Better Crops with PLANT FOOD

April, 1958 10 Cents

BORON AND POTASSIUM HUNGER IN THE RUTABAGA

FERTILE FACTS

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ON THE COVER . . .

. . . We see clear signs of boron and potash hunger in rutabagas.

In the top picture, we see the importance of boron in rutabaga growth. On the upper shelf, the left group of rutabagas represents a crop that received adequate boron. The right group came from a crop deficient in boron, producing limited yield. Boron deficiency is easily identified in the rutabaga. Known as brown-heart or water-core, it consists of brown, water-soaked areas, with a glassy appearance, like those in the center rutabaga on the lower shelf.

In the lower picture, we see definite signs of potash hunger in rutabaga growth—leaves bluish green, surface crinkled, some chlorosis, older leaves drooping, premature and simultaneous withering.

Rutabagas are grown as general farm crops by market gardeners and in home gardens. Commercial production in the northern part of the United States centers mainly around their use during the fall and winter for human consumption and for livestock feeding.

But large quantities of them are rejected yearly because of brownheart—or boron deficiency. In many areas, it has been reported, ten pounds of borax per acre gives good control of boron deficiency, but 15 to 20 pounds per acre gives highly satisfactory control without injuring ordinary crops in subsequent rotations.

Other specialists say when boron is used, it should be thoroughly mixed with the fertilizer and spread evenly in the row and covered with soil before the seed is planted . . . and that the rate of application should be ten pounds of borax per acre.

The safest policy, of course, is to consult your official agricultural advisor and have your soil tested.

Better Crops with PLANT FOOD

The Whole Truth
Not Selected Truth

SANTFORD MARTIN, *Editor*

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Washington 6, D. C.

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April is a good time to credit . . .

FARM COLLEGE BOOSTERS

Jeff McDermid

(ELWOOD R. MCINTYRE)

NO RECORD could ever be compiled of those who upheld the original land-grant college aid to agriculture. Here and there in obscure pamphlets, aged farm journals, old yearbooks and almanacs, the names of old heroes of the hoe are uncovered like stray lost kernels beneath the dust of ancient threshing floors.

All one can do is to select for praise a few veterans of the vernal craft and bless all the rest vicariously.

Sedate colonial patriots rattling over corduroy roads in wagons and chaises shortly after the redcoats decided to evacuate were startled and amazed at what they beheld across the face of a hillside meadow near Burlington, New Jersey.

Rubbing specks from their vision, they halted the nags and gazed again and again. Woven in rich green hues of rankly growing timothy and fescue, against a background of duller and shorter growth, were these words: *"This Place Has Been Plastered."*

Maybe the good burghers figured that the one who spread the minerals over the face of the meadow was also "plastered," just as the students remarked about Jefferson's wobbling crooked wall at Charlottesville, Virginia.

"Lack-a-day! Methinks this is just another of old Ben Franklin's noddy notions," they probably said, pushing onward to the market place in some concern about the latest evidence of queer quirks from the Postmaster General, whose antics with key and kite and printing press had already disturbed their decorum.

They knew that the indomitable and erratic printer of Boston and Philadelphia was addicted to all manner of cultural kinks and tests on his plantation estate—such as writing a treatise on gardening and grafting, and bringing into America some roots of a new herb called "rhubarb," said to be unexcelled for a spring tonic to be taken in the pleasant form of pies.

And not a few of the gentry in the colonies had the latest edition of Poor Richard's Almanac dangling from a kitchen peg.

Apparently the redoubtable Benjamin did some select grafting on the scion of his own household, for his son, William Franklin, kept up the agricultural tradition. He monkeyed a lot with nature and the seasons while he was governor of New Jersey.

We find him granting the charter to Rutger's (Queen's) College in later years. This institution is not even now unknown to fame, as it claims priority as the first state college to blossom forth under public aid in behalf of the folks who get callouses on their hands. Other equally honorable citations could be laid at the door of Rutgers.

FARMING HAD STARTED ON ITS CAREER . . .

The Franklins were busy boosters for bucolic things. They helped form the Philadelphia Society for Agricultural Promotion. This group of worthies made quite a ceremony when the first medal ever struck for agricultural achievement was bestowed with unstinted oratory on Colonel George Morgan in tribute to his neat scheme of farm landscape design.

It was he, with Master John Stevens of Hoboken, who joined in making the astounding prophecy before the year 1800: *"No subject of rural economy will be eventually of more importance to agriculture than the cultivation of lucerne."* George Washington had discovered the truth of their statement, albeit not as convincingly perhaps as these New Yorkers, Quakers, and Jersey experimenters.

Two other far-sighted men emerged about this time, far in advance of their generation. Both of them outlined very clearly the need for an agricultural college under some public support. Jesse Buel in 1825 petitioned the New York solons at Albany for an agricultural college like Switzerland then enjoyed. As a judge and farm journal publisher, Buel exerted wide and effective influence.

Much earlier, Thomas Budd, a West Jersey Quaker, advanced his hunch for a plan of granting the rentals from public lands for the support of farm schools and vocational education. In fact, the whole Quaker concept of learning was directed broadly toward reaching the submerged 95 percent as fast as available funds and continued liberality would permit.

But not all ideas of a new kind were "Yankee notions." We had experimenters and dreamers of a new day in the South. Likewise, we are indebted to the foreigners for much excellent hints on agriculture. As St. Paul evokes, "we owe a debt both to the Greeks and to the barbarians." Just two examples of the assistance from abroad are not amiss.

The first man bears a flowery name indeed—J. Hector St. John de Crevecoeur of Normandy. Its cadence makes you think of old turreted towers and ancient roads seen through the bright hues of tile roofs and apple blossoms on April mornings. It takes you back to seeing great bunches of grapes clustered on wires in the glass orchard houses of Belgium, the tempting pears of Anjou, the wine presses of Epernay, and the flower-laden barges of Holland.

Crevecoeur ran two farms as private experiment stations dedicated to the public benefit. They were in Orange county, New York, and Sussex county, New Jersey. He wrote much and he lectured about what he had seen on his wide and observant travels. He was known in his day as "Agricola." This French savant is said to have introduced sanfoin, alfalfa, and vetch to our list of farm forages. Who knows if any of the land which then comprised the Crevecoeur estates remains in cultivation?

Then we had among us in those long ago years a pioneer botanist and nurseryman, also from France—Andre Michaux. Not so much is known of his influence on the colonial farmers and gardeners, but it did add a sense of tone and systematic science to the cultivation of the soil. And

. . . AS A PROFESSION

we needed a stronger sense of dignity, too, for the food producing craft. As we so often realize, the man from some other region carries more weight than the closest neighbor—"a prophet is not without honor save in his own country."

The year that Washington died (1799), a smart young New Yorker named Simon DeWitt graduated from Rutgers (Queen's) College. Thereafter he was heard from vocally and demonstrably. He asked loud and often for an educational institution where husbandry might be taught as consistently as Plato and Aristotle. You may add a wreath to his memory and look him up more fully.

The wave for giving college courses in agricultural science swept from the Carolinas up the seacoast to the northeast. Among the first feeble attempts to establish a new deal in educating farmers were the Boston Asylum and Farm School; Rensselaer Institute of Troy; Trinity College, Hartford; Union Academy and Freehold Institute of New Jersey; Amherst College, Massachusetts; the Farmers' College near Cincinnati; and that peculiar academy run by James Mapes of Newark. Mapes advertised in farm papers that his graduates were prepared to sell their services as "consulting agriculturists." *Farming had started on its career as a profession.*

But what everybody connected with these innovations wanted most was a national policy, federal recognition and sanction, and the union of scattered forces pleading for a sounder rural culture. This was achieved

—like a foot thrust in the doorway—when the Morrill Act of 1862 was passed and signed.

One is perplexed to know whether Jonathan Baldwin Turner of Illinois and Yale, or Justin Morrill of Vermont should be credited with drafting the land-grant college magna charta. Of course, there were others standing with them. Turner spoke at a few fiery meetings in the Midwest and kept the heat under the boilers. Turner solicited both Douglas and Lincoln during the famous debates and secured the support of these influential statesmen at a time when other less harmonious topics were before the public. Morrill took care of the ultra-conservative New Englanders, while busy leaders in Dixie advanced the cause of rural education with equal fervor.

Files and reports tell us that the Morrill Act passed the Senate by 32 to 7, and the House endorsed it 90 to 25. Nobody thought to save the pen that Lincoln used to sign it. Other pressing business of the day drove mementoes of this nature into the discard. No flash-bulb artists were there to say: "Smile, now, Uncle Abe; and give us a grin, Senator Morrill!" Mr. Brady was elsewhere with his wet plates.

History remains silent as to current smiles, back-slapping, and congratulations. Such manifestations are reserved for us. ◄◄◄

CARRY-OVER POWER...RETURNS EXTRA PROFITS

MIDWESTERN agronomists report that fertilizer's carry-over power can return extra profits for several years after the plant food has boosted crop yields and income the first year.

In Minnesota tests, fertilizer boosted corn yields 18 to 21 bushels per acre the first year and then its carry-over power increased oat yields from 15 to 40 bushels per acre the second year.

In Wisconsin, a 60-bushel increase in grain yields the first year from fertilizer use was followed in the next two years by increases in hay yields of 2 tons per acre.

Iowa agronomists report that there is a considerable carry-over of nitrogen, phosphate and potash when the amounts of each nutrient applied the previous year are about 40 or more pounds per acre.

The average carry-over of nitrogen applied to corn can run about 25 per cent on silt loam and heavier textured soils, the Iowa specialists say.

Phosphate carry-over can be as much as 40 to 60 per cent on many soils from an application of 40 to 70 pounds of phosphate to corn the previous year.

The carry-over of potash from corn and small grains can average up to 60 per cent when crop residues are not removed from the soil. The Iowa soils men figure the removal of the straw cut the carry-over to about 40 per cent. Removal of the stover in corn reduces the carry-over to about 30 per cent.

Four Steps To Good LADINO

1

LADINO clover is the most popular pasture legume in Vermont. Surveys show that it is grown on more than half of our farms. In spite of this popularity, farmers still find it hard to maintain uniform ladino stands from year to year.

Dr. Glen Wood, Vermont Agricultural Experiment Station agronomist, says that *proper management* has been found to be vital to long-lived ladino stands.

2

Less than 20 percent of the farmers who successfully established ladino stands have been able to maintain them for more than five years. What is the secret of their success?

Dr. Wood offers four key steps:

(1) Ladino needs about 180 pounds per acre of potash.
(2) It should have rest periods between grazing.
(3) Overgrazing and undergrazing should both be avoided.

(4) Light applications of manure in winter and spring will cut down winterkilling.

Potassium is the key to persistance. It is needed for *food manufacture, disease resistance,* and *efficient use of water*. Smaller and *more frequent applications* help make it available to ladino.

A pasture grazing system that aids ladino is most important. Overgrazing strips the plant because leaves are above the "bite line." Undergrazing permits grasses to compete excessively with the ladino. Regular clipping after each grazing controls weeds. Recovery of 8-10 inches of growth between grazings is important. This is particularly true during hot weather. A 3-4 inch stubble is recommended for wintering.

Timing is most important in manure application. Topdressing lightly with 6-8 tons per acre during late winter reduces winterkilling by insulating the exposed creeping stems from which next year's growth develops.

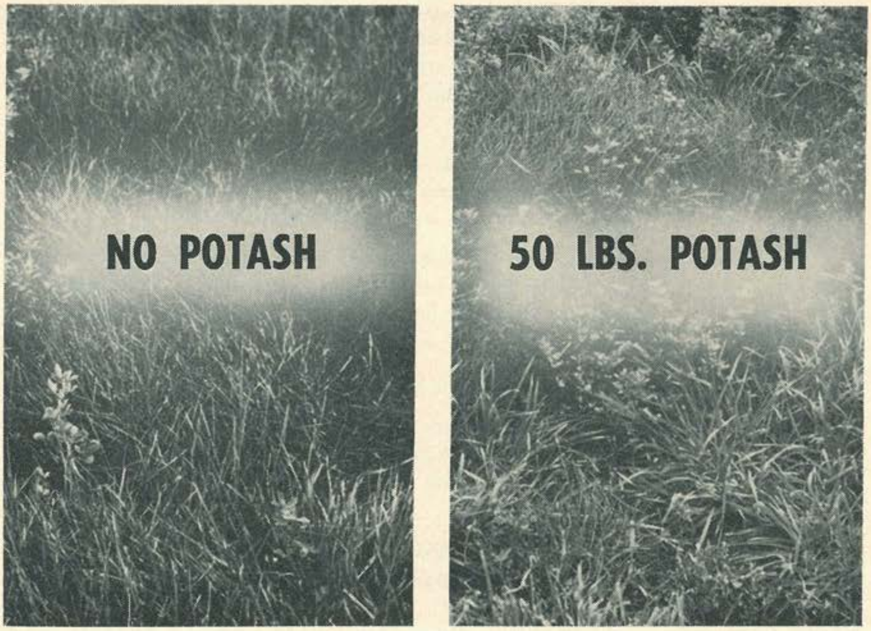
3

Ladino should be seeded only on high organic matter loams or silt loams with a good water holding capacity. To guard against boron deficiency, a mixed fertilizer containing boron should be used when seeding down. It should also be used occasionally as a topdressing on established stands.

Avoid using weed control chemicals in ladino pasture because they will damage the clover, Dr. Wood cautions.

—John Spaven, Editor
University of Vermont Agricultural Extension Service

4



This series of pictures, above and on the facing page, stresses the importance of potash in maintaining alfalfa. Each plot received 100 pounds P_2O_5, plus none, 50, 100, and 200 pounds

ALFALFA has often been called the "Queen" of all forage crops and is the oldest of all crops grown entirely for forage.

