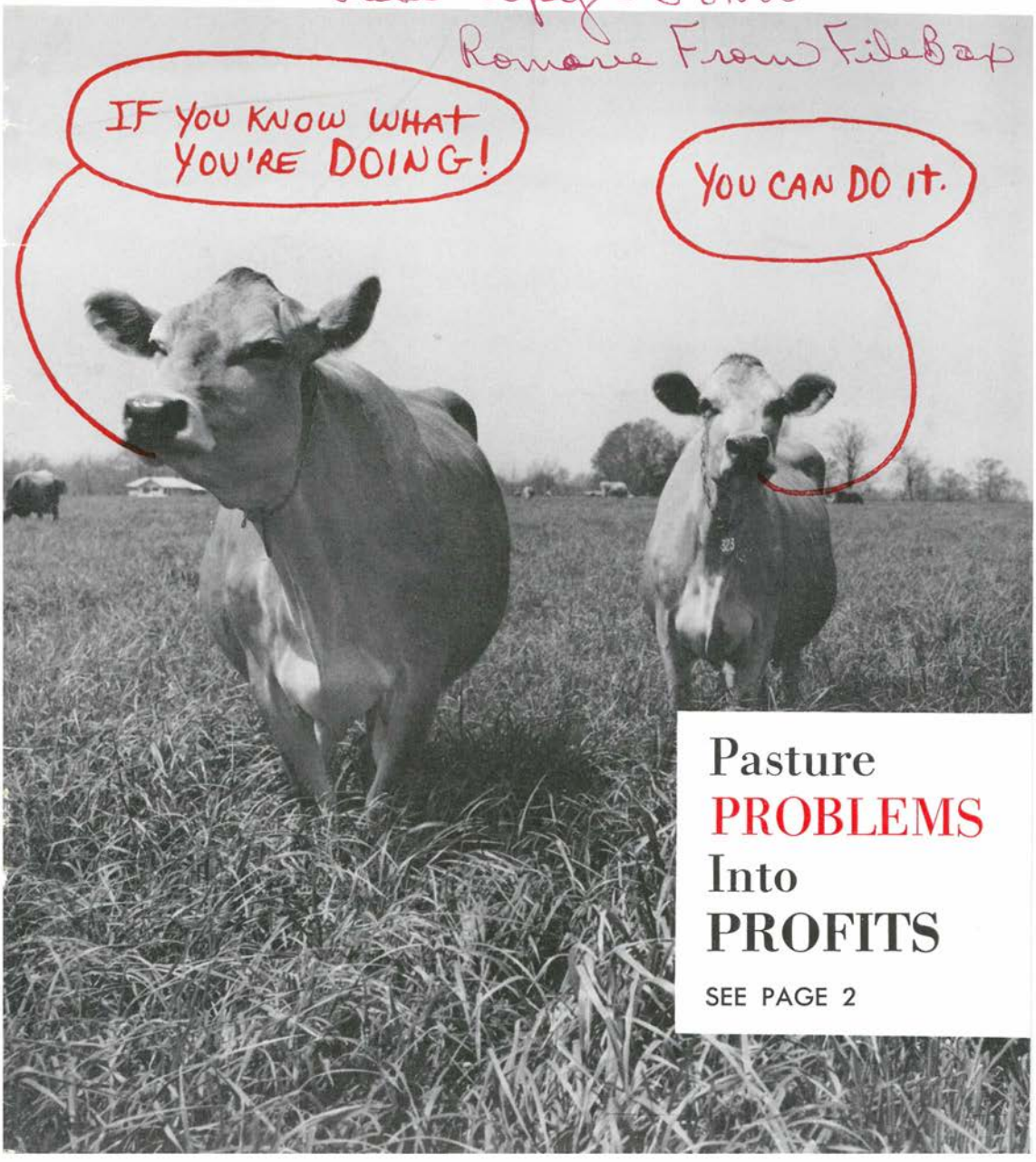
Better Crops

WITH PLANT FOOD

May-June, 1963

Last Copy - Do Not Remove From File Bap

20 Cents



Pasture PROBLEMS Into PROFITS

SEE PAGE 2

Better Crops
WITH PLANT FOOD

The Whole Truth—Not Selected Truth
$1.00 for 6 Issues, 20¢ Per Copy

Vol. XLVII Washington, D. C. No. 3

Santford Martin, Editor
Selma Bushman, Assistant Editor
Barbara Martin, Circulation

Published by
The American Potash Institute Inc.
1102 16th Street, N.W.
Washington 6, D. C.

CONTENTS

ON THE COVER

. . . a good permanent pasture can't be built overnight. But it can be done, as the background lady contends here. IF you know what you're doing, as the foreground lady warns. Actually it is a matter of good management, including proper fertilization. For some down-to-earth, understandable tips, read the Thompson-Bailey suggestions starting on page 2. They know their pastures.

Aerial Fertilization

To Help Hill Pastures BOOST Economy

THE future of West Virginia's agricultural economy is in beef cattle, sheep, and dairy, according to West Virginia University Vice President Ernest Nesius, who estimated the state should double the income from this class livestock "if we can get the West Virginia slopes to produce the grass they are capable of producing."

A key way to make strong, productive hill pastures was introduced this spring—via aerial fertilization.

Nearly 150 people witnessed the first aerial application of fertilizer on mountainous pasture held at the West Virginia University Animal Husbandry farm.

High analysis fertilizer in the form of pellets was dropped from airplanes over 22 acres of the University farm. This fertilizer, distributed by the evenness of air scattering, cuts down on the amount of load needed, thus making application practical by the use of airplanes.

Steep mountain pastures are hard, sometimes impossible, to be reached by conventional fertilizer spreaders. This prompted Monongalia County Extension Agricultural Agent Burkey Lilly to encourage local farmers to pioneer an 800-acre aerial fertilization project here.

Appraising reactions of the farmers whose land was fertilized by air, Lilly said many have expressed enthusiasm about the program with several hoping to cover their entire farm by aerial fertilization next year.

While observing the demonstrations, Dr. Nesius recalled the open lands he had seen in the past while flying over the state, "land which would make good pasture."

He reported that on much of the land the sod is not thick enough—in fact, is thin-turfed and unable to cover the ground, revealing much bare ground.

The point in the future, he concluded, is to have a good strong sod through a fertilization program—and aerial fertilization is one of the ways to put fertilizer on the hill land.

Adapted—West Virginia News

Such problems as broomsedge, wiregrass, etc., thrive on low fertility soils plagued with weeds and cursed by poor management.

Convert Pasture PROBLEMS

W. R. Thompson
Mississippi State University

Starkville Mississippi

E. H. Bailey
American Potash Institute

PASTURES of today are completely out of date—are not keeping pace with the fast growing livestock industry.

Most of the permanent type pastures have been so exploited that they can no longer maintain and produce the quality desired in animals. This has resulted in low soil fertility and a trend toward poorer grasses and weeds. Such pastures can be seen along many highways in the South. Will this picture change without conscious effort by both agriculturists and farmers? No. Not without a *systematic program* of fertilization and good management.

A good permanent pasture can't be built in one year. It demands good fertilization and management for several years to bring old pastures back into good production:

Such crops as Coastal Bermudagrass or such practices as winter grazing (with oats, other small grains, ryegrass) can bring profits.

. . . Into Pasture PROFITS

1 Lime applied every 4 to 6 years, according to forage grown, and fertilizer applied annually to supply necessary nutrients.

2 Weeds destroyed early to prevent seed production and competition for available plant food.

Better grasses and legumes soon take over in well-fertilized pastures, reducing the weed problem. The poorer plants—such as broomsedge, smutgrass, wiregrass, needle grass, and others—thrive on low fertility soils but can be replaced by the better plants in a good fertilizer-management program.

When the writers asked a successful cattle farmer about the growing broomsedge problem in pastures, he replied:

"Begin a lime and fertilizer program with annual applications of fertilizer, but mow the surplus broomsedge and other grasses while green, bale the hay and feed it back to the cattle in the winter. This type hay is not by any means the best, but, along with a protein-salt supplement, it will carry the cattle through the winter."

This farmer's method might be a good beginning in a pasture improvement program. Under such a program, your forage quality would improve from year to year. Annual fertilization will move broomsedge out

To prevent grazing waste, a hot wire keeps milk cows on the choice grass and the dry heifers on cleanup to give clover a chance to come through. To insure good clover, keep close check on soil nutrition since grass is a greedy potash user, at clover's expense.

of pastures and keep it out. Many renovate broomsedge areas to start with.

What about the farmer with more pasture than he is financially able to lime and fertilize?

It is better to lime and fertilize *special areas or fields each year* than to skip about treating new areas each year, top specialists agree. The pasture becomes progressively better and the carrying capacity for additional animals increases.

When should pasture fertilizer be applied?

Lime, phosphate, and potash can be topdressed on pastures nearly any time of the year convenient to the farmer, if not applied on young plants such as clovers just coming up. While plants are dry is the best time to insure against burning damage.

Nitrogen is best applied near the time it is to be used by the growing crop, since it is more subject to leaching and loss in run-off water. Fertilize clover and other legume crops in the *fall* and grass and lespedeza or grass only in the *spring*.

What is a good rate of fertilizer for the permanent pasture?

If needed, lime should be applied at the recommended rate to do the

Cutting hay is a good way to clean up pasture. But the large amounts of plant food removed in hay should be replaced by annual fertilization. You can forget broomsedge under this type management. Here W. R. Thompson compares grasses in the plots.

job. The same thing applies to fertilizer, though money to be invested usually enters the picture.

For Minimum Job

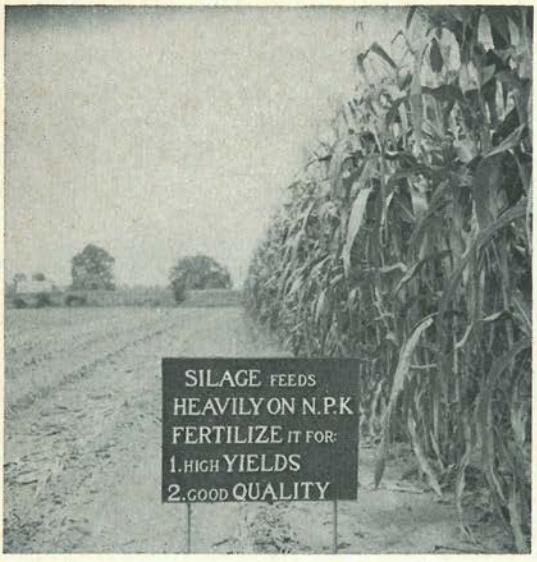
Minimum phosphate and potash rate for a *clover-grass* pasture should be no less than 100 lbs. P_2O_5 and 100 lbs. of K_2O to start old pastures back. Apply 80 lbs. each of phosphate and potash on clover pastures each fall and a minimum of 60 lbs. each of phosphate and potash on summer grass pastures, except Coastal Bermuda which needs a minimum of 80 lbs. each of phosphate and potash on it.

For Better Than Minimum

The farmer seeking better pasture results will use at least 80 lbs. of P_2O_5 and 80 lbs. K_2O on *all* pastures annually for maintenance.

For Top Job

And the farmer seeking a top job with his grasses and clovers, like the farmer who produces two bales of cotton per acre, may use 120 lbs. P_2O_5 and 120 lbs. K_2O—or even more, depending on his type farming and the carry-capacity desired.



Liberal NPK can mean the difference between good and poor silage and between "wiregrass" and Johnsongrass. Silage is no better than the crop (corn, sorghum, millet) that goes into the silo. High yields of top quality hay comes from Johnsongrass raised on set-aside area and liberally fertilized.

How can clover be introduced into the established grass pasture?

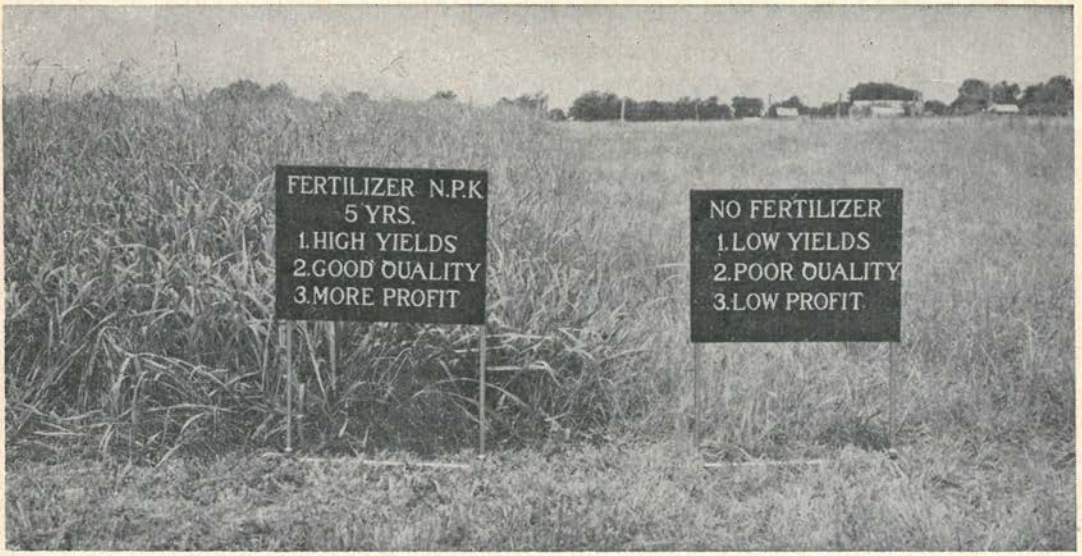
Either graze the grass very close, or clip it low, before or at seeding time. Even when white clover is already in a grass pasture, the grass should be grazed close in the late summer or fall, or clipped close and removed, to allow the clover to come back.

