Better Crops

WITH PLANT FOOD

July-August 1963

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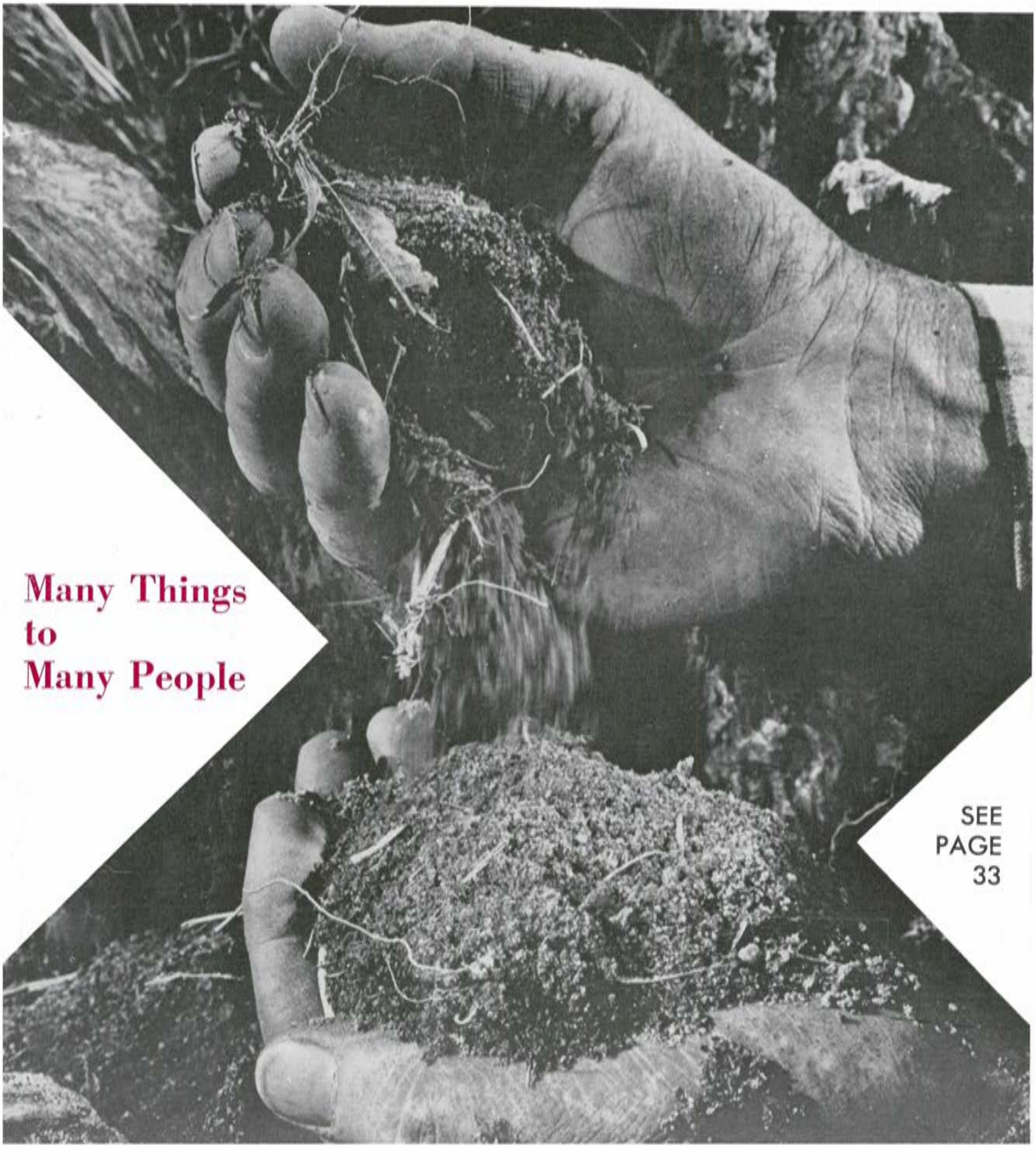

Many Things to Many People

SEE PAGE 33

Better Crops
WITH PLANT FOOD

The Whole Truth—Not Selected Truth
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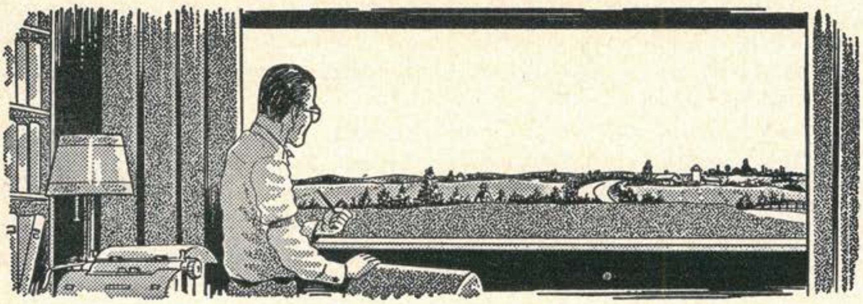
Vol. XLVII Washington, D. C. No. 4

CONTENTS

ON THE COVER

. . . what flows from the upper hand to the lower may be questioned by the more meticulous expert of experts. But to the dirt farmer, there is no doubt—though his advisers might well urge him not to call it dirt, but truly what it is: soil, "a precious mixture of mineral and organic matter, air and water on which life depends."



Knowledge From A Dream

By Jeff McDermid
(Elwood R. McIntyre)

OF ALL the pieces I've seen about the Land Grant College Centennial, one stands out.

It brought to life the dream of special schooling for farm folks that originated in the fertile mind of Justin Morrill, as he sweated over bellows, forge, and hammer in his father's blacksmith shop at Stafford, Vermont.

You can almost smell the smoke and see the coals glowing. Probably the Vermont setting caused my extra interest in this story, appearing in *Progressive Agriculture in Arizona.*

You see, my father was born in rugged Vermont and he also helped his own Dad run the smithy on Bennington Green during the late 1840's —in fact, there were three of our generations of Tubal Cains in that trade in the same location.

Likewise, the author of this article, John Burnham, Editor of Arizona College of Agriculture, comes from Vermont stock. And their home farm mortgage in Wisconsin acreages was largely financed at times by shipments of pure Vermont maple syrup, sent west for local trade.

SCANT CURRENCY TODAY

What makes me both happy and humble about this is a note received from John Burnham himself. He said: "*I still feel there is value in the old style writing of things that have scant currency in this day of technical agriculture.* So I wrote this piece about Senator Morrill with three men in mind: You, Prof. Bill Sumner, and my Father. You are the only one of the three left to read it."

As for myself, I had known and admired Prof. Sumner a long time. He was a journalism teacher who never grew away from Youth or failed to keep up with the times. John's desire to have "Prof" read this Vermont essay is typical of the esteem earned by this Kansan in half a century of Land Grant College work.

As a traveling farm paper man, I took a cue from Sumner—to stop frequently in country newspaper shops. There the pulse of agriculture could usually be felt as fully as at the farm stores, grist mills, creameries, and livestock yards.

At each pause for country replenishment, the editors of the 8-page weeklies—some of them blanket dimensions—made us welcome in make-up nook and cluttered sanctum.

There we "called the roll" of bucolic men and events while the job presses clanked and the Whitlock flat-bed shook and slammed.

Stud horse posters, programs for the Grange, and notices of auction sales and school elections lined the variegated walls.

A FURIOUS PACE

It was a furious pace sometimes for the country town. The proofs, mats, and dummies overflowed the copy hooks and roll-top desks to flop on the inky floor. Green young apprentices toted the water, learned the case, washed the forms, and sprayed the type lice.

In the light soil area of central Wisconsin, farmers relied on Irish potatoes for their main cash crop, and read the *Waupaca County Post*. The mast head bore the well known name of D. F. Burnham, editor and the identity: "Republican, weekly, Thursdays."

Its brisk circulation covered 18 postoffices and the Veterans Home. Editor Burnham had been a school teacher and superintendent before joining the Fourth Estate.

He was a slim, dark-eyed, lively, energetic person—a good debater and a storehouse of facts and figures.

For me he was a steady, reliable source of information about farm organizations and current markets, unafraid to take a stand or stir up arguments in dull seasons.

He stood for an educational system that would serve farm folks. For a period the district school was ordered by the legislature to give courses in agriculture—not too practical. Later a few county agricultural schools were set up with state aid.

First attempt to reach the farm folks by the University was a two-term Short Course. Gradually the Land Grant College drew more youth to enroll in full-time, four-year courses in agriculture and home economics.

Burnham had two boys ready to take up this opportunity for rural education—Don and John. From their teens, both boys enjoyed a good graphic arts training right at home. Later, they were not educated *away* from agriculture, *as too many were!*

Donald was graduated at Wisconsin in 1917. He is an active agronomist with U. S. D. A. and the University of New Mexico. John of Tucson received his B.A. degree in 1926. Both men are busy studying and reporting in the great Southwest far from their native heath.

. . . WHO FIRED EDUCATIONAL EMBERS

Take a moment to enjoy the opening part of John Burnham's Land

To Page 5

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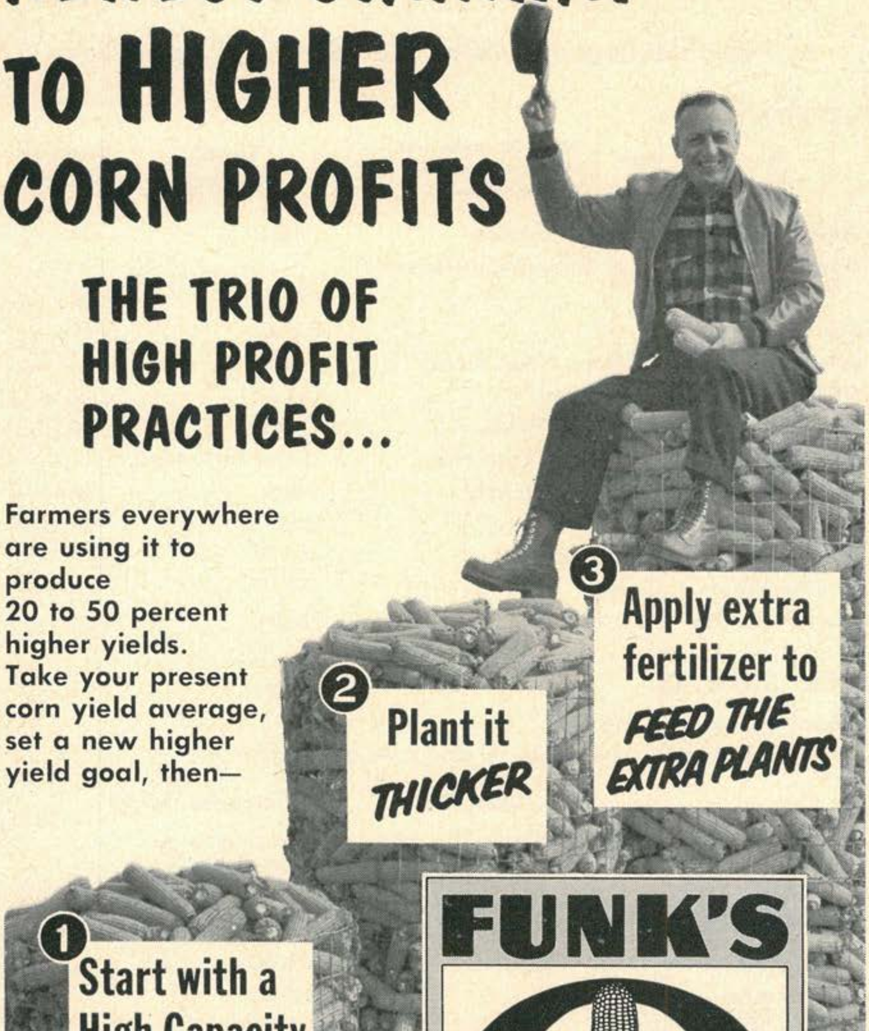

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Grant College narrative about the Vermont blacksmith boy who fired educational embers:

The slim lad ran a hand down his leather apron, gazed across the blacksmith shop redolent of burned hoof, anvil fire, and hickory shavings from a newly turned wagon spoke.

