Better Crops

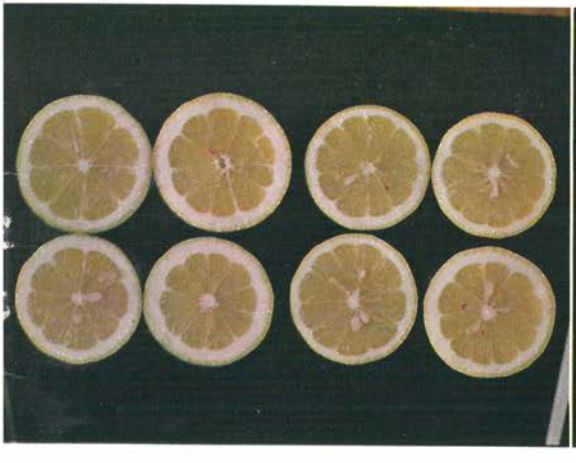
WITH PLANT FOOD

July-August, 1964

20 Cents

−K

+K



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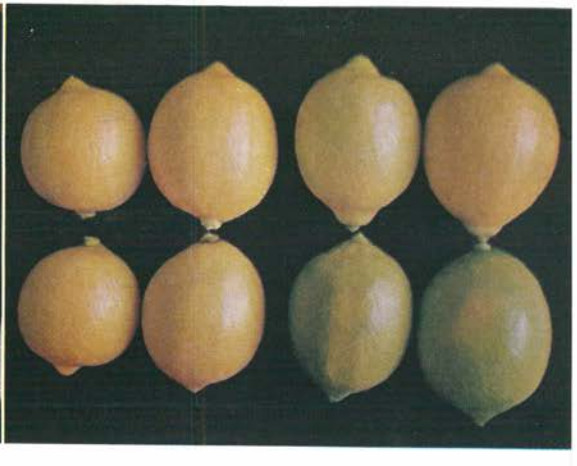

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POTASSIUM (K) HUNGER SHOWING UP ON LEMONS: PAGE 2

Better Crops
WITH PLANT FOOD

The Whole Truth—Not Selected Truth
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CONTENTS

. . . . potash deficiency of lemons is reported for the first time from California. The deficiency shows up as bronzing and abaxial curling of leaves and premature yellowing of fruit. See the report starting on page 2.

SYMPTOMS TO WATCH FOR

Potash HUNGER In Lemons

BY
T. W. EMBLETON
W. W. JONES
A. L. PAGE

University
of
California

Citrus Research Center

Riverside

Potassium (K) deficiency has shown up on lemons in two widely separated areas of California—a state where K hunger of citrus in the field has not been recognized before, though K applications have increased fruit size of oranges in some cases.

Let's look at signs of K hunger on lemons and some methods for correcting this deficiency:

The symptoms have been observed (1) near San Diego on Lisbon lemon on Cleopatra mandarin rootstock and (2) near Santa Barbara on old-line Eureka lemon on Sweet orange rootstock.

In the Lisbon experiment, three sprays of potassium nitrate (KNO_3) per year at 30 lbs. per 100 gallons of spray solution practically eliminated the visible symptoms of the deficiency in about one year.

In the Eureka experiment, 20 lbs. of potassium sulfate per tree broadcast under the trees in two successive years markedly reduced visible symptoms of deficiency in about two and a half years.