Farmers desiring good clover in their pasture should keep close check on the plant food level of their soil. Grass is a greedy feeder on potash, using available potash at the expense of the clover. If potash level is kept high, the clover is hard to keep out of the pasture. If potash is low, the clover cannot be kept in.

What are the fertility demands of the pure grass pasture?

It needs to be fertilized with a *complete* fertilizer, N-P-K, instead of only P and K as the clover-grass pasture already mentioned.

This can be done by applying a recommended complete fertilizer grade, high in phosphorus and potash, and following with periodic top-dressings of nitrogen as required for crop growth, or any other convenient method desired by the farmer. In any event, the extra nitrogen applications should be applied as needed for crop growth.



A good permanent pasture can't be built in one year. It demands continuous good fertilization and management for several years to bring old pastures back into good production. Here are some results from 5 years of fertilization—with the fertilized plot producing 30 times as much forage as the unfertilized area.

Is it practical to have clover-grass on part of your pasture and pure grass on other areas?

Yes, this is very practical for the farmer with large pasture acreage. The good bottom land and certain other adapted areas can be limed, fertilized, and managed for clover, while other areas can be treated for pure grass. Each area, however, will require a specific type of fertilization and management.

Coastal Bermuda for Grazing and Hay

Coastal Bermuda acreage is rapidly increasing in Mississippi and the South, offering farmers one of the most productive summer perennials for grazing and hay.

Bred for high yields, Coastal Bermuda grass uses large quantities of nitrogen, phosphate, and potash. And the higher the nitrogen, the higher the phosphate and potash rates must be to meet the high yield demand and the heavy nutrient removal from the soil.

Advantages of Coastal Bermuda

1 Coastal will use more fertilizer than most other grasses.

2 It has a longer grazing season.

3 It has a higher carrying capacity per acre.

4 It is more productive under drouth conditions.

5 It gives 30 days longer grazing with better quality grass than common.

6 Legumes can be maintained in Coastal, while it is almost impossible to keep clovers or other legumes in Common.

7 In average years, Coastal will be ready to graze in May.

8 With clovers or other legumes, it can be grazed starting in early March.

MORE SPOTLIGHT ON SILAGE

Farmers are giving more thought to silage. The quality of silage is no better than the crop that goes into the silo. Corn, sorghum, or millet with leaves fired half way up the stalks is poor silage to begin with, and preserving it does not improve the quality.

Proper fertilization with nitrogen, phosphate, and potash will help keep the silage crops green to the ground and assure high quality forage for the silo. So every farmer should study his soil needs—*the NPK requirements of* his crop—and fertilize for high yields and good quality.

Hay crops should occupy first place in the farm program for the coming year. Some of the leading crops are:

1 **Alfalfa.** On all soils where it can be profitably grown. For success, follow the rules in Extension Publication 402, "Seven Rules for Growing Alfalfa." They are given in detail.

2 **Johnsongrass.** For the Black Prairie Belt and Delta Area and certain other Mississippi areas. For best results, set aside an area for Johnsongrass hay production alone. Fertilize annually with enough phosphate and potash to replace that removed by the hay, or according to soil test, and apply nitrogen for each crop of hay removed. With proper fertilizer-management, Johnsongrass should produce from 6 to 8 tons of good hay each year.

3 **Coastal Bermuda and Bahia Grass.** When producing these crops for hay, set aside hay-growing areas from the rest of the crops and fertilize for high yields and top quality hay. No better hay crop can be found for South Mississippi when handled right.

4 **Oats and Vetch.** These are good hay crops for the dairy farmer in certain areas with local problems—offering winter grazing and spring hay crop. It can be grown while moisture is plentiful. If weather is not favorable for hay saving, the crop is good for the silo. As a forage, oats and vetch remove large amounts of plant food from the soil—that must be replaced.

5 **Lespedeza.** Lespedeza meadows scattered over Mississippi will produce good yields of high quality hay if properly fertilized and managed. Topdress with 300 to 400 lbs. per acre of 0-20-20, either in fall or

before plants come up in spring, for good grazing or hay. Best suited varieties are Kobe and Common.

Why winter grazing crops?

During most years, winter grazing crops from oats, other small grains, and ryegrass will pay profits ranging from $30 to more than $60 per acre. This means the crop must be used in a planned grazing program. And it is profitable for both beef and dairy cattle.

Why temporary summer grazing?

It can be very profitable. A big area of well-fertilized millet or sudan grass can be a life saver for any cattle farmer, especially the dairy farmer. These crops are heavy producers of high quality forage, profitably used for controlled grazing, green feeding or silage.

Like all forages moved from the soil, these crops remove large quantities of plant food that should be replaced in the fertilizer. Millet and sudan should be fertilized with at least 500 lbs. per acre of a complete fertilizer, such as 12-12-12 and topdressed later with 40 to 60 lbs. of nitrogen, if more growth is wanted.

Low soil fertility . . . weeds in pastures . . . poor hay yields have caused the farmer much concern in recent years.

Whether your forage problem is one of worn-out pastures, too little silage or poor quality hay, you should contact your agricultural adviser and develop a blueprint for pastures that will produce higher yields of good quality hay and silage.

THE END

Forage Guide Ready

"TRENDS in Forage Crops Varieties"—a publication of interest to workers in research, extension and industry concerned with seeds and forage improvement—has just been released by the USDA Federal Extension Service.

Write the extension agronomists at your State College of Agriculture for copies.

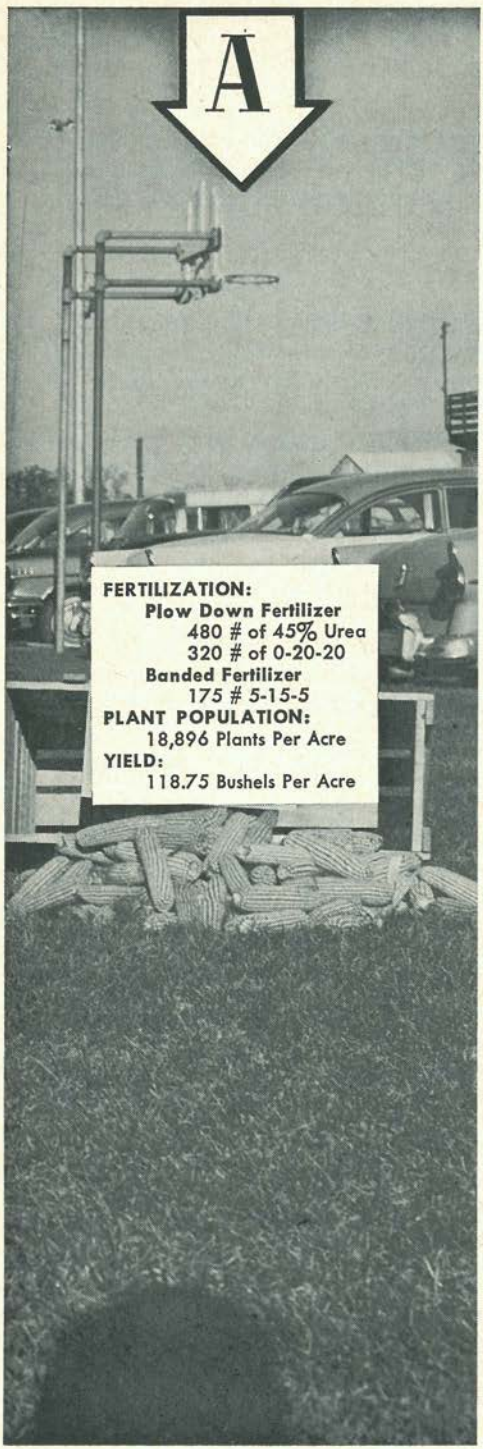
It provides seed handlers and producers with useful guidance on the question of which varieties are expected to increase in usage and which to decline.

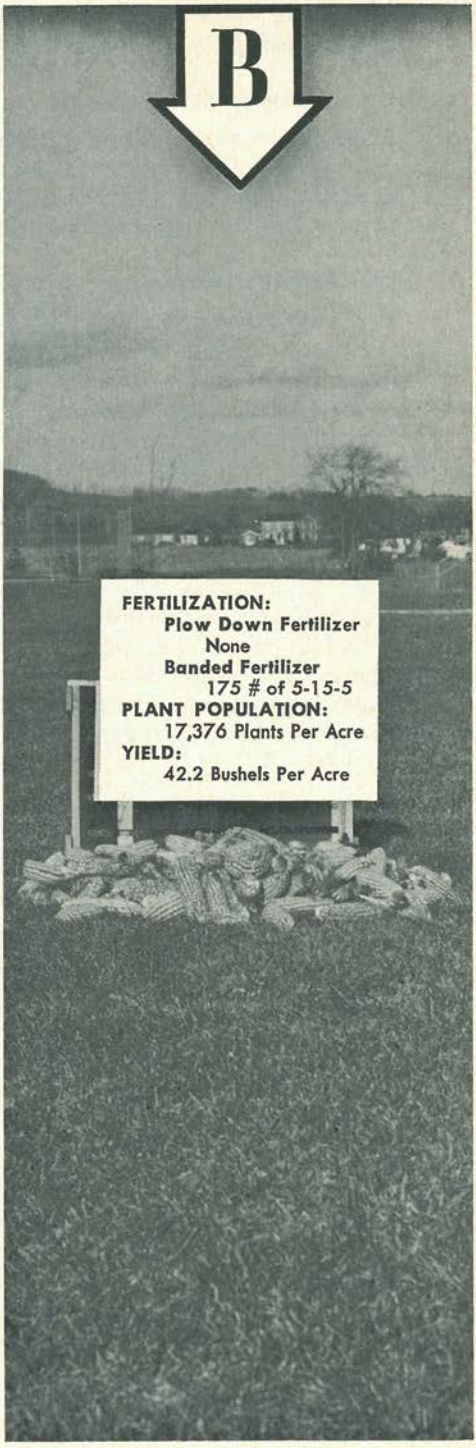
It brings together the judgments of agronomists in 49 states, based on performances noted in their variety tests together with farmer acceptance.

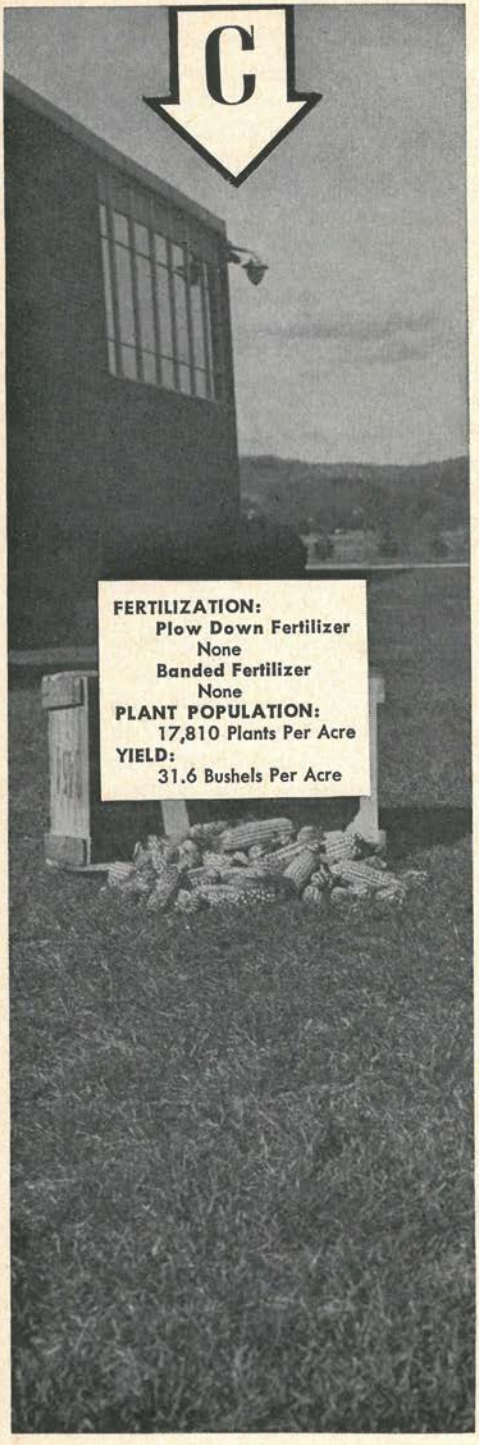
From farmer-user standpoint, report encourages displacement of inferior forage varieties with the better, usually newer ones.

The number of new forage varieties emerging and the tendency of seed production to become centralized emphasize the usefulness of variety trends information.