As a hay crop, it is of first importance in the United States, especially on soil adapted for favorable growth. The increase in importance of alfalfa in the last 25 years has been due largely to the introduction of *new varieties* and a better understanding of its mineral requirements.

Aside from climatic conditions, the success or failure of alfalfa is governed quite largely by the mineral content of the soil, both in kind and amount.

Although alfalfa will supply its own nitrogen needs, its requirements for phosphorus, potassium, calcium, magnesium, and other essential elements are substantial and exacting.

The importance of high yields, long life of the stand, and high quality

By
John L. Gerwig

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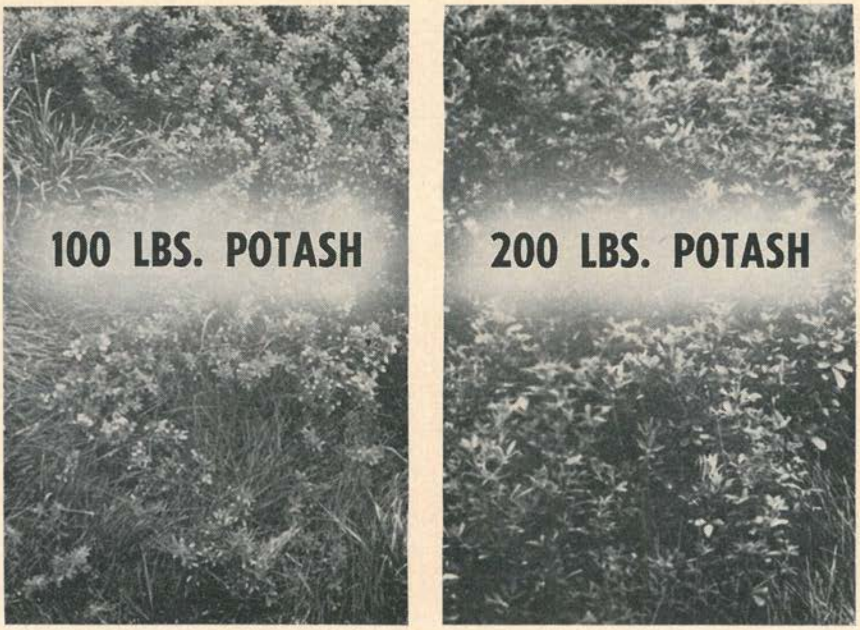
Extension
Rutgers University



of K_2O annually. The pictures were taken at the end of the fifth harvest year. Annual applications of 200 pounds K_2O were needed to obtain maximum yields and satisfactory stands.

KEY TO ALFALFA YIELDS

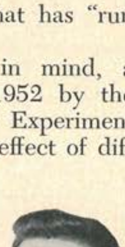
forage cannot be underestimated. The economic survival of many farmers under the present cost-price squeeze will be determined, in many cases, by the adequacy of their forage programs.

This means that they must obtain high yields of quality forage and maintain a stand for a suitable life-span to fit their rotation system.

The desirability of maintaining a high yielding stand for at least a 5-year period has been evident since ancient times. This is due chiefly to the cost of seedling establishment, loss of yield during seedling stage, and the desirability of plowing down a good stand rather than one that has "run out."

With these features in mind, a study was initiated in 1952 by the New Jersey Agricultural Experiment Station to determine the effect of dif-

Dr. John L. Gerwig, Extension Farm Crops Specialist at Rutgers University, earned his B.S. and M.S. at West Virginia University, his Ph.D. at Rutgers. Before joining Rutgers, he taught agriculture in a vocational school and served as a farm manager-supervisor. He is a West Virginia native.



ferent fertility levels on the yield, persistence and chemical composition of alfalfa.

The experimental area was located on a Nixon loam characterized as well drained, in good tilth, and adapted for alfalfa culture.

Atlantic alfalfa, drilled alone at the rate of 20 pounds per acre, was seeded in August 1952. An application of 500 pounds of 5-10-10 per acre was made at date of seeding. Soil tests indicated that this soil had a pH of 6.2, was medium in residual phosphorus and potash, and within the optimum range for boron and manganese.

Fifteen different treatments ranging from none to 200 pounds of nitrogen, none to 400 pounds of P_2O_5, and none to 400 pounds of K_2O in various combinations were applied in March of each year.

Appropriate sprays were applied as needed to prevent insect damage. The hay crop was harvested 3 times each season—the first crop when the alfalfa was at 1/10 bloom and the next two crops at ½ bloom.

Nitrogen Fertilization

The fertilizer treatments shown in tables 1, 2, and 3 were applied on small plots repeated 5 times. The hay yields given in these tables are average values for 5 replicated plots. To save space, hay yields are given for 1953, 1956, and 1957 and for the 5-year average, 1953-57 in Table 1.

The phosphorus content of the alfalfa plant tissue for the 1953-55 period is given in Table 2 and the potassium content in Table 3. The 1953 yield data were omitted in Tables 2 and 3.

The 1953 results represent the first year following establishment. An application of 25 pounds of nitrogen per acre was responsible for the highest yield of the initial harvest season and was significantly higher than the 50-pound rate.

These results would be interpreted as a small application being beneficial to establishment and 50 pounds as detrimental to nitrogen fixation by the plant. Higher nitrogen treatments offset this nitrogen loss, and therefore no significant differences in yield were recorded.

Further evidence that the plots receiving the 50 pounds of N were suffering from nitrogen deficiency in 1953 was indicated by the decreased nitrogen content of the plant tissue. The alfalfa plants on the 50-pound rates had a nitrogen content of 2.86, whereas all other nitrogen treatments were 3.04 or higher.

In 1954 and 1956, no significant difference was found due to nitrogen treatments. However, in 1955 and 1957 those treatments receiving 50 pounds of nitrogen or more were significantly lower than the other treatments. This was due primarily to chickweed (Stellaria media) competition.

Table 1. The Yield of Alfalfa As Influenced by Different Rates of Nitrogen.

Fertilizer applied yearly in March (1)	Dry matter—Tons/acre of alfalfa			
	1953	1956	1957 (2)	1953–57 ave.
0–0–0	4.40	0.28	0.5	1.89
0–100–200	5.18	3.34	2.96	3.95
25–100–200	5.60	3.17	2.99	3.99
50–100–200	4.95	3.41	2.33	3.66
100–100–200	5.34	3.26	2.40	3.69
200–100–200	5.21	3.15	2.03	3.52

(1) Expressed in pounds per acre of N, P_2O_5 and K_2O.
(2) Only 2 cuttings harvested due to extreme drought.

Table 2. The Yield of Alfalfa As Influenced by Different Rates of P_2O_5.

Fertilizer applied yearly in March (1)	Dry matter—tons/acre of alf.			% P content of alfalfa tissue
	1956	1957 (2)	1953–57	1953–55
0–0–0	.28	.05	1.89	.310
0–0–200	3.33	3.07	3.90	.271
0–50–200	3.64	3.14	4.05	.278
0–100–200	3.34	2.96	3.95	.295
0–200–200	3.52	2.74	3.82	.304
0–400–200	3.53	2.55	3.85	.339

(1) Expressed in pounds per acre of N, P_2O_5 and K_2O.
(2) Only 2 cuttings harvested due to extreme drought.

In general, nitrogen fertilization tended to decrease yields and stand, to increase weed competition as the stand grew older, and to have no effect on the nitrogen content of the alfalfa after the first season.

Phosphorus Fertilization

As stated previously, soil tests indicated the soil contained a medium amount of residual phosphorus. No significant increase in yield was found in the first 3 years. In 1956, the 50-pound rate became beneficial. However, higher rates proved to be of no value and actually decreased yields for the 5-year average.

The detrimental effects of high phosphorus treatments are believed to be the result of a deficiency of minor elements. Many investigators believe that Zn and Cu become unavailable when phosphorus is applied in large amounts. The decrease in yield for the 5-year average suggests such a problem with the 200- and 400-pound rate in this study.

The phosphorus content of the alfalfa increased with each increment of phosphate applied. However, since no beneficial results in terms of persistence or yield were recorded, the use of additional phosphorus could not be justified.

Potash Fertilization

The need for a high level of potash fertilization is an absolute must if stands and high yields are to be maintained. Where no potash was applied, potash deficiency was responsible for loss of 80% of the stand at the end of 4 years and 98% at the end of 5 years. With an annual application of 200 pounds K_2O, there was a 77% stand

Table 3. The Yield of Alfalfa As Influenced by Different Rates of K_2O

Fertilizer applied yearly in March (1)	Dry matter—tons/acre alf.			K content of alfalfa plant tissue
	1956	1957 (2)	1953–57	1953–55
0–0–0	.28	.05	1.89	1.20
0–100–0	.29	.06	1.85	1.16
0–100–50	2.79	1.91	3.34	1.31
0–100–100	3.65	2.37	3.69	1.64
0–100–200	3.34	2.96	3.95	1.99
0–100–300	4.00	2.93	4.17	2.37
0–100–400	3.65	2.91	4.07	2.71

(1) Expressed in pounds per acre of N, P_2O_5 and K_2O.
(2) Only 2 cuttings harvested due to extreme drought.

at the end of three years—with 300 pounds K_2O, a 92% stand. See Table 4. This effect on stand is reflected in the yields in Table 3 and illustrated in Figure 2.

The greatest loss of stand on plots receiving no potash was evidenced following the first cutting in 1955. At that time the crowns were unable to regenerate new growth following harvest. Kentucky bluegrass (Poa pratensis) and other weedy species invaded the plots in the fall of 1955 and one year later the plots were mostly grass. On those plots receiving 200 pounds or more of potash, a stand of alfalfa still remains that is capable of producing 4 tons of alfalfa per acre if growing conditions are near optimum. Weather conditions prevented normal growth in 1957 and low yields resulted.

During the first and second year of this study, 100 pounds of potash were sufficient to give maximum yields. However, there was a drain on the residual potash in the soil both years as indicated in Table 5. From the third year on, at least 200 pounds were required, and in 1956 response was recorded at the 300-pound level.

As indicated by Figure 1, the stands were eliminated on those plots receiving *no potash* and seriously injured when *only 50 and 100 pounds* were applied.

Over the past 20 years, various research workers have attempted to establish the optimum nutrient requirements of each essential element of various plants. This has been approached by analyzing the plant tissue. Many have suggested that alfalfa will readily absorb more potassium than is needed for normal plant functions if it is readily available.

The level at which the needs of the plant are met is termed the *critical percentage,* higher levels are designated *luxury consumption,* and lower levels are called *poverty adjustment.* Since alfalfa has a narrow range as far as potassium is concerned, this concept can be readily applied.

In 1953, 1.83% potassium was required to insure maximum yields; however, in 1954, 1.55% was sufficient. In 1955, 1.52% was not sufficient and 1.84% was required.

Therefore, one might conclude that the *critical percentage* for potassium content of alfalfa may vary from season to season and probably is between *1.55% and 1.84%.* The 300- and 400-pound rates were in the zone of luxury consumption with a potassium content of the alfalfa analyzing 2.37 and 2.71 respectively.

Table 4. Stand of Alfalfa After 5 Harvest Seasons

Annual fertility treatment	% Stand of alfalfa
0–0–0	2
0–100–0	3
0–100–50	29
0–100–100	36
0–100–200	77
0–100–300	92
0–100–400	93

Climatic conditions can greatly influence the variation in the potassium content of alfalfa. When growing conditions are near optimum, the nutrient requirements increase. This can be observed in alfalfa fields in the spring when conditions for maximum growth are present. Alfalfa will often show deficiency symptoms at that time and will not appear at any future time throughout the growing season.

The potash applied and that removed by the alfalfa followed a curve of diminishing returns as shown in Table 5. Those treatments receiving less than 200 pounds of potash per acre seriously depleted the residual potash in the soil.

Inefficient use of potash at the 300- and 400-pound rates was quite noticeable. Not only was the amount returned well below that applied, but the alfalfa was also absorbing more

Table 5. Relationship of Pounds of Potash Applied and That Removed in Alfalfa Hay.

Annual fertility treatment	Pounds of potash removed per acre 1953–1955	Pounds of potash applied per acre 1953–55	Soil balance K_2O applied–K_2O removed lbs.
0–100–0	251	0	−251
0–100–50	383	150	−233
0–100–100	499	300	−199
0–100–200	648	600	− 48
0–100–300	800	900	+100
0–100–400	901	1200	+299

potash than was needed for maximum yields.

Conclusions

1. The year following seeding, 25 pounds of N were beneficial. Higher rates tended to discourage N fixation and to be of no value.
2. After the first season, nitrogen was not beneficial and tended to decrease yield and stand and to increase weed competition.
3. An application of 50 pounds of P_2O_5 gave a slight increase in yield with higher rates tying up minor elements and decreasing yields.
4. An application of 200 pounds of K_2O is needed to insure maximum yields. This level appears to be the most practical even though the 5-year average indicated response up to the 300-pound level.
5. Where no potash was applied, potash deficiency was responsible for loss of 98% of the stand in this 5-year study.
6. The *critical percentage* for potassium content was found to vary from season to season and probably is somewhere between 1.55 and 1.84%.
7. The results of this study would seem to indicate that a fertility equivalent of 25-50-100 would be most satisfactory the year following establishment and an equivalent of 0-50-200 would be most desirable thereafter. ◄◄◄

A JACK . . . AND . . . MASTER

In this age of specialization, the farmer is one of the few persons left, outside of the medical profession, who can rightly call himself a "general practitioner."

This was well summed up in an article which recently pointed out that the good farmer is literally a jack-of-all-trades and master of all.

He must be economist enough to know when and what to buy and sell; bookkeeper enough to spot his weaknesses and strong points.

He must be engineer enough to run thousands of dollars worth of machinery and mechanic enough to repair it.

He's a veterinarian as he cares for his livestock and an agronomist as he selects his seed variety, matches it with his soil conditions, and decides on the planting date.