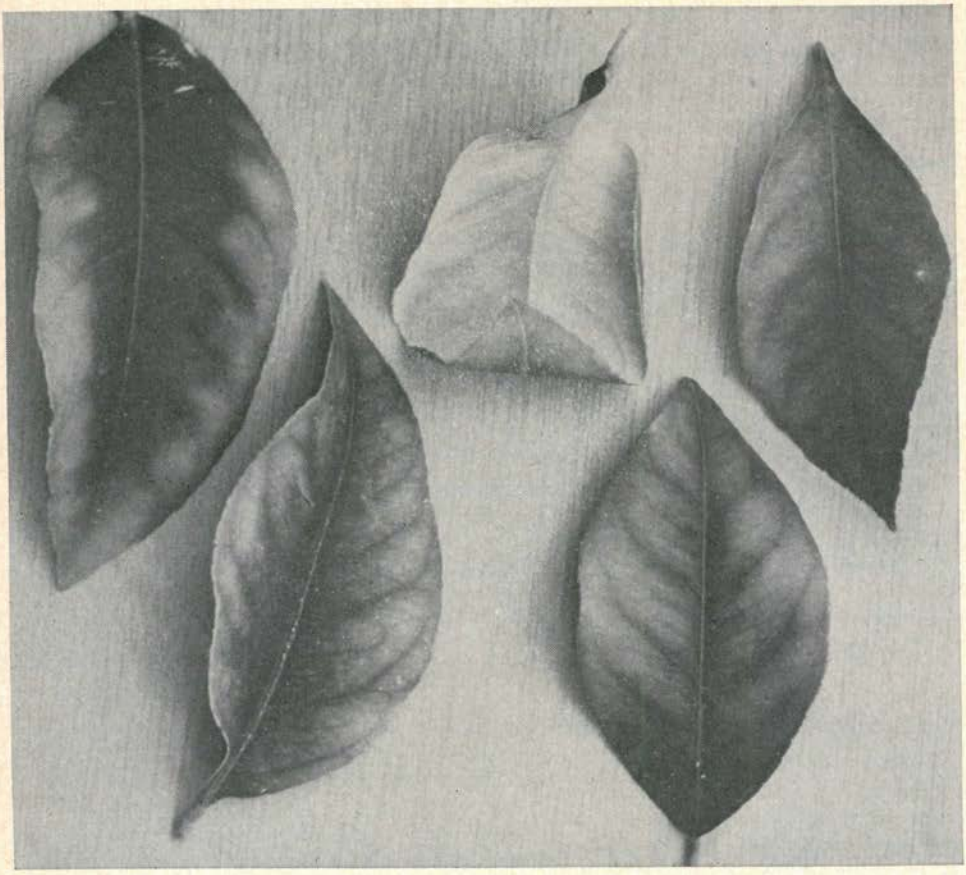
FOLIAGE SYMPTOMS OF K HUNGER

Foliage symptoms of the deficiency on lemon resemble those reported on grapefruit in Florida by P. F. Smith and G. K. Rasmussen.

The symptoms develop predominantly on the older leaves. Numerous yellow to yellow-bronze patterns appear, and gradually the whole leaf may become a yellow-bronze color (see front cover and page 3).

The affected leaves may curl toward the lower surface. Leaves from healthy trees tend to curl but not as much as those on K-deficient trees. Affected leaves drop prematurely. Where many leaves on a shoot are affected, new growth may not develop and dieback results.

In some ways, the foliage deficiency symptoms resemble those of excess salts, particularly of boron and sulfur. This probably explains why K-hunger was not detected sooner in California. The low-K condition in the two orchards where experiments are being conducted was detected by **leaf analysis.**



K HUNGER SHOWS mostly on older leaves . . . first by many yellow and yellow-bronze patterns . . . with the whole leaf gradually becoming yellow-bronze . . . and sometimes curling toward the lower surface.

FOLIAGE SIGNS

TABLE 1. POTASSIUM AND CALCIUM IN LEAVES FROM K TREATED AND UNTREATED TREES[1]

Treatment	6/62	11/62	1/63	4/63
	K, per cent in dry leaves			
−K	0.82	0.45	0.39	0.35[2]
+K[3]	**0.93**	**0.54**	**0.50**	**0.38**
Significance[4]	**	**	**	**
	Ca, per cent in dry leaves			
−K	2.45	4.74	4.85	5.47
+K[3]	**2.18**	**4.24**	**4.35**	**5.00**
Significance[4]	**	**	**	**

[1] Green, terminal leaves from nonfruiting shoots were sampled on each date.

[2] Chlorotic leaves of the same calendar age as the green leaves contained 0.20% K and 6.35% Ca.

[3] Sprayed with 30 lb of KNO_3 per 100 gal of spray in April, June, and November, 1962. Leaf samples were obtained just prior to spraying in June and November, 1962.

[4] ** = significant at the 1% level.

FRUIT SYMPTOMS OF K HUNGER

Lemons, for the fresh market, are picked on the basis of size and color. Large fruit, green to light green, are the most desirable. On K-deficient lemon trees, many of the fruits turn yellow in color before they are large enough to harvest. The fruit has a smooth-textured peel and is frequently more round in shape. Preharvest drop also occurs.

LEAF ANALYSIS

Leaf analyses from the Lisbon experiment are shown in Table 1.

In this area, lemons are flushing and fruiting more or less throughout the year. But the *major growth flush* occurred in March. An effort was made to obtain leaves from this flush on all four sampling dates.

The calcium (Ca) concentration in the leaf offers a reasonably good guide to the age of the leaf. The percentage of Ca in the leaves *increased* on each successive sampling date, indicating the leaves were older on each successive sampling date.

The K concentrations in the leaves also *decreased* as the leaves became older and there was a higher concentration of K in the treated trees on all dates.

However, the greatest difference from treatment occurred in January: −K, 0.39; +K, 0.50. The difference in K concentration in the old leaves sampled in April was very small: −K, 0.35; +K, 0.38.

Foliage symptoms on the untreated trees became most apparent in February and March and persisted through the following summer. There were some foliage symptoms of the deficiency on the treated trees but to a considerably less degree than on the untreated trees.

FRUIT ANALYSIS

Table 2 shows that K treatment increased the K content in the peel and juice and delayed the development of yellow color on the fruit.

TABLE 2. SOME EFFECTS OF K TREATMENT ON FRUIT, MAY, 1963

Treatment	Fruit color rating[1]	Ratio length/ width of fruit[2]	Percent acid by weight in juice[2]	Pounds acid per ton fresh fruit[2]	Percent K in peel[2]	Mg K per 100 ml juice[2]
−K	1.72	1.30	6.40	47.3	0.51	137
+K	**1.88**	**1.34**	**6.88**	**53.7**	**0.70**	**162**
Significance[3]	**	*	**	**	**	**

[1] Mean rating of 50 fruits per tree when each fruit was placed into one of three of the following classifications: 1 = completely yellow, 3 = completely green, and 2 = intermediate.

[2] Means from 20 fruits per tree with equatorial diameter of 47 ± 2 mm.

[3] * = significant at the 5% level.
** = significant at the 1% level.