THE END


A
FERTILIZATION:
Plow Down Fertilizer
480 # of 45% Urea
320 # of 0-20-20
Banded Fertilizer
175 # 5-15-5
PLANT POPULATION:
18,896 Plants Per Acre
YIELD:
118.75 Bushels Per Acre


B
FERTILIZATION:
Plow Down Fertilizer
None
Banded Fertilizer
175 # of 5-15-5
PLANT POPULATION:
17,376 Plants Per Acre
YIELD:
42.2 Bushels Per Acre



LEARNING BY DOING

ABC Test Plots Teach Value of PLANT FOOD

By Walter S. McDanel
Teacher of Agriculture
Boyertown, Pennsylvania

A basic principle of education—*learning by doing*—was used to convince skeptical high school students that proper soil nutrition pays in crop production.

On the Boyertown (Pa.) Area High School farm, we conducted a scientific experiment in corn fertilization, to determine the effect or non-effect of plant food on corn yield.

The results spoke for themselves—from 118.75 bushels per acre on the adequately fertilized plot to 31.6 bushels on the unfertilized plot—in a growing season hampered by low moisture.

In fact, I believe adequate fertilization helped reduce our losses from low rainfall, since Plot A (the fully fertilized one) suffered little drought damage in contrast to definite damage on plots B and C.

Realizing our limited knowledge of scientific experimental procedure, we sought the cooperation of various community resource leaders.

Cooperators included the Berks County Farm Bureau, which supplied us with a professional agronomist to help set up the procedure for the plots, the Pennsylvania Farm Bureau, the Zimmers Feed Mill, the Hoffman Seed and Grain Company, and DuPont Chemical Company.

Our test plot, consisting of a 3-acre field divided into 3 equal parts, was planted on May 10, 1962 to utilize the full growing season, and our crop was harvested on October 30 with a moisture percentage of 25.4%.

We applied 500 lbs. per acre of ground limestone to the entire plot of land, used Lorax for weed control on all three plots, and cultivated once during the growing season.

PLOT A

Plot A was given 480 lbs. of 45% Urea, as a source of nitrogen, and 320 lbs. of 0-20-20 fertilizer disced well into the soil. At planting time (May 10, 1962) we applied 175 lbs. of 5-15-5 fertilizer. Hybrid Muncy Chief 760 was the type corn planted, at the rate of 21,450 plants per acre, which gave us a final population of 18,896, in 38″ rows. This type of agricultural practice yielded 118.75 bushels per acre.

PLOT B

No plow down fertilizer was used on this plot, but we did apply 175 lbs. of 5-15-5 per acre at planting time. Again using the corn planter at 38″ rows, we planted at a population of 21,450 plants per acre. After obtaining a plant population of 17,376, the final yield was 42.2 bushels per acre.

PLOT C

Plot C was given no fertilizer at all. We planted at 21,450, and obtained a population of 17,810 plants per acre, which gave us a yield of 31.6 bushels of corn per acre.

At the end of this student-centered experiment, I believe our students had a better understanding of corn production problems—especially the need for adequate fertilization.

Through such a test plot, they were directly exposed to the scientific demands of plant growth and were able to develop their skills in soil testing, farm machinery use, yield determination, and calibration of planting and spraying equipment.

And not least, they were made aware of fine specialists available to such a community as theirs.

An active test plot is not only an invaluable teaching aid, as this experience convinced us, but it is also a solid relations builder between school, FFA, and community.

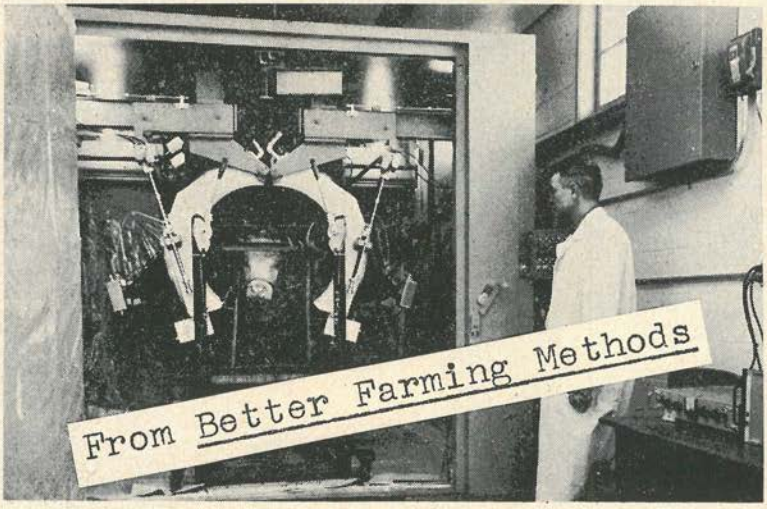
Solid, scientific results publicly displayed, help the public *know* their vocational agriculture students are engaged in constructive, practical enterprises.

THE END

News Mats and Useful Reprints See Pages 47-48

Measuring Potassium In Animals

. . . for quality lean meat



Livestock breeders may soon be using a machine to select breeding animals whose offspring will produce carcasses with a higher percentage of quality lean meat.

An instrument, the K-40 counter, is now being tested at the University of Illinois which is hoped will precisely measure the amount of muscle and fat in a live animal. It is believed the technique may provide information on beef carcasses in two minutes that formerly required 24 to 30 months to obtain by progeny testing.

The machine measures the amount of radioactive potassium in an animal. Muscles contain the largest amount of potassium in an animal. Research men are using the counter on experimental animals and then slaughtering them and correlating the data.

The K-40 counter is large enough to be used on beef animals weighing up to 1,200 pounds, as well as on hogs, sheep or humans.

One way to fertilize a mixed forest is shown here in the Netherlands where they use a Plata machine.

FERTILIZERS
For European Forests

By L. C. Walker
University
of Georgia

and

J. H. Stoeckeler
Lake States Forest Experiment Station
U.S. Department of Agriculture

Wood is scarce in Europe, and its price—along with a sort of woodland worship of the forest—dictates fertilization almost without regard to cost.

As early as 1868, foresters in Germany had learned that complete fertilizers are required in young plantations. Consequently, 70 percent of the state forests in the northern section of West Germany are now fertilized sometime during the rotation.

In Bavaria, half of all reforested land is treated at planting time with government funds being used for fertilizing private holdings.

For the Netherlands, a simple test is laid out in every planting operation on every soil type. These plots are followed until tree crowns close and, based upon that experience, a refined experiment is established. Virtually all state forests there are fertilized.

In Norway, forest fertilization is increasing, being stimulated to some extent by tax relief on privately owned forests.

This report highlights research and practice in the fertilization of mineral soils under these continental Europe conditions.

On the NPK plot . . .

. . . note how well this planted stand of fir, larch, beech, and elder responded to an application of nitrogen, phosphorus, and potash. Although the beech was established first it required release from the fir overstory after 8 years.

On Unfertilized plot . . .

. . . note the undergrowth of herbaceous weeds and pines and the exclusion of hardwoods.
(Courtesy Ruhr-Sticksoff)

ON HEATH PLAINS

Much of northern Europe is heather, or moor, plains. Scientists believe these vast areas of *Calluna*, ground juniper, and grass were in oak-birch forests until, perhaps, the year 1200. Following clear cutting, the land may have been cultivated for agriculture for hundreds of years.

Then, for many centuries, sheep grazed on the heather plants as podzolization (the leaching of iron and aluminum from the surface soil) took place.

Professor W. Wittich at the University of Göttingen believes the heather contains antibiotics that hasten podzolization, for the ash-white color indicative of the process is found only where heather plants have encroached and become established.

As farmers removed the low-lying vegetation for cattle bedding over many centuries, some mineral soil was carried away with it. In timber stands, the raking of the ground for bedding and fuelwood further depleted the soil. Consequently, these acidic sites are often low in nitrogen, potash, and magnesium.

In addition, some ancient heaths in the Netherlands require phosphorous fertilization for adequate larch growth. Copper may also be deficient, but not enough to depress growth markedly. While many moors have been reforested for several centuries, large areas yet lie wasted because of conversion costs.

DRAMATIC INCREASES

In Germany

In the Luneburger Heide of Germany, nitrogen, potash, phosphorous, and calcium are experimentally applied to plantations of Norway spruce, Scotch pine, Japanese larch, and red oak.

Frequent nitrogen treatments appear necessary—perhaps at time of planting and 1, 2, and 5 years later. Six years after phosphorous and potash treatments, supplies of these elements are still adequate.

Nitrogen additions totalling 210 lbs. per acre result in dramatic height increases, sometimes causing phosphorous and potash deficiencies in good rainfall years. These trials showed that calcium supplements were not needed.

Red oak was the most responsive of the four species fertilized and, by the twelfth year, had suppressed the pine with which it was interplanted. In fact, shading by hardwoods causes pine branches to be smaller than those in unfertilized sites.

Pine response was also inferior to that of spruce but, with complete fertilizer, has amounted to 60 percent height increase in one year. Almost all untreated stems die promptly.

In the Netherlands

Scotch pine in heaths of the Netherlands has a needle disease which is corrected with potash and magnesium applications.

On the same sites, Douglas-fir (the most nutrient-demanding conifer planted in the Netherlands) receives complete fertilizer. Trees are planted after removing the humus layer and tossing it aside. A single application of 80-80-80 per acre is used as a top dressing.

In Denmark

In Denmark, the poorer grades of heather soils have shown consider-

Such stands as these—slowly growing Scotch pines, with Norway spruce in the understory, on strongly podzolized outwash sands in Sweden—usually respond well to nitrogen fertilization.

This is below average Scotch pine in Sweden at 120 years. The trees on right were fertilized with 60 lbs. N per acre two years before picture. Results: greater crown density and doubled diameter growth. Swedish experts consider this type stand most suitable for fertilization. *(Courtesy C. O. Lamm)*

able response to N-P-K fertilizers, with N causing much of the response.

The industrialist Juncker uses up to 1,000 lbs. per acre per year of urea. Phosphorous, as basic slag, frequently is used with nitrogen in the ratio of 10:1—the ratio in humus and in living plants. In this proportion, pine slash decomposition is stimulated and nitrification encouraged.

WOODLAND REHABILITATION

Woodland rehabilitation through fertilization is common, especially on lands cut over for shipbuilding, agriculture, and war reparations.

Typical is a northern German area of acid soil with raw humus 6 inches deep. Forests of oak, birch, and beech grew here until they were needed for shipbuilding at Baltic naval yards 100 years ago.

5-Step Method

Later efforts at reforesting failed, or growth of trees was slow, except where sites were (1) cleared of brush and plowed, (2) given heavy rates of complete fertilizer, (3) planted to beech trees, (4) fertilized again with nitrogen in the second and third years after planting, and (5) seeded 3 years after planting with lupine to maintain soil nitrogen levels.

One stand so treated had an average d.b.h. (diameter at breast height) of 15 inches and a merchantable height of 48 feet at age 22. Many species, native and exotic, respond to this treatment.

Douglas-fir of northwestern United States source may exceed 14 d.b.h. and 50 feet of merchantable timber in 22 years.

3-Step Method

Another method of reclamation is to (1) lime and plant under existing stands, (2) fertilize with nitrogen and phosphorous, and (3) after 7 years, cut the overstory. Beech is very sensitive to calcium deficiency.

NPK Role in Netherlands . . .

Rehabilitated sites in the Netherlands may require potash amendments for hybrid poplar trees, especially on older alluvial soils composed of sandy material washed to the Low Countries from western Germany.

Elsewhere, poplars are fertilized with nitrogen at planting.

On humus podzols where phosphorous is needed for poplar growth, such amendments unfortunately result in copper deficiencies. For Japanese larch and Douglas-fir, total phosphorus in Dutch soils is correlated with tree growth.

Although spruce trees apparently are relatively demanding for nitrogen and phosphorous in the Netherlands, potash is also required, especially when high nitrogen rates are employed. Sixty to 80 lbs. per acre of nitrogen are used.

Professor Van Goor says about one-third of the Dutch stands respond to phosphate and all species except Scotch pine are fertilized if a deficiency is indicated. They use 500 lbs. per acre of rock phosphate, followed in spring of the second year (for spruce and Douglas-fir) with 15-10-15 topdressing. Sixty lbs. per acre of nitrogen are then applied at age 6.

. . . In Norway

In a heavily leached river terrace

in Norway planted to Scotch pine, both calcium nitrate and complete fertilizer appreciably increased growth proportionally to the application rate.

The increase in both diameter and height did not appear until a year after treatment. The growth curve rises rapidly at first, decreases 2 to 3 years after the last application at age 4, and then increases 8 to 9 years after the initial fertilization. The latter spurt is probably from improved soil fertility accompanying the decomposition of twigs, litter, and ground cover during the treatment period.

. . . In Finland

In Finland, mature stands fertilized 20 years before harvest sustain a growth increase for 5 years.

. . . In France

Old-growth forests of France located near population centers are fertilized with basic slag and lime to maintain vigor, while those of the Maritime Provinces receive nitrogen and phosphorus fertilizers.

The latter is essential for both wet and dry sandy soils. Height growth of 2-year-old Corsican pine has increased 50 percent over untreated trees where the plant food was broadcast and plowed in.

