alfalfa production. Dr. Miller points out that the extra hay from the two cuttings alone has paid for the cost of fertilizer and lime. He also states that alfalfa persists much longer when properly fertilized and limed.

Dr. Miller suggests that established stands of alfalfa be top-dressed annually with fertilizer. The time of application appears to have little effect on the total yield of alfalfa for the season and for this reason the fertilizer can be applied when most convenient. However, if you haven't applied fertilizer to your alfalfa this year, an application during August or September is recommended. In the absence of soil tests, Dr. Miller suggests the use of 500 pounds per acre of 0-15-30 or its equivalent. The fertilizer should supply 10 to 20 pounds of borax per acre.

THE END

". . . FOR ANY DAIRY FARMER WHO PLANS TO STAY IN BUSINESS"

Adelbert A. Magoon, Lamoille County farmer, has a simple formula that helps bring higher dairy returns. Reduced to its essentials, it means that a good alfalfa program is good business.

"Alfalfa hay produces more milk on less grain," he reports. "It has been a big help in my farm management program the last few years."

To make alfalfa grow where it wouldn't before, Magoon followed the advice of the Vermont Extension Service and other agronomists.

When he bought his farm 18 years ago, the pH was under 6.0. Magoon applied lime and fertilizer in the modern manner. Today, his alfalfa acres have a pH of 7.0 or better.

"I top-dress my alfalfa just as soon as I can get on the land in the spring," he says. "I repeat it after each of three cuttings. My best field is four years old. It looked as good last year as the first year it was seeded."

Magoon finds that a pH of 7.0 or above, plus highly fertile soils are essential to begin an alfalfa roughage program. Continued fertility maintenance is another big factor in securing a long stand.

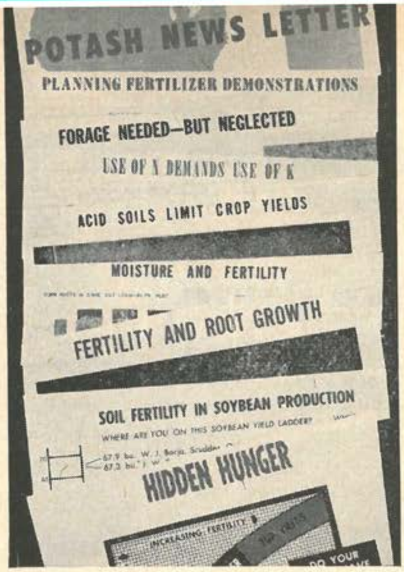
Two years ago, the top-dressings were a light coat of manure plus four applications of 200-250 lbs. of 0-15-30. Last year, the extremely dry weather forced cancellation of one of the 0-15-30 applications after the first cutting.

Magoon says he usually disks a complete fertilizer (300 lbs. per acre of 8-16-16) in with the manure at seeding time. Nitrogen and phosphorus are emphasized to push the cover crop and establish the seeding. The 0-1-2 ratio always is used for top-dressing to provide additional potash for maintenance.

Until Magoon abandoned his corn program two years ago, corn always was grown the year before the land was seeded. He applied lime on the corn year, plus 400 lbs. of 8-16-16 and a heavy coating of manure. Now, he finds, new seedings can be made directly from plowing of grass sod.

The Morrisville farmer likes alfalfa because it comes back quickly after a cutting, has three crops a year, is drought-resistant and cures quickly. Last summer, his alfalfa fared well while clover and grass dried up during the drought.

(CUT ON DOTTED LINE—YOUR MAGAZINE WILL NOT BE HARMED—SEE REVERSE SIDE FOR OTHER MATERIALS)



NEWS LETTERS

ON SPECIAL SOIL FERTILITY SUBJECTS

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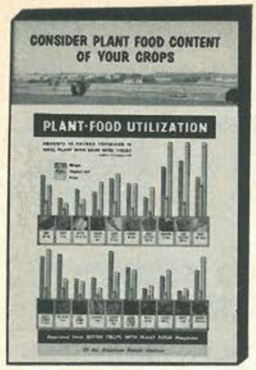
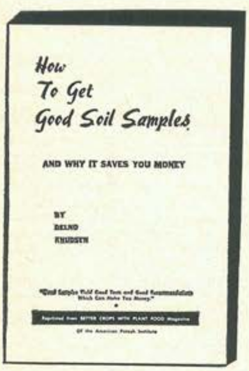


EE-12-57

Q-11-59



JJ-12-58

A KIT-OF-THREE FOR YOUR SOIL FERTILITY WORK

ON PLANT FOOD REMOVAL

This gives how much plant food your crops remove from the soil, a composite picture of the N, P, K contained in good yields of 28 important crops citing large removals by legumes, plant food sources, and the trend toward higher analysis plant foods.

ON FERTILIZER CONTENTS

This clearly explains what a fertilizer is, why it is important, what the different types are, the difference between material and grade and ratio, a look at specialty materials, how they should be used.

ON SOIL SAMPLING

This gives the steps to good soil samples—the advice, what tools, how to divide field, depth by auger or spade, proper mixing, labeling, diagramming field, information, proper packing, etc.

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ONE MISSING LINK RETARDS DEVELOPMENT

Each individual nutrient has a special function to fulfill in plant life. If the plant is short of only one nutrient, its whole development comes to a standstill. Plants inadequately nourished remain backward in their growth . . .

. . . . they remain small and form but little foliage.

. . . . their flowers cannot develop properly.

. . . the ears of the cereals carry only a few light grains.

. . . fruit trees bear few fruits.

. . . the tubers of potatoes and the roots of sugar beets remain small.

Very often the farmer attaches little importance to the gradual reduction of his yields but blames the weather or other uncontrollable factors. However, a day comes when the deficiency of nutrients *does* become visible. The plants show symptoms of acute diseases, as demonstrated in color pictures featured in past issues of this journal . . .

. . . the leaves show necrotic spots and margins, while development, fruitfulness, stability, formation of constituents such as vitamins, volatile oils, etc. are further restricted and reduced.

. . . animal and fungal pests attack the loose, badly developed plant tissues.

No farmer can afford to let things go as far as this on his fields. For he would have already suffered for a long time great losses by reduced yields. And once the soil is impoverished to such an extent, then much labor and money must be spent to put it right again. Therefore, apply the right fertilizers at the right time.

WITH THE single exception of the air we breathe, nothing is as important to our existence as water.

Clean, pure water—the universal vehicle of life—is in ceaseless demand on this earth of ours.

Today water supply is in danger. By 1980, the population of the United States will have reached 250 million, and our water needs will have more than doubled.

With all our scientific ingenuity, we haven't yet figured out how to get more fresh water than nature provides. Perhaps some day we can; we may *have* to.

For the present time, however, we because the United States is rapidly approaching the time when we will need and use all the water we can possibly get from every conceivable source: from the conservation of streamflow, from the greater use of underground sources, from the salvage of previously used waters of every sort, and from the most rigorous elimination of waste in water storage, transportation, and use.

Our headlong rush toward such a time is indicated by the computation being made for the Select Water Committee of projected water demands between now and years 1980 and 2000, as compared with potential in sight.

water-

in 1980, our demand will begin to

By Theodore M. Schad, Staff Director

Senate Select Committee On National

In the Carolina Farmer

must plan water development, and in some areas, water use, on the basis of how much of this vital resource is actually available. We cannot count on a scientific miracle to help us out.

The United States Senate, recognizing the problems we face in this area, established a Senate Select Committee on National Water Resources to study our water needs and sources on a comprehensive basis.

A breakthrough in new techniques, which I believe ultimately must come, can be achieved only after a long and arduous search into the innermost secrets of the water molecule and the atmosphere.

I hope that success will come soon,

These figures indicate that by 1980, at least five of 22 water resources regions into which the country has been divided for the purpose of the Committee's studies, will have generated demands for water that will exceed the sum total of the available supply, even with widescale reuse of water.

Import Water

This would necessitate either the importation of water from other river basins or the making of decisions as to which uses of water would have to be foregone in deference to other, more desirable uses.

These regions are in the western part of the country, and the Committee is not in a position to release specific figures on them until the studies are completed and checked. They may carry rather serious implications.

The 17 other more adequately watered regions face the need to build systems of dams and reservoirs such as only the more arid regions of the West have experienced heretofore.

This nationwide study of water needs *vs.* supplies, the first of its kind ever made, tells us that we are approaching a strange, new day in our land, when we must create a planned sufficiency of water, rather than passively enjoy a natural abundance of the resource, as in the past.

The results of this study will provide the primary basis for the report

exceed the supply

Water Resources

which the Select Water Committee will make to the Senate next January. This committee has been directed to find out how much water development will be needed between now and 1980; when and where it will be needed; and what the pattern of development should be.

Also, it was told to ascertain what the economic limits on water development are, and how much expenditure of public and private funds can be economically justified for water program.

While I cannot anticipate the Committee's action, it is not likely to recommend specific projects. Rather, it will probably indicate the nature and extent of development it believes required for each river basin, and will recommend legislative policy that will assist in meeting these needs.