He hesitated a moment, then placed a hand on the withers of the parson's gray gelding, as to seek support for what he was to say.

"Father, why couldn't there be a school where boys could learn to be better farmers?"

The father straightened from the anvil, his hammer in mid swing at such a startling statement from his son. But the lad continued: "I don't mean just farming, but how to do things, how to learn the skills to make a living. Like carpentry and making tools and implements for farming. And taking care of sick animals and even knowing more about food—for folks and animals, too." His words trailed away.

"Justin, lad, I don't know where you get all the foolishness stored in that round head of yours. I swear you come up with the most outlandish things. Now get back to your work. Remember, the parson's horse favors that nigh forefoot, so build up those heel caulks a bit. Here, let me show you. I'll make a sound smith of you yet."

"That's just what I mean," said the boy. "Here you are a perfect teacher, and you have but one pupil—your own son. Here in this year 1824, all we learn is what is learned from father to son, from mother to daughter. I think if there were schools—not just to teach Latin and Greek, like now, not only for the sons of the wealthy, but if the skills of home and farm and factory could be taught by those best able, to boys and girls most eager . . ."

Again his words trailed away.

Sunday afternoon after church found young Justin Morrill roaming the Vermont hills with his friends. As they rested, he told of his ideas, but his comrades were derisive. "One thing," said Justin, "might be machines for doing much of the work around the farm and home. Do you realize how hard our mothers work, how quickly they are crippled with age?"

Davie Allen rolled in the grass and sat up laughing. "How our friend does dream. I suppose there will be machinery to carry water from the stream, and you'll just push a magic button, and the oven will be just right for baking. There'll be a magic griddle for pancakes and waffles, and a special machine for making toast."

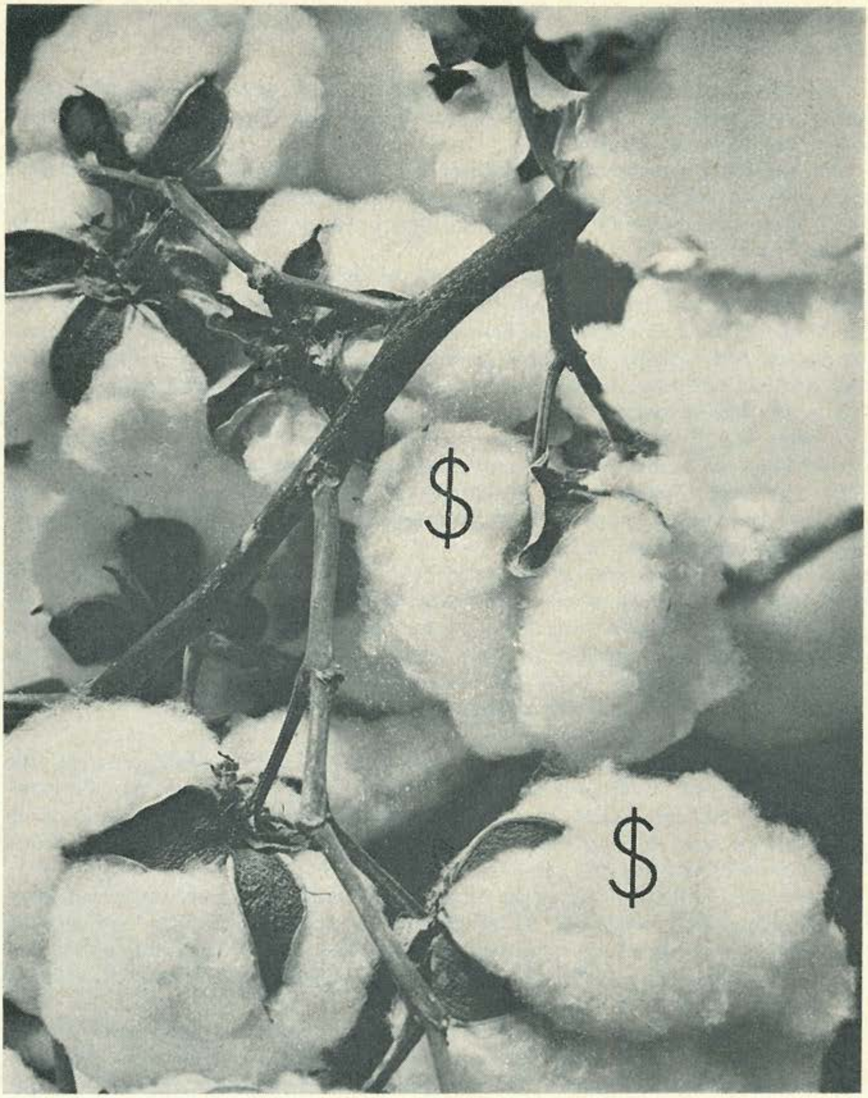
"And you'll shave with a machine, and have a machine to plow and harrow and milk cows. And the day will come when you have farms without horses—just machines; and we'll mow the hay and put it in the barn without lifting a fork," said Willie Williams, laughing.

"Justie, lad, you're crazy as a red-head water bug."

But Justin was obdurate. "All I am trying to say is there should be colleges for *all*, colleges to learn not just languages and history, but skills for living and making a living. There must be better ways, easier ways to do these things. This father-and-son learning is too slow. Maybe the government should start a new kind of college just for this purpose."

Justin Morrill quit his own schooling when he was 15. He went to the U. S. Congress in 1855, where he found a friendly ear for his dream. He had a 44-year record of Congressional service.

THE END



Cotton—principal cash crop of Texas that brought over $820 million for lint and seed last year—has been accused of depleting cropland soils.

"Such accusations are just as silly as the belief that automobiles are responsible for deaths on the highways," **C. B. Spencer, Chairman of the State-Wide Cotton Committee,** contends. "But we must admit cotton has been misused, largely because growers do not fully realize the importance of growing cotton under a management system that will make them the most net income while improving their soil's fertility."

How can it be done—grow cotton profitably at the same time you improve your soil productivity? BETTER CROPS is pleased to present some pointers toward the right track, prepared by **Chairman Spencer of Texas Cottonseed Crushers' Association** with the help of leaders in the soil fertility field.

COTTON Is MONEY

BIG Money When Grown Right

To grow cotton profitably, while improving soil productivity, growers must recognize the crop's needs. Then, they must take all necessary steps to meet these needs adequately and efficiently. The grower should recognize:

1 That Cotton Is a Clean Tilled Crop.

It must be grown on fairly level land in a conservation system of farming to prevent wind and water erosion.

Wind and water erosion have taken their toll of Texas soil fertility—especially in the Blackland Area. Much of the cropland has lost 1,000 tons of topsoil per acre.

It is estimated each ton contained 2.4 lbs. nitrogen (N); 1.6 lbs. phosphorus (P_2O_5); and 12 lbs. potassium (K_2O). The acre loss of these plant food nutrients alone, in 1,000 tons of soil, would be 2400 lbs. N; 1600 lbs. P_2O_5; 12,000 lbs. K_2O.

The *first* step in controlling runoff and erosion is *adequate fertilization*. With low fertility and weak plants, erosion is serious. With high fertility and vigorous plant growth, it is not. The erosion problem can be solved with (1) vigorously growing plants and (2) all the residue returned to the soil, supplemented by terraces, grassed waterways, and contour cultivation on moderately sloping cropland.

It is the landowner's responsibility to establish such conservation measures on tenant-operated farms and the tenant's responsibility to maintain them properly.

2 That Cotton Is a Low Residue Producing Crop.

It must be grown in rotation with high residue producing crops to provide an adequate level of organic matter in the soil—for crop production becomes more hazardous and expensive as organic matter declines.

Organic matter in the soil is obtained from plants and animals, crop residues, manures, fungi, bacteria, worms, etc. Decaying organic matter helps bring soil minerals into solution, improves physical condition of the soil, increases water intake, improves aeration, and serves as an important nutrient source. It contains most of the available nitrogen and phosphorus in the soil.

A recent soil test summary for Texas indicates that average cropland soils now contain less than ½ of their original organic matter content. A good example is the High Plains of Texas. The sandy soils originally had around 1½% organic matter—now their average is only .7%. The heavy soils formerly contained an average of around 2½%—now the average is about 1¼%.

Soils high in organic matter help prevent erosion because of greater water intake. They, also, allow more efficient use of fertilizer, rainfall, and irrigation water. Crops supplied with adequate organic matter and plant food use water more efficiently. For example, approximately 15 usable inches of water are required to produce a bale of cotton on well fertilized land, compared to over 30 inches on unfertilized fields.

POTASH: improving cotton yields

Addition of potash fertilizer to sandy loam soils in several areas of Fresno County has resulted in improved cotton yields in a series of yearly tests under the supervision of Les Stromberg, cotton farm advisor for Fresno County.

During the 1962 season, potash tests were also made for the first time on silty loam soils located on the Westside of Fresno County.

For the field trial, a paired plot with 10 replications was used. Each plot was four rows wide by 620 feet long. The cotton was planted on April 12, and side-dressed with 1000 pounds KCl on May 29. The total yield for the cotton which received 600 pounds K_2O per acre was 1290 pounds, compared with 1156 from the check plots. This was a yield increase of 134 pounds lint

The most practical way to maintain an adequate level of organic matter is to apply the amount of fertilizer needed to produce vigorous high-yielding plants. Return all crop residues to the soil. An average annual return of from 3600 to 4000 lbs. of dry, above-ground residue is required to maintain an adequate level of organic matter in an acre of soil. It is harder to maintain or increase organic matter on sandy soil than clay soil due to more rapid decomposition on coarse textured soils.

The dry above-ground residue available for return to the soil from yields of three representative crops are: (1) 4500 lbs. grain sorghum: approximately 5500 lbs.; 80 bushels oats or 40 bushels wheat: 4000 lbs.; and bale per acre cotton: 2000 to 3000 lbs.

All cotton burs should be returned to the soil to help improve the soil's physical condition. Rate of water intake is increased and plants are able to use water more efficiently. The major nutrients in a ton of dry burs averages about 18 lbs. nitrogen, 9 lbs. phosphorus, 77 lbs. potassium. The plant food in a ton of burs is worth about $6, in addition to the value of its organic matter.

3 That Cotton, Like All Harvested Crops, Removes Plant Food Nutrients from the Soil.

Texas farmers produced 271,555,000 bales from 1866 through 1962. A bale of cotton removes 40 lbs. nitrogen (N); 20 lbs. phosphorus (P_2O_5); and 15 lbs. potassium (K_2O) in the lint and seed. Therefore, cotton is responsible for removing approximately 10 billion pounds of N; 5 billion pounds P_2O_5; and 4 billion pounds of K_2O. Figuring N at 10¢, P_2O_5, at 8¢, and K_2O at 5¢, the removal of major plant food nutrients by cotton amounts to 1.6 billion dollars.

The cotton produced was worth over 27¼ billion dollars.

Approximately 80 lbs. of nitrogen (N), 40 lbs. of phosphorus (P_2O_5),

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. . . in California

per acre as a result of fertilization with potash fertilizer.

According to Stromberg, the tests showed that a soil as fine textured as clay loam will respond to the addition of potassium provided native exchangeable potassium is below 100 ppm., according to the soil report.

One of the most important things brought out by the test was the fact that a significant response can be obtained from potassium even where there are no visible plant deficiency symptoms, according to Stromberg.

Les Stromberg says his continuing tests with potash fertilization of cotton point up the importance to the grower of plant analysis for determining deficiencies of the vital elements necessary to plant growth and production.