DUNES

Inland sand dunes are especially important in the Netherlands.

In contrast to coastal dunes, they are low in lime. Developed during the Middle Ages, many inland dunes have been forested with Scotch pine. Sometimes organic matter and nitrogen are favorable, but more often the residual soil developed on dune surfaces is blown away, leaving serious deficiencies of these components.

Inland dunes covered with Scotch pine are also fertilized with magnesium. The deficiency symptom for this is a bright yellow needle tip that is sharply delineated from the green base.

Potash Hunger Common

In contrast, potash deficiencies, also common, are shown by a gradual transition in color from the green base to chlorotic tip.

GLACIAL OUTWASH PLAINS

Sand plains of northern Europe are characterized by thin podzol soils with raw humus about 2 inches thick. Many sites are covered with moss, others typically heath.

Most tree roots occur in the humus and in the top 1-inch layer of mineral soil and organic matter mixture.

Moss and lichens increase following timber harvests, because the nutrient content is lower where elements are no longer obtained from tree foliage.

The soil of an outwash plain may be but a few inches thick, overlying deep sands that exceed 15 feet, from which nutrients are rapidly leached.

A dark brown, iron humus "pan" may occur in the subsoil. Humus podzols, occurring in soils developed on ice-age rock deposits, are also characterized by an organic subsoil.

Toxic concentrations of the heavy elements (such as iron, copper, and zinc) in this organic horizon result in shoot dieback and easily bent branches. Douglas-fir and Norway spruce are especially susceptible to

these maladies, but all species grow poorly.

NPK on Mineral Soils

Professor C. O. Tamm of the Swedish Forest Research Institute reports nitrogen as the element most likely in short supply on mineral soils in Sweden and that 50 lbs. per acre gives good response in stagnated stands of spruce and pine.

Further improvement, as evidenced by foliage color and height growth, is obtained with phosphorus and potash additions. Volume growth increases of 50 percent have been recorded 4 years after treatment.

Although no further increases in growth were obtained for 100 and 200-lb. nitrogen applications, the element in plant tissues is greater than for the lower rates. Thus, if annual or biennial treatments cease, the higher rates would likely give better growth eventually through the use of "stored" reserves.

Nitrates apparently are leached rapidly from pine foliage, which is shed within 2 or 3 years. The nutrients for spruce trees are stored in other plant parts, and growth stimulation is more lasting.

Sandy Sites Hold Promise

Swedish experts believe sandy sites growing spruce and pine will be fertilized in practice within "a few years," since foresters are now looking into the economics of fertilizing 5 to 10 years before the rotation ends.

The best sandy sites of Finland are generally adequately supplied with phosphorus, potash, and magnesium. On poorer sites, nitrogen may be applied at planting time—and if accompanied by lime, its effects are longer lasting.

With 100-year-old pines on a medium-to-good mineral soil, treatment with 20-50-50 and 1,500 lbs. per acre of calcium nitrate is appropriate. Recommended for optimum growth of both pine and spruce plantations are applications of 50 to 70 grams of 12-8-4 per tree in a zone within a radius of 1 foot of the tree.

CONCLUSION

Notably scarce in European forest fertility studies are approaches involving new materials (innovations of the fertilizer industry) for slower solution and longer life in the soil.

Similarly, tests in America combining cultural practices (drainage, irrigation, weed-tree control) with fertilizer application are rare. Screening races, strains, or crosses of a species for nutrient utilization efficiency is unknown.

Nevertheless, the long-term field trials, so precisely planned and installed over so long a period, are an asset of no minor import to later researchers, here and there.

References

1. Bonneau, M. Acquisitions actuelles et problémes a résoudre dans le domaine de la fertilisation forestiére. Revue Forestiére Francaise No. 3. 1962.

2. Bransteg, A. Et gjødslingsforsøk i furuskog. Norske Skogforsøksvesen 61: 243-288. 1962.

3. Hagenzieker, F. Fertilizing forest trees. World Crops 10 (10): 369-732. 1958.

4. Mar-Moller, Carl and Schafflitzky de Muckadell, M. Skovbrugsafdelingens gødningforsøg i rødgran. Dansk. Skovforen. Tidskr. 8: 391-453. 1957.

5. Mitscherlich, G. Düngungsversuche in älteren Beständen Badens. Allg. Forst. Jagdzeitung 129: 169-190. 1958.

6. Tamm, C. O. and Carbonnier, C. Växtnäringen som skoglig produktionsfaktor. Statens Skogsforskningsinstitut No. 82. 1961.

7. Themlitz, R. Untersuchungen zur Nährstoffwanderung in einen Heideboden und Nährstoffdynamik junger Kiefern. Kali-Briefe Fachgebiet 6, 2 Folge, 12 pp. 1958.

8. Themlitz, R. Nahrstöffmangelerscheinungen an jungen Kiefern als Folge unausgeglichener Düngung und ihre Diagnose durch differenzierte nadelanalipen. Kali-Briefe Fachgebeit 6. 5 Folge, 10 pp. 1959.

9. Viro, P. J. Evaluation of site fertility. Unasylva 15(2); 2-8. 1961.

10. Wehrmann, J. Methodische Untersuchungen zur Durchführung von Nadelanalysen in Kiefernbestanden. Forstl. Cbl. 78(3-4): 65-128. 1959.

11. Wittich, W. Die grundlagen der stickstoffernährung des waldes. In Der Stickstoff-Seine Bedeutung für die Landwirtschaft 10: 335-367. 1961.

12. Wittich, W., Ronde, G. and Hausser, K. Auswertung von Düngungs-und Meliorationsversuchen in der Forstwirtschaft. Ruhr-Stickstoff. 168 pp. 1958.

THE END

A Route to Valedictorian

. . . OR THE WELL-ROUNDED EEL

ONE time the animals had a school. The curriculum consisted of running, climbing, flying, and swimming, and all the animals took all the subjects.

The Duck was good in swimming, better, in fact, than his instructor; and he made passing grades in flying, but he was practically hopeless in running. Because he was low in this subject, he was made to stay in after school and drop his swimming class in order to practice running. He kept this up until he was only average in swimming. But average is acceptable so nobody worried about that except the Duck.

The Eagle was considered a problem pupil and was disciplined severely. He beat all the others to the top of the tree in the climbing class, but he had used his own way of getting there.

The Rabbit started out at the top of the class in running, but he had a nervous breakdown and had to drop out of school on account of so much make-up work in swimming.

The Squirrel led the climbing class, but his flying teacher made him start his flying lessons from the ground up instead of the top of the tree down, and he developed charley horses from overexertion at the take-off and began getting C's in climbing, D's in running.

The practical Prairie Dogs apprenticed their offspring to a Badger when the school authorities refused to add digging to the Curriculum.

At the end of the year, an abnormal Eel that could swim well, run, climb, and fly a little was made valedictorian.

[Source unknown, reprinted through the courtesy of C. D. Flory, Secondary workshop, University of Wisconsin, Summer 1942.]

HOW FUNK'S-G ANSWERS THE 3 HOTTEST QUESTIONS IN CORN FARMING

1 HOW THICK SHOULD I PLANT?

Probably thicker than before the development of High Capacity Hybrids. There is a **right** plant population for **every** farm. A few farmers are approaching it now—but many are still far too low. Chances are most can go higher—**if** they plant a High Capacity Funk's G-Hybrid.* These newer hybrids are specifically bred to produce higher yields under thicker planting. More and more corn farmers who are going for top yields are planting 18,000 to 24,000 kernels per acre.

What happens in a dry year? Even under unusually dry conditions, High Capacity Funk's G-Hybrids—planted thicker and properly fertilized—have consistently yielded **more** than when planted at lower populations and under lower fertilization in the same field.

2 SHOULD I PUT ON MORE PLANT FOOD?

Yes—almost always if accompanied by a higher plant population and a hybrid bred to respond to higher fertility.

There are a few qualifications. Some farmers may not need extra plant food if they by chance have an unused surplus of N, P or K in their soil or from carry-over. But as we aim for higher and higher yields, the soil becomes less able to supply necessary plant food, **regardless** of what soil tests may show. (Here is a handy rule-of-thumb: For each 10 bushels per acre yield increase expected, put on 20 to 30 **extra** pounds of N, 10 to 15 **extra** pounds of P_2O_5 and 10 to 15 **extra** pounds of K_2O per acre.)

3 AM I PLANTING THE BEST HYBRIDS?

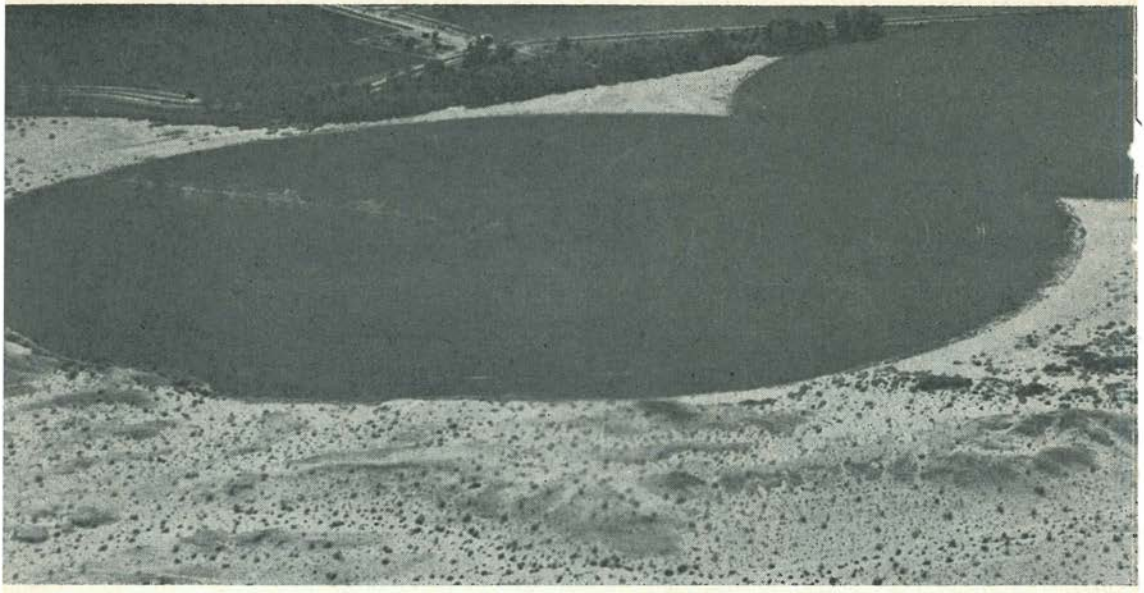
Today, there is a whole range of High Capacity Funk's G-Hybrids. These great hybrids have raised the yield levels on thousands of farms. High Capacity Funk's G-Hybrids are bred to perform better under present corn growing practices—but more important, they are bred to yield **more** under thicker planting and higher fertility. They form the base of the high-profit corn triangle: 1) take a high capacity Funk's G-Hybrid; 2) plant it thicker; and, 3) feed it extra plant food.

This simple plan is recommended to help corn growers increase their profits per acre and increase their volume of business. There **is** a Funk's-G dealer in every locality corn is grown.

FUNK'S G HYBRID ®

THE PRODUCERS OF FUNK'S G-HYBRIDS

*Funk's G-Hybrid is the registered trademark of Funk Bros. Seed Co., Bloomington, Illinois



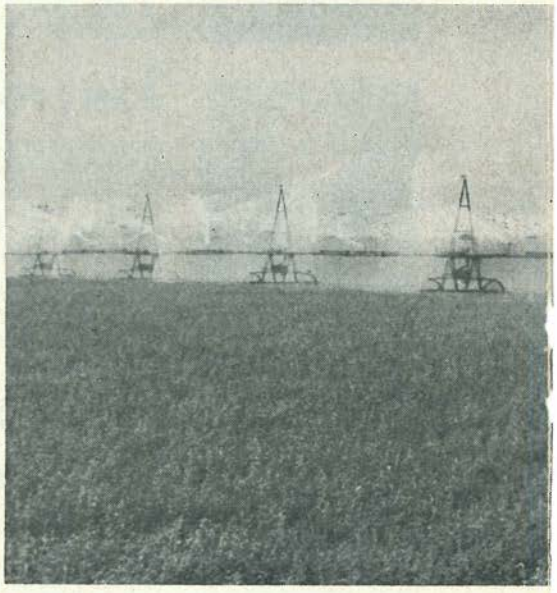
From DESERT

From the air, the lush alfalfa field a sharp contrast to the desert that s Self-Propelled irrigation equipment, each year. The equipment moves thr

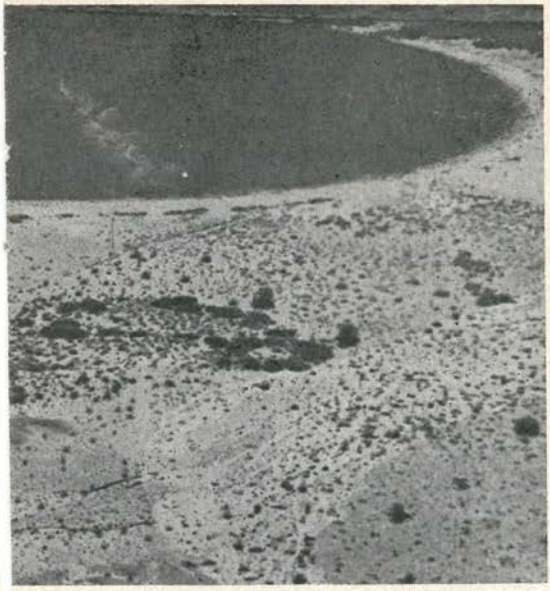
SIX months before, this was sagebrush and desert, but the desert will blossom like a rose, automatically and without labor, when it is irrigated by the unusual circular system of Self-Propelled Irrigation.