This delay in yellow color development increases the proportion of fruit that goes into the fresh marketing channels. More elongated fruits were associated with the K treatment as indicated by the ratio of length/width.

The greatest effect of K treatment was on the pounds of acid per ton of fresh fruit—large enough to be very important for fruit that goes into processing channels.

The response in the two experiments has not yet been long enough to evaluate yields adequately. Such records are being obtained.

SOIL PROPERTIES

Although the two areas in which K deficiencies were recognized are widely separated, the chemical properties of the soils on which the lemon trees were grown were rather comparable.

Table 3 shows representative data from the two locations. Although the exchange capacities differ markedly, the percent of the exchange complex taken up by Na, K, Ca, and Mg, and the pH are essentially the same.

Compared to most agriculturally important soils in California, the exchangeable K values are extremely low and the exchangeable Mg values abnormally high. This soil condition—low exchangeable K and high exchangeable Mg—generally leads to K nutrition problems in many crops.

THE END

TABLE 3. SOME CHEMICAL PROPERTIES OF THE SOILS

Soil location	Exchangeable cations				Exchange capacity	pH saturated paste
	Na	K	Mg	Ca		
	%				me./100 g	
San Diego	5.7	**0.7**	**46**	41	42	6.4
Santa Barbara	3.9	**0.6**	**43**	48	15.5	6.3

SOIL TESTS TELL

BY R. S. LINCOLN, LAPEER (MICH.) COUNTY EXTENSION DIRECTOR

Five winters ago—in 1958—Lapeer County farm leaders decided to encourage more soil testing—to make it more popular and convenient for farmers.

At the time, several commodity committees were meeting to analyze current problems and project recommendations for the future. At the heart of the soil and land use committee report was this suggestion on soil testing.

"Farmers should make more use of the soil testing service. Fields should be tested more often as a series of soil tests over a period of years is of more value than only one test. The soil testing service should be improved. Fees should be increased to provide for taking soil samples, making maps and recommendation charts. Most farmers do not know how to take representative soil samples and the test can be no better than the sample from which it is made."

The Agricultural Council endorsed the report. As a result, a soil testing and management service program was offered to farmers in June of 1958.

● FIRST—MORE PRACTICAL REPORT FORMS

Three Council members offered themselves and their farms as test farms—to test the program's operation, how understandable the report

. . . in Michigan's Lapeer County where a 5-year soil test-management program uncovers clear needs for lime, phosphorus, and potassium.

AND L. S. ROBERTSON, EXTENSION SPECIALIST IN SOILS

forms were, how often a farm should be tested. These farms were sampled each spring and fall for three years.

We soon found that organic soils for vegetable production should be tested each year. Three-year testing intervals seem about right for all other soils, with the least change expected in clay loam and loam soils.

Soil test results and fertilizer and lime recommendations were recorded on the standard forms supplied by the ASCS Office the first year. This meant recommendations for only the crop to be grown in any particular year, leaving the farmer to get a new recommendation from the agricultural agent each year. We soon found this method was not practical.

So the Lapeer County Extension staff redesigned the forms to give each field a separate page for the fertilizer recommendations for each crop grown on the farm. This system is still used.

Recommendations are made in ratios and pounds of plant nutrients needed for each crop. By a conversion table, the farmer can convert the recommendations to pounds per acre of a fertilizer grade. A supplemental nitrogen guide sheet helps the farmer figure additional nitrogen pounds needed for crops that respond to supplemental nitrogen.

TABLE 1. 5-YEAR SUMMARY OF FARMERS AND ACREAGE SAMPLED IN LAPEER COUNTY

Year	New Cooperators		Mineral Soils (1) (Second Sampling)		Organic Soils (2)		Totals	
	Numbers	Acres	Number	Acres	Number	Acres	Number	Acres
1958 (3)	44	4,997			1	80	**45**	**5,177**
1959	47	6,215			1	80	**48**	**6,295**
1960	70	7,715			4	372	**74**	**8,087**
1961	43	4,927	13	2,725	6	962	**62**	**8,615**
1962	21	3,621	15	2,306	4	855	**40**	**6,782**
1963 (4)	27	3,206			9	1,372	**36**	**4,578**
Total	**252**	**30,681**	**28**	**5,031**	**25**	**3,721**	**305**	**39,534**

(1) Retest recommended after three years.
(2) Testing recommended every year for vegetables.
(3) Service started June 1958.
(4) Covers period from January 1 to May 10, 1963.

● HOW IT OPERATES—WHAT IT COSTS

To receive the service, a farmer must furnish a roughly drawn map of his farm, showing field acreages, boundary roads, building sites, etc. Any areas (sandy spots, problem areas) or fields once worked separately can be set off with dotted lines to be sampled separately.

Shortly after the map is received, a trained sampler goes to the farm to take as many samples as necessary to get an accurate sample of the soil.

During the first three years, the county ran its own soil testing laboratory. The cost of the service during this period was 20 cents per acre, with a $12 minimum. In April, 1961, the county closed its lab and started sending all samples to the state laboratory at Michigan State University.

This was done (1) to insure more accurate testing, (2) to increase the number of tests run on each sample, giving more information on which to base recommendations.