He's a gambler on weather and prices and last, but not least, he's a diplomat when he persuades his wife that he needs a new baler more than she needs a new washing machine.

DESIRABLE SOIL NUTRIENT LEVELS FOR COMMERCIAL VEGETABLES

MISSOURI TESTING PROCEDURES

	PHOSPHORUS P_2O_5 LBS./A.	EXCHANGEABLE POTASSIUM LBS./A.	EXCHANGEABLE MAGNESIUM LBS./A.	EXCHANGEABLE CALCIUM LBS./A.
LIGHT SANDY OR GRAVELLY LOAM 8-11 M.E./100 GMS.	280-300	325-400	200-225	2000-3000
MEDIUM SILT LOAM 12-16 M.E./100 GMS.	300-350	425-550	275-400	3000-4500
HEAVY LOAM & CLAYS ABOVE 16 M.E./100 GMS.	375-425	500-650	475-650	5000-7500

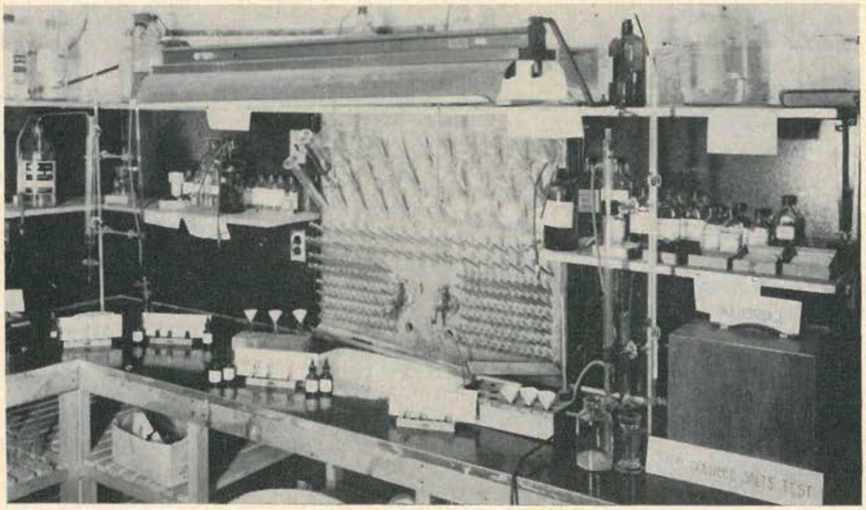
THESE NUTRIENT LEVELS, ESTABLISHED AFTER SEVERAL YEARS OF RESEARCH AND FIELD TRIALS ARE CURRENTLY RECOMMENDED ON SOILS WHICH ARE TO SUPPORT COMMERCIAL VEGETABLE PLANTINGS.

Figure 1

Dr. Victor N. Lambeth is a member of the University of Missouri Horticulture Department. He received his training at Missouri and has made distinct contributions on nutrient and water needs of vegetables, as well as in breeding.

Toward more efficient

Vegetable Fertilization



Soil testing—conducted in laboratories like this—is essential to help determine the lime and fertilizer needed to adjust the soil to the high fertility level required by vegetable crops.

By Victor N. Lambeth

Department of Horticulture University of Missouri

THE "pioneering spirit" of the vegetable grower—exemplified by his early acceptance of *heavy fertilization* and *irrigation*—has contributed much to agricultural development and to the health and well-being of mankind.

Historically, the vegetable grower was among the first to apply soil technology to agricultural practices in the continuing attempt to "push" yields and quality as far as hereditary and climatic conditions permit.

Even today, vegetable growing requires special skill to match the soil's contributions to the plant's demands. With high per-acre-value crops, limited markets, keen competition between areas of production, the vegetable grower must produce efficiently.

He cannot allow fertility and moisture deficiencies to limit production.

Must Know Species Requirements

While the successful vegetable grower looks to the soil fundamentally for his guide to efficient fertilization and irrigation, he must also know the nutrient requirements, the growth and development and rooting habits of many vegetable species.

Compared to regular farm crops,

vegetables are *heavy feeders* of these nutrients commonly absorbed by the colloidal fraction of the soil, *especially potassium*. With these relatively immobile nutrients, availability to the plant depends largely on the extent and distribution of feeder roots.

Thus, celery with a high nutrient content and a limited root system, is widely recognized as a gross feeder and a poor forager. Similarly, favorable response of the Irish potato to band placement of fertilizer may be due to its rather sparse distribution of feeder roots.

Many vegetable species, too, are "finicky" toward nitrogen feeding. Vegetables which carry on vegetative and reproductive functions simultaneously—such as tomatoes and beans—may drop their flowers when grown on nitrogen-rich soils or when heavily fertilized with nitrogen early in the season. Yet, these same crops respond well to nitrogen applied *after fruiting starts*.

Test-Guided Programs Increase Efficiency

Because of inherent soil variations and such species differences as rooting habits, vegetative-reproductive balance, nutrient content of crop, and sensitivity to certain fertilizers, highest efficiency cannot be obtained by "guess," "past experience," or "standard" recommendations. Old "rules of thumb," common among gardeners a generation ago, have largely given way to test-controlled programs.

Exchange Capacity—An Often Unrecognized Factor

Missouri's vegetable fertilization program centers around the philosophy of *feeding the soil, then the crop*. This seems plausible when we consider (1) that most vegetable soils in the state have appreciable exchange capacities and are to varying degrees unsatisfied with respect to absorbed nutrients, (2) that vegetable requirements for reserve minerals are high, (3) that soil losses from leaching and erosion are generally low.

Where these conditions exist, recognition of a particular soil's ability to furnish nutrients over a prolonged period is an important consideration in making vegetable fertilizer recommendations.

For example, medium to high exchange soils showing a good fertility status may grow vegetables satisfactorily for several years with only "light" applications of fertilizer.

On the other hand, high exchange soils showing a "low" fertility level will require significant quantities of fertilizer to satisfy the fixation capacity before appreciable crop responses can be expected.

Low exchange soils, since they do not have the necessary fertility reserves, are poorly adapted to perennial vegetables and even short-term crops must be fertilized *frequently and heavily*. However, since these soils have lower buffering capacities, there also exists the danger of overfertilization where heavy rates are applied indiscriminately.

High exchange soils are favored in market-garden areas, too, for with them it is possible to build back nutrient reserves that have been exhausted by many years of extensive cropping.

Since the exchangeable nutrients—calcium, potassium and magnesium and absorbed phosphorus are relatively immobile—they move through soils quite slowly and are not readily leached. *These nutrients, particularly, should be mixed thoroughly with the soil in the rooting zone for most effective use.*

Sufficient reserves of these nutrients can be stored in the soil to meet the major nutrient needs of most vegetables for several years. With the fixation capacity satisfied, crop needs can be easily met by seasonal *starter and maintenance applications*.

The exchange capacity is an important criteria in determining its suitability for specific vegetable crops. Most heavy feeders of potassium and calcium, *such as celery and spinach*, are more satisfactorily grown on soils in *the medium to high exchange range* and cannot be grown on light sandy soils without extensive "spoon" feeding.

On the other hand, such vegetables as *sweet potatoes and watermelons*, which demand a soil fairly depleted in nitrates as they mature, should not be grown on heavier high-exchange soils or those high in organic matter. For these vegetables, a light sandy loam has long been recognized as the ideal soil type.

When considering the proper balance between the cationic nutrients, reference may be made directly to the status of the soil's colloidal fraction as providing a balanced supply to the plant root.

On the heavy Wabash series in the Missouri River bottoms, occasional difficulty is encountered in maintaining proper balance between the exchangeable calcium and potassium levels. This relationship is made more difficult because of the effect of liming on soil pH.

These soils, largely of limestone origin and subject to overflow, frequently have very high exchangeable calcium concentrations, high pH's, and occasionally have free carbonates. *Induced potash deficiencies may occur, particularly during wet seasons, on vegetables with high potash requirements.* Under these circumstances, the exchangeable or buffer hydrogen should be determined as well as the pH, since it indicates the degree to which colloidal contact stations are available for other cations, such as potassium.

In many cases, no exchangeable or buffer hydrogen remains, having been replaced by other cationic nutrients. In such cases it is helpful, when interpreting relationships between elements, to express concentrations in chemically-equivalent rather than weight-equivalent values —*that is, as milliequivalents per 100 grams of soil rather than as pounds per acre or parts per million parts.* Once this conversion is made, the concentration of a particular cation can be given as a percentage of the total cation exchange capacity.

On low exchange soils, the pH may sometimes be found favorable, but the calcium level insufficient to maintain growth of calcium-loving vegetables. Under these conditions, knowledge of the exchangeable hydrogen and the extent to which it changes with small limestone applications is helpful in achieving proper cation balance without the risk of over-liming.

Establishing a Favorable Foundation Fertility Level

Efficiency in vegetable fertilization practice depends on continuing research to establish more definite correlations *between nutrient concentrations and growth and fruiting responses of vegetable species on many soil types.*

Because of different testing techniques, these quantitative relationships are determined separately for each soil testing system. The testing procedures used by the Missouri Station includes extraction of phosphorus and calcium with 0.1 N HCl and 0.03 N. NH_4F, of potassium and magnesium with 25% Na NO_3 and exchangeable hydrogen with P — nitrophenal buffer.

An exchangeable hydrogen concentration of 1 to 2 milliequivalents per 100 grams soil (1000 to 2000 pounds per acre calcium carbonate equivalent) and a pH of 6.0 to 6.5 are desirable.

The concentrations shown in Figure 1 correspond in a general way to a base exchange complex where calcium comprises 70 to 75%, magnesium 4 to 6%, potassium 3 to 6%, and exchangeable hydrogen 14 to 20% of the total cation exchange capacity.

In addition, nitrogen fertilization, to provide 20-30 pounds of actual nitrogen per acre at planting time, will normally be sufficient for early development of most vegetables (see supplemental nitrogen feeding).

Using this system, the soils are tested annually *until these saturation levels are established.* Thereafter, they are tested every three to four years as necessary *to maintain the basic fertility level.*

Placement of Basic Applications

In most cases of soil building in Missouri, *significant quantities of potassium and phosphorus are needed along with calcareous or dolomitic limestone.* Because of the relative immobility of these nutrients, their availability to plants is largely dependent upon the extent to which the root surface is in contact with nutrient-laden soil particles.

Therefore, *heavy applications of fertilizer containing these nutrients should be mixed thoroughly within the upper 8-10 inches of soil (deep furrow slice).*

At least half of the material should be broadcast, disced in, and plowed under, and the remainder put on the surface after plowing and worked in during preparation of the seed or plant bed.

Heavy fertilization of the surface soil layer is likely to result in high salt concentrations, seedling injury, poor root distribution, and lessened tolerance to drought.

Feeding the Crop and Annual Maintenance

Once the above-fertility level has been established, favorable for vegetables in general, *specific requirements of species* can be met by varying the rates and analyses of fertilizers applied annually. These applications also roughly correspond to the plant food removal of these crops when grown in rotation.

Specific rates and analyses are given for convenience—other combinations to provide equivalent amounts and proportions of nutrients are just as satisfactory.

Tomatoes, Eggplant, Peppers	600 lbs/A of 4–12–12 or 5–10–10 analysis. Apply one-half as a plow-down and one-half as a band application at or soon after transplanting.
	Nitrogen side dressing: 20–30 lbs/A nitrogen after the first fruit are size of marbles and follow with two more applications at approximately 3-week intervals depending on the plant growth and weather.
Cabbage, Broccoli, Cauliflower	400 lbs/A of 10–20–20 or 800 lbs/A of 5–10–10 placed in **double** bands 4–5 inches to the side of the row and about 4 inches deep.
	Nitrogen side dressing: 20 lbs/A nitrogen 10 days—2 weeks after transplanting and repeat two times at approximately 2-week intervals.
Green Beans and Peas	600 lbs/A of 5–10–5 or equivalent. Apply one-half broadcast and disk in and one-half in bands about 3 inches to the side of the row and 3–4 inches deep at or soon after seeding.
	Nitrogen side dressing: 15–20 lbs/A nitrogen **after** heavy set of pods (not at time of first bloom).
Sweet Corn	300 lbs/A of 5–10–10 as plow-down before seeding. 300 lbs/A of 5–10–10 as band at time of seeding or first cultivation.
	Nitrogen side dressing: 40 lbs/A nitrogen when the plants are 8–10 inches tall and again about 2 weeks before silking. On heavy soils much of this nitrogen can be "plow-down."

Sweet Potatoes	600 lbs/A of 3–12–12 or 3–9–18. Apply 300 lbs/A as a plow-down and 300 lbs/A broadcast and disked in after plowing. **Do not plant on nitrogen-rich land**. On soils above 3% organic matter, apply the equivalent of phosphorus and potash but **no nitrogen**. Do not side or top-dress with nitrogen.
Watermelons	Work into the soil in a broad band under the row 500 lbs/A of 5–10–10 when preparing seedbed. Do not side-dress with nitrogen.
Beets and Carrots	800 lbs/A of 5–10–10. Plow down approximately 500 lbs/A and 300 lbs/A broadcast and disked after turning. No additional nitrogen.
Irish Potatoes	800 lbs/A of 5–10–10 or equivalent. Plow down about 400 lbs/A and place 400 lbs/A in a band 2–3 inches to each side of the seed pieces and on a level slightly below the bottom of the seed pieces. **Nitrogen side dressings:** 30 lbs/A nitrogen when the plants are about 8 inches high and again after the tubers start to form (bloom stage).
Onions	800 lbs/A of 5–10–5 or 5–10–10. Plow down 500 lbs/A and 300 lbs/A as a side band. **Nitrogen side dressing:** 20 lbs/A nitrogen 10 days to 2 weeks after bulb first starts to form.
Established Asparagus Bed	Disk in 300 lbs/A of 10–20–20 as top-dressing before growth starts in the spring and apply 300 lbs/A of 10–20–20 as top dressing after cutting season is over. **Nitrogen top-dressing:** 30–35 lbs/A nitrogen about 10 days after cutting season starts. Avoid late summer and early fall applications.
Spinach	Broadcast and work into surface 600 lbs/A of 5–10–10 or equivalent when working down seedbed. In addition, on over-wintering spinach apply 200 lbs/A 16–48–0 early in the spring as growth starts.
Cucumbers and Cantaloupes Squash Pumpkin	Broadcast and work into surface 500 lbs/A of 5–10–10 when preparing seedbed. **Nitrogen side dressing:** 20 lbs/A nitrogen when first fruit half-size and again in approximately 3 weeks.