At Blythe, California, two lush 50 acre fields of alfalfa are cut nine to ten times each year, to provide much needed forage.

The unique Self-Propelled system operates around a central pivot point with the sprinkler pipe supported by towers on wheels every 96 feet.



In 6 months



The entire system is moved around the field by its own water power. All the operator does is press a button and irrigation goes on night and day and unattended.

Since desert land is light and sandy, a key consideration is water three times a week—a rate almost impossible with conventional pick and move systems—but easy with Self-Propelled.

Self-Propelled is a patented product of Valley Manufacturing Company, Valley, Nebraska. Systems are operating in some 27 states.

Holland Dreves News, Nebraska

to Lush ALFALFA

it Blythe, California, shows up in urrounds it. Irrigated by Valley , the field is cut nine to ten times rough the field by its own power.

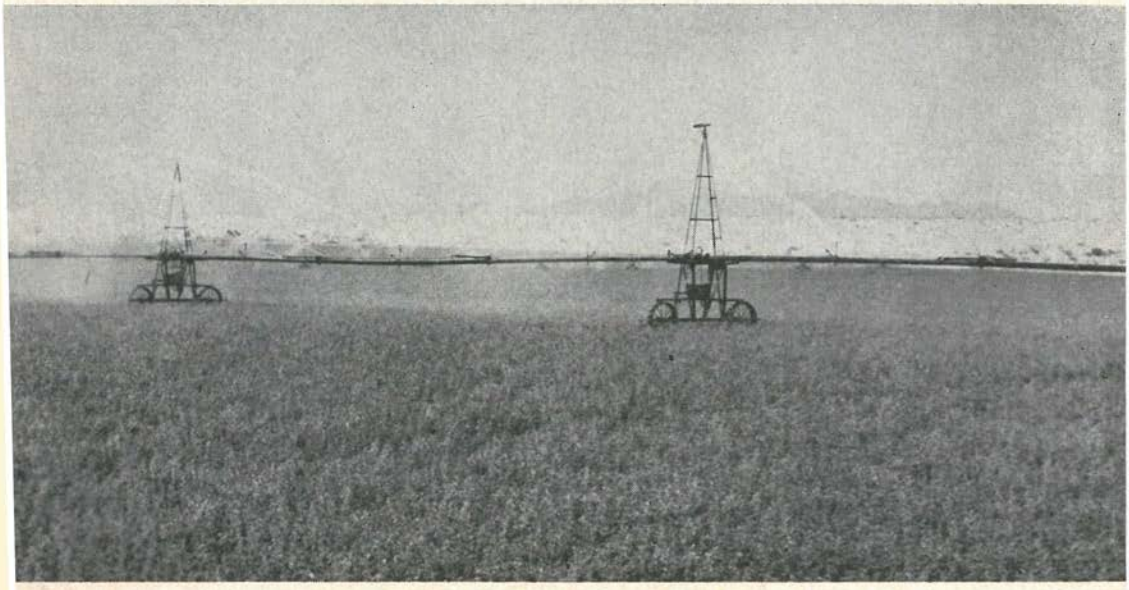


Figure 1—Soil leveling has left many soil spots low in productivity, such as this cut area low in potash. This potato field was fertilized with nitrogen and phosphorus. After plant symptoms appeared, both soil and plant analyses confirmed the need for potash—at a late date for helping yield and quality of the crop.

In Washington's Columbia Basin . . .

Where almost any level of phosphorus or potassium can be obtained from the same field, depending on the area of field from which the soil sample is taken and what sub-samples go into the composite sample.

Where high potato yields and high specific gravity can be obtained with high potash rates in the fertilizer if nitrogen and phosphorus levels are also high.

Where tests showed the higher the potassium level in the plant petiole (100 days after planting) the lower the blackspot index.

Potato POTASH NEEDS Show Up On Leveled Lands

By R. Kunkel

Washington State University

The average potato yields in Washington's Columbia Basin, a relatively new irrigated agricultural area, have been among the top in the nation. Occasionally yields from the better growers exceed 600 CWT per acre, made possible by a long growing season, almost unlimited irrigation water, a few serious diseases, and good cultural practices.

The principal variety is the Russet Burbank. Most of the potatoes are shipped to market between August 1 and October 30, a practice now in the process of changing since more and more storages are being constructed.

UNEVEN IN FERTILITY And Most Difficult to Sample

Of the million-plus acres eventually to be irrigated, just over a third have been developed to date. The area is relatively level. But numerous hummocks must be leveled off, and occasionally extensive cuts and fills made to create a surface suitable for furrow irrigation.

The cut areas are low in productivity (Figure 1). The soils are low in nitrogen and phosphorous but generally contain adequate

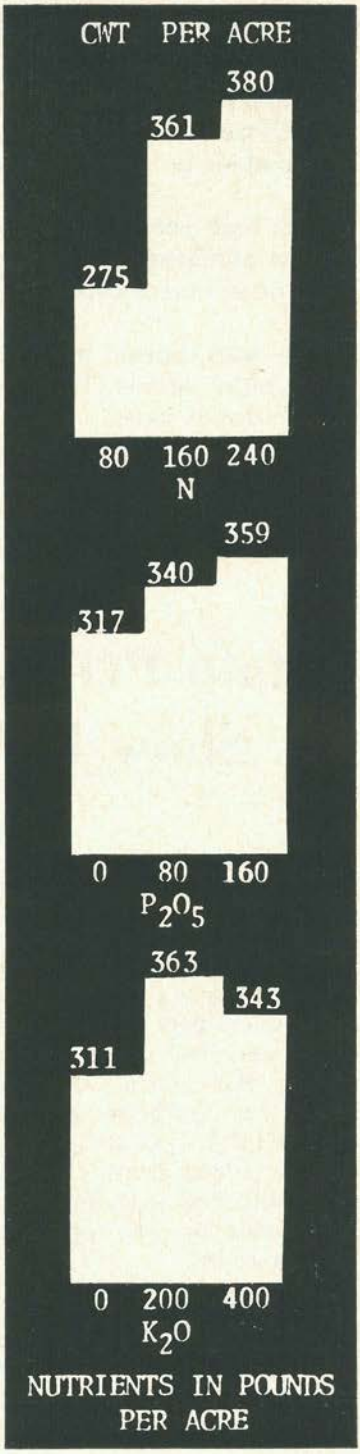


Figure 2—These yield increases resulted from fertilizing cut spots due to land leveling. The leveling process has left the land very uneven in fertility and very difficult to sample adequately for soil analysis.

TABLE 1—THE PROBLEM OF OBTAINING AN ADEQUATE SOIL SAMPLE ON WHICH TO BASE A POTATO FERTILIZER RECOMMENDATION.

1. Size of area surveyed	**1.4 acres**
2. Average phosphorus test in pounds of P per acre	**14.2**
(a) Range in samples obtained	6 to 20
(b) Per cent of area testing low in phosphorus	49
(c) Per cent of area testing between low and high	23
(d) Per cent of area testing high in phosphorus	28
3. Average potassium test in pounds of K per acre	**320**
(a) Range in samples obtained	114 to 741
(b) Per cent of area testing low in potassium	24
(c) Per cent of area testing between low and high	44
(d) Per cent of area testing high in potassium	32

amounts of potash, *except in those areas that were cut during land leveling (Figure 2).*

The leveling process has left the land very uneven in fertility and most difficult to sample adequately for soil analysis, (Table 1).

For Phosphorus

The analysis for phosporous in the soil samples taken from the experimental area shows:

1 That the soil is variable.

2 That the truly composite soil sample gave a low test (14.2 lbs. P/A), indicating a yield response could be expected if phosphorous were applied—though 28 percent of the area would not have responded to additional phosphorous because the test was high.

3 That a phosphorous recommendation based on a test of 14.2 lbs. P/A would not be adequate for 49 percent of the area.

For Potassium

The analysis for potassium in the soil samples shows:

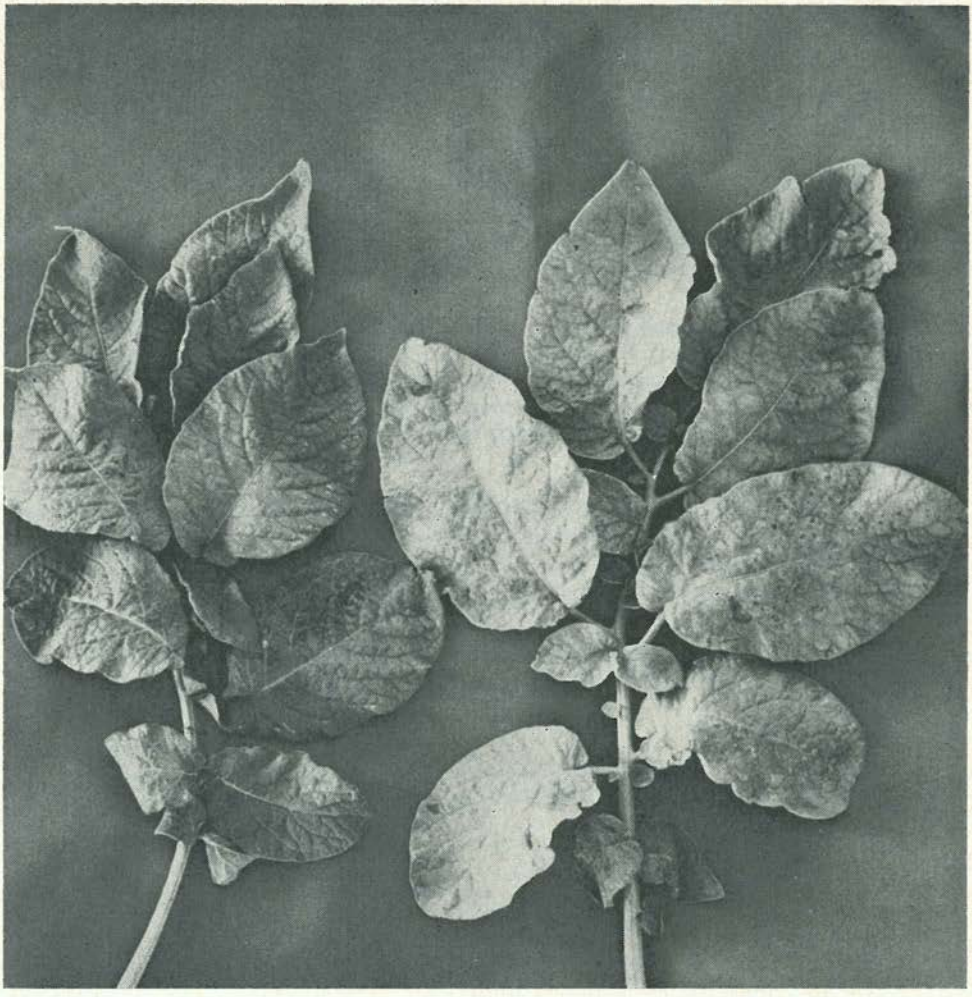
1 That the soil is extremely variable in potassium content.

2 That the truly composite soil sample gave a test of high (320 lbs. K/A), indicating no yield response would be expected if additional potash were applied in the fertilizer—though 24 percent of the area would have responded to potash applications.

It should now be apparent that almost any level of phosphorous or potassium can be obtained from the same field, depending on where in the field the sample was taken and what sub-samples went into the composite sample.

Though the yield differences shown in Figure 2 are statistically significant, the block-by-treatment interaction indicated the treatments responded differently in different parts of the experiment.

Since conventional statistics were developed for use on relatively *homogeneous soils,* they are of limited value for making recommendations under the *extremely heterogeneous conditions* of the Columbia Basin. The yield differences required for a significant 19:1 difference are from 40 to 80 CWT per acre. The difference required is so much larger in dollar value than the



ADEQUATE N **LIMITED N**

IN NEED OF POTASH

Figure 3—The necrotic interveinal spots shown on these potato leaves indicate the plant's need for potash, both when nitrogen was adequate and inadequate. Under such conditions, the necrotic areas begin as small necrotic spots, developing into light tan or brown interveinal necrotic areas or leaf surfaces that have a wrinkled surface.

cost of a 100 lb. application of potash that it is outside the realm of practicality.

SAMPLING PROCEDURE
3 Practical Ones to Choose From

Limited space prevents discussion of sampling procedures, but one of the following is suggested, depending on which is most practical:

1 Obtain a land leveling map of the field, locate the cuts and treat them separately with both phosphorous and potassium.

2 Divide the field into a grid, take composite samples within each grid, keep the composite samples from each grid separate, have them analyzed separately, and treat each area according to the soil analysis.