With a rise in testing cost, this Lapeer County service rose to 35 cents per acre sampled, with a $25 minimum per farm. This increase has barely affected the amount of farmers requesting the service.

Since its beginning, the service has been self-supporting, covering all soil testing and form printing costs. No attempt has been for profit.

● THE REPORT TO THE FARMER

The county extension agent makes the fertilizer and lime recommendations for each farm. Each field sheet contains the test results, lime recommendations, fertilizer recommendations for every crop grown on the farm, and a section for the field's crop and soil treatment record. The report is placed in a notebook along with sheets of specific information on crops and soil management.

When he takes the report to the farm, the agent spends enough time with the cooperator to insure that he fully understands the test results

and recommendations and how to use them. This takes from one to three hours. Also, he files a copy of the report in the county extension office, for easy counsel with the cooperator by telephone or letter when any questions arise.

● HOW POPULAR WITH FARMERS?

In the five-year period (June 1, 1958-May 10, 1963) some 39,533 acres have been sampled—24.5 per cent of the total crop land in Lapeer County.

Table 1 briefly summarizes the progress of the sampling service. Some changes are occurring in this program:

1 A few farmers now take their own samples, mainly to reduce costs. This is permitted, with every effort to instruct for accurate sampling.

2 Two high schools have introduced a soil sampling program to their vo-ag classes, teaching students to take samples and make recommendations. Both the instructor and extension agent check these recommendations.

3 One elevator serving the county promotes the program by helping their customers prepare maps and sharing part of the cost. In this case, the extension agent makes the lime and fertilizer recommendations and supplies the elevator with a copy of the report. In such cases, the county extension office charges $2 to cover cost of the notebook and recommendation forms.

● MORE LPK NEEDED

Soil tests can tell you much about the soils of your county—sometimes unknown problems.

For example, not until we used the state laboratory did we realize some Lapeer County soils were very low in magnesium. From this knowledge, we are correcting the deficiency with very little additional cost where the soil needs lime.

Table 2 proves the need for an educational program, not only by the extension service, but also by the fertilizer industry—*to increase use of lime, phosphorus, and potassium.*

TABLE 2. 5-YEAR SUMMARY OF SOIL TEST RESULTS IN LAPEER COUNTY

Soil Texture	Per Cent of Soils Needing Lime	Per Cent of Soils Testing Medium or Less		
		P	K	Mg
Clay loam and loam	41	86	**77**	2
Sandy loam	54	68	**87**	18
Loamy Sand	59	46	**83**	39
Sand	53	17	**90**	55
Organic Soils	9	30	**55**	0

● INTERPRETING RESULTS

For Lime

Forty-one per cent of the clay loam and loam soils need lime. Of those needing lime, .4 per cent required 5 to 6 tons; 3.7 per cent 4 to 5 tons; 19 per cent 3 to 4 tons; and 19 per cent 2 to 3 tons of lime per acre. Similar values have been calculated for each of the other groups of soils in the county.

For Magnesium

A deficiency of magnesium varies greatly with soil texture. The sandier soils on the average had greatest need for this element.

For Phosphorus

Eighty-six per cent of the clay loam and loam soils tested medium or low in phosphorus. The percentage of samples testing medium or low in phosphorus declines as sand content of the soil increases.

For Potassium

Seventy-seven per cent of the clay loam and loam soils tested medium or low in potassium. As soil texture changes from clay to sand, the percentage of samples testing medium to low in potassium increases.

As an important dairy area, Lapeer County ranks second in Michigan alfalfa production, devoting about 41,000 acres to this crop. Alfalfa is a heavy feeder of potassium, requiring 40 pounds K per ton. So, our soils may be below the critical level in potassium, especially on farms where alfalfa is an important crop.

To increase yields and maintain potassium levels, alfalfa fields should be topdressed each year according to recommendations based on soil results. Failure to maintain good potassium levels affects not only forage yields, but also crop yields that follow in the rotation.

● MICRONUTRIENT FUTURE IN YIELDS

Higher yields seem to pinpoint the need for micronutrients on certain crops. Though no specific test is now made for micronutrients, their availability is tied directly to the kind of soil and pH level. For example:

1 At pH levels above 6.5, the need for certain micronutrients on some crops increases.

2 Crops that respond to manganese are beans, potatoes, sugar beets, and small grains.

3 Crops that may need boron are sugar beets and alfalfa.

4 Crops that may respond to zinc are beans and corn.

Micronutrients can be used in several ways. Since they represent an extra cost, it is not good economics to apply them to crops unless the need is clear.

● THE VALUE—AND FUTURE

We realize soil testing is not the ultimate in evaluating soil fertility levels and balance. But today it is the best method—and as more research is completed, the value of testing will increase.

It is hard to put a dollar value on Lapeer County's soil testing program. We have had many testimonials on high yield, improved quality, dollar savings. Undoubtedly soil testing will become more popular as more farmers recognize its value.

Micronutrients are becoming increasingly important for producing some crops. The need for these elements are best learned by soil testing.

Soil testing is the key to efficiency in crop production—and efficient production is the key to increased profits.

THE END

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BY T. C. MAURER
SCS
SPARTANBURG, S. C.

WHY They WON'T Give Up

The drought of the early 50's was a blessing in disguise to fescue growers in the Southeast.