Supplemental Nitrogen Feedings

In many respects, nitrogen presents a problem different from the mineral elements. The nitrate nitrogen, being soluble and mobile, can be applied as necessary during the growing season *to supplement* the normal microbial release and *"throttle"* the growth as desired.

Response to nitrogen is fast—often detectable in three to four days after application. The "throttling" effect by nitrogen on growth requires that it be used discriminately on certain vegetables which carry on vegetative and reproductive functions simultaneously, such as tomatoes and beans.

High nitrogen levels early in the plant's development may cause unfruitfulness. High nitrogen levels at the start of the season can cause soft, loose heads of cabbage and lettuce—or heavy top growth but poor root development of root crops.

For most vegetables, the addition of fertilizer to provide 20-30 pounds of nitrogen per acre at planting time will provide a sufficient supply to support early development without endangering fruitfulness.

However, where large quantities of carbonaceous materials such as straw, corn cobs, grass sod, etc., are plowed under, *an additional 30-35 pounds of nitrogen per ton should be applied* to prevent the soil microbes from robbing the crops of available nitrogen.

A significant portion of the nitrogen needs of vegetables in their late stages of development is supplied from the decomposition of organic matter. Hence, it is important that a rapid turnover of organic matter be maintained through the regular incorporation of green manure crops and, where available, barnyard manures.

The demands for nitrogen become increasingly greater during advanced stages of growth and fruiting, as the activity of micro-organisms slows down. During the high soil temperatures of July and August, supplemental nitrogen feeding may be necessary to fulfill the "peak" demands of the crop.

Nitrogen feeding by top dressing, side dressing, or through irrigation water, as recommended, will usually give *good growth responses* and pay *big dividends.*

In summary . . .

1. Vegetable growers cannot afford to let fertility be limiting.
2. High basic levels of fertility should be established.
3. Maintenance applications each year can correspond roughly to crop removal.
4. Supplemental nitrogen additions are essential. ◄◄◄

STARTER BOOST NEEDED

Alfalfa needs a mixed fertilizer application when it's seeded, says John Falloon, University of Missouri extension soils specialist. Several different analyses can be equally satisfactory.

Thirty to 40 pounds of soluble phosphate and a like amount of potash are needed. Only about a third as much nitrogen is needed in the "starter" as such. Yet, the fertilizer, if high in nitrogen, may supply enough nitrogen for the full needs of the first crop.

Satisfactory "starters" for alfalfa are 200 pounds of 5-20-20, per acre, 300 pounds of 4-16-16 or 3-12-12, 200 pounds of 4-24-12, or equal amounts of other similar analyses.

Such analyses as 12-12-12, 14-14-14, 10-10-10, and other 1:1:1 ratio mixtures used at the rate of 300 to 400 pounds per acre as a "starter" will supply nitrogen needs as well as phosphate and potash. This eliminates the need for a separate application of a straight nitrogen fertilizer.

This "starter" fertilizer is, like all other soil treatments, most wisely used when applied according to soil test and plowed under, Falloon notes.

FREE ENTERPRISE

At Its Finest

AMERICAN agriculture is still the biggest privately owned business in the world. Farmers have about 170 billion dollars invested in land, buildings and equipment.

Agriculture has shifted from a rustic way of life to a highly technical business, requiring great scientific knowledge and much management ability. Capital requirements are enormous.

Of the 62 million gainfully employed workers in the United States, 10 million work on farms. Another 6 million manufacture and sell farm production supplies, such as farm machinery, fertilizers, feed and the like.

An additional 9 million are needed to process and distribute farm products—meat packers, canners, food handlers, etc. Thus about 40 per cent of the workers in this country are associated with agriculture.

It's our basic industry affording almost unlimited opportunity for well trained men and women. If you plan to enter college next fall and are undecided about your course of study, may we suggest agriculture?

A bright future awaits thousands of young people well trained in this field.

FERTILEGRAMS

Sugar cane producers will have to use a good amount of fertilizer if they want good yields, advises Dr. W. J. Peevy, agronomist for the Experiment Station and Agricultural Extension Service at LSU.

The Experiment Stations have found they get about one ton of cane for each 6 to 10 pounds of nitrogen used, where there is a good stand of cane and not much grass, he points out.

"If you use 36 pounds of nitrogen, you cannot expect an increase of but about six tons of cane," he asserts. "If you use 60 to 100 pounds of nitrogen, you could increase your yield by as much as 10 to 15 tons per acre.

"Where phosphate or potash are low, further increases of 3 to 5 tons of cane have been obtained by using about 40 pounds of available phosphate and 60 pounds of potash.

"Most soils west of the Teche need phosphate and potash. Some of the river-bottom soils need these elements. A soil test can help determine whether you need them."

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Fertilizer increases the yield of seedcotton, according to results of outlying cotton fertilizer tests at 10 locations conducted by the University of Arkansas Agricultural Experiment Station.

According to Station researchers Richard Maples, J. L. Keogh, and L. H. Hileman, harvested yields of seedcotton were significantly increased by fertilizer in 10 of the 12 trials that included major nutrient treatments—N (nitrogen), P (phosphorus), and K (potassium). Nitrogen alone increased yields in 9 of these 10 tests.

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California farmers and home owners used 5% more of commercial fertilizers in 1957 than they used in 1956, the California Fertilizer Association reports, indicating the agriculturists of the State recognize the importance of proper fertilizer use, especially during periods of high costs and lower returns. Home owners are using more commercial fertilizer on lawns, shrubs, trees, and flower beds to enhance their beauty.

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Alfalfa acreage is continuing to increase in Virginia—a healthy trend, say VPI agronomists, since no other perennial forage crop will produce a higher yield or is as resistant to drought when grown on suitable soils.

Acreage last year reached 264,000, an increase of 24,000 acres over the preceding year.

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Soil management that "makes sense" must provide four basic essentials, reports M. D. Weldon, Extension agronomist at the University of Nebraska.

1. The program must provide the amount and kind of plant food needed for high levels of production.

2. It must provide satisfactory soil tilth to promote the development of crop roots and to encourage good

from Across the Land

FOR BETTER SOILS • FOR BETTER CROPS

water, air and temperature conditions in the soil.

3. It must give protection against excessive soil loss and damage from erosion.

4. It must provide storage of subsoil moisture to carry the crop through drought periods during the growing season.

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Georgia Agricultural Extension Service agronomists urge buying fertilizer on the basis of cost per pound of plant nutrient. A 4-12-12 or 5-10-15 fertilizer is a much better buy than a 4-8-6 or a 4-8-8 because it is cheaper per pound of plant nutrients.

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Important as nitrogen fertilizer is, it returns the biggest dollar profits to the farmer who makes sure his soil also has plenty of the other plant food nutrients—phosphate, potash, and lime—reports University of Minnesota soils scientist A. C. Caldwell.

The limiting nutrient—the one that makes the biggest difference in yields—can vary in different soils, Caldwell explained. In experiments with corn on land low in potassium, for example, adding high-potash fertilizer made the biggest yield increases.

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

Yet, Caldwell added, "in all three of these experiments, a balanced fertilizer containing nitrogen, phosphate, and potash gave the best corn yields."

Lime may be equally important in getting the best yields, Caldwell stated. "If soils are too acid, some nutrients, like phosphorus, are fixed in an unavailable form. Then, even added phosphates become unavailable very quickly. Also, beneficial action of soil organisms is inhibited and organic matter breakdown slows down."

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***Alfalfa rates at the top* as the best hay to feed ewes with lambs. Dixon Springs Experiment Station scientists, in Illinois, are testing alfalfa, Korean lespedeza, mixed clover and Sericea hay. The Korean lespedeza and mixed clover are running a close second to the alfalfa, but the Sericea is far behind.**

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Results from alfalfa experiments in Tennessee indicate this crop should be topdressed with liberal amounts of fertilizer in early spring.

Fertilizers should be applied just before growth starts in the spring or immediately after the first cutting, advises Joe D. Burns, assistant Extension agronomist.

Studies conducted at the Middle Tennessee Experiment Station show slightly better results were obtained where the fertilizer was applied just before growth started.

Alfalfa is a heavy user of potassium and boron, Burns explains. The use of these materials should be based on *recommendations from a soil test.*

Leaf sampling can be done in vineyards, on fruit and nut trees, on truck and field crops.

It is important to take the sample from the *right part* of the tree or plant at the *right time* of the season.

PLANT ANALYSIS—Fo

TODAY'S successful farmer cannot depend on guesswork as a guide to fertilizer application. He can't afford to. Farming today is a precision business. It calls for precise knowledge of plant nutrition needs. And that's why University of California scientists are perfecting an accurate system of plant analysis.

With studies already well advanced on sugar beets, researchers on the Berkeley and Davis campuses are beginning another project to develop a plant analysis system for beans. They are looking for a quick, accurate way to answer the farmer's questions: Should I fertilize? Which fertilizers should I use? How much should I use? When and how should I apply them? How often should I repeat the application?

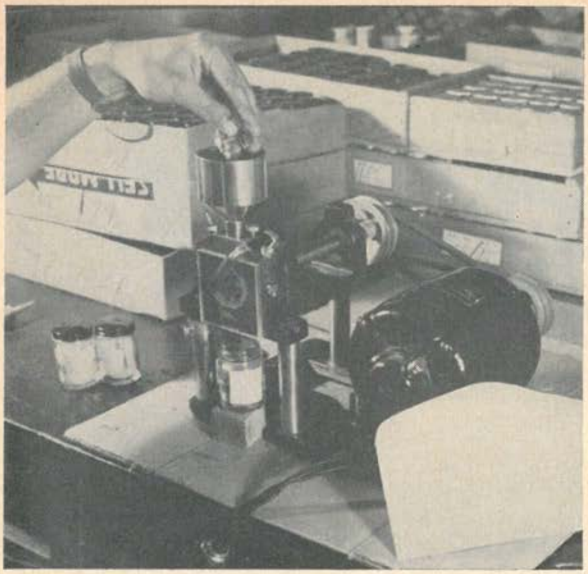
This booklet free. Write Dept. B. C., American Potash Institute, 1102 16th St., N. W., Washington 6, D. C.

Plant analysis is a relatively rapid and simple means of answering these questions—of diagnosing the nutritional needs of a crop *by using the plant itself as an indicator*. In brief, it works like this:

Sample plant materials (usually certain selected leaves or leaf-stalks) are collected in the field and taken to a laboratory. Quantitative chemical tests are made on the sample material, and the concentration determined for the major nutrients—nitrogen, phosphorus, and potassium—and other nutrients such as sulfur, magnesium, calcium, and occasionally zinc.

Then these nutrient levels in the samples are compared with adequate or "safe" concentrations for plant growth as established through greenhouse experiments and field trials. From this comparison, the farmer can determine which plant nutrients his trees or plants need.

Two pioneer workers in the field of leaf analysis have been M. E. McCollam, western manager of the American Potash Institute, and Forest Fullmer, Institute agronomist. McCol-



In the laboratory, chemical analysis of leaves or other plant tissue by accepted procedures reveals nutrient needs.

Such scorched leaves on the new growth of apricot trees indicate a shortage of potash.

r Precision Farming

lam's two studies—"Leaf Analysis, A Guide to Better Crops" and "The Leaf Analysis Approach to Crop Nutrition"—have had wide circulation among specialists and farmers interested in this method of determining crop hunger.

The booklet, "Leaf Analysis Approach to Crop Nutrition," discusses how leaf analysis can reveal "the *whole* situation under which the plant is growing."

It explains how leaf samples taken around mid-season are the most indicative of the nutrient status of the crop.

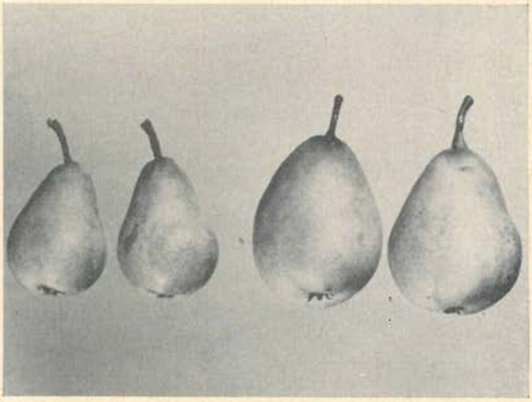
It advises one to gather only leaves of the same approximate age, meaning the leaves must be taken from the same relative position in all plant samples.

It suggests that for most species of fruit trees, 100 leaves per tree are sufficient. But with small leaves, such as the olive, double this number is needed. Leaf petioles are used for analysis of grapes and sugar beets. Satisfactory sample size for these crops has been found to be 80 grape petioles and 40 beet petioles.

In a capsule, the booklet offers four areas of basic, useful information:

(1) Exactly what leaf analysis is and its value.
(2) Some good leaf-sampling methods—a guide for leaf-sampling procedure on a number of crops, suggesting the part of the plant to sample and the time to take it.
(3) Critical nutrient levels and interpretation —for phosphorus, potash, and nitrogen.
(4) And practical uses of leaf analysis—for fertilizer recommendations, for surveys of plant nutrient status to locate areas of deficiencies, and for identifying abnormal symptoms on plants.