3 Use a blanket fertilizer application, applying high enough rates to supply the most deficient areas adequately.

POTASH HUNGER SYMPTOMS
Via Split Spots or Soil Spots

Potash deficiency symptoms are of two kinds: (1) those that develop under conditions of low general fertility, (2) those that develop under conditions of high general fertility.

If nitrogen and phosphorous are low, the plants are dwarfed but almost no symptoms of a potash deficiency develop.

If nitrogen and phosphorous are high and potash is limited, the plants will seem to be normal but will have a deep green, almost bluish-green color. If an entire field were uniformly deficient under these conditions, to the eye it might be considered in good health and growth.

The differences described are strikingly apparent only where normal and abnormal plants can be compared side by side, as in split plot experiments or in soil spots that occur in fields not otherwise adequately fertilized with potash.

Leaves Can Talk . . .

The leaves on affected plants have a wrinkled surface, and the necrotic tissue is almost a dark chocolate brown in color. Under certain light conditions, the necrotic areas take on a purplish sheen.

. . . Through Necrotic Spots

Plants well fertilized with nitrogen and phosphate but deficient in potash grow well for 90 to 100 days after planting, and then necrotic spots begin to show in the top leaves.

Differences in plant appearance make the soil spots appear as relatively small areas in the field. The spots usually enlarge as the season progresses. Death of the plant occurs within two to four weeks after the necrotic areas begin to appear.

. . . And Interveinal Wilting

On an extremely hot day, leaves on plants growing in plots with a low test for potash showed interveinal wilting. The following day the wilted areas were dead.

Potato plants receiving the same fertilizer treatment but growing in a plot with a high soil test for potash showed no heat scorch.

Two attempts were made to correct the potash deficiency after the symptoms were present. Neither soil injection of a potash solution nor water infiltration of potash directly over the root zone was successful in saving the plants, once

TABLE 2—HOW ADDITION OF POTASH TO THE FERTILIZER (160 LBS. N, 80 LBS. P_2O_5) INCREASED YIELDS WITHOUT GREATLY AFFECTING PERCENTAGE GRADE-OUT, WHILE BANDING PROVED BETTER PLACEMENT METHOD THAN BROADCAST-BANDING COMBINATION. (RUSSET BURBANK POTATOES).

Pounds K_2O/Acre	Total Yield, CWT/Acre		Per cent No. 1 Grade	
	all banded	½ banded ½ broadcast	all banded	½ banded ½ broadcast
0	311	282	58	53
200	363	326	60	54
400	343	298	56	53

deficiency symptoms were present.

This indicates that potash should be applied at the time fertilizing usually is done—that is, prior to or at planting time.

INFLUENCE OF POTASH

On Potash-Deficient Areas

Our experiment plots reported in Tables 2, 3, and 4 were fertilized with 160 lbs. nitrogen and 80 lbs. P_2O_5.

. . . On Yield

Table 2 shows how the addition of potash to the fertilizer increased the yield without greatly affecting the percentage grade-out. It also shows how banding all the fertilizer produced a higher yield than broadcasting and plowing under half the fertilizer and banding the other half at planting time.

. . . On Specific Gravity

Table 3 shows how placement method had little influence on either specific gravity of the potatoes or on the color of the potato chips and how, increasing potash in the fertilizer had a marked effect on the specific gravity.

The higher the potash rate the lower the specific gravity. This could be undesirable if the potatoes were to be processed but desirable if they were sold on the fresh market.

Table 4—in another experiment designed to test rates and placement—shows how high yields and high specific gravity can be obtained with high potash rates in the fertilizer *if nitrogen and phosphorous levels are also high.*

TABLE 3—PLACEMENT METHOD HAD LITTLE INFLUENCE ON SPECIFIC GRAVITY OR POTATO CHIP COLOR, WHILE INCREASED POTASH AFFECTED SPECIFIC GRAVITY MARKEDLY. (RUSSET BURBANK POTATOES)

Pounds K_2O/Acre	Specific Gravity		Potato chip color	
	all banded	½ banded ½ broadcast	all banded	½ banded ½ broadcast
0	1.093	1.093	7.1	7.1
200	1.088	1.088	6.8	7.0
400	1.084	1.084	6.8	6.9

TABLE 4—HIGH YIELDS AND HIGH SPECIFIC GRAVITY ARE POSSIBLE WITH HIGH POTASH RATES IN THE FERTILIZER IF NITROGEN AND PHOSPHORUS LEVELS ARE ALSO HIGH. (RUSSET BURBANK POTATOES.)

Nutrients applied			Total Yield CWT/A		Per cent No. 1 Grade		Specific Gravity	
			all	½ banded	all	½ banded	all	½ banded
N	P_2O_5	K_2O	banded	½ broadcast	banded	½ broadcast	banded	½ broadcast
240	240	240	465	457	80	82	1.104	1.102
320	240	240	495	497	78	79	1.101	1.100
320	320	240	497	487	77	79	1.097	1.101
320	320	320	483	490	77	80	1.100	1.101
400	320	320	530	516	72	80	1.094	1.097
400	400	320	498	518	74	77	1.100	1.097
400	400	400	497	480	72	75	1.094	1.098

. . . On Blackspot

During the 1962 potato marketing season, much blackspot occurred in the potatoes. The amount of potash in the soil, in the fertilizer, and in the tissue has been correlated with the amount of blackspot.

Table 5 shows the effect of potash on blackspot, indicating (1) that more potash was taken into the plant when all the fertilizer was banded than when only half was banded, (2) that the higher the potassium level in the petiole the lower the blackspot index.

Whether the potassium comes from chloride or sulfate form apparently makes little difference in the Columbia Basin.

Such potash effects as these should encourage more attention to the soil spot problem in the future if maximum yields of high quality potatoes are to be produced.

THE END

TABLE 5—MORE POTASH WAS TAKEN INTO THE PLANT FROM ALL THE FERTILIZER BANDED THAN FROM ONLY HALF BANDED AND THE HIGHER THE POTASSIUM LEVEL IN THE PETIOLE THE LOWER THE BLACKSPOT INDEX.

Pounds K_2O/Acre	Per cent potassium in the petiole (100 days after planting)		Blackspot index		Mean per cent decrease in Blackspot index
	all banded	½ banded ½ broadcast	all banded	½ banded ½ broadcast	
0	3.7	3.6	3.4	3.0	0
200	7.8	7.0	2.2	2.4	28
400	8.8	7.8	1.9	1.9	41

NITROGEN POTASSIUM TEAMWORK on FORAGE COMPOSITION

By M. R. Teel
Research Director
American Farm Research Association
West Lafayette, Indiana

Reporting . . .

. . . how research shows that potassium fertilization promotes protein synthesis and often prevents the accumulation of NPN ('non-protein-nitrogen") in grasses and legumes.

. . . how 2-year-old Holstein heifers preferred second growth alfalfa-bromegrass hay fertilized *with both nitrogen and potassium* over the unfertilized hay or the hay fertilized with nitrogen or potassium singly.

. . . how frequent farmer testimonies indicate fertility balance merits top rating for insuring good herd health.

SINCE livestock men occasionally report rumen disorders, nitrate poisoning, and vitamin A deficiencies when cattle are fed nitrogen-fertilized herbage, we must approach the subject of nitrogen fertilization with much realism.

To suggest we abandon nitrogen fertilization is to invite famine. For each acre on which nitrogen fertilizer is accused of causing rumen disorders, there are thousands of acres where inadequate nitrogen produces an even more costly condition—called "hollow-belly" by livestock men.

The cows simply don't get enough to eat!

Yet, we must recognize that when grass plant growth is stimulated by nitrogen fertilizer, the demand for other nutrient elements is increased.

When nitrogen is plentiful, a deficiency of an element necessary for protein synthesis may cause a build-up of organic acids and free amino acids, the latter being the building blocks for proteins.

And with a luxuriant nitrogen supply, some of the organic acids react with the nitrogen to produce amides. Free amino acids, amides and related compounds are classed collectively as "non-protein-nitrogen" (NPN).

Research in our laboratory shows that potassium fertilization promotes protein synthesis (Figures 1 and 2) and often prevents the accumulation of NPN ("non-protein-nitrogen") in grasses and legumes (Tables 1 and 2).

This is no surprise since large quantities of potassium are needed

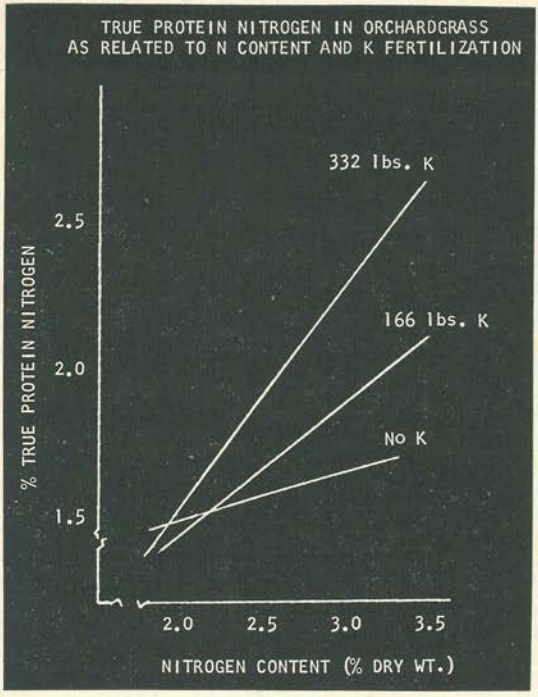


Fig. 1—K fertilization increases the % true protein nitrogen in 6 week old orchardgrass. (Cummings, 1961)

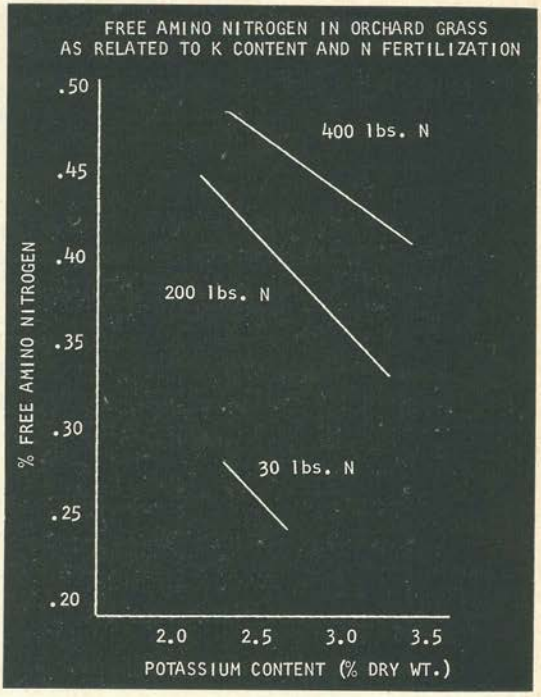


Fig. 2—Free amino nitrogen in 6 week old orchardgrass increases with N fertilization. A higher K content in the plant reduces free amino nitrogen. (Cummings, 1961)

for protein synthesis and sustained full season growth.

However, a serious phosphorus magnesium or sulfur deficiency produces similar effects because they are also essential for protein synthesis.

The extent to which herbage with high organic acid and/or "non-protein-nitrogen" content interferes with rumen function is a matter deserving our close attention.

Someone recently said if we were to learn that auto exhaust fumes cause lung cancer, we wouldn't stop manufacturing automobiles—we would find a way to eliminate the fumes.

Likewise, if nitrogen-fertilized herbage is causing rumen disorders, we must find the reason. Does the plant have an abnormal composition or is it merely a problem of learning the proper way to supplement such herbage so as to eliminate the risks?

NITROGEN

For Top Yield Of High Quality Feed

The chief reason for spreading nitrogen on grasses is to increase yield. The accompanying increase

TABLE 1—INFLUENCE OF N AND K FERTILIZATION AFTER FIRST HARVEST ON COMPOSITION OF SECOND- AND THIRD-GROWTH ORCHARDGRASS. (GRIFFITH 1958)

K added after 1st harvest (lbs/acre)	Nitrogen added after 1st harvest: None		150 lbs/acre	
	Second Harvest			
	Potassium (%)	Asparagine (%)	Potassium (%)	Asparagine (%)
none	1.6	.31	1.4	.52
100	2.3	.15	2.4	.19
200	2.8	.11	3.1	.15
	Third Harvest			
none	1.6	.24	1.4	.48
100	1.8	.15	2.0	.17
200	2.6	.19	2.5	.17

in crude protein is a bonus since it reduces, and often eliminates, the need to feed protein supplement.

The rate at which cells divide and the size they ultimately attain is closely tied to nitrogen supply. In fact, nitrogen accounts for an average of 16.7 percent of the weight of the proteins in the cell.

When nitrogen supply dwindles, the top leaves of a grass plant virtually rob the lower leaves of their nitrogen, as often seen in the yellow, dying bottom leaves of a nitrogen-starved corn plant in late summer.

The relation between nitrogen content and feeding value is well documented.

Within limits, the higher the nitrogen content, the higher the feeding value because of the increased protein content—which explains why legume hay usually gets the blue ribbon.