California Farmer

and 60 lbs. of potassium (K_2O) are utilized in producing a bale of cotton. Part of this plant food will be supplied by the soil, but fertilizer must be applied to bring total supply up to the amount needed to produce yield goals. The ability of plants to recover the applied plant food is a big factor, since the inability of the soil to get or retain moisture limits the amount of fertilizer that can be used gainfully. Based on moisture, physical condition, and organic matter, it is estimated a crop will recover the following nutrients: Nitrogen (N): 30 to 70%; phosphorus (P_2O_5): 10 to 30%; and potassium (K_2O): 30 to 60%.

Soil tests are a good guide for determining fertilizer needs, for removing inadequate soil fertility as a limiting factor. Cotton growers should have their soil tested every 2 or 3 years. They should understand the report, then use it as a fertilization guide and measure of soil improvement progress.

Fertilizer should be applied in a band, deep enough to be in moist soil during dry periods, yet close enough to seedlings to stimulate growth without damaging them. It should be applied in a band, 6-8 inches below the seed. Banding results in less plant food tie-ups and at this depth keeps the nutrients in moist soil. During dry weather, roots near the surface cease to function.

On sandy soils, fertilizer gives best results when applied at planting time. Consideration should be given to nitrogen as a side dressing in addition to starter material.

On clay soils, fertilizer may be applied anytime after the soil has cooled to 50°, for early application helps avoid troubles at planting time. A

COTTON: most important farm–grown industrial

The Nation's cotton crop—worth more than $2 billion a year to farmers—is a top source of cash farm income and our most important farm-grown industrial raw material.

Today's cotton farmers harvest about 150 lbs. more lint per acre than they did a decade ago—representing about $50 more return per acre.

Efficiency in producing cotton has nearly doubled in the past decade. About ten years ago, it required 146 man-hours to produce one bale. Today, it takes around 77 man-hours.

This increased efficiency comes from higher yielding varieties, improved cultural methods, insect and disease control, mechanized harvesting, and more efficient ginning practices—all developed through research.

Utilization research is now helping cotton to compete more favorably with synthetics, which have made serious inroads into traditional cotton markets.

Through chemical modification

widely used method is to apply fertilizer about 4 inches deep in middles ahead of re-bedding.

4 That Cotton Land Should Be Kept in Good Physical Condition.

Soils in good physical condition can make the most effective use of rainfall and plant food nutrients.

Soils can be kept in good physical condition by (1) providing a good cover crop of vigorous plants, (2) plowing or cultivating when the soil is dry, and (3) returning large quantities of residue.

Alfalfa, sweet clover, vetch, or other legume crops in the rotation add nitrogen and speed up improvement of the soil's physical condition.

5 That Water is Often the Limiting Factor in Cotton Production.

Irrigation facilities should be developed when water is available and its application feasible. Moisture is needed for stand and early growth. An adequate supply during the period from ⅓ grown square stage to open boll stage is necessary for maximum yields.

6 That Cotton Plants Can't Stand Wet Feet.

A good drainage system is often needed to remove surplus water during excessive rainfall periods. Good drainage is also important to an irrigation system in areas subject to big rains.

7 That Cotton Plants Are Attacked by Diseases.

The disease problem increases with soil depletion and poor crop man-

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raw material

of cotton fiber, scientists have developed fabrics with wash-and-wear convenience, with flame, water, rot, and mildew resistance, and with less tendency to become soiled.

Because of our rising living standard and population increase, the total market for wearing apparel has increased by nearly a third in just a decade. But the amount of cotton used in wearing apparel has increased by almost half—due greatly to wash-and-wear developments.

Production of wash-and-wear cotton goods is now better than 2 billion square yards a year—using more than a million bales of cotton worth $150 million a year to farmers. Without cotton utilization research, this market for cotton might well have been lost to competitive materials.

During the past decade—or the area of the 50's—the total of all funds invested by public agencies in research on cotton amounted to $62 million—only a tiny fraction of the increased gains made each year by the cotton industry as a result of research.

USDA News

agement. The Texas crop was reduced 22.1% by diseases in 1962, according to Cotton Disease Council estimates. This amounts to 1,327,700 bales or around $225,000,000 lost by farmers.

Control is primarily a program of prevention on successful farms. Cotton should be planted in rotation with fibrous rooted crops. Careful attention should be paid to the quality and disease tolerance of planting seed, to fertilization, to plowing and other practices that reduce disease losses.

8 That Cotton, Especially Well Fertilized, Vigorous Heavy Fruiting Plants, Attracts Insect Pests.

Failure to control insects caused thousands of farmers to quit cotton. But, losses from insect pests can be kept minimum by preventive practices.

Successful growers join with their neighbors and plant good seed during the optimum planting period. They follow up with community-wide early season control, a must in sections where boll weevils are a problem. They apply late season control as needed, based on inspections. Early stalk destruction is practiced community-wide when feasible.

9 That Cotton Planting Seed May Be of Poor Quality.

A recent planter box survey showed a large percentage of the cottonseed planted is of questionable quality. It takes high quality seed to get the crop off to a fast, sure start.

Planting seed should be of an adapted variety and all planting seed should be treated, and tested for germination. High quality seed will germinate with 90% or more vigorous sprouts.

10 That Cotton Should Be Kept Free of Weeds and Grass.

The weed and grass problem has increased with the cost and scarcity

From Rust to PROFITS

COTTON RUST, once thought to be a serious disease, is nothing more than potassium deficiency.

In the late 30's cotton rust was taking a heavy toll from the already low farm income. Today, as a result of research begun in 1939 on the problem of rust and behavior of potassium in the soils, Alabama farmers are enjoying an extra 30-million dollar annual income from increased cotton yields alone, according to Dr. R. D. Rouse, soil chemist, Auburn.

The main purpose of this project was to provide a basis for determining the potassium fertilizer needs of crops on Alabama soils.

When this project was started, the only kind of complete fertilizer used in Alabama was higher in phosphorus than potassium. An analysis of the 130,000 soil samples sent to the soil testing laboratory of the Station from all parts of the State during 1953-62 showed that only 11 percent of the fertilizer needs were of this type. The of farm labor. A control program must be practiced to keep weeds and grass from robbing cotton plants of moisture and plant food. They interfere with harvest and also lower grades.

Weeds and grass can be controlled by cultural practices, including the rotary hoe on clean farms, though chemicals are being used more and more to prevent expensive hoe bills on farms where the problem justifies the expense.

11 That Cotton Requires Defoliation and Desiccation for Mechanical Harvesting.

Defoliants are recommended for machine picking and desiccants for stripping. They should be applied as early in the season as maturity permits. They not only help prepare for harvest but also help stop insect buildup. Yet, too early application can reduce yield and quality of both lint and seed.

12 That Cotton Should Be Harvested Early.

Cotton harvested early in the season is usually of higher grade and brings a better price than late harvested fields. When bolls open, the crop should be harvested dry, loose, and clean. It should be harvested with 8% or less moisture.

Every cotton grower should decide on a reasonably high goal for his farm and work toward it. Many successful growers average a bale or better on dryland. Growers with irrigation often make from 1½ to 3 bales per acre.

Such producers manage their farms like any good business—to make a profit from the crop and to improve their inventory. Cotton is money—big money when grown right.

THE END

. . . or an extra $30 million

research on this project was largely responsible for this interpretation. Use has changed and in 1962 only 8 percent was high phosphorus-low potassium whereas 89 percent was equal in phosphorus and potassium.

Through research on this project, chemical soil tests for potassium have been developed that permit reliable evaluation of potassium fertilizer needs for any field. Farmers of Alabama can take advantage of this by sending soil samples to the soil testing laboratory, Auburn University Agricultural Experiment Station.

In 1962 Alabama farmers spent more than nine million dollars for potassium in commercial fertilizers. This represents an increase of more than fourfold in use of potassium fertilizers since 1942. However, research information available at that time indicated that with present land use profitable yield increases could be obtained from the use of over twice the amount used in 1962.

—Alabama Farmer

The THREE Brothers

From the original
By Dr. W. Jervitz
Sterlitz-Berlin

Published over a half century ago

In great amazement, the traveler asked what was wrong.

"Dost thou come here to increase our misery, and to perish thyself?"

Such were the words used by the hungry and poor looking guardian of the gate of the mighty city of the Kalif, to the traveller who, on his sturdy palfrey, craved permission to enter the city.

In great amazement the traveller asked what was amiss and received the answer, "Thou evidently hast come here from afar, O Stranger, that thou knowest not of the great misfortune that has befallen our all-powerful Kalif and his city. Although the God of Mohammed makes the sun to shine on us as he used to do, and although the good spirits of heaven send us rain when we are in need of it, yet grow our grain and our millet no more as in former years.

"Every year the devastating famine comes anew, bringing our children into dreadful misery and leaving our best warriors powerless and defenceless against our enemies.

"And have ye then tried no remedy for this pestilence?" asked the stranger.

"By the beards of the Prophets, Yea! For years already has our land been cursed, and the Ruler of the Faithful proclaimed that he who succeeded in banishing these evil spirits from the land would receive in marriage the hand of his daughter. But all means which have been tried have been of no avail, and we must face further famine."

The stranger listened with great eagerness to the words of the guardian of the gate and entreated him to tell him further and with more detail all that had taken place.

He heard that at first the priests and the wise men assembled had tried to dispel the ban by prayers and charms. All these proved of

A Tale From The ARABIAN NIGHTS

Told in a language of another world . . . in another age . . . about a principle that is both universal and ageless . . . as long as there is soil to be nourished and food to be grown on it.

At first, the priests and wise men tried to dispel the ban by prayers and charms.

no avail, and the Kalif and his people were in veritable despair.

At last there came two strangers from the Land of the Setting Sun, each carrying with him a most mysterious sack. They wished to be brought into the presence of the Kalif, and each declared that by means of the content of his inexhaustible sack, the misery could be stayed, and the land be made as rich and happy as in former days.

"What did they call themselves, and what success had they?" cried the newcomer in great excitement.

"Should'st thou know these two strangers, then thou hast reason for deepest compassion. One called himself Phosphorus, and the other, who also had a name strange to our ears, was called Nitrogen. Both of them now languish in prison, because they could not fulfill their promise with deeds.

"The one, Nitrogen, declared that he could make the corn grow so luxuriantly, as no one in the land had previously seen; the other said, 'What use is it to you that the corn grows high, if the ears be empty?' and promised to produce grains of corn as large as hazelnuts.

"The Kalif, in his wisdom, entrusted to each a province in which he should prove the magical virtues of his sack.

"In truth, after a year Nitrogen produced stalks higher than a man, and the grains of corn which Phosphorus produced were as large as hazelnuts. Alas, in the second year, the corn and straw were again small, and in the third year the old misery, famine and pestilence returned.

At last, there came two strangers, each carrying a mysterious sack.

Each stranger declared that the content of his inexhaustible sack would make the land as rich as before.

"Then the Kalif was wroth and had them both thrown into prison, where they led a miserable existence in the company of snakes and poisonous vermin.

"O! lead me to the Kalif," cried the stranger.

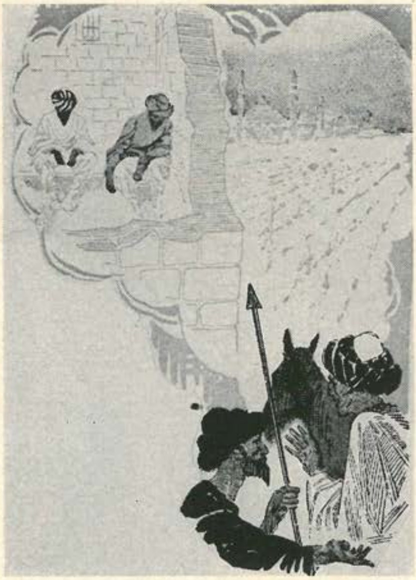
"Unfortunate creature, wilt thou rush headlong to ruin? What would'st thou do?"

But the stranger heeded not the warning; he was brought before the throne of the Kalif, and bending low said, "Ruler of the Faithful, I have heard of the misery that prevails in thy land, and I wish to help thee."