Copies of this study, in reprinted booklet form, are available for your use through the American Potash Institute.



Leaf analysis can uncover hunger not apparent to the eye, before the size and quality of the crop is affected. Left, potash-hungry pears; right, potash-fed pears.

THE EDITORS TALK

Of Space Age Farming

IN THE hills of the South, there once was a farmer who said he wouldn't believe there was such a thing as an airplane until he saw it.

When he saw it one day, he took off further into the hills behind his home. It would be dramatic to say, "And he never came out." But he did come out—out enough to say, "After seeing that 'contrapteen', I'll believe anything they tell me from now on—even the fool that plans a trip to the moon."

Our friend has gone now. But we feel quite sure he wouldn't "board up his place" or "take to the hills" if he were to read our plans for making a trip to the moon—soon.

Only one thing would throw him, we believe, and that's the experts who say space ships may carry along complete little gardens of growing vegetables.

These gardens, they say, will serve two purposes: (1) help use up the carbon dioxide and wastes produced by the human passengers, (2) furnish welcome fresh vegetables for the jaded appetites of the travelers.

If our friend happens to join them along the way out there, being the farmer he was we feel sure he'll ask them if they brought their soil test equipment along and sufficient plant food to get them started wherever they land.

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Of Declining Students

STUDENT enrollment in 33 of the 48 land-grant agricultural colleges in the country *dropped* for the 1957-58 school year when compared to the previous year, a recent report from the American Association of Land-Grant Colleges and State Universities shows.

The declines ranged from one to 138 students. The average decline was 40 students. The 15 agricultural colleges reporting increases in enrollment showed jumps from three to 94 students, with an average increase of 29.

When you combine the figures for all Colleges of Agriculture, you find that the 48 institutions lost a total of 890 agricultural students—an average loss of 18.5. The total number of students enrolled in agriculture in 1956 was 32,637 and in 1957 it was 31,747—a loss of some 890 students studying agriculture.

As long as our pantries are full and our missiles are getting off of the ground, these figures might not seem important. But, somehow, they remind us of a remark by a one-time Russian peasant, Nikita Khrushchev: "We aren't going to blow up the capitalist world with bombs. If we overtake the U. S. in per capita production of meat, butter, and milk, we shall have hit the pillars of capitalism with the most powerful torpedo yet seen."

Of ✓ Champion Yields

REPORTS from champion crop growers in various sections of the country indicate what an important part proper fertilization played in their successful management.

For example, Henry Hirada, known as the vegetable king of New Mexico, introduced potash to his area, though soil tests show the land sufficiently supplied with potassium. He says his tomatoes *stand up under shipping better* when extra potash is added.

The 4-H lad in Mississippi, Lindon Ratliff, who grew the nation's champion corn yield for 1957, used 700 pounds of 15-15-15 in his subsoil, then 300 pounds of 15-15-15 at the side of the plants, as part of his fertilizer program to get 250.85 bushels from *one measured acre*. In addition to 70 loads of manure, he also used 700 pounds of ammonium nitrate (33-0-0) and 300 pounds of ammonium nitrate sidedressed.

And the champion tomato growers of Indiana, Don Harts and his father, Roy Harts, of Miami County, produced 449.8 tons of tomatoes from 26 acres in 1957, an average of 17.30 tons per acre. To do this, they used 700 pounds of 5-20-20 and 100 pounds of 33% nitrogen fertilizer per acre on 16 acres of the plot and 600 pounds of 5-20-20 and 120 pounds of 33% nitrogen fertilizer per acre on 10 acres of the plot.

Nothing succeeds like success. And, apparently, successful yields per acre unit of land depend greatly on the part fertilization plays in the management program. The Hiradas, the Ratliffs, and the Harts are convincing evidence of that.

Outlying fertilizer plots in the state of Washington contribute to applied research and bring the results of fertilizer early to the farmer.

ON THE FARM RESEARCH

By Darrell Turner

Outlying Tests Program **Washington State College**

AN important agricultural program in western Washington is "On the Farm Research"—or outlying testing.

Darrell Turner, Extension Specialist in Outlying Testing for Washington State College, earned his B.S. and M.S. in Agronomy at Washington State. For seven years, he was County Agent in Clallam County and two years ago joined the Extension program at his alma mater.

Its purpose is two-fold (1) to conduct fertility research on forages and pastures under the varying conditions existing in western Washington, (2) to demonstrate to farmers the results being obtained so that the research may be more readily put into actual practice.

The outlying testing program in western Washington presently evaluates fertilizer treatments on forages and pastures and correlates fertilizer response with soil tests.

Outlying testing is set up by the State College of Washington under

With Forages And Pastures In Western Washington

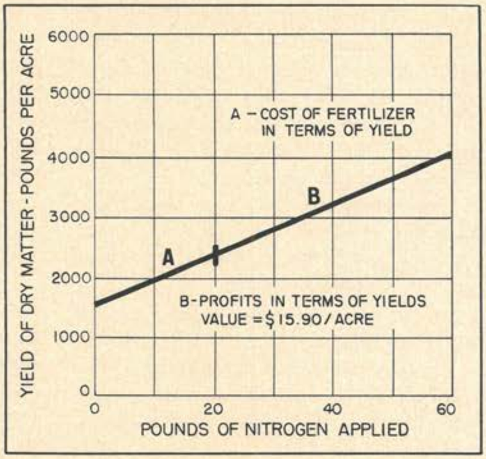

Figure 1:

Here is shown the average first cutting yield increases from addition of 60 pounds per acre of nitrogen to seven outlying test sites. Line segment A represents the amount of the yield increase to meet the *cost* of fertilizer, and line segment B indicates the portion of the yield representing *profit*. The return on the investment was *190 per cent*—good for money tied up only 60 to 80 days.
(Value computed @ $20.00 per ton on dry weight basis.)

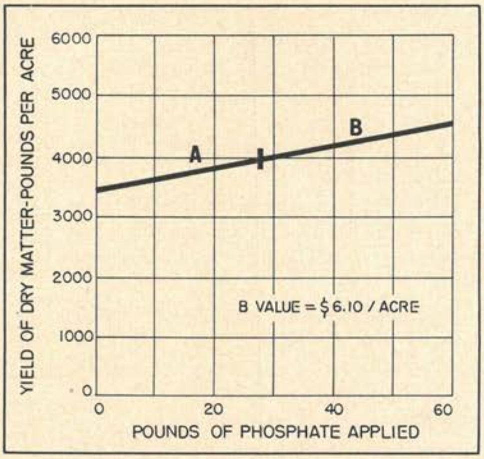

Figure 2:

Here is shown the yield increase obtained from application of 60 pounds per acre of phosphate. These are results from six outlying test trials. Use of phosphate gave a return on the investment of *113 per cent*.
(Value computed @ $20.00 per ton on dry weight basis.)

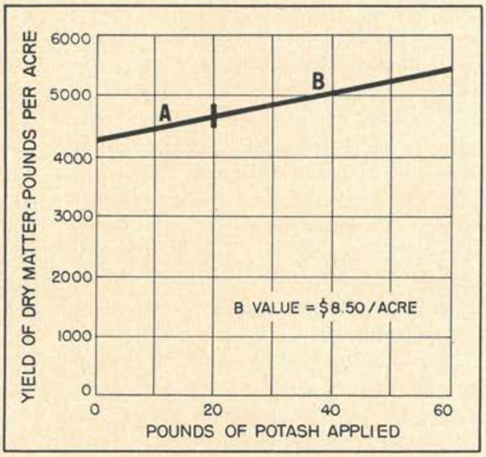

Figure 3:

Here is shown the yield increase obtained from application of 60 pounds per acre of potash. These are results from six outlying test trials also. Use of potash gave a return on the investment of *283 per cent*.
(Value computed @ $20.00 per ton on dry weight basis.)

joint Experiment Station-Extension Service administration. The county agent has an integral part in determining the plot sites, assisting with the mechanics of the trials, and seeing that the information is utilized throughout the area.

The farmer is the most important member of this team, since his interest and cooperation forms the basis for the whole program.

At the present time, outlying testing is conducting trials in 17 of the 19 counties of western Washington. The majority of the trials are on a pasture mix of ladino clover and orchardgrass.

An occasional trial is seeded to alfalfa and a companion such as orchard or bromegrass.

No attempt is made to establish all seedlings alike. Soil variables must be dealt with as they are encountered, and this demands flexibility in the seeding mixture.

The plant nutrients of primary concern in the outlying testing plots are *nitrogen, phosphate, potash,* and *lime*.

Magnesium has also been tested, but as yet an increase in yield has not been noted. Future work involving *boron and molybdenum* is contemplated on alfalfa stands.

Outlying testing plots are located on uplands and lowlands, both irrigated and non-irrigated. All plots are established in replicated, randomized blocks and harvested as often as growth permits.

Number of harvests varies from one on non-irrigated uplands to as many as four on irrigated sites. In addition to yield data obtained, the botanical composition of the forage stand is also noted. This is checked against fertilizer treatments to determine the effect on the clover and grass population.

A soil sample from each treatment in each trial is taken *once a year*. These samples are tested to chart possible soil fertility changes that have occurred. It is readily apparent that every field cannot have a fertility trial, so some method must be used to evaluate large numbers of fields. If a good increase in yield is obtained by applying phosphate or potash fertilizer to a field testing low in these nutrients, we expect that under similar conditions on a different field these responses will again be obtained.

The outlying testing trials are an excellent source of correlative data for improving fertilizer recommendations based on soil tests. Just as the outlying testing program extends the findings of the experiment stations, so do soil tests extend the findings of outlying testing.

Several hundred different soil series exist in western Washington, lying within the realm of this program.

Most of the soils of the northern section have been formed from glacial debris. Those in the southern portion are generally residual in nature. Scattered throughout are stream valleys with alluvial soils. And, of course, there are peats, mucks, and other associated soils.

Precipitation varies from 15 inches annually in eastern Clallam County to well over 100 inches in several coastal counties. The majority of this precipitation occurs during the winter. Summers are often dry, demanding irrigation especially on the gravelly upland soils.

Farmers are aware of the irrigation need, apparently. Western Washington farmers increased irrigated land from 38,000 acres to 61,000 acres during the five-year period 1949-54.

The summer of 1957 revealed some interesting irrigation practices. A wet spring was followed by a dry summer. Non-irrigated fields produced little forage after the first cutting. Irrigated fields, though better, did not produce the forage expected simply because they did not apply the needed amount of water in time.

For proper fertilization to produce the desired results, such factors as stands and moisture conditions should *not be limiting.*

Value of Soil Tests

Since soil samples are taken on all of the outlying testing plots, along with yields, it is possible to predict the probability of obtaining a fertilizer response under the different conditions according to the soil test.

If all of the outlying test plots had been fertilized over a three-year period on the basis of present soil test information for phosphorus, potash, and lime, significant yield responses would have been obtained *in some 72 percent of the cases.*

However, had the soil test information been disregarded, a significant yield response would have been obtained *in only some 42% of the plots.* This certainly indicates the value to the farmer of fertilizing according to soil test information.

The figures in Table I point out the success a farmer may have for each of the major plant food nutrients if he fertilized with and without the aid of a soil test.

Since nitrogen is needed on almost all of the soils in western Washington, it is not included in the soil test. One interesting aspect is the significant yield response to nitrogen over a three-year period, *averaging some 78%.*

These responses varied from a low of 63% in 1957, to a high of 89% in 1956. As mentioned previously, moisture was a limiting factor in some of the trials in 1957, and was the main reason for the low percentage of responses.

The figures given in Table I are considered *tentative values.* The outlying testing program has not yet worked on sufficient locations to attach too much significance to these figures. However, they certainly point out that a farmer about to fertilize his pasture is much better off with a soil test rather than without one.

A slight revision of present interpretation levels of the soil test would substantially improve the prediction score and move it above 80%. Whether such revision is in order will likely be determined by outlying test plots in the future.

Table II shows the distribution of values obtained from soil tests made on the outlying testing sites. These figures show a majority of the soils in which the plots were located are *low in available phosphorus and potassium.*

Economics of Fertilization

The farmer is concerned, not only with yield increases, but also with the margin of profit shown as a result of his fertilization program. He is interested in whether or not there is anything left for him after he has paid for the fertilizer.

The outlying testing program has shown that under proper conditions *fertilizers will give better quality forage, more forage per acre, and more forage at a time when it is needed at a profit to the farm operation.*

In western Washington most farms have sufficient pasture early in the season, but in the late summer and fall, pasture production falls off. And it is this period which limits the number of livestock that can be supported.

The test plots have shown that when satisfactory growth conditions

Table I. Percentage of Plant Food Nutrients and Lime Giving Significant Yield Responses. Average 1955, 56, 57

Predictions	Nitrogen	Phosphorus	Potash	Lime
With soil test	no test	61%	71%	86%
Without soil test	78%	44%	42%	6%

Table II. Percentage Distribution of All Outlying Testing Trials with Soil Samples Tested for Available Phosphorus, Potassium, Calcium and Magnesium and for Soil Reaction

Nutrient tested	Rating		
	Low	Medium	High
	%	%	%
Phosphorus	92	4	4
Potassium	55	24	21
Calcium	10	52	38
Soil reaction	pH below 5.4	pH 5.4–5.9	pH above 5.9
	17	69	14

are present, a farmer can expect a good dollar return above the cost of fertilization. The better quality feed and the fact he has this feed during the critical periods are additional bonuses.