But, a high nitrogen content does not necessarily guarantee a high true protein content. Much of the nitrogen may exist as NPN—"non-protein-nitrogen." The possible harmful effects of NPN are understood by livestock feeders who use urea as a substitute for protein. They carefully limit the intake for reasons discussed later.

BALANCE NITROGEN

With Other Essential Nutrients

Farmers are perhaps more conscious of nitrogen need, especially for high corn yields, than the need for certain key elements that help insure efficient use of absorbed nitrogen.

High yields are not possible if a single essential nutrient element is short. Even when high yields are obtained, high quality is not assured in either the grain or the herbage unless the crop composition is normal. And normal composition demands proper balance of nutrients.

The problem is a subtle one. We must learn not only which nutrient

TABLE 2—COMPOSITION OF THIRD GROWTH ORCHARDGRASS (6 WEEKS RECOVERY) AS INFLUENCED BY NITROGEN AND POTASSIUM FERTILIZATION, (CUMMINGS, 1961)

Nitrogen applied (lbs/acre)	Potassium Applied lbs/acre zero	166	332	average
		True Protein Nitrogen		
30	1.70	1.58	1.85	1.71
200	1.48	1.54	2.08	1.70
400	1.66	2.00	1.97	1.88
average	1.61	1.71	1.97	
		Non-Protein Nitrogen		
30	.37	.43	.39	.40
200	.95	.92	.52	.80
400	1.38	1.05	.96	1.13
average	.90	.80	.62	
		Malate		
30	1.27	.54	.52	.78
200	1.83	.68	.99	1.17
400	1.35	1.41	1.06	1.27
average	1.48	.88	.86	1.07

becomes first to limit yield, but also what bearing it has on feeding values.

Here we focus on potassium because in recent research on both legumes and nitrogen-fertilized grasses, potassium became the limiting element governing both yield and certain key metabolic plant systems associated with quality.

POTASSIUM

Essential For Protein Synthesis

In addition to yield and winter hardiness, potassium is involved with herbage quality because of its role in transforming carbohydrates into proteins.

In a limited feeding trial with alfalfa-bromegrass hay, 2-year-old Holstein heifers preferred second growth hay fertilized *with both nitrogen and potassium* over the unfertilized hay or the hay fertilized with nitrogen or potassium singly (Table 3).

The hay was fed twice daily (3 heifers per lot) in amounts slightly over that readily consumed. In addition to hay, the heifers were fed 8 pounds of grain mix and free choice minerals.

Forage consumption in favor of the "nitrogen-plus-potassium" treat-

TABLE 3—INFLUENCE OF N AND K FERTILIZATION ON PLANT COMPOSITION AND VOLUNTARY CONSUMPTION OF SECOND CUTTING ALFALFA-BROMEGRASS HAY.

Fertilizer added after first cutting (5/30/60)	Soil test K_2O/acre (7/15/60)	Plant Composition [1] Alfalfa		Bromegrass		Voluntary consumption (lbs D.M./ Cwt. body wt.
		K	asparagine	K	asparagine	
lbs/acre	lbs/acre	(%)	(%)	(%)	(%)	lbs.
none	88	1.28	.61	2.91	.03	1.48
113 lbs N as urea	83	1.75	.38	2.94	.04	1.20
166 lbs K as KCl	362	2.01	.36	3.36	.03	1.36
113 Lbs N 166 lbs K	299	2.12	.40	3.41	.05	1.60

[1] Average of two replicates, two samples per replicate.

ment approached significance at the 5 percent level of probability —an interesting trend with so few heifers per lot and such high level of grain feeding.

We also noted two interesting relationships in forage composition:

1 Bromegrass contained nearly twice as much potassium as alfalfa with virtually no asparagine (an amide used as an index to NPN accumulation).

2 A 0.5 percent change in potassium content of the alfalfa from the urea treated plots reduced the asparagine content to the level found in the high-potassium hay.

These results suggest ammonia from the urea may have increased the availability of the potassium—a relationship deserving further investigation.

POTASSIUM

Important For Alfalfa Recovery

The composition of the alfalfa prompted a closer look in 1962 at the need for potassium fertilization to support alfalfa recovery after the initial harvest. The results are shown in Table 4:

1 A field of Ranger alfalfa with soil test indicating 125 to 150 lbs. of available K per acre was divided into 3 equal areas and fertilized in mid-April with 0, 50, and 100 lbs. of K per acre.

2 The areas were refertilized at twice the original rates after the initial harvest on May 17, 1962.

3 The effect of additional potassium on yield and plant composition is clear, with growth rate during recovery period increasing by 26 lbs. dry matter per acre per day.

Note how this growth rate is *inversely* related to the concentration of malate and citrate but *directly* related to the malonate content.

Such reciprocal relationship indicates a rather definite amount of carbon as organic acid is shunted into the organic acid pools, and the

TABLE 4—INFLUENCE OF POTASSIUM FERTILIZATION ON YIELD AND ORGANIC ACID CONTENT OF SECOND CUTTING ALFALFA.

Potassium treatment	K content of second growth	Second cutting yield 7/16/62	Growth rate during 30-day recovery	Organic Acid Content milliequivalents/gram		
				Malate	Citrate	Malonate
lbs/acre [1]	(%)	(lbs/A)	(lbs/A/day)	(m.e.)	(m.e.)	(m.e.)
none	1.57	2846	95	230	65	150
50+100	2.27	2898	97	140	65	200
100+200 [2]	2.81	3643	121	157	54	278

[1] Split application: April 15 and May 17, 1962.
[2] Caused severe lodging.

particular type of acid produced is a function of the mineral balance.

Further examination of this relationship in Table 5 shows how random alfalfa samples, carefully selected from areas of high, medium, and low potassium soils in the brome-alfalfa field that had received no fertilizer in two seasons, reflected relationships similar to Table 4.

The tendency for the proportion of total acidity accounted for by malate, citrate, and malonate to remain a constant suggests organic acid analyses may be a valid approach for further studies on the effects of fertility balance.

But one might expect the number of acids involved to change with plant species (Table 6).

CHEMICAL COMPOSITION

How It Affects Feeding Value

What are the theoretical relationships between organic composition and feeding value of herbage?

From a practical viewpoint we cannot ignore the possibility of depressed palatability, shown in the Table 1 experiment.

Little is known of the possible influence of organic acid imbalance on forage quality. But there are several reasons why we should guard against the accumulation of NPN ("non-protein-nitrogen") in herbage.

Enzymatic release of ammonia from amino acids and amides causes rapid build-up of ammonia in the rumen unless the animals are allowed to become adapted to the ration slowly—permitting new strains of microorganisms to multiply and to utilize the ammonia.

During such transition period, it's wise to feed grain or low-protein hay or even straw. Such carbohydrate reinforcement enables the rumen microbes to multiply more rapidly and incorporate the excess ammonia into microbial proteins which the animal later digests.

SOME HARMFUL EFFECTS

From NPN Accumulation in Herbage

If the ration is low in carbohydrates, the microbial population is more or less static. With a limited

TABLE 5—POTASSIUM SOIL TEST AS RELATED TO POTASSIUM CONTENT AND ORGANIC ACID CONTENT OF ALFALFA. (AVERAGES OF 6 SAMPLES)

Soil Test K_2O/acre	Potassium Content	Percent of Total Organic Acidity Accounted for by			
		Malate	Citrate	Malonate	Sum
lbs	(%)	(%)	(%)	(%)	(%)
70–145	.78	53.0	27.5	12.5	93
145–180	1.27	46.5	23.5	21.0	91
180–550	2.24	38.0	13.0	39.0	90

population, the ammonia accumulates and causes a number of harmful effects:

1 It appears directly or indirectly related to depressed absorption of calcium and magnesium.

2 It may raise the acidity of the rumen fluid, creating unfavorable environment for the desirable organisms.

3 Under prolonged excessive intake of NPN, much of the ammonia is absorbed through the rumen wall into the veins which drain the organ. In the venous blood it is carried to the liver where it is converted to urea, unless the liver is overtaxed. This conversion takes energy that could perhaps be more wisely spent for growth, gains, or production. Much of the urea is excreted by the kidneys, though some is routed back to the rumen through blood or saliva.

4 It is easy to exceed the liver's capacity to filter out ammonia, research at other stations shows. When the upper limit of animal tolerance is exceeded, the animal suffers from some form of ammonia intoxication. It is agreed the brain and nervous system are affected since the animals are nervous and often stagger. In advanced stages they may go into a coma or die.

There is much controversy over the exact metabolic systems involved. Treatment to relieve the stress usually includes calcium and magnesium salts of a sugar derivative. Some theorize magnesium quiets the animal while calcium restores the disturbed mineral balance.

The sugar derivative supplies cells with organic acids that serve as "sparkers" in cellular metabolism.

FERTILITY BALANCE

One Insurance Farmers Attest to

Does ammonia intoxication or any of the closely related conditions, such as tetany, milk fever, or ketosis occur more frequently on pastures testing low soil potassium?

The answer is not clearly established.

But frequent farmer testimonies indicate fertility balance merits top rating for insuring good herd health. Some report increased milk flow or improved gains on beef cattle when the protein level in the grain mix is reduced. In almost

TABLE 6—NON-PROTEIN NITROGEN AND ORGANIC ACID CONTENT OF TALL FESCUE AS RELATED TO NITROGEN FERTILIZATION (SAMPLED 7/12/62).

Treatment	NPN Content	Organic acid content (Milliequivalents/gm. d.m.) Unknown	Succinate	Malate	Citrate plus malonate	Fumarate	Total acidity
none	0.76	9.44	3.44	21.48	57.49	56.99	148.84
150 lbs N/A on 5/7/62	1.03	18.59	22.22	118.81	59.58	19.19	238.39

every case known to the author, the operator was blessed with forage of high crude protein content.

The problem seems to be clearly related to excessive intake of non-protein nitrogen. So, if he is to safeguard the health of his livestock, the animal agronomist should become well acquainted with both plant and animal needs.

Potassium fertilization is believed to be a safeguard for livestock health on soils with low potassium supply since it favors protein synthesis and normal carbohydrate metabolism in the leaves and stems of several common forage plants.

THE END

Tailor-made Milk

. . . from "ice cream cows"?

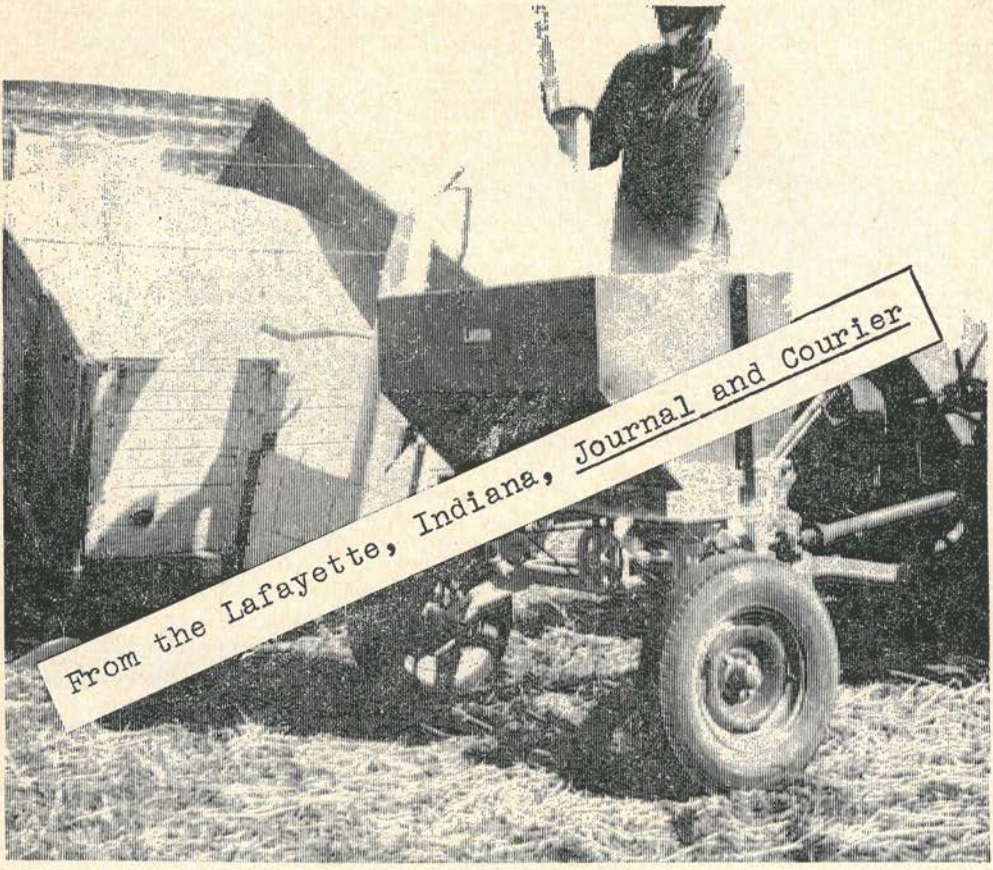
WITH specialization coming in almost every phase of agriculture, it may be no surprise to some that dairy researchers are predicting specialized cows.