It proved to them that this dependable cool-season grass will give good grazing year after year, drought or no drought, when properly managed.

And—perhaps more important—it proved its value in a sod-based rotation with every row crop grown in the region.

Fescue that had been well fertilized and properly used for grazing and seed production had a deep, vigorously-growing root system that enabled it to withstand the drought. Some fields that had seemed to be completely grazed out made surprising recoveries.

Most of the fescue losses occurred from a combination of unfavorable factors: (1) Growing fescue on soils to which it was not well adapted, (2) too little fertilization, (3) heavy over-grazing, (4) failure to provide summer rest periods, (5) the drought that lasted too long.

BECAUSE FESCUE-LADINO sod disked for row crops can mean better quality crops following the grass-based rotations.

The favorable combination of good soils, proper fertilization, spring rest periods to permit the grass to make seed, summer rest periods, and proper grazing helped improve the longevity and productivity of fescue.

A WONDER FOR ROTATION

It proved not only to be the "wonder grass" that Big Hugh Bennett once predicted it would become—but also a wonder grass in crop rotations.

Fields where the grass appeared to

BECAUSE FESCUE provides knee-deep grazing in December—as in this field: 4,600 days of grazing, 9 tons of seed, 2,900 bales of hay during the year.

BECAUSE FESCUE provides needed soil and water conservation for new orchards—as shown by the vigorous growth of 3-year-old peach trees.

be dead or badly damaged were plowed and put to other crops. Plowing was tough through the mass of roots and crop residue. Some farmers said it was hard to work up a good seedbed or get a good stand.

But when the harvest was over, one man summed up the results: "It was the cheapest corn crop I ever made."

After harvesting good, high-quality crops following fescue sod, farmers started remembering back over the season:

1 Some didn't remember seeing any water come off their fescue field even after heavy summer downpours.

2 Other farmers remembered a 10-day to 2-weeks drought where "fescue-corn" didn't suffer and the dark-green color could be spotted as far as it could be seen.

3 In the tobacco and truck sections, those crops looked better than usual. The roots of these crops were found to be practically free of root knot nematodes. Yield and quality were better than for the same crops in continuous row crop systems.

AT WORK IN ORCHARDS

Peach trees have been planted in fescue fields in a wide variety of patterns. In many cases, three to four feet strips were plowed out of sod for the tree rows.

The trees grew more vigorously in every fescue field, regardless of the pattern followed. Where the tree rows were plowed on the contour and the middles left in grass there was no soil or water loss.

In most cases, the natural drains were left in fescue for disposal of excess runoff—if and when there was runoff.

The "insoak" of water into a field where fescue has been turned is almost unbelievable—that is, until the soil is examined closely:

1 Clumps of roots and pieces of the fescue crown are scattered all over the surface.

2 These pieces of crop residue keep the raindrops from packing the soil particles together as they strike the surface. The impact of the raindrop is dispersed by the fescue residue.

3 The water soaks into the soil as fast as it falls. And there is more crop residue under the surface of the soil.

INCREASES WATER STORAGE

When farmers first started turning under fescue for row crops, they tried to turn it all under—but couldn't. This proved to be fortunate because the residue left on the surface increased infiltration.

The residue under the surface throughout the plowed area helped the water to move down into the soil. Fescue roots have been found three to five feet deep in heavy soils, silts, clays, and combinations of these.

The fescue roots decay, leaving a myriad of root channels below the plowed layer for the water to go on down deep into the subsoil. Crop roots go down and get the moisture that has been stored with the help of the fescue.

In addition to water storage in the soil, fescue residue returns some plant nutrients.

To find out why, Soil Conservation Service agronomists studied farmer experiences with crops after fescue, which had been established according to the conservation plan.

The Watkinsville Experiment Station had shown that unused fescue would supply 16 tons of oven-dried residue per acre, but these farmers were using their fescue primarily for grazing. Field measurements under all conditions finally gave an average figure of eight tons of air-dried residue per acre.

FERTILIZATION STEPPED UP

Ordinarily, this much grass residue should have brought on serious nitrogen deficiency symptoms in succeeding

crops. Surprisingly, such complaints were few.

One reason is that the use of nitrogen on crops has been stepped up tremendously in the past few years. Another is that fescue leaves, root hairs, and small roots decay rapidly.

If we assume the fescue residue as one percent nitrogen, eight tons provides 160 pounds of nitrogen. Phosphate would be approximately .6 percent or 96 pounds per acre. Potash would be 2.5 percent or 400 pounds.

This, with 20-30 pounds of nitrogen in the fertilizer applied to the crop, partly explains the good growth and higher yields of crops following fescue.

Farmers in the southeastern states have never given up on fescue. They have learned how to use it to their advantage. Since it is the only cool-season grass adapted to this entire area, they must use fescue or depend on annuals that are subject to fall weather conditions.

It gets too dry or too cold at most inopportune times for annual winter legumes, small grains and grasses.

Farmers who fertilize and then rest their fescue from June through October can be sure of grazing from November through May. Those who go one step further and produce seed get their grazing at no cost. The seed crop pays the fertilizer bill and usually produces some extra income.

BEST GRAZING AGE

Now that southeastern farmers have experienced the benefit of fescue on all row crops grown, they are rapidly increasing the acreage of new seedings for grazing and for crop rotation.