Most of the background reports are now completed, or nearly so, and their contents are revealing. In addition to showing the tremendous quantities of water we will need to meet national growth, the studies indicate that preservation of quality of water will be of equal importance and difficulty.

Quality Problem

In fact, we appear to be much better prepared to provide the quantity of water needed than to preserve its quality.

The Committee's studies indicate that flows needed for dilution of sewage and industrial wastes under present treatment techniques will be extremely high. Such a large quantity of storage will be required for dilution that new techniques for handling waste must be developed.

As for example, by 1980 the Ohio Basin will require about twice the six-million feet of reservoir storage now available, in order to provide sufficient dilution for a reasonably clean river. This would still mean odorous and bad tasting water at certain times and places, and survival of only certain species of rough fish.

Recreation

We could live with such water, particularly since so many of us either have forgotten the taste of good water —or never knew it. But the need for increasing use of our rivers for recreational purposes indicates that the American public may demand something better.

Altogether, the studies show combined national water needs by 1980 of 600 billion gallons daily. This is all some engineers say that can be made available with present development techniques. It is about half of the total average run-off of all streams in the United States.

So one wonders: "Where in the world is the water coming from?"

The answer is that we are going to have to use our available water over and over again, cleaning it up each time we use it just like we send our dirty shirts to the laundry. Much of our total use—possibly half of it—will be as cooling water for electric power plants. This use leaves no contamination, but it does complicate the pollution problem by causing stream temperature to rise.

Rationing

If our water development is planned wisely, based on a pattern that will ultimately lead to full conservation and use of the waters of each basin, and if our planning is supplemented with proper management of water resources, we should have a sufficient amount in most places, although not enough for all the things people will want to use water for in certain areas.

Even if new methods are developed, and with treatment of sewage and waste to the point where only clean water is returned to the streams, we shall still ultimately need full conservation and regulation of the waters of most, if not all, of our important river systems.

The time will soon come when saying that a man spends his money like water will no longer be a way of describing him as improvident. For we are now entering a new period when we will have to spend our water like we should spend our money—to get the most possible for the most sparing use of this vital, limited resource.

THE END

LONG ALFALFA STANDS VIA PLANT FOOD

It's no trick to keep good alfalfa stands on those rolling hills for 8 or 9 years.

In University of Minnesota trials, alfalfa stands 8 or 9 years old are still producing up to 3 and 4 tons of forage per acre—where the right kind of fertilizing and management plan is being followed.

But with haphazard managing, the fields may be taken over by grass, J. M. MacGregor learned in plots at the Rosemount Agricultural Experiment station.

MacGregor found that potash, as well as phosphorus, is a must on long alfalfa stands. The most productive alfalfa plots after the first few years were ones receiving plenty of both nutrients.

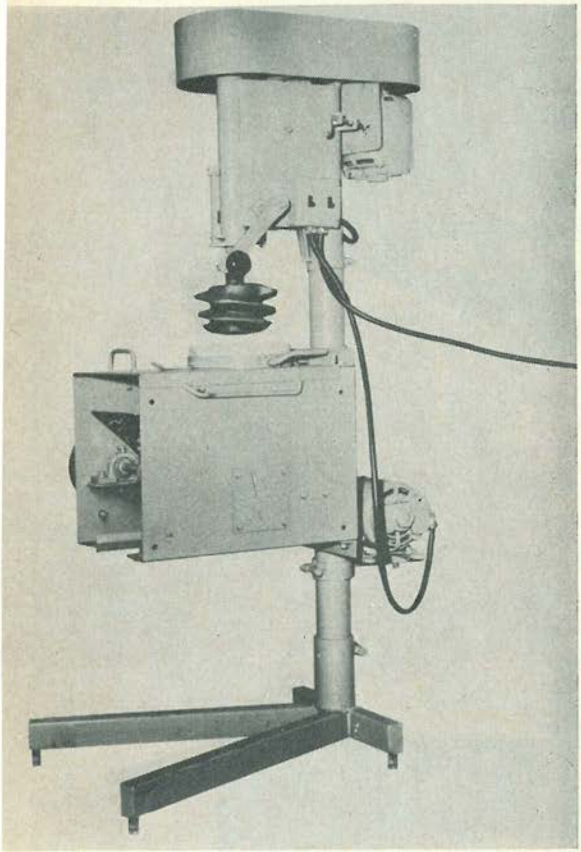
Annual topdressing was also important, and better than putting fertilizer on the alfalfa every other year. For the 8-year period, it cost $30 more to apply 200 pounds of 0-20-20 annually than every second year, but the annual topdressing also meant an extra half ton of hay per acre each year.

However, topdressing every second year was much better than not at all.

Starter fertilizer helped too. Where researchers applied a starter like 300 pounds of 0-20-20 the year before seeding and followed up with annual topdressings, alfalfa went 3.5 tons more per acre over the 8 years than with topdressing alone.

Fall topdressing brought results about the same as spring topdressing.

Based on these tests, 300 pounds was satisfactory application rate for the starter fertilizer.



Asplin mechanical soil pulverizer, developed in the soils laboratory of the University of Wisconsin, pulverizes soil samples in preparation for soil analysis in less than a minute. The new device is practically dustless in operation, can process samples 8 times faster than hand-grinding methods, maintains particles without grinding them into powder.

NEW SOIL PULVERIZER SPEEDS WORK

WITH A new machine developed in the soils laboratory at the University of Wisconsin's College of Agriculture, samples of soil can be prepared for analysis in a minute or less.

The invention accomplishes the job of deaggregating the soil to desired and uniform mesh sizes without crushing or "powdering" the individual soil crystals.

Wisconsin soils authorities state that one operator can process more than 100 soil samples in a single hour with the specially developed power-driven machine.

They point out that this kind of volume is from 6 to 8 times greater than an operator can produce by hand with the normally used mortar and pestle, and that soil samples prepared with the machine make it possible to obtain more accurate analytical results.

The Nasco-Asplin Soil Pulverizer, named for its manufacturer and its inventor, James Asplin, is described as a mechanized mortar and pestle.

It consists of a new type of finned pulverizing head which rotates at adjustable speeds. The head is lowered easily into a locked-in mortar to any desired level, depending on the amount and condition of the sample to be processed and the required fineness of the resulting particles.

The deaggregated soil is sifted through a screen which is kept in constant eccentric motion by means of a separate motor. The runoff through the screen is directed into a standard sample container.

The annoying, and often hazardous, problem of dust formation is practically eliminated in the Asplin device, largely because of the specially designed fin on the auger type head which creates a downdraft in the mortar and helps prevent dust from rising into the air.

Contamination of the sample by stones or other foreign objects does not injure the equipment, and because of the unique mechanical design of the pulverizer, these objects can be quickly and conveniently removed.

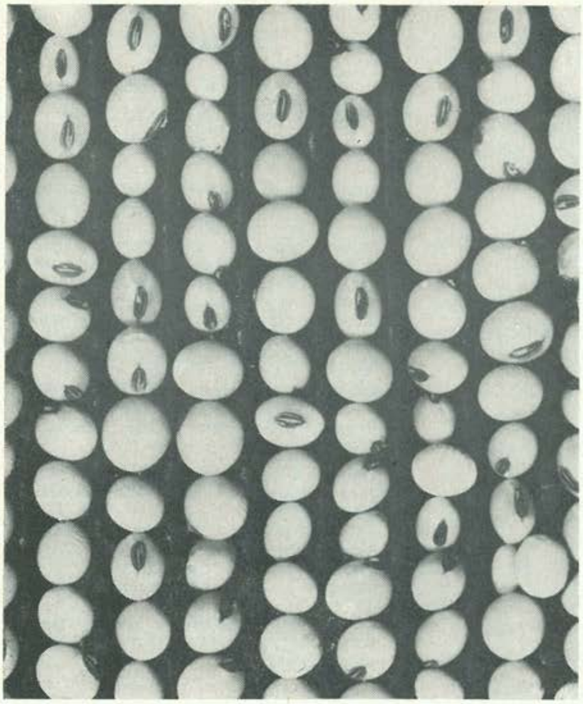
Soils experts state that with the increased volume of samples now being submitted to soils laboratories for analysis, the Asplin invention is a significant and important development. It makes it possible for soils laboratories to maintain a greatly increased rate of production and to process more samples more economically and more uniformly than in the past.

Of special importance is the fact that the Asplin machine is designed to separate, or deaggregate, aggregations of soil particles. It does not grind them into a fine powder.

Resulting chemical analysis therefore, indicates the levels of nutrients which are available rather than total nutrient content. The latter reading is of little use to the farmer in evaluating his soil. pH determinations are also more accurate when the soil samples are deaggregated instead of being very finely ground.