But the Kalif said, "Hast thou also heard of these men, who came from the Land of the Setting Sun, and who now languish within the walls of my prison? They came here with as foolish notions as thou; would'st thou share their fate?

"As Allah ordains!" answered the stranger. "Set both of these men free, and I will, with their help, thy land deliver. These men are no impostors, as thou hast naturally supposed, but they lack prudence. Their selfishness has led them into this misfortune. Should it please your Highness, I will relate to thee their story which is the same as my own:

"There lived once in the distant Land of the Setting Sun a merchant to whom a kind magician had pre-



But, by the second year small corn and straw again and by the third year famine and pestilence.

No impostors, these strangers, only victims of their own selfishness, their young brother explained.

sented a talisman which consisted of three magical sacks whose contents were inexhaustible. He had only to strew a little from each of these three sacks on the land and even the driest sand bore a hundred-fold. As the merchant was at the point of death, he summoned before him his three sons, whom he had named to honour the magician after the three spirits which dwelt in the three sacks.

Handing over to them the talisman, he said, "I bequeath to thee jointly these three sacks. Ye will procure for yourselves riches and honour, if ye hold fast together and never part from one another. The spirit of the sack called *Nitrogen* makes the plants grow quickly; the spirit of the second sack called *Phosphorus* makes the grains large and the ears full; the spirit of the third, *Potash*, gives to the plants health and vigour, it makes the corn nutritious and gives the fruit its good flavour.

"None of these qualities can the plants, which we mortals must cultivate for our daily bread, lack. Woe be the day, when ye quarrel and strive over possession of the sacks and drift apart!

"Only if the three spirits work in unison can the blessing of the good magician, who gave me these three sacks, be obtained. Think over this well!"

The father had bequeathed to his 3 sons the 3 sacks, for future rewards IF they would work in unison.

But the sons soon quarrelled and separated, each taking a sack.

After the merchant had said this, his soul departed. But the sons quarrelled with one another and obeyed not their father's words, so that they went and divided up their inheritance, each taking a sack. The eldest brother took that which obeyed the spirit Nitrogen, the second that which gave the full ears of corn, and the third the sack in which the spirit of Potash dwelt.

That youngest brother am I, O Kalif! Both my brothers then went into the country places amongst the farmers and promised them rich harvests by means of their magical sacks, if they gave them large sums of gold.

The farmers believed them and paid them well. But when I came and told them the magical power of Potash was needed to give the grain vigour and health, they sent me away for they had no more money. But the magical power of the talisman only works when Nitrogen, Phosphorus, and Potash work in unison, and my sack, with the spirit of Potash, they had not.

So the people got no return for the money they had spent—and when my brothers returned again

And—the farmers had already invested their means with the older brothers.

Though the magic of the talisman only fulfills its purpose if the *three sacks are taken together*.

the next year, they were driven away with insults and abuse. Now they have also come to thee, O Follower of the Prophets, and may Allah send his blessings on thee!

"How much less could each brother working alone serve thee, seeing that the magic of the talisman only fulfills its purpose if the three sacks are taken together. But if thou be generous and grant them their freedom so that we can all set to work together, then wilt thou and thy land be prosperous for all time."

Then spoke the Kalif, "If thou has spoken truly, Stranger, thou shalt wed my daughter, but if thou hast lied, then thou must die."

Then he sent his Vizier with the stranger to the prison. And when Potash saw his brothers, he embraced them and said, "My brothers, know ye now that ye have done me a wrong? Why did ye wish to leave me, the youngest, behind? Ye should at any rate have known that without me, Potash, ye could accomplish nothing. I have now come to succor ye. Promise to abide by me with your sacks, and then ye shall be free."

Then they spread the content of each sack, mixed together, upon the fields . . .

. . . and the fields yielded corn, straw, fruits, and grapes in abundance again.

And the brothers agreed willingly and said: "We have seen that we did wrong; we will in the future go hand in hand together."

The brothers then sowed the content of each sack, mixed together upon the fields, which now yielded corn, straw, fruits, and grapes in plenty. From this time onward was famine banished from the kingdom. The Kalif was happy once more and wished to give his daughter as wife to the youngest brother, Potash.

But the latter said, "Ruler of the Faithful, may the God of Mohammed thank thee for thy favour. But we can no longer remain in thy land. Allah wills it that Potash, Phosphorus, and Nitrogen shall perform good works in all lands. Call us at seed time, and we will see to it that thy corn waxes strong and thy fruit trees flourish."

Loaded with gifts the three brothers took their departure, honoured and esteemed by old and young. And whenever seed time arrives, the Kalif sends his messenger to bring back to his kingdom the *three brothers*—Potash, Phosphorus, and Nitrogen.

THE END

ROOT PATTERN INFLUENCED

Extensive studies on the influence of the soil on rooting of alfalfa have been conducted for many years in Nebraska. Nutrient availability has been found to be a major factor influencing the pattern of root development.

Calcium and phosphorus were two nutrients studied. Applications of lime and phosphorus in the plow layer encouraged much more extensive root development to 8 feet or below.

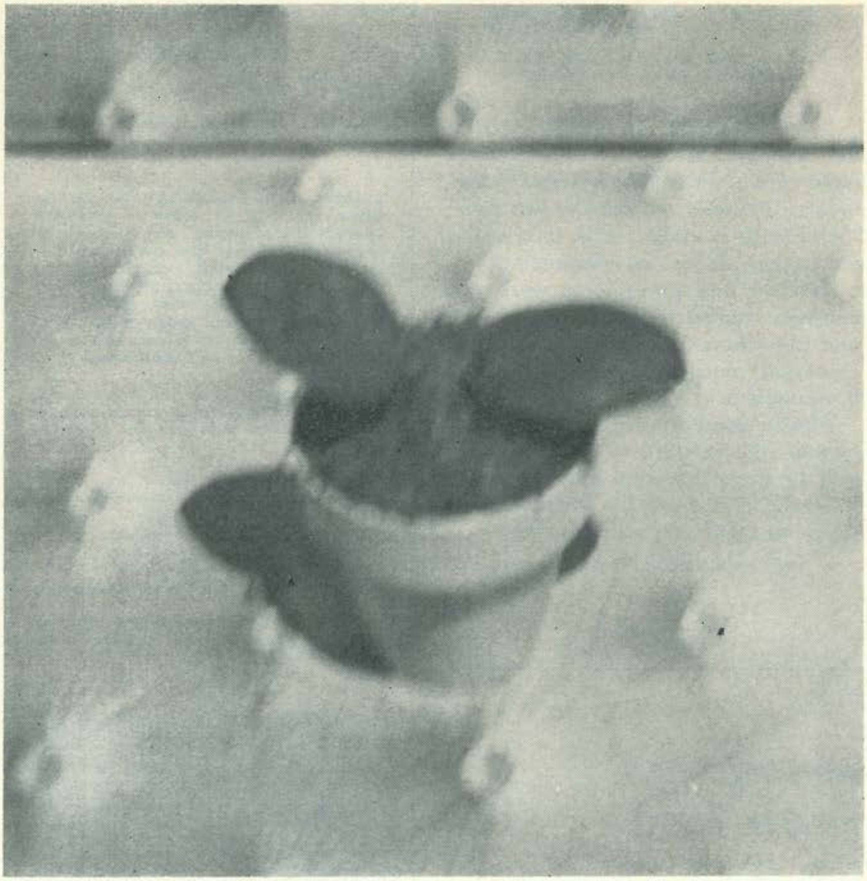
Alfalfa can be justly accused of depleting soil moisture to the disadvantage of crops following it in dry years. However, it can provide feed in years when no other crops can survive.

—*Midwest Potash Newsletter*

WINTERIZE YOUR ALFALFA ROOTS
Page 43

IMPROVE SOIL TEST CALIBRATIONS
Page 33

PROFIT-BUILDING CORN FACTS
Page 4—Easy Order



Without fertilizer . . .

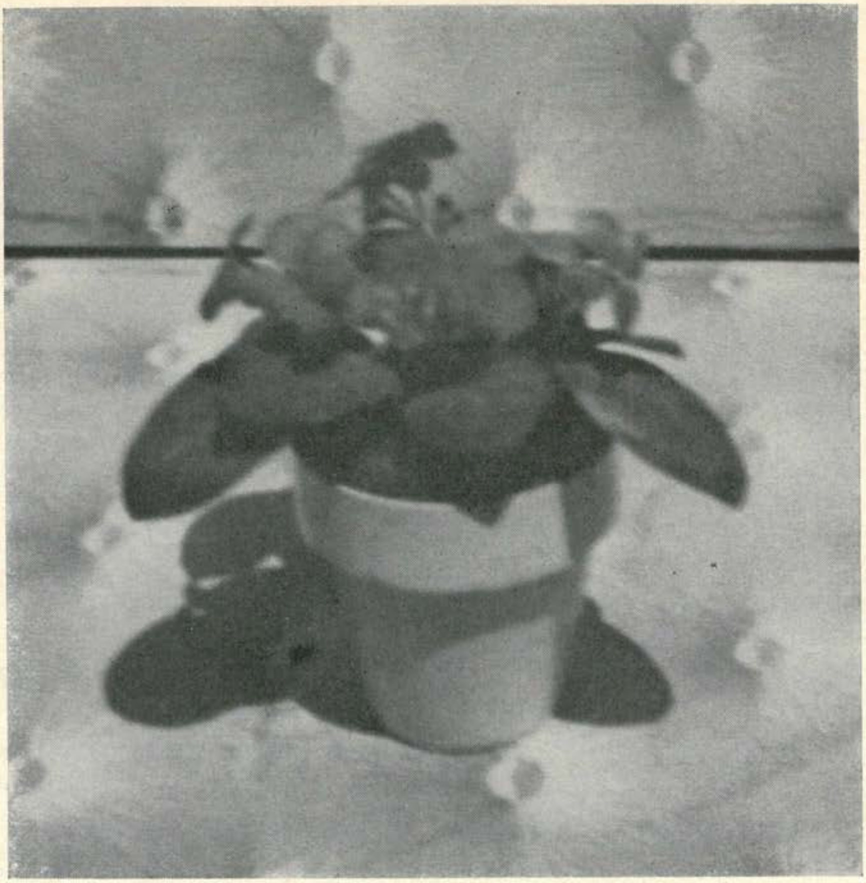
What A DIFFERENCE!

By Ruth K. Stroh
Maryland School Teacher

An accident caused this contrast in African Violets—believe it or not!

Although I had tried African Violet cuttings to root and grow many ways—under different lighting, in all types of soils, even some called "just for violets"—I had been unsuccessful.

But I must admit the importance of plant food did not enter my



and with fertilizer

thinking until I emptied an old bag of fertilizer where some wild violets grew near my garden pond.

How they did flourish! I took notice—probably not unlike the farmer who may notice striking growth at the end of a cornfield where some "empties" were shaken out.

The fertilizer not only caused more blooms, but the plants seemed less fragile, with less falling-of-petals, less stem rot, etc.

I'm no soils scientist with a sophisticated table of correlations to explain what happened.

But it doesn't take a scientist to see what happened from a 4-week diet of plant food on my African violets, when everything else seemed to be in order.

THE END

THROUGH

WORK

EFFICIENCY

FAITH

Editor's Note:

In an age when
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COMPET
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By Erwin J. Benne
Michigan State U

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TITIVE Farming SHOESTRING

niversity

conditions of costs and profit margins,
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e competitive, without heavy capital
of them?"
ncerns many thoughtful people today.
ck, easy answer to it, though Albert
, Alice, near Lansing, Michigan, are
ng it in their own way.
ly—Albert 35, Alice 33, Wayne 9,
6, Kathy 1—own only seven acres of
ome and barns are located, but last
18,000 bushels of corn, 3,000 bushels
shels of oats, 500 market hogs, and
ggs.

OW IT HAPPENED

they started farming on a part-time
r's formidable accomplishment rep-

To Page 26

"What I See Ahead . . ."