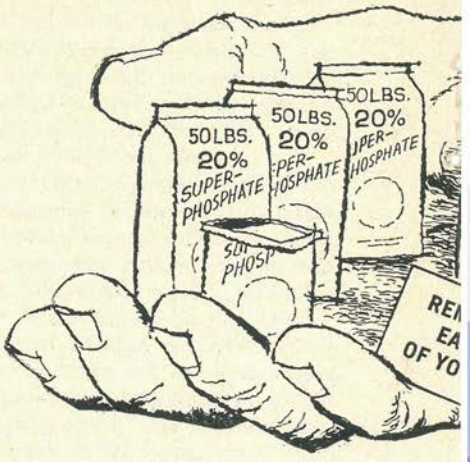
The farmers who are really studying fescue report that grazing is better on 2- and 3-year-old fescue than on 6- and 8-year-old stands. Not only is the fescue better grazing, but the chances are better of keeping an adapted legume in with the fescue.

This is a fertilization, seasonal grazing, and stocking-rate problem that still remains to be solved.

Tobacco, truck and, general farmers have learned that two to three years of fescue cuts root knot nematode to a minimum and gives 75 to 80 percent of the total benefit to succeeding row crops, if the grass has not been heavily over-grazed.

These are some reasons that farmers in the Southeast have never given up on fescue. They've found it good for their cattle, their soil, their crops—and their pocketbooks.

THE END



SOYBEANS GET I

By Assistant Editor Hal Johnso

The old idea that soybeans is a scavenger crop is sound—up to a point. They *will* pick up and use nutrients left over from an earlier crop.

Trouble is, beans can't scrounge plant food that isn't there. And a 40-bushel bean crop needs 35 pounds P_2O_5 (15 pounds P) and 55 pounds K_2O (46 pounds K).

Soil tests and surveys are showing that in far too many fields there aren't enough nutrinets left over to satisfy a big bean crop's appetite. And with lime also lacking in the majority of these fields, chances for top profits are doubly slim.

In Delaware, almost one out of four fields checked in 1963 showed severe nutrient deficiencies. In North Carolina, soil test results show 90% of soybean land short on fertilizer and 85% short on lime! Similar conditions exist in most Southern states.

North Carolina's average soybean yield was 24 bushels in 1963. Yet the top yield was 60 bushels. (See "Sixty Bushel Soybean Barrier Broken!" page 24.)

Fertilizer isn't the only answer to low soybean yields but it often is the most important.

What sort of diet does a high-producing soybean crop need? In general, it should be medium to high in phosphorus and potassium, adequate in trace minerals, with a pH between 6.0 and 6.5.

- **Lime** is the place to start boosting fertility on most farms. Nodulating bacteria that convert nitrogen in the air to a form soybeans can use need a pH near 6.2 to do their best work. Beans also show little response to applications of P and K when soil is acid. If calcium and magnesium are deficient, dolomitic lime will supply these elements while it adjusts pH.

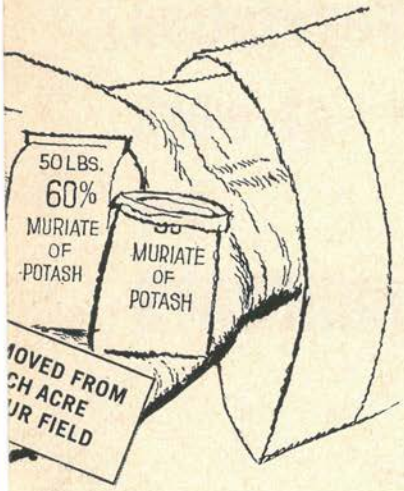
On Maryland plots, researchers got up to $6 return for every lime dollar spent.

Don't overlime, however, on sandy coastal soils. Natural manganese deficiencies are aggravated when pH goes much above 6.2.

- **Phosphorus** is necessary to give plants a fast and vigorous start and stimulate top yields. Phosphorus deficiency can fool you, too. It won't cause visible plant symptoms.

- **Potassium** is "steak and potatoes" to soybeans. This is the element needed in large amounts. If it's lacking, you'll notice these symptoms: Leaf edges will turn yellow and cup. Maturity will be delayed, defoliation slow, and yields 'way down. In cases of extreme potassium deficiency, beans will be wrinkled and shriveled.

- **Trace minerals** are also critical to high yields, but most are abundant in Southern soils. Manganese, copper, and molybdenum are deficient in certain soils, however, and can greatly depress yields if not applied in fer-



You'll get highest yields by supplying needed nutrients in a balanced ratio, N. C. Experiment Station results show:

Treatment	Return Per Acre Above Costs
Lime only	$ 7
Lime plus 40 lbs. P_2O_5	10
Lime plus 80 lbs. K_2O	16
Lime plus 40 lbs. P_2O_5 and 80 lbs. K_2O	26

HUNGRY, TOO!

n In The **Progressive Farmer** Magazine

tilizer, dusts, or sprays (or seed treatment for molybdenum).

If you figure you're doing everything else right, but can't get yields up, suspect a trace mineral deficiency. Ask your county agent for help if this seems to be your problem.