Patents for the new soil processor have been assigned by the inventor to the Wisconsin Alumni Research Foundation, Madison, Wisconsin, and earned *royalties will go into a fund from which grants are made to support scientific research at the University of Wisconsin.*

The Foundation has licensed National Agricultural Supply Company (NASCO), Fort Atkinson, Wisconsin, to manufacture and distribute the invention. **THE END**



FROM
RIGHT
NUTRIENTS

You may lose hundreds of dollars from hidden hunger before quality differences like these show up.

10 WAYS TO STEP UP YOUR

Suggested By The

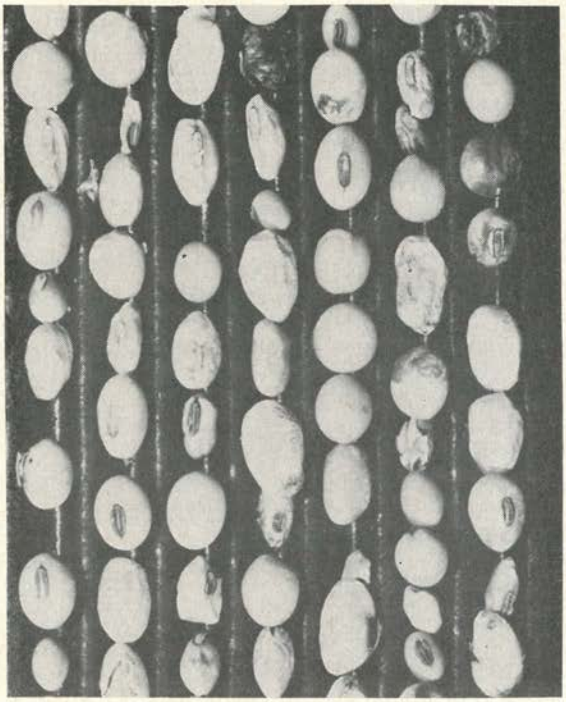
(1) Use Narrow Rows:

Research at Illinois shows that planting soybeans in 24-inch rows will give 15 percent more yield than 40-inch rows. The researchers found this to be true regardless of variety, location, and planting date. This increase from narrow rows raises a 30 bushel field to 35 bushels and that means the extra beans on a 50-acre field would be worth $400—worth doing something about. In southern states the advantage of narrow rows for early planting would not be so great. However, the gain from narrow rows increases there with late plantings.

(2) Fertilizer Placement is Important:

Ohio researchers tested four methods of soybean fertilization and found that the best stands and the highest yields can be obtained when the fertilizer is placed about 1½ inches to the side and 1½ inches below the seed. They say growers can lose as much as $20 to $30 per acre by placing the fertilizer too close to the seed. Well inoculated soybeans will fix

FROM EXTREME HUNGER



Poor quality beans, as the ones shown on the right here, only appear from stunted, late-mature K-starved plants.

SOYBEAN YIELDS

Soybean News

most of the nitrogen they need. A soil test is a good check on the phosphorus and potassium they may need. If there is a deficiency of manganese or iron in your soil then the proper application of manganese sulfate or iron sulfate will greatly increase yields. Your County Agent can be of help here.

(3) Weed-Free Soybeans Produce More Bushels:

Weeds and grass left in the row can be quite expensive. Tests in several states show that yields may be cut from 2 to 10 bushels per acre. The rotary hoe is an effective and economical weed killer in soybeans. Three year tests at Iowa with row-planted soybeans gave six bushels better yield for "timely" rotary hoeing plus cultivation than with cultivation alone. Increased herbicide technology should soon give us chemical weed control for soybeans at costs more comparable to cultural weed control costs.

Never give the weeds a chance. Many good farmers start the rotary hoe before the beans come up. They want to kill those weeds just after they germinate—while still "in the white". After the plants have emerged it is best to give them that second rotary hoeing in the hot part of the day. Run the rotary hoe fast enough and deep enough to stir up the soil and expose the little weeds to the sun. You will help the beans too. Two rotary hoeings and two cultivations generally give good weed control under ordinary conditions.

Missouri researchers found in two year tests, that on plots hand-weeded and cultivated twice, yields were increased an average of 7.5 bushels per acre compared with the yields of plots cultivated only. Where there were three cultivations, hand-weeding increased yields by 4.5 bushels per acre. A good pre-emergence herbicide giving results equal to hand-weeding would be worth from $9 to $15 per acre.

(4) Lime Acid Soil For Increased Yields:

A pH level of 6.0 to 6.5 is best in most states. A soil test will determine the amount of lime needed. Moreover, increases from fertilizer will be greater if the pH of the soil is brought up to the required level. A lot of other crops will benefit too.

(5) Use the Best Variety:

Length of days and nights is the primary control of soybean flowering and maturity. Since length of day is governed by latitude, varieties are adapted to rather narrow belts running east and west. Highest yields are usually obtained from a productive, well adapted full season variety, but for late plantings in the Northern States an earlier maturing variety will usually give better results. In the Southern States with a much longer growing season, the full-season varieties usually yield as well as earlier varieties even on late plantings. Seed should be pure and high in germination to insure good stands. Use disease resistant varieties where disease is a problem. Control insect pests.

(6) Best Yields Came on Fertile Well-Drained Soils:

Of course, soybeans grow better than most other crops on soils that are low in fertility, droughty, or poorly drained, but don't expect to break the state yield on that kind of field.

(7) Inoculation is Good Insurance:

For 10 to 15 cents an acre you can help this crop to fix its own nitrogen and even leave a residue in the soil for other crops. Use inoculation made especially for soybeans and follow directions on the container.

(8) Plant Enough Seed:

The general rule to follow is plant one good seed every inch of row. This encourages rapid growth and aids in weed control, but stands closer than 10 to 12 plants per foot of row may seriously increase lodging. Check your planter, see if you are planting the proper amount of seed.

(9) Plant At Best Time:

Soil temperature and day length determine the best time to plant soybeans. In the Northern States it is when the temperature and the soil are warm enough to give rapid germination and growth—which is about corn planting time. In the Southern States it is best to wait a while or the short days will cause most varieties to flower too early and thus reduce yield and quality and increase the problem of weed control.

Prepare a good weed-free seedbed, then just before planting the soybeans kill the weeds with a harrow or disk. Plant the seed 1 to 2 inches deep in moist soil. If the soil is too dry, better wait for a rain than to plant too deep trying to reach moisture.

(10) Don't Let the Combine Throw You:

The farm machinery makers have not yet got around to building machines especially for soybeans. Therefore, planters, cultivators, and combines made for other crops must be adjusted for soybeans. Adjusting the combine is mighty important. Harvesting loss can cut your profits; losses of 10 to 20 percent at combining time are not uncommon. Don't let it happen to you. Four beans to the square foot in the field means a bushel per acre.

Reel and cylinder speeds and cylinder clearance must be adjusted. Spend a little time checking your combine instruction manual for proper settings. It may pay better than any other time you spend with the soybean crop.

A WONDER CROP

SOYBEANS have become the wonder crop of the Southern States. Except for a few acres planted in localized areas largely for local markets, hay and home feeding, the soybean was not an important crop in the South 15 years ago. But since the war, acreage seeded to soybeans has skyrocketed. Yield per acre and total production have increased accordingly.

Total Production of Soybeans By States 1945, 1950 and 1959 in The Southern Planter Territory and U. S.

	1945	1950	1959
		(1,000 bushels)	
Maryland	585	1,139	4,202
Delaware	574	882	3,442
Virginia	1,264	2,888	5,966
North Carolina	2,700	4,752	9,592
South Carolina	70	744	5,920
Georgia	54	286	1,392
United States	193,167	299,249	537,895

Soybeans are ideally suited to the South. The crop fits well into Southern rotations, frequently making double-cropping possible after small grains, winter pasture and silage crops. There is a ready market for soybean oil and the oil meal finds an ever-expanding demand in the South's rapid shift to livestock, dairy and poultry production. Better varieties, better culture, and better marketing methods augur well for the soybean's future in the South.

—The Southern Planter

ON GRASS

NITROGEN ON GRASS PAYS . . .

- When the legume has failed or thinned out in grass-legume mixtures and it is impractical to renovate.

- When steep pasture land contains good grass stands.

- When soils are too poorly drained for growing legumes.

- When Bermuda grasses and other high yielding grasses are well-adapted to the climate and soil.

BUT NITROGEN F

. . . Because high-nitrogen
ously that they absorb larg

. . . Because these nitroge
phosphate, lime, and pot
from the soil—especially p

. . . Because yields and q
other plant foods are n
quantities. . . . .

PROPER FERTILIZATION PAYS

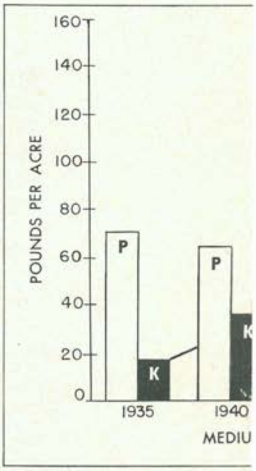
ON LEGUMES

POTASH IS A MAJOR KEY TO GOOD LEGU

- Because legumes need it more critically than they need any other plant food.