. . . as viewed by North Carolina Farmer J. T. Moss, of Youngsville, N.C., a producer of certified hybrid seed corn and purebred polled Hereford cattle, in a talk before an editorial conference of *The Progressive Farmer* magazine.

GREATER pressure than ever is on farmers to come up with top crop yields and livestock production. Costs have gone so high that one major failure can be disastrous.

We are now paying three to four times as much for machinery, labor, buildings, fences, and land as we did 20 years ago. Some other production items—fertilizer, insecticides, custom work, feed, seed, etc. —haven't gone up so rapidly. But per acre costs of growing a crop are up greatly.

Successful farmers have stayed ahead by increasing volume and efficiency. Population has increased fast enough to take up part of the surplus in farm production. Even so, the balance has gradually worked against farmers. While population was increasing 2 to 3% annually, farm productivity was going up 5 to 6% a year. In the future we must look more to world markets to dispose of more of our farm products. Best prospects appear to be in Asia, South America,

To Page 26

COMPETITIVE farming From A SHOESTRING

resents a long step toward future farm ownership.

Their success formula includes (1) honesty, (2) willingness to work hard, (3) courage to try new methods and materials, (4) intelligent management, (5) ability to make full use of available facilities and opportunities, (6) family teamwork, (7) unusual skill and ingenuity in caring for livestock and in operating and maintaining machinery and equipment.

Both Albert and Alice were born and raised on Michigan farms. As children and teenagers, they participated in 4-H Club and other farm youth organizations. Thus, very early in life they became ingrained with a love for growing things and an appreciation for rural living.

A GOOD WIFE—VITAL

After finishing high school and a college short course in agriculture, Albert worked for a number of successful farmers. It was here that he met and married Alice, the eldest daughter of a neighboring farmer.

Almost immediately after their marriage, Albert was called by the government for two years service with the air-borne forces.

For a short time after his release from service, he entered into a partnership with his father-in-law and a brother-in-law. Dairying was their principal activity.

An earlier knee injury made certain parts of this work difficult for Albert. This, combined with a desire to manage his affairs independently, prompted him to leave the partnership.

FROM COW TESTING . . .

After securing a job as tester for a cow-testing association, he and Alice bought what remained of an old farmstead most of which had been diverted to subdivision uses.

The purchase included a century-

"WHAT I SEE AHEAD . . ."

and Africa, and to a lesser extent in European Common Market countries.

I believe the trend in the future will continue toward farm specialization. Crops will be grown in areas and on land where they are best suited. Decision on what to grow must take into account labor, equipment, and manager's ability. There will be more "diversified specialization." By this I mean the finding of crop and livestock enterprises that fit well together. Examples might be broilers and layers and dairy cows, or feeder cattle and hogs, or some cash crop and livestock combination that does not compete too greatly for land and labor.

Each farmer must become more expert in what he does. Output per worker must be increased. This will lead to fewer but more skilled workers. We have cut from six to four men since '49. Larger units of old house, which the Cooks have made homey and livable, a barn, a small poultry house, and seven acres of land.

Albert's days as a cow tester often began as early as 4 a.m. and ended as late as 11 p.m., since he had to be on hand to take samples from each cow when she was being milked.

. . . TO CUSTOM WORK

During the day, Alice helped test the samples for butterfat, keep records, and make reports. This left time for Albert to do some farming of his own on rented land and to do custom work for neighbors.

Purchase of a large tractor and supplementary machines assured his time as operator would be efficiently spent.

Credit for buying this equipment was largely in the form of character loans based on personal integrity and promptness in meeting financial obligations, attributes Albert has maintained and still uses to advantage.

He developed a reputation for getting things done, soon having all the custom work he could do. In the spring he planted hundreds of acres of corn for people who preferred to hire their planting done rather than own and operate their own planter.

USING MIDDLE HOURS . . .

Use of liquid ammonia as a carrier for nitrogen fertilizer had become popular. Albert bought an applicator and tank wagon, applying ammonia to many of the cornfields he had planted for his customers. During harvest time, he used the middle hours of the days for combining his own grain and that of many of his neighbors.

As older farmers in the neighborhood retired, or sold parts of their farms for housing subdivisions, he rented more land and increased his field crop production. Last year he had 300 acres of corn, 90 acres of wheat, and 50 acres of oats.

. . . TO BUILD HIS FUTURE

He does not hesitate to buy new machines if they will increase his

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equipment will be used. There will be specialized machines for each major operation—livestock feeding, tobacco harvesting and curing, peanut combining, vegetable harvesting. All this will call for still higher capital investment. Some of OYF's (Outstanding Young Farmers) I talked with at the national meeting had as much as $1,000 an acre invested in land. There will be an expansion in use of irrigation.

I'm now figuring on two-way radios as a means of communication. In my opinion, these will be tied in with supply stores within next 10 years. If you need a machinery part, for example, you can radio the message in and have the part sent out.

I'm already faced with a need for more skilled, better educated workers. Wage rates will have to be competitive with industry. We now carry accident insurance on our workers. Working from "sun to sun" is a thing of the past—8 to 10 hours is a "day." Any rush job calling for longer hours earns overtime pay. I hope we never have labor

COMPETITIVE Farming From a SHOESTRING

efficiency and make it possible for him to accomplish the maximum in a minimum time. His latest acquisition is a self-propelled combine with interchangeable attachments for harvesting small grains and corn.

The old chicken house was converted into a small farm shop, which after being provided with an electric welder and other metal-working tools, permits Albert to do much of the repair work on his machines.

This not only holds down operating costs, but also saves time that otherwise would be spent going to repair shops and waiting his turn to have work done.

. . . TO ADAPT HIS PLACE

Albert remodeled the basement of his old barn into a farrowing house and the ground floor and loft into a double-deck house for laying hens. He bought a discarded barn from a farm purchased by the State University and used the material in it to construct a two-story laying house large enough for 1,200 hens.

After building up a laying flock of 2,200 birds, and attaining an annual production of about 500 pigs, he gave up his cow testing job, and is now devoting full time to his own farming operations.

In addition to part-time help, the Cooks hire a family man full-time, with use of the house on a nearby rented farm as part of his compensation. Additional buildings on this place include a barn, which shelters hogs being finished for market, and a granary for storing their feed.

Corn grain in Michigan often maintains a high content of moisture far into the winter. To insure safe storage of early-harvested, shelled corn, the Cooks installed a grain dryer on their little farm. Heated with propane gas, this dryer was kept busy last year during the harvest seasons for reducing the moisture contents to safe

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"WHAT I SEE AHEAD . . ."

unions on farms. The best way to avoid farm labor organizations is to provide satisfactory working conditions for our help.

A great deal of farmland is lost to urbanization each year. Up to now, new lands have been brought in to offset that going out of production. Nationally, we are gaining new land by draining swamps, and irrigation in the West. In the future we will need planning boards. It will be their responsibility to determine land best suited to agriculture and where houses, roads, industrial plants can be placed to protect the nation's need for food and fiber.

Farm chemicals have been one of the fabulous developments of the last 10 years. I expect to see a still further increase in use of fertilizers, insecticides, fungicides, herbicides, hormones, and medicated feed. This will raise the cost of production, but reduce chances of failure. Higher analysis fertilizstorage levels of a combined total of about 20,000 bushels of shelled corn, wheat, and oats.

. . . AND TO TOP $40,000 GROSS

Last year the Cook family's gross income exceeded $40,000. Although rent, interest, operational, maintenance, and labor costs absorbed much of this gross, net gains were registered in the form of a happy, well-fed, well-clothed family, a new station wagon, and lowered indebtedness on machinery.

In addition, increased experience in managing a large scale farming operation represented a valuable, intangible return.

BUT NOT ALL WORK

Yet, the Cooks don't work all the time, as they inch their way toward future farm ownership. Albert and Alice participate in a local chapter of their Farm Bureau, and the entire family participates in church activities. Nothing short of an emergency is allowed to interfere with regular church and Sunday school attendance by the whole family.

And each year they manage some sort of trailer-house family vacation.

America has great need for young people like the Cooks. People who are building lives based on clean living, hard work, and faith in each other, in their country, and in God.

THE END

ers will be used. Specialized formulas will be made up to a farmer's specifications. Minor elements will be added where needed. Fertilizer will be moved in bulk and as liquids. The burlap bag will become obsolete.

Government programs of the future are a big question mark. Trying to say what they may be is like trying to predict the winner of the Kentucky Derby in 1973. Most farmers I talk with would like less control. But they want any move in this direction to be gradual. We have had "supply management" so long it would be disastrous to cut it off all at once. Our tobacco program has worked well. Wheat and corn have become "political footballs." Some sort of voluntary land retirement may be the answer.

A reasonable carryover of essential food and fiber products should be maintained by the Government. They are even more necessary in times of disaster, such as drouth and war, than a stockpile of metals.

Pays Even On HIGH Fertility Soils

EVEN where a field yields 100 bushels or more corn without fertilizer, some extra plant food can still put more dollars in the farmer's pocket.

At least, such is the case in some of the Fayette and similar soils of southeastern Minnesota, according to John Grava, supervisor of the University's soil testing laboratory. He reported results of fertilizer trials on three farms—two in Goodhue and one in Wabasha county.

On each of these farms, corn yields went over 100 bushels even where no fertilizer was used. These levels were due to extremely favorable weather, high plant populations (20,000 or more per acre), weed control, liming, and good management.

Yet, fertilizing brought profitable increases per acre in every case. For example, soil on one farm showed, in soil test results, a phosphorus availability level of 58 pounds per acre. This is a very high level. Nevertheless, 80 pounds phosphorus per acre (40 in broadcast treatment, 40 in row application) increased yields another 19 bushels per acre.

Similarly, it paid in each case to add 80 to 120 pounds potassium per acre and 60 to 120 pounds nitrogen per acre, even though these soils showed medium to high potassium levels and release much soil nitrogen for plant growth.

Purpose of these trials, according to Grava, was to gain information which can be used in recommending fertilizer for specific kinds of soil with specific fertility levels. He said that for most farmers, the question of whether to apply fertilizer has long been settled. The main questions, he concluded, are how much and what kind.

The trials were conducted cooperatively by Grava, extension soils specialist Lowell Hanson, farmers, and county agents.

—MINNESOTA EXTENSION NEWS

"WHAT I SEE AHEAD . . ."

An adding machine, typewriter, and filing case should be standard equipment on a farm. Not only are records necessary for tax purposes, but detailed cost accounts are needed for business study. Performance records have done more to upgrade beef production and profit opportunities than any other one thing. We have also come to rely on crop production records. Facts on soil tests are another necessary production "tool."

Farmers can increase their bargaining power by more cooperative selling. But some co-ops have become so big that they may bring on Government restrictions. As proportion of population engaged in farming decreases, joining farm organizations becomes even more desirable.

The farm wife needs conveniences to a greater degree than the city housewife. She has more laundry to do, more food to freeze,

Your "Available" Potash

. . . what determines it?

THE AMOUNT of "plant available" potash in a soil depends not only on the amount of potassium-bearing mineral present, but also on the size of these mineral particles—according to researchers M. L. Jackson and M. H. Milford of the University of Wisconsin.

They said very small clay particles called illite release more potassium to plants than larger particles do, because they have more "edge surfaces."

The potash-bearing mineral particles are thin flake-like structures. Potassium ions in this mineral that are exposed at edges of the "flakes" are more readily available to plants than the ones that lie between the flat surfaces. The smaller the particles, the more edges, and the more potassium exposed.

Other small clay particles also affect potassium availability. Montmorillonite is an example. It does not contain potash within its structure as illite does. But montmorillonite particles have many negatively charged "exchange sites" on their surfaces, which pull the positively charged potassium ions from the soil solution or from other soil particles, and holds them available to plants.

In a survey of several soils in the northern U. S., the researchers found striking differences in exchangeable potassium content among soils of varying particle size.