• **Nitrogen** applications have gotten poor response on most Southern soybean land. Although beans use large amounts of N, most of it is provided by nodulating bacteria on crop roots. Maintaining pH at the right level and inoculating your seed beans each year will keep nitrogen supplies adequate.

How you apply plant food affects soybean yields, too. Beans are especially sensitive to fertilizer applied too close to the seed.

Many states recommend broadcast applications unless fertilizer can be banded at least 2 inches to the side and 2 to 4 inches below seed. In South Carolina studies, 300 pounds 0-14-14 (or its equivalent) placed closer than 4 to 6 inches from seed reduced yields, even though stands were not affected.

Virginia recommends broadcasting needed fertilizer on the cover crop preceding beans, with no direct fertilization of beans. Broadcasting and plowing down fertilizer ahead of beans helps avoid seed injury.

In all cases, a soil test is the best way to determine nutrient needs on your soybean land. The test will tell you: 1) how much fertilizer you need, 2) how much lime, and 3) whether dolomitic or calcitic lime is best in your case.

If you can't test in time this spring, be safe. Apply 300 to 400 pounds 0-10-20 or its equivalent per acre.

On today's soybean market, 12 to 15 bushels per acre will pay all your costs, *including lime and fertilizer.* Every bushel you can push yields above this is pure profit.

Progressive Farmer

Vegetation at work for HIGHWAYS

THIS HYDRAULIC MACHINE can seed and fertilize 65,000 sq. ft. of graded roadside in about 20 minutes. Use of bulk urea, triple superphosphates and muriate of potash has cut fertilizer handling as much as 50%.

By E. F. BUTTON

STAFF AGRONOMIST
CONNECTICUT STATE
HIGHWAY DEPARTMENT

Condensed from
Public Works Magazine

Establishing vegetative cover on highway embankments presents difficulties that are not insurmountable if the fund of available knowledge in the related fields of soil management, landscape engineering, soil and water conservation, and plant ecology is utilized.

WORK BLAZED BY BLASER

The reader is referred to the vast amount of highway vegetation slope stabilization work accomplished by Dr. R. E. Blaser of V.P.I., Blacksburg, Va., and published in the fine reports of the Virginia Council of Highway Investigations and Research. Much of his work is also reported in past Proceedings of the Highway Research Board of the National Academy of Sciences, Washington, D. C.

BURLAP AFTER SEEDING prevents erosion until seed is established. The burlap is carefully placed in the median depression to guard against washing topsoil and clogged catch-basins.

"More potash with nitrogen topdressings on medians would promote winter hardiness and disease resistance. Rates of each are subject to local conditions."

HYDROSEEDING PIONEERS

The development of the hydroseeder and the hydroseeding method for mixing seed, fertilizer, and insecticide in a water slurry and spraying onto the soil surface (by John L. Wright and William C. Greene of the Connecticut State Highway Department in 1939-40) eliminated costly topsoiling on most highway embankments.

Continual work by these men greatly reduced the amount of seed required per acre.

A high degree of uniformity of seed and fertilizer distribution can be accomplished by well-trained workmen. Hay or straw mulch placed at a rate of 1½ to 2 tons per acre on slopes freshly seeded produces grass or legume stands comparable to stands obtained by older conventional methods, and at a small fraction of the former costs.

Using mulch on slopes is essential to produce initial vegetative stands.

FERTILIZATION ESSENTIAL

Maintenance topdressings of fertilizer are necessary to hold the initial stand in the critical first three years after establishment. Yearly applications of low rates of complete fertilizers, or of nitrogen (depending on type of vegetation, soil conditions, and climate) should be planned and budgeted from the very beginning.

A New York State Department of Public Works report in 1955 estimated top soil alone cost between $2400 and $5600 per acre. Total costs of soil

preparation and establishing grass cover on embankments often exceeded $9000 per acre.

Current costs of establishing grass or legume cover on shaped highway embankments (including seeding and mulching) are often less than $480 per acre, where the hydroseeding method is used on unloamed areas.

Commercial hydroseeders now available at reasonable costs are superior to the Connecticut prototypes and can efficiently handle slurries of a much higher solids content. Commercial mulch blowers are efficient and most are now equipped to dispense an asphaltic emulsion on the hay or straw as it leaves the discharge nozzle of the blower. Flexible extension "tubes" on some models permits more uniform distribution of the mulch on higher slopes and under less-than-favorable wind conditions.

GRASS AND LEGUME SPECIES

Present use of various combinations of K-31 or Alta Tall Fescues, Creeping Red Fescue, Kentucky Bluegrass (with either Redtop or ryegrass for quick emergence) has been generally satisfactory in the Northeast.

Ryegrass rates when seeded with the fescues or bluegrass should be kept under a maximum of five pounds per acre.

Field bromegrass, an annual, should find its way into more highway mixtures for fall or early spring seeding. This plant is not persistent, and has a very sparse topgrowth; but the root growth in the early part of the season is very heavy and fibrous, imparting excellent soil holding properties until the more permanent species become established.

Tall, coarse-bladed reed canary grass, contrary to popular opinion, does very well on droughty sites, making a good companion for Crown vetch on sites not in full view of the traveling public.