- Because yields are low, stands are rapidly lost without ample potash supplies.

- Because the need for potash has been clearly recognized by many states recommending as much potash for alfalfa as for such crops as tobacco and vegetables. . . .



. . . For example, potash
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rates remain about th

By S. E. Younts
N. C. State College

ERTILIZATION *ALONE* IS *NOT* ENOUGH . . .

treated grasses grow so vigor-
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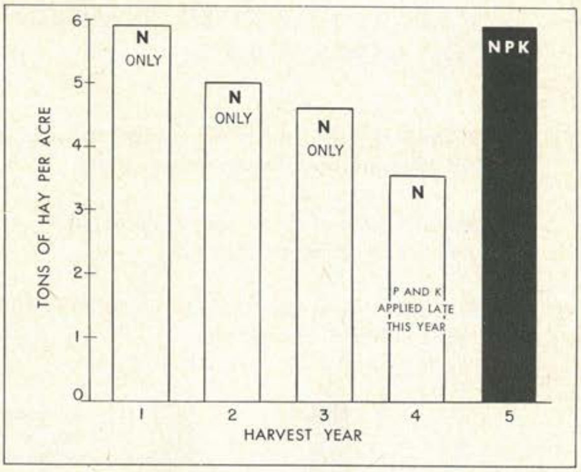
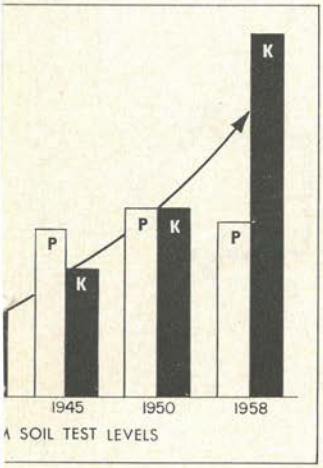


. . . For example, this orchardgrass, receiving 300 pounds of nitrogen per year, continued to decline in yields *until* 100 pounds of phosphate (P_2O_5) and 200 pounds of potash (K_2O) were applied late in the fourth harvest year. (Cornell data)

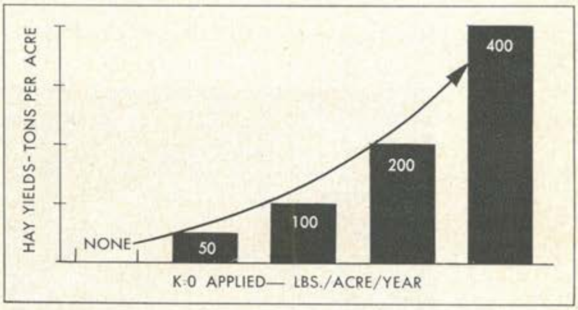
ME PRODUCTION



ates recommended in 3 mid-At-
nue to increase while phosphate
same.

IT INCREASES YIELDS . . .

Like this alfalfa-orchardgrass mixture

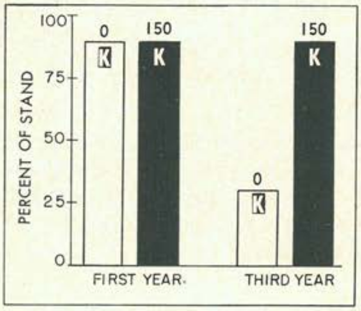


. . . And makes stand strong enough to resist encroaching grass and weeds . . . Like this 6-year-old pasture did.

POTASH APPLIED ANNUALLY LBS. K-0 PER/A	STAND COMPOSITION	
	% LADINO	% GRASS AND WEEDS
0	20.6	70.3
50	37.3	52.6
100	47.8	42.6
200	60.0	31.1

POTASH IS NEEDED TO MAINTAIN GOOD GRASS STANDS . . .

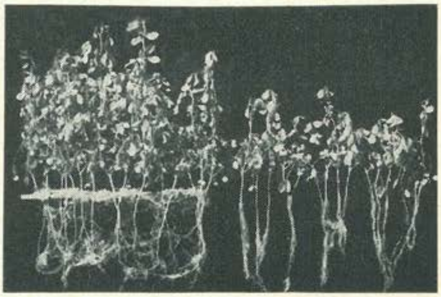
- Because it is the most likely nutrient to become limiting when nitrogen is applied to grass.
- Because lack of it not only reduces grass yield but also causes stands to thin out.
- Because it must be sufficiently available to insure high quality grass forage.



For example, two-thirds of this orchardgrass stand was lost by the third year after seeding because *no* potash was applied. But 150 pounds of K_2O maintained the stand.

. . . AND BUILDS LEGUME PERSISTENCE

- By building up carbohydrate root reserves
- By building up disease resistance
- By increasing strong root growth like this . . .



300 Lbs. 0-20-20 No Fertilizer

Remember:

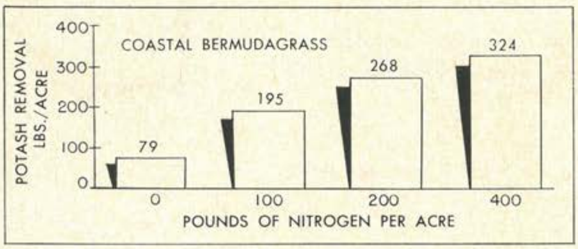
When grass and weeds creep in, look for potash shortage—for grass robs legumes of badly needed potash.

GRASSES CAN TAKE AS MUCH POTASH AS LEGUMES . . .

For example . . .

✔ One ton of grass hay and one ton of alfalfa hay remove about the *same* amount of *potash* from the soil.

✔ Tests show the more nitrogen you apply the more potash the grass removes.



✔ The 200-pound nitrogen rate produced 6.3 tons per acre, which removed 268 pounds of potash—or 43 pounds K_2O for *each* ton of grass hay.

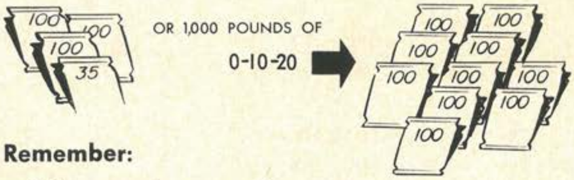
LEGUMES NEED SUFFICIENT POTASH . . .

For Establishment:

To insure seedling vigor at the start, some authorities suggest *80 to 120 lbs.* of potash per acre at seeding time on soils testing medium or less in potash.

For Maintenance:

To keep your stand going, remember a 4.5 ton alfalfa crop removes over 200 lbs. of K_2O from the soil. To get this much K_2O back in your soil would require 335 lbs. of muriate of potash.



Remember:

What potash your soil cannot supply must be gotten from fertilizers.

TO GROW GRASSES SUCCESSFULLY REMEMBER . . .

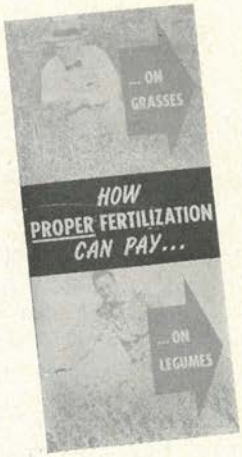
- High yields of hay pasture or silage depend on proper fertilizing.
- All high yielding crops demand—and use—extra plant food.
- Proper fertilizing means *complete* fertilizing—nitrogen *plus* adequate lime, phosphate, and potash.
- A soil test will tell you how much potash, lime, and phosphate you need.
- Consider how much nitrogen you apply and how much yield you expect—and add potash accordingly.

TO GROW LEGUMES SUCCESSFULLY REMEMBER . . .

- Grow them on well-drained soils.
- Use variety meant for your area.
- Have your soil tested and lime to pH 7.0.
- Develop firm seedbed.
- Use starter fertilizer (based on soil test) to promote seedling vigor.
- Maintain stand with care.

  For example—
  –On soils testing low potash apply enough fertilizer to give 200 lbs. K_2O per acre annually.
  –Watch for phosphate and boron needs.
  –Control insects and weeds
  –Cut and graze right

ORDER THIS MATERIAL IN FOLDER FORM



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POTASH PUSHED BEANS

Sometimes a late application of potash applied to soybeans will increase production. It depends a lot upon soil conditions. Last summer Charles Barnhill of Hoxie in Lawrence County, with the assistance of the county agent, diagnosed the yellowing of leaves of knee high Dorman soybeans.

From the color pattern of the leaves, a tissue test, and past cropping history they agreed that the plants needed potash. Barnhill put on 60 pounds per acre as a sidedressing. Weather and moisture conditions turned out well and the beans began growing. Four rows were left as a check. Barnhill estimated an increase of yield of from 3 to 5 bushels per acre.—W. A. Anderson, County Agent, in *Arkansas Farmer*.

DEPT. B.C., AMERICAN POTASH INSTITUTE
1102 16th St. N.W., WASHINGTON 6, D.C.

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For quantities above stated free policy:

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Bill me $______

ASHES OR

By T. S. Buie

FARMERS of the Southeast are beginning to ask the question: "Why burn grain straw for soybeans when they can be planted directly in the stubble with one operation?"