One may give milk that is especially good for cheese-making, another one give "ice cream milk" and so on. Cows can be bred with this in mind because research workers have found that certain ways of feeding may encourage growth of a specific kind of bacteria in the cow's rumen. These will help produce milk with tailor-made qualities.

This stomach, or rumen, might be viewed as a fermentation vat. Fermentation takes place there because the conditions are ideal for the growth of countless bacteria and protozoa. Billions of these microscopic animals and plants work at breaking down the food that bossy eats.

And it may be possible, by the right kind of feeding, to get just the right kind of milk for the topping on that ice cream cone, that wedge of cheese—or even for children's milk or special milk for a weight-conscious adult.

—Ontario Milk Producer



THE MODERN WAY—To apply bulk fertilizer in the modern way is to use one of these spreaders, which use a whirling fan-like device to scatter the plant food. Here, William German loads up a spreader with muriate of potash. He said he prefers this style machine to the conventional agitator models because it is faster. He also said it is no trouble to cover 150 acres a day with the machine. The Germans are applying potash to their corn ground—about 1,000 acres. They follow a program for growing corn of applying 200 pounds of the potash—a high phosphate starter—and 120 pounds of nitrogen. (Staff photo by Arthur Yocom)

Still the Best Bargain

ON the average, each dollar invested in plant food returns the farmer $3 in cash income. *Feed your crops and they'll feed you!*

Fertilizer is still the cheapest production item the farmer buys.

Yet, according to USDA, only 11 per cent of farmers use recommended rates of fertilizer, 37 per cent use no fertilizer at all on their cash crops.

For almost every crop there is a minimum and maximum amount of fertilizer recommended per acre. Sound farm management would advise maximum amounts.

A successful farmer can't afford to skimp on plant food. You can't starve profits into field and forage crops. Liberal fertilization saves labor, increases yield, improves quality, and makes profits possible.

—*Southern Planter*

For Some, JOY— For Some, STATUS

THE growth of garden supply sales has been spurred by the increase in leisure time, rising incomes, and the movement of city dwellers to the suburbs.

For many home owners gardening is an enjoyable, satisfying hobby. Others, however, seem to feel compelled to work and spend on their yards.

"They probably wouldn't admit it, even to themselves, but a portion of the so-called 'garden enthusiasts' really dislike gardening," asserts the Federal Reserve Bank of Philadelphia in a recent candid report on the "outdoor living" market.

The report contends many amateur gardeners are driven by such motives as the search for status, competition with their neighbors, and the desire for self-expression.

PETUNIAS INSTEAD OF PICASSO

Moreover, the bank says: " . . . The yard helps overcome the modern house's inadequacies. It is used as an extension of the house—a second living room without walls.

"Many people garden simply as a means to decorate their quarter-acre living room. They use petunias instead of Picasso prints and bluegrass instead of broadlooms. . . . It follows then that gardening and lawn maintenance often assume the status of housekeeping chores—necessary but not much fun."

—The Wall Street Journal

Georgia farmers are making considerable progress in shifting to the use of high analysis fertilizers, reports P. J. Bergeaux, Extension Service agronomist at the University of Georgia College of Agriculture.

In 1950, he said, over 600,000 tons of low analysis fertilizers such as 4-8-6 and 4-8-8 were sold with practically no high analysis fertilizers such as 4-12-12 or 5-10-15 being used. By 1960, however, sale of 4-8-6 and 4-8-8 had dropped to 26,000 tons, and over 800,000 tons of 4-12-12 and 5-10-15 were sold.

"The main reason for this shift to high analysis fertilizers," Mr. Bergeaux said, "was the increased use of soil testing to determine fertilizer needs." In the ten-year period from 1950 to 1960 soil samples analyzed increased from 15,000 to 45,000.

TO THE SHIFT TO HIGH ANALYSIS FERTILIZERS

THE KEY

AND TO HIGHER YIELDS PER ACRE

One of the many Georgia farmers who switched to high analysis fertilizers, the agronomist reported, was Millard Braswell, Jackson County. In 1950, his first year on his present farm, Mr. Braswell fertilized his corn with 400 pounds of 4-8-6 fertilizer and side dressed it with an additional 40 pounds of nitrogen per acre. That year he averaged 45 bushels of corn per acre.

Mr. Braswell soon began using higher analysis fertilizers, switching first to 2-12-12 and then to 4-12-12. He now bases his fertilizer use on soil test results and crop removal of fertilizer elements. He now averages around 80 bushels of corn per acre and has averaged as high as 150 bushels per acre on a ten-acre field.

Georgia News

Cut Your Planting Costs

CHOOSING the right fertilizer can cut your planting cost. Here is why:

1 It's the pounds of plant nutrients, not pounds of material that determine "growing power."

2 If you use high analysis fertilizer, you save in labor all the way along with no sacrifice in crop response. You save in trucking costs as well.

3 If you store the fertilizer on your farm, less space is involved without mentioning the saving in time to unload. You save again when you haul fertilizer to the field—in labor and in mileage.

4 What you will really like is that you can plant more acres in a day. The high analysis fertilizer means that you can apply the same nutrients at a lower rate—this means less filling of hoppers with more crops planted per day. It makes your fertilizer boxes "bigger."

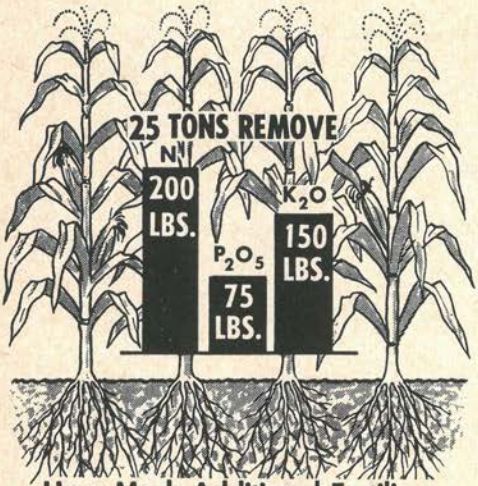
5 It is no trick at all for you to pick up three or four more acres per day by using high analysis over low analysis fertilizer.

In addition to the saving in labor, there is often an indirect dividend since timely planting insures crops that are usually tops in yields.

—Farm Profit

CORN SILAGE

How Much Plant Food?



How Much Additional Fertilizer Does Your Soil Need?

Talk over your program with us.

MAT A

ARE "LEFTOVERS" **ENOUGH ?**

Are you treating your soybeans like a red-headed stepchild—that is, "feeding them from the second table?".

When we first started growing soybeans, we thought they would do very well on "leftovers"—the residual fertility left over from the corn crop.

But as yields have climbed from 20 to 40 even to 50 bushels per acre, we have learned that soybeans respond to direct fertilization on many soils.

And the investment is worth it, when 1½ bushels of beans will more than pay for each 100 lbs. of 0-20-20 fertilizer you use.

Application of broadcast or side-band row fertilizer is a safe way to fertilize soybeans directly.

Have your soybean yields been as high as you would like? If so, forget this message. If not, come in and talk over your soybean production problems with us.

You might try our fertilizer recommendations on just part or all of your field. Your soybeans might well amaze you when they don't have to depend on "leftovers".

MAT B

KNOW YOUR **HAY–RITHMETIC**

Are you getting five tons of alfalfa? If not, then you may not be applying enough fertilizer.

ALFALFA IS A HEAVY EATER.

It has long reigned as "QUEEN" of hay crops because of its superior quality as a feed. It also has another distinction: Remover of more plant food from the soil than most field crops.

EACH TON of alfalfa hay takes up about 10 lbs. of phosphate (P_2O_5) and 45 lbs. of potash (K_2O).

HAY–RITHMETIC

A 5-ton crop removes 50 lbs. of P_2O_5 and 225 lbs. of K_2O.

Five tons = about 154 bales (65 lbs.)

If you want to move to this yield, and stay there, you must meet the fertility needs of your crop.

Convince yourself. Try our alfalfa fertilizer on all or just part of your field. Come in and discuss a complete program with us.

MAT C

NEWSPAPER MATS

■ For official agricultural advisors who like to tie their local newspaper report to an illustrated theme now and then.

■ For fertilizer firms that like to identify themselves with sound educational messages.

Space at bottom of each mat for firm or official agency name.

EDUCATIONAL NEWSPAPER MATS — 10¢ per mat, $10 per 100 — Up to 5 Free official advisors and fertilizer firms

Name _____

Organization _____
(Agricultural Connection)

Address _____

City _____ **Zone** _____ **State** _____

Mat No.	*Quantity*
A	_____
B	_____
C	_____

For quantities above free policy: $_____ attached.

Dept. B.C. **American Potash Institute** **1102 16th Street, N.W.** **Washington 6, D.C.**

CURRENT REPRINTS

ON SOILS AND CROPS AS LONG AS SUPPLIES LAST

REPRINTS	3¢ per copy $3 per 100	Up to 50 copies free official advisors & fertilizer firms	Number Serial	Number Desired
Potassium-nitrogren Balance for High Corn Yields			Q-5-52	
The Leaf Analysis Approach To Crop Nutrition			CC-12-52	
Potash Deficiency of Reforested Pine and Spruce Stands In North New York			DD-12-52	
Balanced Nutrition Improves Winter Wheat Root Survival			J-3-53	
Potash Pays on Forage in New England			BB-6-54	
Shortages of Potash Limit Grape Yields			I-2-55	
Soybean Production in the Southern States			L-3-55	
Potash Prevents "Curl Leaf" of Sour Cherries			R-4-55	
The Production of Sugar Beets on Organic Soils			W-5-55	
Residual Fertility Insures Alfalfa After Drouth			BB-8-55	
Give Your Plants a Blood Test			L-5-56	
Potassium—The Alkali of Life			V-11-56	
Potash Fertilizers And Their Behavior			C-2-57	
Growing Azaleas and Camellias			N-5-57	
Soil Tests Spotlight Turf Needs			P-8-57	
Diagnosing Fruit Needs			X-10-57	
Johnsongrass a Menace?			Y-10-57	
Consider Plant Food Content of Your Crops			EE-12-57	
Mint Grown on Organic Soils			HH-12-57	
Growing House Plants Successfully			F-2-58	
Vegetable Fertilization			N-4-58	
Band Seed Alfalfa in the Summer			U-6-58	
High Nitrogen Increases Potash Needs of Grasses			DD-11-58	
Fertilizers Boost Bell Pepper			C-1-59	
How Legumes Boost Milk Production			H-8-59	
Know What's In Your Fertilizer Bag			Q-11-59	
Growing Alfalfa Successfully			B-5-60	

HANDBOOKS	10¢ per copy $10 per 100	Up to 10 copies free official advisors & fertilizer firms		
Limiting Factors In Crop Production			A-1-60	
Forage Fertilization Pays			F-12-60	
Orchard Fertilization Pays			G-8-61	
Plant Testing			G-5-62	
Moisture and Fertility			A-1-63	

Name_____

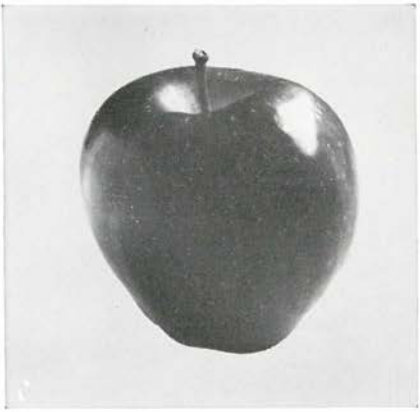
Organization_____
(Agricultural Connection)

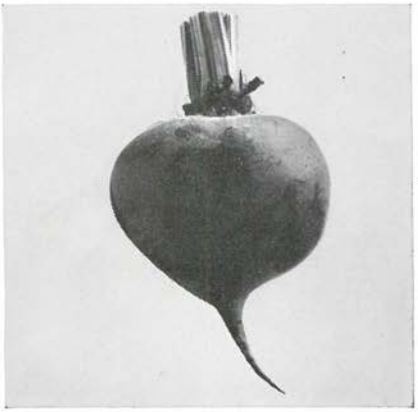
Address_____

City_____ **State**_____

Dept. B.C. American Potash Institute 1102 16th Street, N.W. Washnigton 6, D.C.

For quantities above free policy: $_____ attached.





Why your "money crops" may need BORON

Borated fertilizers are being used widely to improve yield and quality of crops like alfalfa, apples, beets, cabbage, cotton, cauliflower and corn. To help these crops grow better we offer 4 economical sources of boron — each product designed for special needs.

So essential is the trace element, boron, that most authorities recommend **annual** applications. Top-dressing with borated fertilizer has actually doubled alfalfa yields. In one series of tests, $8.50 worth of fertilizer netted an extra $28.62 worth of alfalfa per acre.*

41 states have boron-deficient areas. Ask your state agricultural authorities if your land needs boron, and what specific amounts you should use. Or write us — for the remarkable story of borated fertilizers and what they can do for your "money crops".

*Mimeo Report, C.J. Chapman, Soils Dept., Univ. of Wisconsin

U.S. BORAX®

3075 Wilshire Blvd., Los Angeles 5, Calif.

COMING!

News Column

Radio Spot

AIDS

Suggestions For Official Agriculturists
And Industrial Representatives
Who Can Use Them