When less than satisfactory growth conditions are present, some fields may produce little feed in excess of fertilizer costs. However, there can be great value in getting this feed of high quality at a time when it is limiting. This factor is becoming more and more important in the Puget Sound area where the pressure for land by industry and home owners is increasing rapidly. *A farmer simply cannot afford to own land unless he squeezes every last bit of production from this land.*

Application of nitrogen to pastures can give good financial return to the farmer. Figure 1 shows the average first cutting yield increases from addition of 60 pounds per acre of nitrogen at seven outlying test sites. Line segment A represents the amount of the yield increase to meet the cost of fertilizer, whereas line segment B indicates the portion of the yield representing profit.

The seven locations involved were selected to meet certain requirements. They all had good stands of forage, and they also had an adequate moisture supply. *The return on the investment was 190 percent; not bad for money tied up only 60 to 80 days!*

Of course, all plots treated with nitrogen have not done this well. As previously discussed, lack of soil moisture has a tremendous bearing on the amount of profit realized. But the fact remains that under proper conditions, nitrogen fertilizer applied to pasture or hay meadows can be *a very profitable investment for a farmer.*

What about phosphate and potash; how have they shown up? Figure 2 shows the yield increase obtained from application of 60 pounds per acre of phosphate. And Figure 3 gives similar values from the use of 60 pounds per acre of potash.

Both Figure 2 and Figure 3 indicate results obtained on six outlying test trials. Although total yield increases are less from applications of phosphate and potash than from nitrogen, they have still made *good earnings for the farmer.* Use of phosphate has given a return on the investment of 113 percent, and *application of potash has returned earnings of 283 percent.*

As was true with nitrogen, the farms included in these figures were selected to have a stand of forage capable of response to the phosphate or potash. They had adequate soil moisture. And they were shown by soil test to be low in the nutrient under test.

All outlying test trials have not given such high earnings, but the majority of the time fertilizer applications have at least paid their way even though they did not give the desired increase. *In very few cases* would the farmer actually lose money by the treatment.

Summary

Outlying testing in western Washington represents an attempt by the State College of Washington to carry research work from the experiment stations to the farmer *in the shortest possible time*.

The program is administered jointly by the Extension Service and the Experiment Station and is carried out by the outlying testing staff, the county agents, and the cooperating farmers. Work is in progress on 29 locations in 17 counties.

Findings to date show that fertilization without regard to other growth factors does not give consistently satisfactory results. The value of obtaining a soil test prior to fertilizing pastures or hay meadows is clearly demonstrated.

Data obtained prove that where adequate growth factors are present, and a soil test is wisely used, that fertilization of forage land with nitrogen, phosphate, or potash can give both large yield increases and economical returns to the farmer. ◄◄◄

CALIFORNIA ATTACKS K_2O HUNGER IN POTATOES

Indications of potash deficiency in the potato growing areas of Kern County have recently come to light, according to a statement issued by the California Fertilizer Association.

Studies now going forward under the direction of Dr. Oscar Lorenz, Professor of Vegetable Crops, University of California, in cooperation with Forrest Fullmer, Agronomist of the American Potash Institute, have been brought about because of several potato areas exhibiting a *deficiency scorch or burn similar to that found in the Santa Maria area two years ago.*

To determine the cause of this trouble, many petiole samples from the afflicted areas were analyzed for nitrate, phosphate, potassium, manganese, calcium and magnesium. All of these plant nutrients except potassium were found to be above the critical levels established by Dr. Lorenz. In the case of potassium, where the critical level is between 3 and 4%, samples taken from the afflicted plants contained levels down as low as 1.5%.

Dr. Kent Tyler, an associate of Dr. Lorenz from the Riverside Experiment Station, has conducted soil analysis studies, and has found that samples from the above-mentioned afflicted areas run down to 25 ppm of potash while samples from normal areas contain 60 ppm of potash or more. From the results they have obtained to date, they estimate that soils below 60 ppm are potash deficient.

These findings plus the fact that the potassium deficient samples came primarily from older fields with light textured soils are a strong indication that potash deficiencies are now developing in the San Joaquin Valley and should receive full consideration in any management practice.

The Association points out that 350 sacks per acre of potatoes extracts 262 pounds of nitrogen, 70 pounds of phosphorus pentoxide, and 385 pounds of potash from the soil.

Unless the soil contains these elements in sufficient quantity for the plants needs, they must be added in the form of fertilizer, in order to insure the maximum profit per acre.

Abstracts

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FROM THE AMERICAN POTASH INSTITUTE LIBRARY SERVICES

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

Fertilizer-Irrigation Treatment of Sweet Potatoes

Lana, E. P. and Peterson, L. E.

The effect of fertilizer-irrigation combinations on sweet potatoes in Buckner coarse sand. Amer. Soc. Hort. Sci. Proc. 68: 400-405. Dec. 1956.

A split-plot irrigation fertilization study was conducted on sweet potatoes from 1952 through 1954. Irrigation rates were used on main plots and consisted of one in. water applied every 7 days and one in. water applied every 3-4 days if rainfall did not supply these amounts. Subplots consisted of fertilizer treatments derived from utilizing 3-9-18 at 700, 1200 or 1700 lb. per acre and designed as a 3x3x3 factorial. Continuous irrigation appeared to be most efficient for production of high yields. Fertilizers produced the greatest yields of No. 1 and total yields at the 1700 lb. rate of N and K.

Fertilizer Rejuvenates Worn Out Soil

Plant foods will revive worn-out soils, test findings at Morrow Plots show. Croplife 4(47):3. Nov. 25, 1957.

A plot of land growing corn continuously for 82 yrs. on the University of Illinois Morrow Plots produced a yield of 121 bu. an acre in 1957. This soil had received a manure-lime-phosphate treatment since 1904 with extra N, P and K in 1955, 1956, and 1957. More significant were the results on another plot that yielded 106 bu. an acre. This land had also grown corn for 82 yrs. but had received no plant food treatment until 1955. For the past 3 yrs. it had received lime, N, P, and K. For the three yrs. just before the plant food treatment, yields averaged only 23 bu. per acre. The initial fertilizer application in 1955 was 5 tons of lime, 200 lb. of N, 150 lb. of P_2O_5 and 150 lb. K_2O. In 1956 and 1957, 200 lb. of N, 40 lb. of phosphate and 30 lbs. K_2O an acre were added each year. These applications were designed to completely remove plant-food deficiencies.

K on Photosynthesis in Barley & Soybean

Dorokhov, L. M.

The effect of potassium on the intensity of photosynthesis in barley and soybean. Trudy kishinev. s. -kh. Inst. 8, 197-205. 1956. Abs. Soils & Ferts. 20(1):232. Feb. 1957. Feb. 1957.

Sand cultures with barley and soybean on Hellriegel's mixture containing varying amounts of K showed that acute K deficiency in the zone of the root system not only decreased the intensity of photosynthesis but also resulted in the de-assimilation of CO_2 by the green leaves exposed to light. Increasing K supply markedly increased the rate of photosynthesis. The intensity of CO_2 assimilation was much lower in plants supplied with $(NH_4)_2SO_4$ than with $Ca(NO_3)_2$. This depressive effect of the NH_4 form of N was eliminated by increasing the K supply.

N-K Balance Affects Stalk Rot in Corn

High nitrogen, low potash encourages stalk rot in corn. What's New in Crops & Soils 10(1):26. Oct. 1957.

High amounts of N applied with low amounts of K increased stalk rot on three varieties of corn in Pennsylvania tests. When N was low and K was high, internal rot and stalk breakage was reduced. Stalk rot and breakage was decreased as N and K amounts were balanced.

Soil Test Summaries in Wisconsin

Ahlgren, H. L.

Agricultural Extension Report 1956. Wis. Agr. Ext. Serv. Cir. 551, p. 14. July 1957.

Wisconsin farmers sent nearly 20,000 soil samples to the college during 1956 for acidity, P and K tests. This is nearly twice as many as were sent in 1955. Of the soils tested, 64% were acid, 49% deficient in available P, and 65% low in available K.

Pasture Renovation by Fertilization

Foy, C. D.

An Indiana agronomist reports . . . Croplife 4(37):15. Sept. 16, 1957.

An Indiana agronomist reports that low-yielding, neglected pasture can be brought back to life by topdressing with Ca and fertilizers, or by a complete renovation of the existing sod. It is stated that forage yield can be increased anywhere from 25 to 100% on established pasture by use of fertilizer and lime. A complete pasture renovation will often boost yields 200-500%. The band seeding method is recommended with new seedlings. With this method, part of the fertilizer is placed in bands directly below the seed. When 400-600 lb. of P-K fertilizer is added, about 200 lb. should be used in band seeding and the remainder broadcast and disked into the soil before seeding. After a crop has been harvested from renovated pasture, the field should be topdressed with P-K fertilizer to keep yields at a high level.

Research in Forest Fertilization Needs

Fowells, H. A.

What about fertilizing forests? Amer. Forests 63(12):22-23, 43-45, Dec. 1957.

Before fertilizing forest trees can become a common practice in this country, we need information concerning requirements of various species for the nutrients and the response of the species on a multitude of forest soils. Without this information there could be many hit or miss attempts to improve the tree growth by adding fertilizers. For example, in the red pine study in New York, only fertilizers containing K were effective in overcoming stagnation of the trees. Of course, complete fertilizers contain K but there would have been no point in adding the other components just to get the K. Red pine on K-deficient soils in this study, about doubled its height growth after being treated with K fertilizers. California, Louisiana, Georgia, Mississippi, North Carolina, Washington, Michigan, and Maryland are other states mentioned as conducting forest fertilization studies.

Fertilizer Increases Gum Yield of Pine

McGregor, W. H.

Fertilizer helps pine. What's New in Crops & Soils 10(1):56. October 1957.

Fertilizer increased gum yields of slash pine by 23% and tree growth by 36% in study by the USDA Forest Service near Lake City, Florida. A report of the Lake City Research Center states that 500 lbs. of N per acre with varying amounts of P, K, and minor elements were added annually for 4 years. The study did not test the economic feasibility of fertilizing slash pine, but the marked increases in growth and gum yield suggest the need for further tests.

California Leaf Analysis Survey

Fullmer, F. S.

Leaf and soil analysis survey in two California potato growing areas. Amer. Soc. Hort. Sci. Proc. 70:385-390. Dec. 1957.

Soil and leaf analyses surveys were conducted on 62 potato fields in Kern and Madera Counties, California. With the exception of the potato fields in northern Kern county, 30-40% of the fields included in the survey may have contained deficient amounts of leaf NO_3-N at mid-season. Similarly, P may have been limiting in the same areas. Potassium appeared to be low in Madera county on Ripperdan soils, and to a lesser extent in certain fields on Hanford and Grangeville soil in this area. The advantages of soil and leaf analysis surveys as guides in developing fertilizer practices are briefly discussed.

Potash for Alfalfa Stand Maintenance

Peterson, A. E. and Attoe, O. J.

9-year-old alfalfa still yields high. Wis. Agr. Exp. Sta. Ann. Rept. Part II, Bul. 527, p. 30, July 1957.

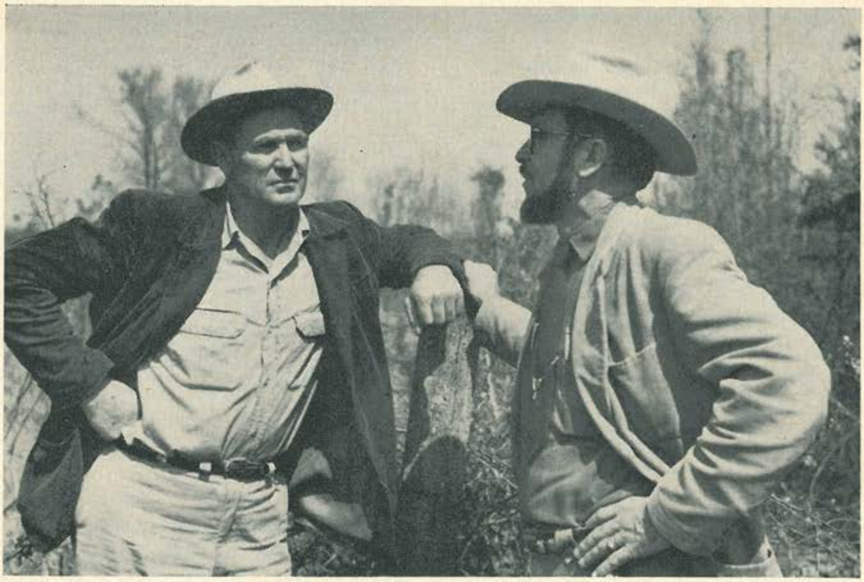
Experiments at the University's Barron County experiment plots have shown that alfalfa may be grown successfully for many years on Spencer silt loams that are properly limed and fertilized. Some of these have grown high yields without reseeding for 9 years and they are going into their 10th year in good shape. The best field has produced a total of 34 tons of high quality hay per acre without reseeding during its 9 years. Thirteen tons of lime, a ton of 0-20-20 fertilizer and 600 lb. KCl topdressing were responsible for keeping the yields high during this period.

N-K Balance Related to Apple Color and Quality

Weeks, W. D., Southwick, F. W., Drake, M., et al.

Nutrition of apple trees. Mass. Agr. Exp. Sta. Ann. Rept. 1955-56, Bul. 494, p. 54. April 1957.

McIntosh fruit color was associated with the N-K content of the tree foliage. Fruit from trees high in N and low in K was significantly poorer in color than fruit from either high-N-high-K trees or from medium-N-high-K trees. Fruit from trees low in N and low in K was also poorly colored. Respiration studies of apples from trees high in N and low in K indicated that the fruit from these trees respired at a faster rate than fruit from high-N-high-K trees. Fruit from the high-N-high-K trees had a respiration rate similar to fruit from low-N-low-K trees. Fruit from low-N-high-K trees had the slowest respiration rate and the firmest fruit.



Clifton McKinney, above left, president of a champion rural community club at Centerville, Mississippi, discusses his county's farm program with County Agent George Mullendore who grew a beard for the Magnolia Centennial. Such clubs—and such leadership—are stimulating every phase of farm life, from social improvement to better fertilization.