And they are answering their own question with their actions. More and more of them each year are seeding the beans directly behind the combine without land preparation. Time is thus saved and there is the added advantage of having the decaying plant residue to protect and enrich the soil.

Until recently the common practice of farmers throughout the Coastal Plains of Georgia and the Carolinas was to burn the straw as soon as possible after grain harvest, then plow and harrow the land in preparation for planting.

But that method is both wasteful and time-consuming. Frequently land

Why burn grain straw . . . when beans can be planted directly in lister rows . . .

MULCH

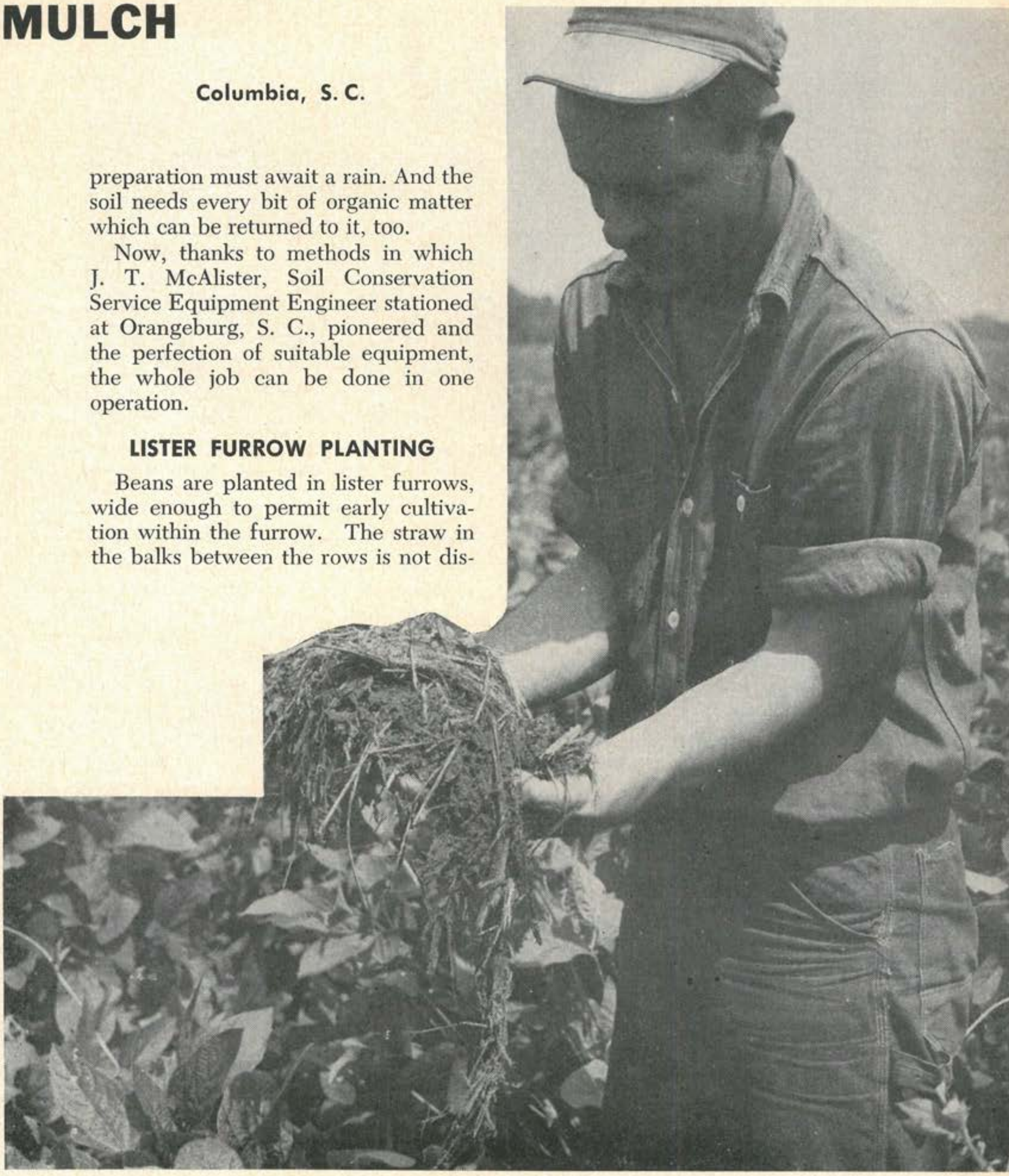
Columbia, S. C.

preparation must await a rain. And the soil needs every bit of organic matter which can be returned to it, too.

Now, thanks to methods in which J. T. McAlister, Soil Conservation Service Equipment Engineer stationed at Orangeburg, S. C., pioneered and the perfection of suitable equipment, the whole job can be done in one operation.

LISTER FURROW PLANTING

Beans are planted in lister furrows, wide enough to permit early cultivation within the furrow. The straw in the balks between the rows is not dis-



. . . leaving the residue to protect and enrich the soil

Everette Kneece, a cooperator with the Lexington (S. C.) Soil Conservation District, loses no time in planting soybeans after his oats are harvested. Note the tractor-planter following directly behind the combine. S. C. S. Photo.

turbed but covered with loose soil as the furrows are made. By the time the middles are plowed out in the later cultivations the straw has all but decomposed.

Benefits of this method of planting are: (1) Plant residues are returned to the land, (2) Soil moisture is conserved, (3) Beans can be planted earlier, (4) There are fewer weeds to combat, and (5) Time and labor are saved at an extremely busy time.

Farmers who use this method of conservation planting say their yields are as good as or better than where the beans are planted in the conventional manner. And, best of all, they estimate a saving of from $4.00 to $8.00 per acre—all profit, too.

The End

HOW THE WISE OLD WOODS COULD LAUGH

One day, thru the primeval wood,
A calf walked home, as good calves should;
But made a trail all bent askew,
A crooked trail as all calves do.

Since then two hundred years have fled,
And, I infer, the calf is dead.
But still he left behind his trail
And thereby hangs my moral tale.

The trail was taken up next day
By a lone dog that passed that way;
And then a wise bellwether sheep
Pursued the trail o'er vale and steep,
And drew the flock behind him, too,
As good bellwethers always do.

And from that day, o'er hill and glade,
Thru those old woods a path was made;
And many men wound in and out,
And dodged, and turned, and bent about
And uttered words of righteous wrath
Because 'twas such a crooked path.

But still they followed—do not laugh—
The first migrations of that calf,
And thru this winding wood-way stalked,
Because he wobbled when he walked.

This forest path became a lane,
That bent, and turned, and turned again;
This crooked lane became a road,
Where many a poor horse with his load
Toiled on beneath the burning sun,
And traveled some three miles in one.
And thus a century and a half
They trod the footsteps of that calf.

The years passed on in swiftness fleet,
The road became a village street;
And this, before men were aware,
A city's crowded thorofare;
And soon the central street was this
Of a renowned metropolis;
And men two centuries and a half
Trod in the footsteps of that calf.

Each day a hundred thousand rout
Followed the zigzig calf about;
And o'er his crooked journey went
The traffic of a continent.
A hundred thousand men were led
By one calf near three centuries dead.
They followed still his crooked way
And lost one hundred years a day;
For thus such reverence is lent
To well-established precedent.

A moral lesson this might teach,
Were I ordained and called to preach,
For men are prone to go it blind,
Along the calf-paths of the mind,
And work away from sun to sun,
To do what other men have done.

They follow in the beaten track,
And out and in, and forth and back,
And still their devious course pursue,
To keep the path that others do.

But how the wise old woods could laugh,
Who saw the first primeval calf!
Ah! Many things this tale might teach,—
But I am not ordained to preach.

Sam Foss

1935

TWENTY-FIVE years ago, this year, the American Potash Institute was launched on an important experiment in cooperation.

The time was July, 1935. The place was Washington, D. C., in a room about three blocks from the White House. The man speaking was Dr. J. W. Turrentine, then president of the new Institute and the chemist who had revolutionized the potash industry by inventing a process for vacuum cooling and crystallizing potash salts.

1940

He was making a point to a group of men vitally interested in the agricultural usage of potash:

"Gentlemen, potash use depends on the recognition of its function as a plant food, which is agronomic, and the ability of the farmer to buy his requirement, which is economic in its bearing on an ever growing and increasingly stable market. In fact, the agricultural usage of potash must be increased *only* on a basis that is sound and profitable to the farmer.

1945

"Consumer betterment is fundamental in our promotion of potash use. If we did not believe that, we should have no moral justification for existence as an Institute. We believe that the prosperity of the consumer is the best assurance of the prosperity of the producer."

1950

Dr. Turrentine was not speaking to a hall-full of official scientists or progressive farmers. He was talking to a private meeting of the Institute's 8-member Board of Directors, top-level officials from the nation's major potash producers of that day, realistic businessmen with the job of selling potash for a profit.