For example, Wabash silt loam contained 660 pounds of exchangeable potassium per acre, while a Bates silt loam had only 112. These soils contained 19 and 4 per cent respectively of fine clay, which includes illite and montmorillonite. This accounted for the difference in available potash, the researchers said.

—WISCONSIN EXTENSION NEWS

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and fewer services nearby. There is a growing tendency for farm families to live in nearby towns. Farm families are becoming community minded. They are interested in better schools and churches that larger groups can provide.

The family farm, in my opinion, will survive. The owner of land is more interested in its production than anyone else. But the family farm will survive only so long as it is efficient. Sub-marginal operations should not be subsidized just to keep them in business. One reason I do not fear large corporation farming is that investment money has earned higher returns in other lines of business.

Editor's note.—Mr. Moss operates a farm at Youngsville, Franklin County, N. C. He specializes in the production of certified hybrid seed corn and purebred Polled Hereford cattle. The above article was taken from notes he used in making a talk to our Progressive Farmer editorial staff at our spring conference.

THE END

Many Things to Many People

Soil is earth to some, dirt to others . . . a nuisance to mothers, a necessity to farmers.

All people have different impressions when they hear the word soil, says L. P. Pittard, extension soil and water specialist at Texas A&M College.

To the small child, soil is mud pies and fun . . . to his mother it is the material tracked on the carpet, Pittard observes.

To the geologist, soil is the barrier between him and the material he is trying to study . . . and to the construction engineer it is sometimes a bad place to build a home.

To the homeowner, soil is an unmanageable mixture of clay, cement, and stones on which grass will not grow and weeds will not stop, he says.

To the farmer, soil is a precious mixture of mineral and organic matter, air and water on which life depends. **He considers soil the medium through which he earns his living and produces food and fiber for the world—and also believes its wise use is basic to the economy of the nation, explains the specialist.**

Can we use our soils wisely and make them last? This is the great challenge today . . . and the answer may determine whether children have mud pies and farmers have land to farm.

Southwestern Crop & Stock

If soil tests are to be used to make reliable predictions of the crop response to be expected from fertilizer applications on different soils . . .

Improving Soil Test CALIBRATIONS

By J. J. Hanway
Iowa State University

Increasing food production is a major challenge in some parts of the world today, while developing ways to produce it more efficiently is the challenge in other areas.

In both cases, soil testing can play a major role—but improvements are needed to make soil testing more effective in this role.

This report is *not* concerned with the operation of a soil testing service program after reliable testing procedures have been developed. It *is* concerned with research needed to improve various phases of soil testing if soil tests are to be used to make reliable predictions of the crop response to be expected from fertilizer applications on different soils.

Soil testing consists of several separate but interrelated operations. Improvement in one operation without improvement in the others is of limited value. Let's look at the operations and some needs, step by step:

1 IN SOIL SAMPLING . . .

. . . the object is to collect soil samples in a way that each sample represents *one* reasonably uniform portion of the field.

Soils in the field vary in both the *vertical* and *horizontal* directions, so restricting a sample to a uniform portion of the soil is not always easy.

In plowed fields, the plow layer represents a reasonably uniform segment in the *vertical* plane. In unplowed fields, the surface inch or two of soil is usually much different from the soil below.

Subsoils vary from very acid to calcareous and from very low to very high in available phosphorus. Subsoils are usually low in available nitrogen and potassium. Such variations can usually be associated with soil type. Studies are needed to characterize nutrient availability in the subsoils of different soil types and to evaluate the effectiveness of subsoil nutrients for different crops.

In the horizontal plane, nutrient availability usually varies between soil types. However, there is often much variation within a soil type, especially in the surface soil. Such variation may be very difficult to distinguish in the field.

A sample can sometimes be restricted to a uniform area by considering (1) *known differences in past management and treatments* (such as distance from barnyard, differences in fertilizer applications, etc.) and (2) *known differences in crop growth and development.*

However, the causes of variation in a field are often unknown. Studies are needed to characterize the variability that exists in different soil areas so the most appropriate method of sampling can be employed for each individual field.

2 IN PREPARING THE SOIL SAMPLE . . .

. . . the object is to obtain for each laboratory test a small subsample that represents the soil that was sampled in the field.

The laboratory test can only characterize nutrient availability in the sample that is tested.

Changes in nutrient availability in the soil samples have resulted from *drying, crushing and/or storing the soil samples prior to the analysis.* For example, drying the soil may increase the level of available K by as much as ten-fold.

The story of SOIL:

Condensed from Missouri Ruralist

Soil fertility is becoming more of a major concern than ever.

We are recognizing the need for building up fertility of our soils to realize higher yields necessary to provide margin of profit for a comfortable living.

Yet, just how much de we know about our soil? The story of soil is one of great interest and very vital to all of us. Soil is a living thing, not just something we plow, fertilize, plant and work. All life as we know it, plant or animal, depends on the soil.

Soil is made up of very small particles of minerals that have been

So, where these changes occur, methods must be devised to test undried, uncrushed soil samples as soon as possible after they are collected from the field. This has been a sadly neglected area of research.

3 IN LABORATORY ANALYSES . . .

. . . the object is to obtain an estimate, or a relative estimate, of the nutrients available to plants *in the sample being tested.*

In the past, soil test improvements usually referred to the development of new and better laboratory tests. There was no need to develop the other phases of testing until adequate tests were available. But now many testing methods are available for the major fertilizer nutrients. The main problem is to be sure the method used is best for *the soil being tested* and *the information desired.*

Selecting the test to fit the soil: Pot experiments in the greenhouse are valuable in selecting proper analysis method to be used for any particular group of soils. But if greenhouse data are used to evaluate and compare different lab tests for nutrient availability, certain requirements must be met to make the estimation of nutrient availability to greenhouse plants as accurate as possible:

1 The soil samples must be treated the same before testing in the greenhouse as they are before testing in the laboratory.

2 The soil samples must not be dried or stored for any appreciable time before testing in the greenhouse or laboratory.

3 Nothing should be added to the soil sample before testing in the laboratory or greenhouse or during the greenhouse test that might influence nutrient availability in the soil.

4 Adequate amounts of nutrients other than the one in question must be supplied to the plants so deficiencies of these other nutrients do not influence the estimate on the critical nutrient.

. . . vital to us all

Via *Farmer's Digest*

broken down from rocks. These particles vary from the size of a pinhead to pieces so fine they cannot be seen without a microscope.

These particles form granules or crumbs that might vary from the size of a grain of wheat to the size of a pea. These granules are important as they help determine the tilth or working condition of the soil.

There also are small openings between these granules that permit air and water to penetrate the soil. Coarser soil particles are covered with a finer material of a black, sticky substance known as humus or organic matter.

5 The plants must be grown on the soils long enough (but with intermediate harvests) to permit a proper and adequate evaluation of the nutrient availability in the soil by the plants.

6 The soil samples should be analyzed in the laboratory by all appropriate methods so the best method can be selected.

These requirements have seldom, if ever, been met in the research studies that have been conducted. Many of the poor relationships obtained between laboratory and greenhouse results have probably been due to errors in the greenhouse evaluation of nutrient availability rather than in the chemical test in the laboratory.

Selecting the test to give the desired information: What laboratory method you use for analyzing any group of soil samples should be based on the information desired as well as the type of soil being tested. Economic considerations both in the field and in the laboratory can influence this choice.

In some cases, it is sufficient merely to learn whether the nutrient in question is inadequate, adequate, or excessive for desired plant growth. In practice, this applies to either high value crops or low cost treatments where fertilizer cost or other treatment is very low in relation to crop value. Many horticultural crops are the high value type. Low fertilizer costs may result from either small need (minor nutrients) or low prices for material (lime in many areas). In these cases, extreme precision with laboratory tests is not necessary because results don't require precision interpretation.

When the degree of nutrient deficiency is needed for selecting proper or economically practical treatment, different kinds of tests may be necessary, demanding more precise laboratory analyses. In practice, this applies to major fertilizer nutrients for most agronomic crops.

International studies should be conducted, using soils from all over

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THE STORY OF SOIL . . .

Then there are all kinds of organisms to be found in the soil—molds, fungi, roots, stems, worms and bugs. All are important, one to the other, in helping make our soils of greater value to us.

These particles of mineral in our soils are the result of many years of weathering by freezing and thawing, wind, rain and sun. These minerals, together with humus, make up the soil as we know it. This is the mineral that must contain the plant food necessary to grow the crops that will mean life to livestock and people.

These plant foods must be available if we are to grow healthy plants. We cannot expect our crops to produce high yields if we do not feed them properly.

The plant might be considered an outdoor chemical factory using plant foods, water and sunshine in the proper relationship to produce grain and forage that will in turn the world to determine the best laboratory tests suited for different soil types and for different cropping and management systems. Once the best method has been determined for a given group of soils and for cropping and management practices to be followed, scientists can then concentrate on other needs, knowing the lab methods are satisfactory for the samples they are testing.

4 IN CORRELATING LAB TEST RESULTS WITH CROP FIELD RESPONSES . . .

. . . the object is to develop relationships through which one can predict with good precision the crop response expected from fertilizer applications in the field.

The only satisfactory method of developing such relationships is to (1) conduct field fertilizer experiments on soils of the type to be tested, (2) test samples of the soil from these experimental sites, (3) develop the desired relationships between the laboratory test results and the crop response obtained in the field from the fertilizer applications.

Types of relationships: As in selecting proper laboratory method, two basic types of relationships are needed between field and laboratory results, based largely on economic considerations in the field—for example, the value of crop response in relation to fertilizer cost. In the first type of correlation, where the value of crop response is high in relation to fertilizer costs, we need only determine the "critical level"—whether the nutrient is inadequate, adequate or toxic. In the second type, where the value of crop response is not so high in relation to fertilizer costs, we need to determine the degree of nutrient deficiency and the amount of crop response to be expected from different fertilizer rates. This second type of correlation requires more supplementary information from the field than the first type.

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produce bread, meat, milk, vegetables and fruit. There are many plant foods necessary for plant growth—carbon, oxygen, hydrogen, nitrogen, magnesium, sulfur, manganese, boron, copper and zinc.

MORE THAN 100 ELEMENTS

These plant foods are known as elements. There are more than 100 known elements. An element is the simplest form of matter, but our plants cannot use these elements in the pure form. Therefore, we must supply these elements to the plant by way of the soil as compounds contained in our commercial mixed goods fertilizer.

Some of these plant foods are supplied direct from the air but the majority are obtained from the soil. The plant takes carbon dioxide from the air and through a process known as photosynthesis, the carbon and oxygen are utilized by the plant for growth and development.

Of the plant foods to be obtained from the soil, nitrogen, phosphorus and potassium are the 3 of greatest concern. These are the

With the complex system of many variable factors in agriculture, it is not simple to predict what will happen when we vary one factor (for example, the amount of a given nutrient applied.)

Field experimental methods: Two basic methods can be used to develop desired relationships in field experiments:

1 Study applications of *one* fertilizer nutrient at a time, holding constant (or nearly constant) all other factors that may influence crop response to that nutrient. Relationships developed from such experiments apply to *only* the one set of conditions sampled. A different relationship must be developed for each different set of conditions in the field. This method requires a large number of relatively simple field experiments.

2 Consider and quantitatively evaluate in each field experiment *all factors* that influence crop response to applied nutrients and then develop one over-all relationship that considers the effects and interactions of all these factors on crop response. This requires fewer field experiments, *but all the different factors that influence crop response must be evaluated quantitatively in each experiment.*

The most practical approach at this time probably lies somewhere between these two extremes. But, in conducting field experiments, you should try to use the best known technology. Factors other than soil tests of the surface soil to be considered and quantitatively evaluated are:

1 Soil factors—Nutrient availability in the subsoil
—Physical properties of the soil
—Chemical characteristics of the soil that influence the availability of added fertilizer nutrients.

2 Plant factors—Because of differences between crops, some of which are very difficult to evaluate quantitatively, it will probably be necessary to develop

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THE STORY OF SOIL . . .

same 3 that make up the 3 numbers on the analysis tag of a bag of fertilizer.