Rural Community CLUBS

By Fred J. Hurst
Jackson, Mississippi

AMONG the dynamic forces now operating in the South to build a better agriculture, a finer, more satisfying rural life, and a more stable economy are the rural community clubs.

Now active in almost every sizable farm community, these organizations conduct carefully planned, well-organized programs that influence many phases of farm, home, and community life.

They are effective instruments of agricultural education, economic co-operation, social improvement, better health, recreational opportunity, personal development, wider personal service, better understanding between town and country.

In recent years, rural community clubs in the Deep South have made spectacular growth, piling up accomplishment records that are reassuring to every one interested in making farming more profitable and country life more attractive and livable.

A basic reason for this greatly widened, accelerated activity has

This is a rare scene—a growth of original virgin long leaf yellow pine on the farm of Fred Ledrer near Magnolia, Mississippi. Most of these trees are valued over $100 each. Some Rural Community Club members have reclaimed worn-out cotton farms with timber, which takes far less labor, conserves the soil, gives regular cash income.

been the interest of businessmen in the towns and cities. They realize the success of their own business is closely tied to welfare of the people on the farms. They sense that the community clubs offer opportunity for activating entire communities in large undertakings.

Chambers of commerce, trade associations, and kindred organizations supply needed incentives by providing additional trained leadership in some instances and by awarding highly attractive cash prizes to winning communities in all cases.

For example, the businessmen of Tupelo, Mississippi, contribute $40,000 a year to promote better farming and richer rural living in their area.

They employ trained leadership in this field and award thousands of dollars in cash prizes to the competing community clubs in their seven-county trade area.

From five to ten communities in each of these counties formed strong local organizations, developed capable leadership, and enlisted as high as 95 percent of all farm families in the community in specific farm, home, and community improvement programs.

These activities range from *soil conservation, liming, better fertilization,* and *planting improved seed* to *stricter control of insect pests, food conservation, home improvement, better roads, better schools,* and *revitalized churches.*

At Alexandria, Louisiana, the Chamber of Commerce initiated a similar program in eight parishes. Thousands of farmers, farm women, 4-H boys and girls participated in the program that amazed the sponsors

These registered Jersey heifers on Mrs. Lillian Pritchard's farm were all artificially bred. Mrs. Pritchard is president of the Pike County Jersey Cattle Club.

with the work done and results achieved.

In Arkansas, Tennessee, Alabama, North and South Carolina, and in other states, the story could be repeated many times.

For a closer look at a single community club, we cite Centerville of Pike County, Mississippi.

The businessmen of McComb, Magnolia, and Summit sponsored the program that included every community in the county.

Biggest reason for the accelerated growth of the "Balanced Farming Program," says County Agent George Mullendore, was the shift from the individual farmer to the organized community group that enlisted all the people in a program of wholehearted cooperation.

The program of the Centerville Club was sparked by Clifton McKinney, president; Burton Godbold, vice-president; and Mrs. Fred Martin, secretary-treasurer.

Of the 82 farm families in the community, *66 turned in farm and home records* covering their work in livestock and dairy improvements, pasture establishment, soil testing for more efficient use of fertilizers, artificial breeding service usage, and farm woodland improvement.

The club held monthly forum meetings, sponsored a Fourth of July picnic, built an outdoor recreation center, arranged for chest X-rays and complete physical examination of all school children, organized a music club, gave programs on radio and TV, entertained the Rotary and Lions clubs at McComb and Magnolia, and sponsored other programs of interest and value to the community.

The organization conducted prayer meetings for the annual religious revival, supported the Daily Vacation Bible School, conducted two Bible study courses, and gave an excellent Christmas program.

Obtaining the help of the county board of supervisors, the club built two new bridges, hard-surfaced three miles of road, improved 15 mail boxes and 75 driveways.

This farm home is over 100 years old—and a good example of Rural Community Club work. It was improved during the Centerville home improvement campaign in 1955.

All the community clubs in the county joined in sponsoring some type of farm program, such as forestry and animal breeding.

Timber production has become a major enterprise. There are 186,000 acres of timberland in Pike County. The county has two fire lookout stations, three fire fighting units, two trucks, two tractors, and one jeep for use in fighting fires.

With all communities fire-control conscious and with adequate fire-fighting equipment, forest fires have been held to a minimum.

Individual farmers are improving their woodlands by deadening undesirable hardwood trees with chemicals, by reseeding too thin stands, and by selective cutting.

The Centerville Club won a "Little Beaver" as a prize. This new machine enables two men to do the work of 16 in girdling, culling, and deadening trees. It is used alternately by farmers throughout the community.

The clubs have done a lot of educational work on fertilizers in cooperation with the county extension agents. As cotton acreage has been reduced, farmers have given more study to use of the right kind and best amounts of fertilizers under all field crops and on pastures.

With over 400 Grade-A dairy farms in the county, pasture improvement and artificial breeding have become important practices. The Magnolia Dairy stud serves four counties. County Agent Mullendore reports that these four counties now have about 40,000 dairy calves, heifers, and young cows from this breeding program.

Pike County has a full-time technician who handles the program. The cost is $5 per cow up to three services if needed. Bulk tank milk coolers are now being installed on dairy farms and economies in milk marketing are provided.

Many of the beef cattle producers of the county have joined the Mississippi Cattle Producers' Association, which owns and operates its own auction barns and sales in the interest of the farmers themselves.

To see the amazing advances in timber production, County Agent Mullendore and Forester George Parker carried us on a visit to the farms of Perry Curtis, Burton Godbold, and Clifton McKinney.

These men have transformed old cotton farms into highly productive timberlands—stopping soil erosion, reducing labor requirements, and marketing timber most any time of the year when they need cash money.

Such community clubs enable farm people to make more effective use of the various public and private services available, such as the county extension agents, the public health service, the state forest service, the soil conservation service, etc.

Many of the clubs are elated to discover local leadership in various fields —recreation, music, landscaping, gardening, forestry—which they never knew was available.

The various programs and activities also provide some training of young people in these fields, making life more interesting and rewarding to them.

Our farm publications and farm trade journals could well give more recognition to what is being done in this field—to rural community clubs that are making rural life more attractive and often more profitable to people who live on the farm.

TO PRODUCE 100 BUSHELS PER ACRE

Have you ever stopped to think of the requirements a soil must meet to produce 100 bushels of corn to the acre?

This is something you may want to consider before spring plowing begins, and as you decide what land you want to place in the Soil Bank's acreage reserve or conservation reserve program, says Samuel W. Bone, Ohio State University extension agronomist.

Some soils can produce 100 bushels of corn to the acre easier than others, Bone notes. To do it, they must furnish about 16,000 corn plants with 420,000 gallons of water. That's about 16 inches.

They also must supply 160 pounds of nitrogen, 60 pounds of phosphorus and 120 pounds of potash.

The average rainfall in Ohio during the growing season is about 18 inches, but much of this may run off, due to soil crusting and erosion on slopes.

To supply a corn crop with 16 inches of water, a soil must be able to hold at least 4 inches of available water at the start of the growing season, Bone says.

It also must be drained of any excess water that might limit root development, *have a high fertility level*, be resistant to erosion, and be able to retain 75 percent of the rainfall occurring during the average growing season.

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Featuring location, formation of American potash deposits . . . Mining and refining potash in California and New Mexico.

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Depicting early South, showing results of one-crop-system . . . reclamation and conservation of southern soils through legumes . . . and modern soil management.

THE PLANT SPEAKS (Series of 4 films)

Thru Deficiency Symptoms—showing soil depletion, erosion, results of plant food losses . . . deficiency symptoms in field and orchard crops. (25 min.)

Thru Tissue Tests—showing value of tissue testing . . . procedure for testing corn tissues in field with Purdue field test kit. (14 min.)

Thru Leaf Analysis—showing use of leaf analysis in determining the fertilizer crops need . . . how leaves are sampled and analyzed. (18 min.)

Soil Tests Tell Us Why—showing where, how to take soil samples, on the farm . . . value of soil tests when interpreted by experienced soil chemists. (10 min.)

BORAX FROM DESERT TO FARM (25 min.)

California desert scenes where borax is produced . . . showing importance of borax in agriculture . . . with boron deficiency symptoms in olives, celery, cauliflower, crimson clover, alfalfa, sweet potatoes, table beets, radishes, apples.

IN THE CLOVER (22 min.)

Showing value, uses, culture, fertilizer requirements of ladino clover in North American agriculture.

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What It Does

Some effects of gibberellic acid, as noted by Rutgers Horticulturist Norman F. Childers in *New Jersey Farm and Garden,* include the following:

- Increases the amylase content of seeds and hastens their germination and the emergence of seedlings, even in cold soil.

- Treated transplants show quicker and better recovery.

- It is nontoxic to the plant at concentrations far above those required to influence growth and fruiting.

- Flowering of plants may be hastened or retarded, depending upon time of application, length of day, temperature, species and possibly other factors. To hasten flowering, the temperature must be near the flower induction temperature for that particular crop.

  The set of fruit on tomato can be increased, even in absence of pollination, with as little as 2 ppm. The seed from treated early flowering plants, such as cabbage, has shown normal germination and growth of seedlings with no carry-over effects.

- Leaves and flowers of such plants as African violet and begonia will stand up, making the plants more attractive and easier to package for sale. On spinach, the leaves stand up in the field, which should afford better mechanical harvesting of the crop for processing.

- Can be used to counter the inhibiting effects on growth of maleic hydrazide.

- Overcomes dwarfism in plants, causing normal size plants. Normal size plants of a species can also be made to grow larger. Bush beans, for example, can be made to resemble pole beans.

The Effects of GIBBERELLIC ACID On Plant Growth

THIRTY-ONE years ago, a Japanese plant pathologist, E. Kurosawa, noticed that rice seedlings which had begun to grow more quickly than usual were the same plants that he found later to be infected with a soil-borne root fungus.

Now, mainly through the work of British biologists and chemists, the more rapid growth noted by Kurosawa has been shown to be due to a hitherto unknown plant hormone which is active in concentrations of from one to ten parts in a million.

The discovery is one of great interest to science, of much more doubtful value to plant growers. Although in some cases increases of up to three- and even four-fold are produced in growth rate, it is only the stems of the plants that are stimulated.

Laboratory Experiments

Kurosawa was not content merely to notice. He grew the rice fungus, "Gibberella fugikuroi," in pure culture in his laboratory; filtered off the fungus from the solution in which it had been growing; and sprayed the roots of rice seedlings with the solution.

SOME RESEARCH RESULTS ON STIMULATION OF CROPS IN BRITAIN

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By
A. W. Haslett
London

The seedlings grew more quickly, showing increased growth of plants infected with the fungus was due to a substance which the fungus produced and which could be dissolved from it.

Perhaps most remarkable about this experiment was that the chief known group of plant hormones—the auxins—had not at that time been discovered. This followed about 1930, some four years later.

By 1939, this research in Japan had led to the separation of small quantities of crystals which were thought to be the pure active substance, but, in fact, were a mixture. Any highly active material is always an attractive bait to a scientist.

And further interest in this case was aroused by the product of the rice fungus appearing to differ markedly in its effects from the auxins. Whereas the auxins produce a multiplicity of different effects—such as, the stimulation of the beginning of root growth, the inhibition of lateral buds, and the prevention of leaf stalks from dropping off—the substance from the rice fungus appeared to affect *shoot growth alone*.

What It Does

- **Pasture and lawn grasses can be made to green up and grow during the winter and in early spring and late fall, using 10-50 grams per acre.** ***Australians have noted that more fertilizer is needed to accommodate the stimulus in growth and to keep the grass from fading in color.***

- **Dormancy of Irish potatoes freshly dug can be overcome by soaking them in a gibberellic acid solution, with the seed pieces germinating immediately. Certain seeds have been found to respond similarly.**

- **In some biennial plants, which grow one season and flower the next, requiring a cold period between (cabbage, carrot, sugar beet, etc.), gibberellic acid will induce early flowering in the absence of the cold period, thus reducing time and amount of land tied up for commercial seed producing companies.**

- **Causes an increase in both fresh and dry weight of the above-ground portion of the plant, with root growth apparently little affected. Most of the increase in weight is due to an increase in carbohydrates, but there is some increase in mineral content.**

- **There is an elongation of stems and petioles and to a lesser extent leaf blades. Elongation is due mainly to linear extension of cells and also an increase in number of cells. Stem diameter is not much affected when applied at the present suggested dosages.**

- **Plant responses are obtained in many cases with dosages as low as 0.1 to 10 ppm, the latter concentration of which seems to be the best for general trial. Sometimes the effects can be seen within hours after treatment.**

Isolated by British Scientists

Biologists and chemists at the Akers Research Laboratories of Imperial Chemical Industries, Ltd., at Welwyn, some 20 miles north of London, then decided in 1951 to make a fresh attack on the problem. The biological work was done by a group led by P. W. Bryan, and the chemical work by a group under J. F. Grove.

Within three years, they had isolated the first pure, active substance—gibberellic acid—to be obtained in any laboratory from the rice fungus.

They found a strain of the fungus whose active product consists almost wholly of this substance.

They studied the conditions of its production and raised the output in laboratory cultures to a figure some 30 times greater than in other published experiments.

Finally, in September of 1956 they published its chemical structure—the result of a complicated chain of deductions that left only a few points still uncertain.

Many experiments were done, too, to study the effects of gibberellic acid on plants. During four seasons trials under field conditions were carried out at the Jealott's Hill Research Station of Imperial Chemical Industries Ltd.

And material for research was supplied for use at other laboratories—in Britain, in the United States, and in other countries. Until near the end of 1956, all experiments with pure gibberellic acid were done with this British material.