America's potash industry accepted his philosophy and through its Institute has just completed 25 years of applying scientific integrity to the wheels of commercial enterprise.

1955

Five years ago the Institute observed its 20th anniversary by devoting an entire issue of this magazine to an explanation of what the organization is, how it works, and regional accounts of the major cooperative work that has been done to find the proper place for potash in a profitable agriculture.

1960

AFTER 25 YEARS OF

AN OPEN LETTER TO OFFICIAL AGRICULTURE

Realizing a whole issue on the same theme just five years later might well succumb to useless repetition, we have decided to commemorate our 25th anniversary much more simply—but no less sincerely—through an open letter to the thousands of dedicated scientists and advisers of official agriculture who receive and read this journal.

After all, our story is your story. Everything we have done in the field of agriculture has been by invitation from you and in cooperation with you.

When anyone comes to us with the latest statistics showing that potash consumption has increased 760% in the past 25 years, that more than 2,250,000 tons of K_2O were consumed in the U. S. and Canada last year, that the average mixed fertilizer today contains 118% more potash than it did in 1935, we would be less than human not to hear them with some pride but also less than honest not to say who was responsible for those remarkable figures. You—in official agriculture.

Cooperation has been the key. Cooperation in research to find the need. Cooperation in demonstrations to prove the need. Cooperation in special activities to evaluate the need. Cooperation in educational information to teach the need.

IN QUEST OF COUNTERPARTS

How has this cooperation been possible—at times in earlier days in the face of official skepticism, sometimes antagonism toward anyone representing a commercial interest? The answer, perhaps, is in the approach and the men behind the approach.

It has been said that when the Potash Institute went out to staff its organization, it went in quest of official agriculture's counterpart. Men whose training and experience would enable them to work closely with agricultural scientists, whose information and guidance in all potash matters would be based on scientific evidence and the farmer's economic welfare. In other words, the same kind of men

CLOSE COOPERATION

FROM THE AMERICAN POTASH INSTITUTE

who are in federal and state agricultural programs—disciplined scientists, as objective as the human mind is capable of being.

Each member of our technical staff has been, at one time in his life, an official scientist or adviser himself. And to the institute each one brought the same adherence to careful, cautious scientific principles.

At times this approach has been considered perhaps too conservative in finding the "proper place for potash" in a rapidly changing agriculture. But it has been scientific. And science is sometimes slow because it must always be accurate in the end.

That is enough to say, on this 25th anniversary, about us as an Institute.

And now—to look upon some milestones which we have had the privilege of watching you erect and of lending a hand whenever you felt we could help.

THE KEY

To find the role of K in agriculture, we early realized that research was the key.

The great network of colleges, experiment stations, and extension programs was a natural laboratory and experimental system. Among the staff members were leading soil scientists. Studying under many of them were promising, deserving young men with a strong desire to do graduate work that would carry them on to important careers in agriculture.

The Institute was determined to find real needs for potash principally on regional problems under local conditions. So we came to you with our first grant. Exactly what it covered or where it was is not important. But we said there were no strings attached. We said we were seeking to find how K could be used most effectively in areas where it was already used. We said we would like to find some new areas of usage when possible and did not want to forget the possibilities in new crop outlets.

Although most of our projects have been conducted around potash, virtually all of them have involved all other plant foods in proper balance. They have also provided findings on other crop production factors. This has been due to the diligence with which the research has been pursued by the many graduate students and their advisers.

We have come a long way with you since that first fellowship in 1935. In fact, official agriculture has given us the opportunity to invest more than $1,500,000 into cooperative investigational projects—which have included more than 100 potash fellowships granted to over 225 graduate students in 40 states and provinces, as well as thousands of field demonstrations and tons of potash salts and mixed fertilizers.

There is not space to call the roll of the many faculty advisers who have guided these potash projects and the students who have conducted them on their way to important careers in agricultural education and business.

Since we cannot mention them all, we shall mention none by name. But we should not leave unmentioned the fact that many of the faculty advisers who have guided potash fellowships—and now many of their former students—are nationally known figures, some internationally known in their fields.

It is not uncommon when visiting many parts of the nation to find a former potash fellow serving as State Extension Director or as Assistant Director of an important Experiment Station or as a Department Head in a major university or as a top-level official in a large agricultural business.

Official agriculture trained them, guided them, led them to the gate and pointed the way. Our role was simply to assist in finding worthwhile research needs and in supplementing the cost of the training.

NOT IN 1,000 YEARS

Soil tests, tissue tests, leaf analysis—all these techniques official agriculture eventually launched and has now perfected to the point that most states have an official soil testing service and some a leaf analysis program receiving samples, not by the hundreds as 10 or 15 years ago, but by the thousands.

The attitude toward potash in the West in the early days is a good example of the challenge science faced—and met. Remember the honest belief that potassium would not be needed in California soils "in 1,000 years?"

Some scientists could not contain their curiosity, however; and began searching among leaves to see if the foliage would reveal anything about the plant's hunger—or lack of it. They started calling it leaf analysis. We welcomed the opportunity to encourage this approach in any way we could.

Eventually official science accepted a potash fellowship to try to develop chemical analysis of leaves as a reliable way to determine the plant food needs of fruit crops.

It was a job essentially of establishing proper leaf sampling (where and when to take them), a rapid chemical procedure for analyzing them, and accurate correlation of the results with responses in the field.

You—and we both—soon learned that different crops would require different sampling techniques and the critical level of potassium in the plant would vary greatly with the crop.

Soon the technique was perfected enough to run extensive surveys on grapes and tree fruits, later on sugar beets, potatoes, small fruits, even alfalfa, and now cotton.

Before long a number of potash deficient areas were turning up where all of us had thought there was plenty for the crops. Some stations started getting occasional reports from large growers about how the new leaf analysis technique had put the finger on the cause for their losses.

After applying sufficient quantities of the nutrients found in short supply in the plant, many reported increases in tree vigor, fruit size, and yield. On experimental orchards official scientists were learning by observation, analyses, and treatment tests to confirm the analyses that leaf scorch, dieback of twigs, stunted trees, and lack of new growth could mean nutrient deficiency—often potassium.

WHY SOIL TESTING?

As recently as 1935, there was no soil testing in the South—none to speak of. By 1959, an estimated 400,000 soil samples were analyzed for southern farmers alone.

At first, soil testing was looked upon by most specialists as so much witchcraft trying to invade agricultural science. But among them were a few scientists who saw the potential and with whom we welcomed the opportunity to cooperate on fellowships eventually involving soil testing—

early in such states as South Carolina, then North Carolina and Georgia, then Mississippi, Tennessee, Arkansas, Louisiana, and Texas, and more recently Oklahoma.

Our role in these efforts, of course, was determined by your policies. After all, we were your guests, sometimes offering suggestions, sometimes receiving them, but always plugging for the soil test.

We believed in the soil test for many reasons. The main one, perhaps, was this: That sound soil testing services in the different states would be one of the best ways to help farmers understand that there was such a thing as "total" potash and "available" potash in their soil.

Many people used to believe that large total potash supplies naturally present in most soils insured these soils from ever needing potash fertilizers for many, many years.

This was before the concept of "availability" had become very well known. It was before official research had shown how the processes of potash release from insoluble minerals by "weathering" were too slow to provide the required nutrients that intensive cropping demanded in a brief growing season.

The reason farmers—and all of us, for that matter—used to underestimate potash needs is because many soils in the U. S., even in the South and East, are relatively well supplied with *total* potash.

The red clays of the Piedmont Plateau are a good example. Occupying large portions of the S. E., they may contain 40,000 lbs. of total K_2O per acre in the topsoil alone.

But later soil tests began to show the *available* potash in these soils is only 100 to 150 lbs. per acre. So, if an average crop was removing about 75 to 100 lbs. of potash per acre every harvest season, the effect soon became apparent to a lot of people. An average crop yield meant little, if any, *available* potash left for the next crop grown on that soil.

This whole concept of potash availability (and your earlier plant food content work to determine how much plant nutrients average crop yields remove from the soil) has been a major milestone on the road to more efficient, profitable crop production on less acres—not to mention sufficient food supplies to keep up with a rapidly growing population.

PLACEMENT PROBLEMS ARISE

Another milestone has been official agriculture's work on fertilizer placement. Remember the older corn planters? They either didn't have fertilizer placement attachments or placed it more or less in contact with the seed, causing injury from even moderate applications. Around this time, in the day of the 125-lb. bag, the saying often went "a bag per acre." The motive, supposedly, was to prevent injury to the germination and seedling process by any heavier applications. Even the upper limit of safe application was around 150 lbs. per acre.

Scientists began to see that fertilizer placement methods should be changed as fertilizers of higher nutrient content were adopted. They began to explain to the farmer that he just could not safely place a 4-16-16 or 5-20-20 fertilizer, for example, in the same way he once placed a 2-12-6.