The first, nitrogen, is the plant food needed to produce the protein of the plant, that livestock need to grow and produce muscle-building tissue. Nitrogen gives the dark-green color to the plant.

Phosphorus is needed by the plant for production of seed and grain.

Potassium is used to produce sugar and starch and strength of straw or stem.

Calcium is used for proteins in legumes and to neutralize the soil.

Magnesium is related to calcium.

The minor elements—manganese, boron, iron, zinc, copper, iodine and cobalt—also are important to the growth and development of the plant. It takes all of these in proper balance to get the

individual relationships for each crop. However, we can develop better relationships for each crop if we have a better understanding of the plants we are fertilizing—how they develop, how and when they take up nutrients, and how different nutrients influence their growth and development. Different varieties of any given crop may respond differently and these differences should be studied more extensively.

3 Environmental factors—Moisture conditions throughout the season.
—Temperature conditions throughout the season.

4 Management factors—Previous cropping practices
—Residual fertilizer effects
—Previous and present methods of fertilization
—Plant population
—Weed, insect, and disease control

Including all factors in one equation is not a simple matter. But, we now have electronic computers that can perform the necessary computations for these complex equations. And progress is being made in developing different types of equations for expressing such relationships. The principle problem is lack of adequate field data. These data are essential if we are to develop the desired relationships for different soils, crops, etc.

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job done, and it takes a large amount of them to produce a high-yielding crop.

For instance, for a 100-bushel crop of corn it takes 5 million pounds of water—equivalent to 21 inches of water covering one acre of land. It takes 6,800 pounds of oxygen—equal to sixty-eight 100-pound cylinders. It takes 5,200 pounds of carbon—equal to the amount of carbon to be found in 4 tons of coal. All in all it requires 5,016,858 pounds of raw materials to produce 100 bushels of corn, about 1,000 times the weight of the corn itself.

All of these nutrients can be and are being lost from the soil annually in large amounts. They are removed from the soil by the crops, from livestock feeding on these crops and being sold from the farm, they are lost by leaching and erosion. Therefore, one is constantly faced with the problem of putting these nutrients back in the soil to main-

5 WHEN INTERPRETING FARMER NEEDS . . .

. . . remember each farm and each farmer is an individual. The best kind and amount of fertilizer and the most appropriate time and method of application varies with the individual farm and farmer, depending upon many factors.

In addition to soil and crop characteristics, one should consider the resources (labor, capital, etc.) and abilities of the individual farmer and other possible methods of investing his resources in determining the best fertilization practices on his farm. Methods are needed to integrate all these factors so the recommendation fits the individual.

CONCLUSIONS

The primary needs are *not* for new and better laboratory tests, but for: (1) Better samples to be tested, (2) use of proper testing method for the soils and the farming practices in a given area, (3) more adequate field experimental data for development of desired relationships, and (4) better methods of integrating many factors so the recommendation fits the individual farm and farmer.

THE END

THE STORY OF SOIL . . .

tain a soil fertility level necessary to get the yield desired.

These nutrients can be resupplied to the soil by use of commercial mixed fertilizers. Therefore it is important that we know what is in the bag of fertilizer.

As already noted, the 3 numbers on the analysis tag indicate the percentage composition of the 3 nutrients—nitrogen, phosphorus and potash; 4-12-4 on the tag would indicate the bag contained 4 per cent nitrogen, 12 per cent available phosphoric acid, and 4 per cent soluble potash or 20 pounds of guaranteed plant food per 100 pounds.

The question naturally comes up as to what makes the remaining 80 pounds in 100 pounds of 4-12-4 fertilizer. We cannot use pure nitrogen, phosphorus or potassium on our crops. Pure nitrogen is a gas. Pure phosphorus is a yellow waxlike substance that must be

Split Boot SPLITS Profits

MODERN fertilizer and out-dated application equipment don't make a very happy couple.

The once-popular "splitboot" fertilizing attachment on corn and soybean planters can cut corn yields by as much as 20 bushels per acre—compared to a band placement device that puts fertilizer about 2 inches below and 2 inches to one side of the seed.

The splitboot attachment puts seed and fertilizer either together or next to each other—so close either way that fertilizer injury may occur.

These findings come from recent studies by Paul Burson, soils researcher at the University of Minnesota. He compared both kinds of applicators using different kinds of fertilizer on corn and soybeans.

In a trial at the Rosemount Agricultural Experiment station, straight diammonium phosphate (18-46-0 in analysis) seriously damaged corn germination when applied through a splitboot. With a band applicator, there was no damage.

As an example: Where Burson applied 200 pounds per acre using a splitboot, 8,700 plants grew per acre. With the band attachment, plant count was about 17,000 per acre. About 18,000 kernels had been planted in each case; a mortality of about 10 or 15 percent is normal regardless of fertilizer use.

Burson repeated the trials with other fertilizers. Corn yields following 40 pounds of potash starter applied with a splitboot were down about 3 bushels from the no-fertilizer plots, compared with a 14.5 bushel increase where the band applicator was used.

When Burson averaged across all fertilizers, he found that yields following band application were about 20 bushels per acre above those involving the splitboot. He found that both nitrogen and potash injure germination when high amounts come in direct contact with the seed. Phosphorus is less harmful, but the splitboot still limits the amount that may be applied.

Minnesota News

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kept under water to keep it from bursting into flame. Pure potassium must be kept under oil to keep it from reacting with the air or moisture. Therefore, these elements become useful plant foods only when combined with other elements to form compounds suitable for use in fertilizers.

Besides the 20 per cent plant foods indicated on the tag there also is 30 to 40 per cent additional plant food in the form of secondary and minor elements. Dolomite limestone is used as a conditioner to make the fertilizer non-acid forming and to supply additional amounts of calcium and magnesium. These agents also keep the fertilizer in good drilling and working condition to flow evenly in the drill.

It takes all these factors working together to get the higher yields. If we look to our soil and build up the fertility necessary for our crops, making sure they are being fed sufficient amounts of complete plant foods, we will realize the satisfaction of high yields and returns for our time and money.

THE END

By V. A. Bandel and C. B. Kresge
University of Maryland

FIGURE 1 This young alfalfa root not getting sufficient K shows vascular bundles concentrated in root center.

POTASSIUM WINTERIZES your ALFALFA ROOTS

Only recently have we learned how potassium increases winter hardiness and disease resistance by increasing the level of electrolytes in the root cells and by altering the size and distribution of the root xylem vessels.

ELECTROLYTE LEVEL IN ROOTS

When potassium increases the electrolyte level in the root cells, the effect is similar to placing antifreeze in your automobile radiator. The more concentrated the electrolytes are in the radiator, the less likely the solution is to freeze and cause the radiator to rupture.

The same principle applies to alfalfa plants—the more electrolytes present in the root cells, the greater the ability of the plant to withstand severe winter conditions.

ROOT ANATOMY

Potassium may increase the winter hardiness of alfalfa through its influence on root anatomy. In microscopic studies of alfalfa roots, the root cells of plants receiving inadequate potassium showed *smaller xylem vessels* than plants receiving high potassium levels.

(Xylem vessels are tubes that

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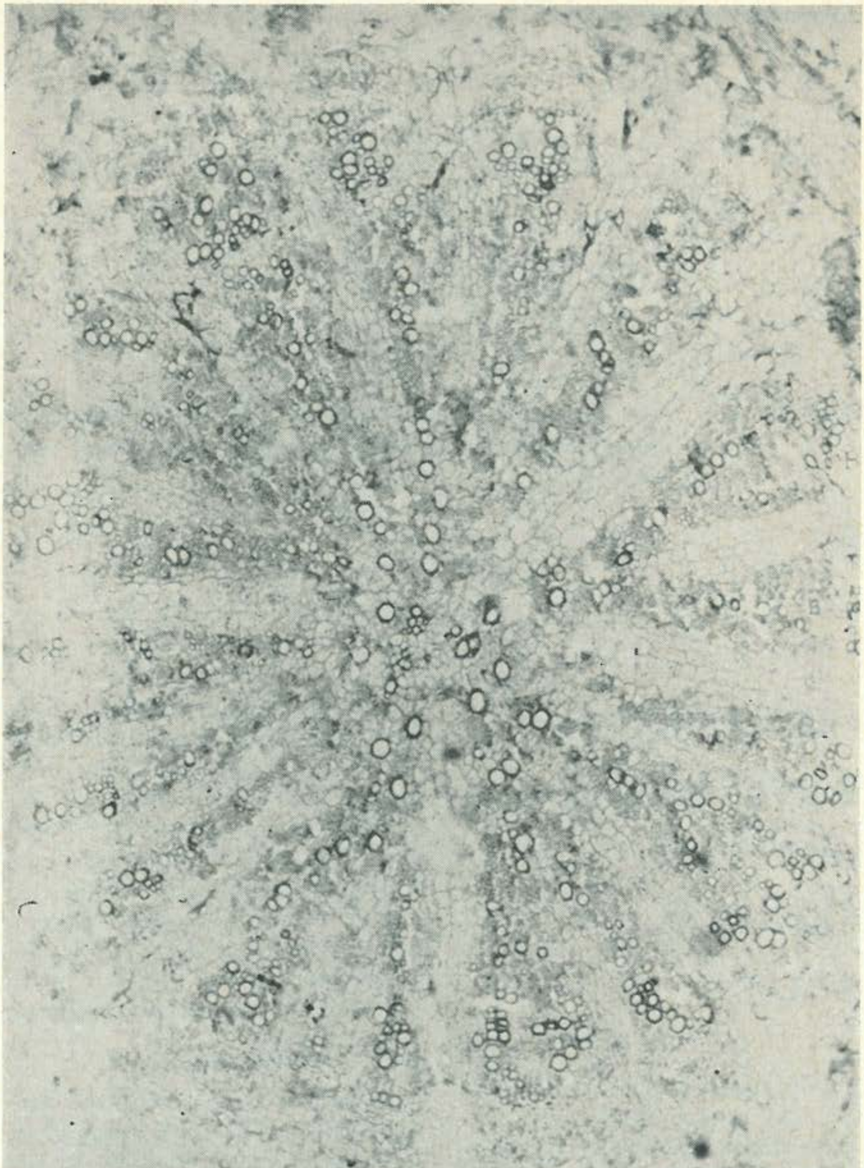


FIGURE 2 When adding 200 pounds of K per acre, large, evenly distributed xylem vessels develop. Such K increases winter hardiness.