Many Questions

So far, the uses of gibberellic acid are surrounded by question marks. Increase in stem length, as such, is useful in very few crop plants. Flax or hemp, used as fibres, and the seedlings of forest trees are possible examples; but there has been no research on these as yet.

In the case of one crop, grass, an increase in total dry weight has been found; but the effect lasts no longer than a month and is big enough to be useful only early or late in the season.

On the other hand, there are some special effects which may be useful. One is in breaking dormancy in potato tubers and possibly seeds. Another, probably more promising, is in inducing spring-sown biennials to flower in their first season. This latter effect was discovered by Dr. Anton Lang in California. It may be worthwhile for plant breeders and producers of seeds.

Dwarf or Tall?

Considered in its own right as a plant hormone, gibberellic acid suggests many intriguing questions for research. Substances at least similar to gibberellic acid have been found in pea seedlings and in immature kidney beans. This suggests that it occurs naturally in plants.

It appears likely also to provide the explanation of why dwarf varieties of plants grow only to lower limits of height. By gibberellic acid, they are stimulated to grow to the same heights as do standard varieties—at least in the case of pea plants and maize, which have both been tested. But in varieties which, genetically, are tall already, it produces little or no effect. It may be that gibberellic acid is what is missing in dwarf varieties.

But then there comes another twist to the story. The latest evidence from the Akers Research Laboratories is that gibberellic acid is active only when auxins are also present; but that, when that condition is satisfied, it produces an additional effect of its own.

It seems, therefore, to be both dependent on the auxins and yet to act also in its own right. However its uses may develop, it should thus be a powerful tool for the study of plant growth and varieties. ◄◄◄

IN DIFFERENT WAYS

Soils research workers have more evidence that fertilizers don't affect all crops the same way.

In trials on fields in northeastern Minnesota, oats needed phosphorus more than any other nutrient. Potatoes needed potassium most, and hay yields were boosted most by phosphate and potash together.

These reports come from A. C. Caldwell, University of Minnesota soils scientist, and W. W. Nelson, agronomist at the Northeast Experiment station, Duluth.

When, they tested applications of nitrogen, phosphate, and potash, alone and in combination, on oats, potatoes, and hay, they got interesting results:

OATS

Unfertilized oats averaged 16.4 bushels per acre. Plots that received phosphate alone yielded 43 bushels—nearly 6 bushels higher than oat plots receiving both phosphate and potash and only a bushel lower than plots that received complete fertilizer.

HAY

In hay, the best increase came from adding both potash and phosphate, but potash was the most limiting nutrient. Unfertilized first-year hay plots averaged about 2 tons per acre, while plots receiving potash alone averaged 3.06 tons. Potash and phosphate together brought yields up to 3.16 tons per acre, but first-year plots receiving all three nutrients actually averaged lower yields—2.77 tons—than potash-phosphate plots. Results were similar in second-year hay, except that adding nitrogen in complete fertilizer did help some in this case. Nitrogen alone, though, made no increase.

POTATOES

Potato yields were highest—304 bushels per acre—on land that received nitrogen, phosphate and potash, but potash made more difference than any single nutrient,. Unfertilized potatoes averaged 74 bushels per acre, compared to 155 where potash alone was added. Phosphate alone brought yields of 87 bushels per acre and nitrogen alone brought no yield increase at all in potatoes.

REVIEWS

April, 1958

Recent publications of the United States Department of Agriculture, The State Experiment Stations, and Canada on Fertilizers, Soils and Crops. Requests for publications listed should be made directly to the original source.

CROPS

"Results of Some Long-Time Experiments with Cotton and Corn at the Pee Dee Branch Experiment Station," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 443, Apr. 1957, G. H. Collings, E. E. Hall, and F. M. Harrell.

"Irrigation and Fertilization Experiments with Vegetables at Dandridge, Tennessee," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Bul. 265, Oct. 1957, A. B. Strand and B. S. Pickett.

"Oats for Winter Forage," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Bul. 266, Oct. 1957, W. L. Parks and E. J. Chapman.

"Pastures and Pasture Practices," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Bul. 272, Sept. 1957, H. A. Henderson.

"Effect of Subsoiling and Deep Fertilization on the Growth, Root Distribution and Yield of Cotton," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 1992, Nov. 1957, C. A. Burleson, M. E. Bloodworth, and J. W. Biggar.

"Fertilizer-Water Depths Tests on Rice, 1956-57," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 2006, Jan., 1958, N. S. Evatt.

"Some Effects of High Rates of Potash on the Yield of Charleston Gray Watermelons at Prairie View, 1956-57," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 2007, Feb. 1958, O. E. Smith and D. R. Paterson.

"Summary of the 1957 Texas Corn Performance Test," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 1999, Dec. 1957, A. J. Bockholt, J. S. Rogers, and J. W. Collier.

"Welcome to Substation No. 16, Iowa Park, Texas," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, MP-246, Nov. 1957.

"Forage Mixtures for Year-Round Feeding," Agr. Ext. Serv., Virginia Polytechnic Institute, Blacksburg, Va., Cir. 739, Jan. 1958.

"Garden Roses for Virginia," Agr. Ext. Serv., Virginia Polytechnic Institute, Blacksburg, Va., Bul. 189, Rev. Aug. 1957, A. G. Smith, Jr.

"Virginia Fire-Cured Tobacco Varieties," Agr. Ext. Serv., Virginia Polytechnic Institute, Blacksburg, Va., Cir. 752, Nov. 1957, G. R. Mathews, R. G. Henderson, and R. D. Sears.

"Washington Berry Crops, Data for 1940-1956," State Dept. of Agr., Olympia, Wash., May 1957.

"Washington Fruit Crops, Data for 1940-1956," State Dept. of Agr., Olympia, Wash., Sept. 1957.

"Corn," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 548, May 1957, N. P. Neal.

"Field Crop Varieties for 1958," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 463, Rev. Nov. 1957.

"Vegetable Varieties for Wisconsin, 1958," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 536, Jan. 1958.

"Growing the Transplant Onion Crop," USDA, Wash., D. C., Farmers' Bul. 1956, Rev. Nov. 1957, H. A. Jones, B. A. Perry, and G. N. Davis.

"Grasses and Legumes for Forage and Conservation," USDA, Wash., D. C., ARS 22-43, Oct. 1957.

SOILS

"Tomato Varieties for Middle Georgia," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Mimeo. Series N. S. 42, Dec. 1957, G. Tereshkovich, B. B. Brantley, and A. H. Dempsey.

"Management of Alfalfa for High Quality Hay on Nonirrigated Lands of Northern Idaho," Agr. Exp. Sta., Univ. of Idaho, Boise, Idaho, Res. Bul. 36, April 1957, C. L. Canode and K. H. Klages.

"Forage and Grain Crops for Kentucky," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Misc. 90, Aug. 1957, S. H. Phillips.

"Results of the Kentucky Corn Yield Test—1956," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Prog. Rpt. 46, Jan. 1957, J. F. Shane, F. A. Loeffel, and R. Richards.

"Data for Farm Planning in the Delta Cotton Areas of Louisiana," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., DAE Cir. 203, May 1957, B. Bolton and M. M. Lindsey.

"Mineral Accumulation in Potato Plants," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Bul. 562, Sept. 1957, P. N. Carpenter.

"Chesapeake—A New Red Clover Variety," Agr. Exp. Sta., Univ. of Md., College Park, Md., Bul. 462, Dec. 1957.

"Effects of Winter Cover Crops on Growth, Quality and Nitrogen Nutrition of Maryland Tobacco," Agr. Exp. Sta., Univ. of Md., College Park, Md., Bul. A-86, April 1957, G. L. Steffens and O. E. Street.

"Private Forest Landownership and Management in the Northern Half of Michigan's Lower Peninsula," Agr. Exp. Sta., Mich. State Univ., East Lansing, Mich., Tech. Bul. 261, June 1957, J. G. Yoho, L. M. James, and D. N. Quinney.

"New Ornamentals for 1958," Agr. Exp. Sta., Univ. of Minn., St. Paul, Minn., Misc. Rpt. 29, Dec. 1957, R. A. Phillips, R. E. Widmer, L. C. Snyder, A. G. Johnson, and R. J. Stadtherr.

"Field Bean Production Under Irrigation in Nebraska," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., S. C. 98, Mar. 1957, F. V. Pumphrey.

"Atlantic Alfalfa," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 787, July 1957, W. R. Battle.

"Blueberries in the Garden," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 579, Jan. 1957, C. A. Doehlert.

"Bush Fruits in the Home Garden," Agr. Ext. Serv., Rutgers Univ., New Brunswick, N. J., Ext. Bul. 298, Oct. 1956, E. G. Christ.

"Soil Judging From the Ground Up," Agr. Ext. Serv., Oreg. State College, Corvallis, Oreg., Ext. Bul. 769, Oct. 1957, A. S. King and M. D. Dawson.

"70th Annual Report of the Pennsylvania Agricultural Experiment Station," Agr. Exp. Sta., Pa. State Univ., University Park, Pa., Bul. 623, July 1957.

"Land Resource Areas in South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Cir. 112, June 1957, G. H. Collings and P. H. Montgomery.

"Salinity Control in Irrigation Agriculture," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Bul. 876, Aug. 1957, P. J. Lyerly and D. E. Longenecker.

"Soil, Virginia's Basic Natural Resource," Agr. Ext. Serv., Virginia Polytechnic Institute, Blacksburg, Va., Bul. 253, Oct. 1957, G. R. Epperson, et al.

"1956 Summary of the Agricultural Conservation Program," USDA, Wash., D. C., Jan. 1958.

"Farm Resources Needed for Specified Income Levels," USDA, Wash., D. C., Agr. Inf. Bul. 180, Dec. 1957, J. M. Brewster.

"Nitrogen and Carbon Changes in Great Plains Soils as Influenced by Cropping and Soil Treatments," USDA, Wash., D. C., Tech. Bul. 1164, Sept. 1957, H. J. Haas, C. E. Evans, and E. F. Miles.

"Questions and Answers on Agricultural Research," USDA, Wash., D. C., ARS-20-5.

"Studies with Radioactive Phosphorus in Soils of the Western States, 1950-53," USDA, Wash., D. C., Production Res. Rpt. No. 12, Oct. 1957.

FERTILIZERS

"Commercial Fertilizers Report for 1957," Agr. Exp. Sta., New Haven, Conn., Bul. 607, Oct. 1957, H. J. Fisher.

"Inspection of Commercial Fertilizers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Insp. Rpt. 7, April 1957, F. W. Quackenbush and O. W. Ford.

"Inspection of Commercial Fertilizers and Agricultural Lime Products," Agr. Exp. Sta., Univ. of Mass., Amherst, Mass., Control Series Bul. 174, Sept. 1957.

"Analyses of Fertilizer Materials," Agr. Ext. Serv., Clemson Agr. College, Clemson, S. C., Misc. Lflt., Jan. 1958.

"Effect of Source and Time of Application of Nitrogen Fertilizer on the Yield and Test Weight of Irrigated Winter Wheat, Deaf Smith County, 1957," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 2010, Feb. 1958, A. Pope.

"Distribution of Fertilizer Sales in Texas," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 2008, Feb. 1958, J. F. Fudge.

"Whys and Hows of Fertilizing," Agr. Ext. Serv., Univ. of Vt., Burlington, Vt., Brieflet 998, W. A. Way.

"Lime—When, Why, and How Much to Apply on Delta Soils in Arkansas," Agr. Ext. Serv., Univ. of Ark., Fayetteville, Ark., Lflt. 243, Aug. 1957, W. N. Miley.

The greatest achievements of mankind have been accomplished by two types of men—those who were smart enough to know it could be done, and those too dumb to know it couldn't.

~

The main influences of the moon are on the tide and the untide.

~

Keep your eye on the ball, your shoulder to the wheel, and your ear to the ground. . . . O. K. Now try to work in that position.

~

A new farm hand from the city was told to harness a mule one winter morning in the early hours. In the dark he tackled a cow instead of the mule. The farmer shouted from the house, "Say there, what's keeping you so long?"

"I can't get the collar over the mule's head," shouted the new man. "Both his ears are frozen solid."

~

The man sawed on his steak, and he jabbed it, but still he couldn't cut it. He called the waiter.

The waiter came over and examined the steak. "Sorry, sir, but I can't take it back. You've bent it."

Indignant wolf to hysterical blonde: "I did not promise to take you to Florida—I only said I was going to Tampa with you!" . . .

~

"What's the matter here," asked the policeman of the battered man lying on the sidewalk outside an apartment house.

"Oh, just absent-mindedness," was the reply.

"What are you talking about?" retorted the cop.

"Well, you see I live on the fourth floor of this building and both my wife and I are very absent-minded. I just got home from a business trip and my wife and I were at the dinner table when a step sounded in the hall and someone tried the door. Well, my wife is so absent-minded that she said, 'Goodness, here comes my husband,' and I'm so absent-minded that I jumped out the window."

~

The millionaire, in a hospital oxygen tent, was slipping fast. He called his only relative, a nephew, to him.

"My boy," he said, "I'm leaving you my entire estate. Please use the money, wisely, please be prudent and be good to the poor."

"Yes sir," the nephew whispered.

"And do me one last favor," the millionaire sighed. "Take your foot off my oxygen tube."

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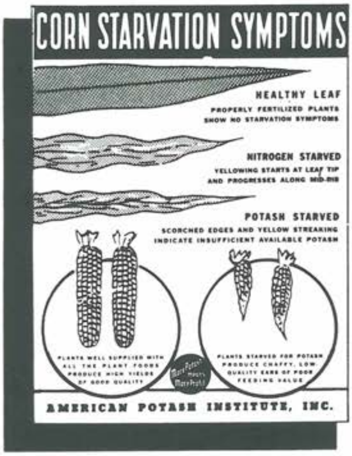

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