If he asked why, the answer usually hinged on nitrogen and potassium. You explained that potash and most nitrogen materials are soluble, and in moist soil the soil solution in the area of fertilizer may become very concentrated. This solution can injure germinating seeds or roots with which it comes in contact. Such explanation began to convince the farmer he'd better avoid concentrating any large amount of fertilizer in contact with the seed.

Work began on fertilizer in bands. At first fertilizer placed in bands or ribbons on both sides of the seed, near but not in contact with it, gave best response. Equipment then came along. Heavier applications in the Midwest soon produced some remarkable corn yields. Some farmers in the Midwest, the West, and Canada were also trying fertilizer applied in bands on the bottom of the plow furrow.

As the nutrient content of fertilizers continued to increase, you began trying single band placement as a safe, efficient method. After all, as recently as 1956 most farmers were using their old split-boot equipment to put down row fertilizers containing about 3 times as much soluble salts as in 1949.

Single band placement, putting the fertilizer in a band about 2″ to the side and 2″ below the seed, produced good results in many experiments. Not long after the method was officially recommended, we had the opportunity of issuing a publication on the subject—written by some of your top specialists—as well as a slide set and script developed with your aid.

WHY SO LITTLE RESPONSE?

On the West Coast we soon faced an interesting question with official agriculture: Why couldn't response to potash in orchard soils be as easily obtained as response to nitrogen?

Official science was finding that even on low-potash soils potash applications sometimes failed to give response. Carefully analyzed leaves showed very little potash intake, even when it was applied.

Something was wrong. We suspected soil fixation. Some soils will lock up most of the potash and make it unavailable to the plants. To try to overcome this problem, we worked closely with your specialists, studying rates and methods of applying *enough* potassium.

At that particular time, much of the potash used in the West was applied in small quantities usually broadcast on the surface soil—or, if applied in bands or ribbons, drilled at shallow depth where it remained ineffective.

The first efforts for more effective application (or placement) were with tree crops. Large units per tree were applied—a concentration of potash in shovel holes and furrows below cultivation depth. Rates ranging from 15 to 50 lbs. K_2O per tree were tried, soon revealing interesting things about potash absorption by the plant.

Using leaf analysis to measure potash intake and the effectiveness of various application methods, two experiences important to the orchard grower were observed: (1) that heavy initial applications of potash, applied in furrows, were more quickly effective on tree conditions and crop, (2) that such applications were economically practical because they had residual (carry-over) effect for 4 or more years.

Soon the furrow application method of heavy potash rates was being put into commercial practice to put potash into the trees where lack of it was limiting production.

Yes, we believe the way you have kept on top of the placement problem—always searching, testing, anticipating more efficient ways to use increasingly nutritious plant food —is, indeed, a splendid milestone.

NOT SO "LUXURIOUS," AFTER ALL

Your work on the nutrition needs and peculiarities of certain important crops has been another milestone. We cannot mention them all. But we shall long remember a problem official scientists in the East—in New Jersey to be exact—once tackled and solved. It had to do with alfalfa and clover. The yield—or production—was dropping off in spite of adequate fertilization, or what they considered to be adequate fertilization.

Since legumes are heavy potash eaters, the scientists decided to run some tests with potash. They topdressed up to 400 lbs. of potash per acre each year on established stands. The results were surprising—even to us, after they invited us to look in. Production of both clover and alfalfa increased. Longevity of stands greatly improved.

At the same time, they had applied low applications of potash on the same type stands—to see if this really was the problem in this case. The alfalfa died out in a year or two. But with high potash, the alfalfa persisted for 7 or 8 years—sometimes longer.

A big principle was involved here—one that has been repeated in many places studying alfalfa nutrition problems. It is called "luxury" consumption. Alfalfa absorbs relatively large amounts of potash, at times beyond the point of furthering the yield.

This has often caused official specialists—as well as us—to caution farmers about using too high applications. It was not considered economical.

But through this New Jersey experience we all saw that a certain degree of "luxury" consumption might not be so "luxurious" after all, if it means prolonging the life of the stand. In other words, work on this problem is indicating more and more what a fine line there seems to be between impractical and practical amounts of potash on alfalfa to maintain the stand for an economically profitable number of years.

Out of this particular project grew recommendations of 180 lbs. potash per acre annually for alfalfa in that state—

now up to 270 lbs. K topdressed annually. Not many years before, someone had said topdressing established fields with phosphate and potash was not a paying practice.

Similar interesting experiences could be reported on cotton and peanuts in the South, on corn and soybeans in the Midwest, on fruit and potatoes in the West, on forages and fruits in Canada. There isn't space.

But speaking of solving problems in crop nutrition, your refusal to be defeated has always amazed us. When crops have failed to respond to fertilizer applications called for by your various soil and leaf tests, you have kept searching. Your soil compaction discovery is a good example.

AFTER MUCH TRAMPING

In one area, something as simple as men walking across a golf green gave your scientists an idea. After much tramping by people, they found the soil badly compacted, reducing the air space in it, limiting root development and absorption of plant nutrients. If people could do that to a golf green, then surely increased use of heavy machinery, often in unfavorable weather, might cause harmful compaction in field soils.

They found a good amount of compacted soils—restricting root development, causing some plants to lodge easily, to suffer more than usual during drought, to be damaged by rainy periods.

They reported that the lack of good aeration for roots to breathe sufficient oxygen was one of the big problems in such compacted soils, preventing many crops from absorbing enough applied nutrients to get adequate response.

They advised greater care in working soils under unfavorable weather conditions, as well as use of certain implements to break up the compacted soil. But they warned that these steps might provide only temporary relief—that deep-rooted legumes, such as sweet clover and alfalfa, might be very valuable in fighting this problem since legume roots have the ability to penetrate a compacted soil layer and help open it up, as well as add organic matter.

Out of such work eventually came a soil core sampler for getting accurate samples of the soil profile from measurable levels. Cleancut cores soon made detection of compactions a simple matter, while the chalk-water test became a good way to determine soil porosity.

Your discovery that soil type alone is not a safe basis for making fertilizer recommendations led to other important developments.

Your scientists began to find that many farms, on the same soil type, often have different plant food needs due to previous differences in soil treatments and cropping practices.

Many specialists began warning the farmer that higher yields from new corn hybrids, from improved varieties of wheat, oats, barley, from insect and disease control on such crops as tomatoes and potatoes were all factors draining away more of his natural soil potash.

HIGH N MEANS MORE K

A major development was the realization that usage of more and more nitrogen, in mixed fertilizer and as material, was automatically increasing the potash need of many soils.

This principle started showing up in many yield tests on corn, even on grass (surprisingly, at first) where high nitrogen treatments had increased the yield—you might say "the grass's appetite"—so much that most of the available potash was being removed from the pasture soil.

Of course, grass is a greedy feeder on potash, anyway. But the point was established—that most factors which increase yields automatically increase potash needs. Nitrogen seemed to be no exception.

The years of careful scientific usage of nitrogen on many of the orchards of this continent—in the East, on the West Coast, in Canada—were probably an important factor in the many discoveries of potash needs on some of these orchards by the 40's and 50's.

One such experience in Canada stands out in our memory. At the Vineland Station in Ontario Province, the scientists began to notice leaf scorch and "die-back" among their apple seedlings and in the peach orchards. At first, they thought it might be spray injury or winter killing. But then they began to suspect potash trouble by the looks of the foliage.

They ran tests on some of the afflicted trees. Potash deficiency was indicated. From just moderate applications of muriate of potash the recovery of the seedlings was amazing. Kodachrome pictures recorded conclusively the quick recovery of the potash-treated trees, while the untreated trees grew progressively worse and finally died.

From this experience, they began to wonder about the whole Niagara District, which led to a systematic study of the nutritional levels of the orchard soils in this and other areas.

In four years, they surveyed the most important orchard sections of the Province, finding potash needs in several places. Many growers are now familiar with the symptoms once suspected at Vineland—in fact, now believe in checking out their nutrient needs periodically and scientifically.

Somewhat similar experiences with potatoes in the Caradoc community of Ontario were just as interesting. There, we recall, the people observed the community's prize crop drop drastically in quality, yielding pear-shaped potatoes of atrocious cooking quality that threatened the reputation of growers who had always taken pride in their product.

The trouble was threatening their business. Some thought it was a virus. Others suggested a pathogenic organism not yet identified. Federal and Provincial officials, along with the London Chamber of Commerce and the growers themselves, organized a fact-finding survey. They invited Ernie Hampson, of our staff, to serve with this group.

The group had the cooperation of a government potato expert who conducted a scientific investigation. Nutritional tests were the basis. He found the soils had become greatly depleted of minerals and organic matter. Tests proved conclusively that plants nourished with adequate potash produced normal shaped potatoes.

Good yields returned. Quality and shape, too—plus a hard-won reputation as producers of superb potatoes.

RESEARCH INTO DEMONSTRATIONS

We of the Potash Institute early realized that research results which go undemonstrated usually go unused. For that reason, we have welcomed many of the opportunities you have given us to cooperate with you in getting your research findings to the farmer in a way he can understand —and use.