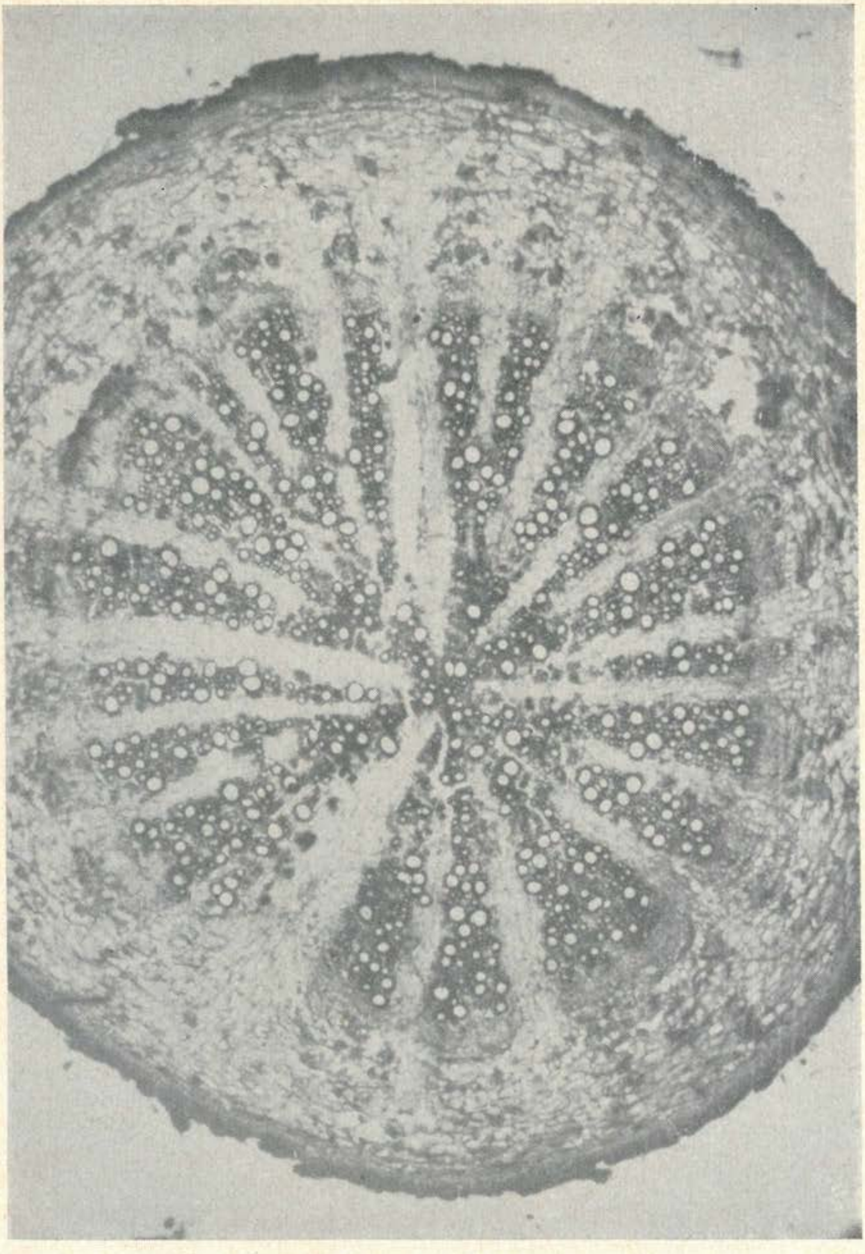


FIGURE 3 This root of K-deficient alfalfa from 6-year-old stand contains distinct growth rings with many small xylem vessels.

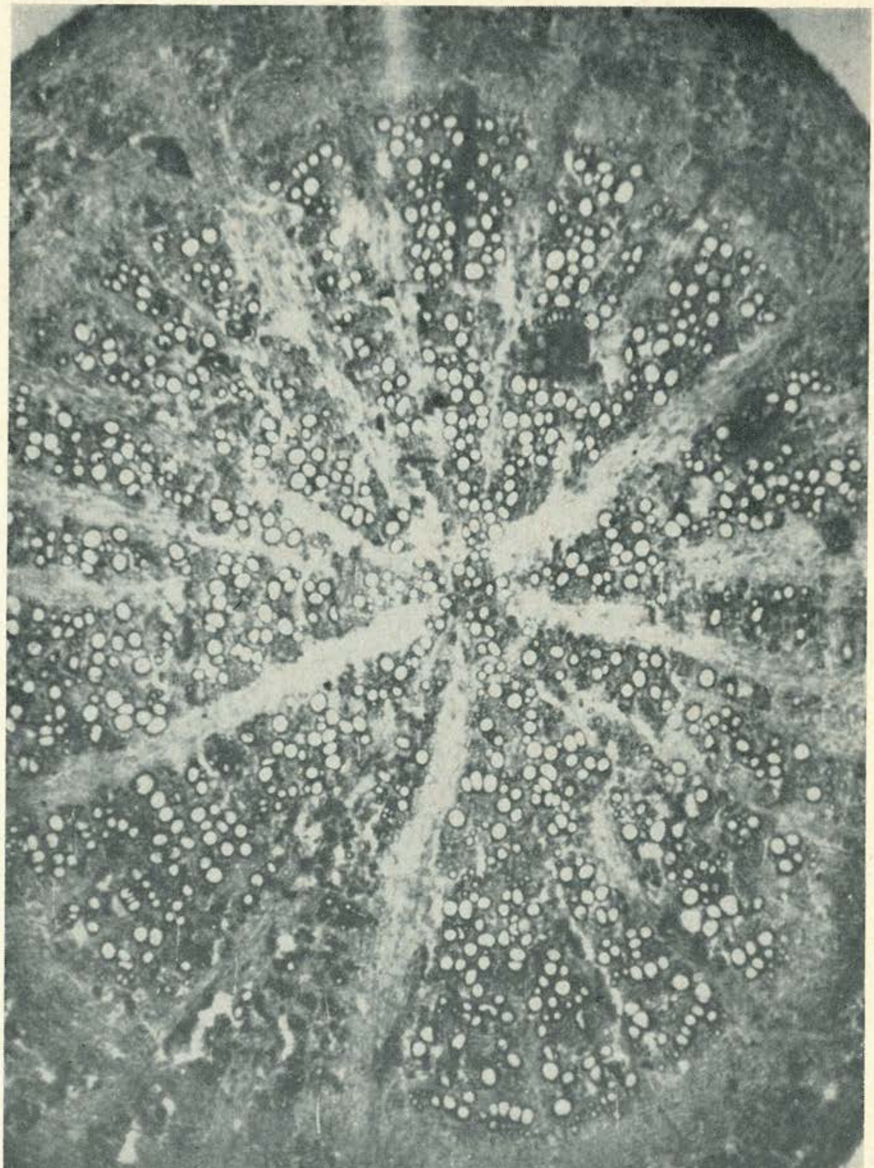


FIGURE 4 All root xylem vessels are large in alfalfa receiving 225 pounds of K per acre, as shown here.

conduct raw materials from the roots to the leaves before they are converted to plant food.)

In some young alfalfa plants grown in the greenhouse, the xylem vessels in the potassium deficient plants were clustered close together in the center of the root, as shown in Figure 1.

Roots that had received sufficient potassium had larger, more uniformly distributed xylem cells, as shown in Figure 2.

Apparently, potassium not only increases the electrolyte level in alfalfa roots, but also permits a larger volume of electrolytes to be transported to the root cells.

Roots that had undergone freezing conditions showed more disruption of the parenchymatous tissues in those roots receiving insufficient potassium than in those receiving sufficient potassium.

Alfalfa plants from a 6-year-old stand exhibited similar differences from potassium treatments. For example, roots receiving yearly applications of 0 or 80 pounds potassium per acre exhibited distinct annual growth rings with many small xylem vessels, as shown in Figure 3.

But, in plants receiving 225 pounds potassium per acre per year, no distinction could be made between xylem cells formed in the spring and those formed later in the season. All of the xylem cells were large, permitting increased electrolyte distribution and greater winter hardiness, as shown in Figure 4.

DISEASE RESISTANCE

Increased xylem size also helps explain why plants not deficient in potassium have a higher disease resistance than potassium-deficient plants.

Bacterial wilt and root knot nematode are vascular disorders caused by organisms entering and constricting the xylem vessels.

So, the flow of electrolytes and other raw materials could be greatly restricted if the vascular system became clogged from these organisms.

But when sufficient potassium is present, the resulting xylem vessels are more difficult to clog or constrict and the flow of materials through the plant is not greatly restricted.

SUMMARY

Evidence indicates potassium can cause a change in the anatomy of alfalfa roots. The presence of high potassium levels in roots results in:

1 Larger xylem vessels and less distinctive growth rings.

2 Better distribution of the vascular bundles throughout the root.

From these anatomical changes, there can occur better electrolyte distribution throughout the root which results in:

1 Increased winter hardiness.

2 Increased disease resistance.

Through continuing research, we hope the exact role of potassium in plants can be more fully understood. This would lead to more efficient use of potassium and other fertilizers on alfalfa.

THE END

NITROGEN-POTASSIUM TEAMWORK

On Forage Composition

A Special Editorial Explanation:

Widespread interest has been expressed toward an article appearing in the May-June, 1963, issue of this magazine: "Nitrogen-Potassium Teamwork On Forage Composition," by Dr. M. R. Teel, Research Director of the American Farm Research Association in West Lafayette, Indiana.

Due to this extensive interest, the editor hastens to make this special reference to an editorial oversight. In identifying the article written by Dr. Teel, *Better Crops* inadvertently omitted the fact that the work was conducted through the facilities of Purdue University while Dr. Teel was a member of the staff of that University's Department of Agronomy. This explanation is made for anyone desiring to know where this significant work was performed.

sm.—editor

ALFALFA requires less water per ton with increasing fertilization, Arizona research shows.

Over a 4-year period, alfalfa receiving 400 lbs. P_2O_5 required 8.4 inches water per ton contrasted with 14.2 inches per ton for the alfalfa receiving 100 lbs. P_2O_5.

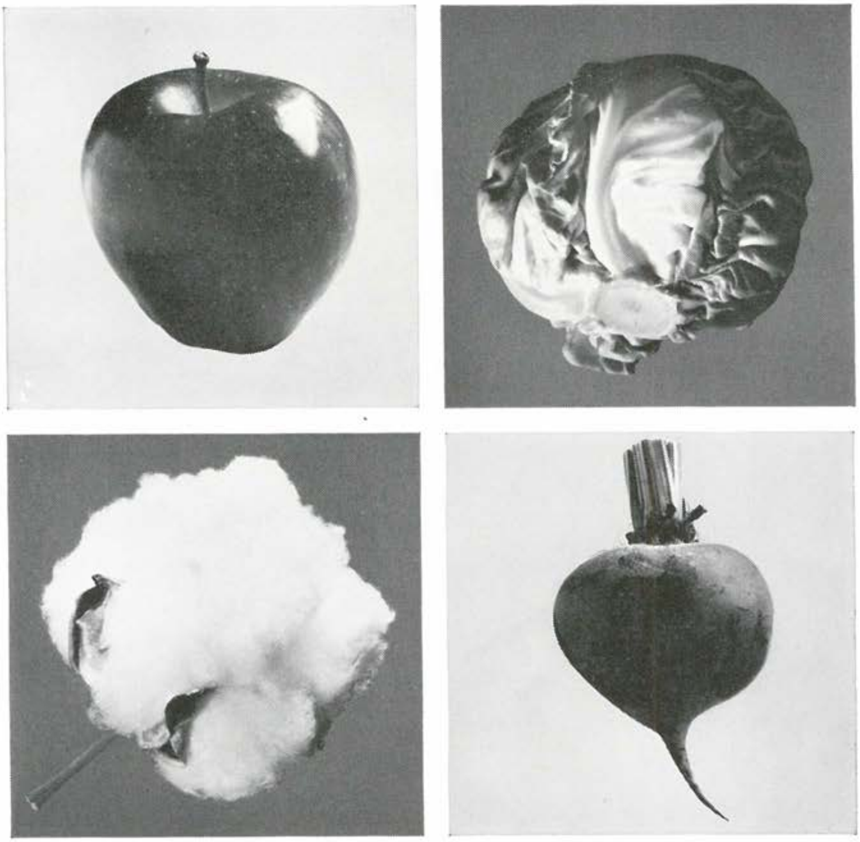
Such higher water efficiency, accompanied by increased acre yields from sound fertilization practices, builds profits per acre. Heavier fertilization more than tripled profits, shown here.

WATER DEMANDS DOWN . . . PROFITS UP . . . VIA ALFALFA FERTILIZATION

Fertilizer Treatment Lbs. P_2O_5/A	Yield Tons/A*	Water Use Inches/T	Additional Net Income Dollar/A*
100	7.3	14.2	——
200	8.1	11.4	13.25
300	9.7	9.0	42.00
400	9.8	8.4	40.00

* Average Annual Yield and Dollar Return.

Adapted from CFA Handbook



WINTERIZE your alfalfa roots with POTASSIUM

By V. A. Bandel and C. B. Kresge
University of Maryland

Have you ever stopped to wonder why potassium fertilization results in higher yields and longer life of alfalfa stands?

Research has shown that potassium increases winter hardiness and disease resistance.

But how?

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Better Crops
WITH PLANT FOOD

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