Many of the potash projects in which we have cooperated have taken the form of demonstrations comparing different fertilizer practices. They were not designed simply to show the value of potash but to promote a sound, well-balanced fertilizer program along with other good farming practices.

This demonstrational work with you has taught us two important principles—(1) that it is necessary to grow crops under approved conditions on plots adjacent to unfertilized or inadequately fertilized plots to show the difference, (2) that there is no such thing as a permanent plant food ratio and per acre rate of usage.

This is true because agricultural science moves constantly forward and soils undergo constant change—sometimes to their improvement but too often to their own detriment through depletion by cropping, leaching, and erosion.

While working with you of official agriculture on many demonstrational efforts, we have observed you teach more and more farmers to be as agronomic-conscious as they are dollar-conscious when considering their fertilizer program.

In fact, many official economists began explaining to the farmer some time ago that a large return per dollar invested in fertilizer does not mean he is making the most profit—but is actually using too little fertilizer. Their point was this: that if enough fertilizer is applied to give near maximum yields, actual return per dollar invested in the fertilizer itself will be less but his *total profit much greater* from increased efficiency of farming at higher yield levels.

Usually located near highways and clearly placarded, the cooperative demonstrations have often been used as focal points around which to organize meetings for farmers, teachers, fertilizer representatives, and other people in related fields. Out of them have grown local newspaper articles, photographs for extension publications, and official data increasing the known benefits of potash in crop life.

JUST TWO—FOR EXAMPLE

But the big factor about these thousands of demonstrations is the success you have had with them—the impact they have had on farmer practices, in all parts of the land. An example or two of how your specialists have converted research into demonstrations into usage should not go unmentioned.

We have in mind an unusual alfalfa program in Tennessee and a tissue test survey in Missouri.

In Tennessee, alfalfa acreage had dropped from 183,000 acres in 1949 to 100,000 acres in 1952—a nearly 45% decline. The growers said they were not getting good production, their stands were hard to maintain. Station and Extension specialists invited some of our southern staff to join them in a tour to study the problem. Together, out of the number of factors uncovered, they all agreed the chief cause of the trouble was an inadequate maintenance fertilizer.

They decided to set up cooperative fertilizer demonstrations on about 100 alfalfa fields in the major alfalfa-producing counties of the state. One acre of alfalfa in each field was treated with needed quantities of fertilizer, the rest of the field left as the farmer ordinarily treated it.

The results surprised everyone. Tennessee farmers *saw* without question that they could grow alfalfa very successfully when they fertilized it and managed it properly. Once again alfalfa acreage is increasing in Tennessee, as farmers follow official suggestions on annual applications of such grades as 0-12-12, 0-10-20, and 0-9-27, all containing borax.

In Missouri a few years ago after tissue testing had become an accepted diagnostic technique, your specialists invited some of our Midwest staff to cooperate with you in surveying 125 cornfields in Montgomery County. The object: to determine by use of the tissue test and quick soil test just how well the soil testing recommendations from Missouri's Soil Testing Laboratory were meeting the farmer's need.

The tests effectively pointed out hidden deficiencies, as well as showed the value of fertilizing according to soil tests.

Many of you have said experiences similar to these helped cause the outstanding soil testing programs now serving states all over the Midwest—such as those in Kentucky, Missouri, Kansas, Michigan, Ohio, Iowa, Illinois, Indiana, Wisconsin, etc., often resulting in soil test summaries that pin-point major deficiency areas.

Out of cooperative projects in the East grew soil testing laboratories in such states as Virginia, Maryland, and New York, as well as leaf analysis for determining needs of fruit trees in such states as Pennsylvania and New York.

ON AND ON—THE MILESTONES

How you developed the dipicrylamine filter paper test for potassium in plant tissues at Penn State, with later modifications made at Illinois and Purdue, is a whole story in itself—not to mention the earlier Purdue Rapid Test Kit. By the mid-50's official specialists were requesting potash test papers to conduct tissue tests in some sections, as our staff welcomed invitations to help trouble shoot wherever we could.

All this rapid test work early pointed the way toward the hidden hunger concept, now understood by more and more farmers. Science began telling him the hunger he could *not* see, although not as harmful to his crops as the hunger he could see, was still a heavy drain on his profits and well worth guarding against. The best insurance was simply to use recommended amounts of plant food, preferably based on scientific soil and plant tests.

On and on the milestones could go:

Reports on reduction of frost injury of potato vines by high-potash fertilizers in Michigan—teaching of high potash needs of muck soils in Indiana, Michigan, and Ohio—outstanding responses of corn and wheat to potash applications on Hopkins' "Poorland Farm" at Salem, Illinois, where only lime and phosphates had previously been used—root studies on corn, wheat, soybeans, clovers, and alfalfa grown under different fertility conditions in Illinois showing how lack of lime, phosphate, or potash restricts root growth, as well as top growth—cherry leaf analyses confirming potash need in Wisconsin—grape trials and leaf analyses showing K need in Michigan.

They are all major stories within themselves—out of just one region, the Midwest.

TO SUPPLEMENT EYE-WITNESS

Demonstrations are fine. Seeing is believing. But there are *millions* of farmers. Only a small fraction are ever organized into tours to visit demonstration plots, especially during busy summer months when results are at their best.

We—as you in your informational offices—early realized how important it was to supplement eye-witness education with educational publications that were practical, up-to-the-minute, and scientific.

Our magazine, *Better Crops with Plant Food*, its reprints, our regional news letters, handbooks, folders, wall posters, movies, slides, all grew out of this belief.

Many official scientists and specialists have said they consider our little magazine almost an official bulletin. Why? Because the vast majority of the articles in it have been written by you. That is the purpose of it—to circulate useful reports and findings from important research studies in official agriculture.

We have just compiled some figures on the distribution of our publications during the past 25 years. They greatly surprised us. We believe they will interest you.

As you read them, you should remember that you are responsible for them. You wrote most of the material. You requested it for various uses in your work. We were only an instrument through which your information could be nationally circulated.

During the first 25 years of our Institute, official agriculturists and a few authors in related work have published 1,405 articles in *Better Crops*. Out of these, 1,029 articles have been reprinted and distributed on request. You have requested 10,317,050 copies of these reprints to use in your work. This includes our special handbooks of recent years.

These reprints have covered every subject from How To Get Good Soil Samples to Efficient Management for Abundant Pastures. It is not possible to list all of them and their authors. More than 60 of them have enjoyed circulations ranging from 20,000 to 100,000, ten of them 100,000 and much higher. Such subjects as What's in That Fertilizer Bag, What Is the Matter With Your Soil, Alfalfa—the Aristocrat, Potash Losses on the Dairy Farm, Year-Round Grazing, Fertilizing Vegetable Crops will ring a familiar note to many.

The largest single circulation—445,000 copies—has been made by the reprint, Consider Plant Food Content of Your

Crops, which features a composite picture of the N, P, K contained in good yields of 28 important crops.

In addition, you have requested 333,000 copies of our color posters on Plant Food Utilization, Cotton Rust Is Potash Starvation, and Potash Deficiency on Corn and on Legumes to use on your walls. And of our folders, you have requested 2,400,000 copies.

Since the first Potash News Letter appeared on July 17, 1935, we have published 356 issues—11 out of Washington, 108 out of the East, 118 out of the South, 104 out of the Midwest, 26 out of the West, and 4 out of Canada. Your usage of these has totaled around 2,000,000 copies in 25 years.

The advent of color photography provided you and us with a most useful educational tool—one of the really important means of increasing more and more people's knowledge of nutrient deficiency symptoms on crops. Out of it have grown special publications illustrating potash deficiency signs as they actually appear on different crops.

With your help and close cooperation, we have produced more than 20 motion pictures, most of them in color and sound on various phases of sound fertility. Many of you, perhaps, are quite familiar with "The Plant Speaks" series. Our latest is "Growing Alfalfa Successfully." Many land-grant colleges and official agencies over the country have served as distributing agencies for all these films. For the past two decades they have reported more than 80,000 showings to more than 5,000,000 people.

In addition, you have helped us put together slide sets and scripts authentically treating such subjects as Soil Fertility and Soybeans, Successful Alfalfa, Fertilizer Placement, and Potassium Hunger Signs.

And there have been hundreds of exhibits, contests, conferences, roundtables, committees, professional societies, etc. in which you have invited us to participate and cooperate.

Some of our happiest opportunities have been with crop production contests, watching vo-ag students in a state like Mississippi compete under the guidance of their teachers over a 4- or 5-year period for crop yield awards or providing champion 4-H tobacco growers of a state like Kentucky with trips to their National Convention.

You have permitted us to donate samples of potash salts,

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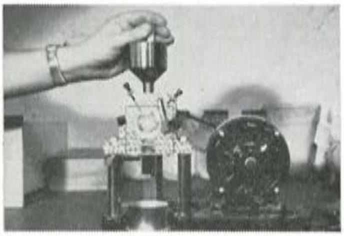

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