Crown vetch seeded with either (or both) ryegrass and tall fescue makes an excellent low-maintenance ground cover for highway embankments and will soon become more popular with northeastern highway departments. Crown vetch requires at least three years to become well-established under Connecticut conditions (from seedings) and should not be planted with creeping red fescue for the best results.

In many areas, Birdsfoot trefoil will perform as well as Crown vetch. Occasional topdressings of phosphorus-potash fertilizer, with some hydrated lime, would be beneficial to either Crown vetch or Trefoil stands.

In the southern portions of the Northeast, various shrub and seeded lespedezas are suitable for low-cost slope vegetation.

FERTILIZATION FOR SEEDING

A reasonable amount of nitrogen should be derived from ureaforms for low-cost, slow-release nitrogen. In some areas, good 10-20-10 grades are available—but double the rate of a 5-10-5 is not quite the same thing. Using high amounts of 5-10-5 in place of a 10-20-10 can lead to an excessively high (and temporarily toxic) salt content on low-buffered soils as sand or gravel.

A 10-10-10 formulation can be fortified by adding extra ureaform nitrogen to the application. *For example, more potash with nitrogen topdressings on medians would promote more winter hardiness and disease resistance. Rates of each are subject to local conditions.*

Soils should be limed if the pH indicates acidity, if calcium and magnesium are low, or if toxic aluminum is medium high to high, especially on the lighter soils.

The importance of adjusting soil pH for proper utilization of plant nutrients cannot be overemphasized. On soils with a high silt-clay fraction, the addition of gypsum (land-plaster) can help keep the soil surface from puddling, help keep the soil more open to root and water movement. Gypsum is not

a good surface additive. To be fully effective, it must be worked into the top few inches of soil.

MULCHING MATERIALS

Connecticut has experimented with many materials for mulching or soil stabilization purposes.

SODIUM SILICATE (water-glass) helps stabilize soils against movement, provided the "soda" can be removed sufficiently to allow the silicate to harden. An application heavy enough or with enough acid to "set" the material would not be conducive to establishing new grass or legumes.

AERO-SPRAY 52 BINDER can be used on soils with a high percentage of "fines" for dust control and limited surface wind and water erosion. Rates above 5 percent by liquid volume at 1,000 gallons per acre seem to be the limit endured by new seedlings.

LATEX FORMULATIONS sprayed on freshly seeded areas have successfully produced good stands of vegetation—but any material that depends on a surface-film over the soil is at some disadvantage if the film is broken. Wind or water can get under the film to cause some erosion.

NETTINGS of various types to hold down hay or straw in place of asphaltic emulsions have proved expensive in either material or labor costs. Jute nettings have helped drainage-ways bearing intermittent water. Common burlap works equally as well in such situations.

WOOD CELLULOSE FIBER is the most attractive and economically manufactured mulch on the market for hydroseeding today. Adding temporary green marking dye helps the hydroseeding crew to determine adequate coverage. This material as an alternate for hay or straw is now approved by the Connecticut Highway Department and several other State Highway Departments.

Its use, added to the seed, fertilizer or insecticide slurry results in a dramatic reduction in the number of laborers and expensive pieces of equipment required to seed and fertilize a complete acre. *Final costs can stay within 10¢ per square yard for seeding and mulching.*

Final stands of grasses or legumes are usually cleaner of unwanted grasses or weeds often introduced with hay or straw mulch. Wood cellulose fiber tends to be more fire resistant than hay or straw, an advantage on highway slopes.

The author does feel it should be used at higher rates than the manufacturer's recommended 1,000 lbs. per acre on very steep slopes or slopes comprised of a soil with a silt-clay fraction lower than 30 percent.

The author has also noted quicker stands of grass obtained (under conditions of low moisture availability) if part or all of the seed is applied *under the wood cellulose fiber mulch.*

The advantage of a one-shot application, however, is important enough to over-ride this small disadvantage by increasing the seed rate per acre by at least 10 percent.

PRE-GERMINATED SEED FUTURE

In the near future one will be able to obtain pre-germinated seed in a form easy to handle and store (for a brief period of time). Adding such pre-germinated seed, along with a portion of untreated seed to the hydroseeder slurry, will enable the landscape engineer or seeding contractor to establish growth on a new area in a very short and predictable time, other conditions being suitable.

DIP TREATMENT TESTS

The author is now experimenting in the laboratory with a material that can be used as a dip treatment for seed, as an additive to a seed slurry, or as a spray over a seeded area according to the manufacturer.

When added in the moisture required to germinate the seed of creeping red fescue, it has produced 35 percent emerged, healthy seedlings in

eight days as compared to only 12 percent emerged seedlings from untreated seed; and 65 percent from the treated seed in 22 days as compared to 37 percent in the same period from untreated seed.

This material is derived from seaweed, and appears to contain one or more plant hormones or enzymes thus far not isolated or identified.

LAWNS VIA HYDROSEEDER

The author has been making a two-year study on the use of the hydroseeding method for lawns or small areas.

Lawns of various sizes and areas with slopes steeper than 45 degrees have been seeded by this method with fine turf grasses such as combinations of Pennlawn and Merion bluegrasses with common creeping red fescue and Kentucky bluegrass.

In such areas, soil preparation is of paramount importance. On areas high in silts and clays, as much as 2 tons of gypsum and 600 lbs. of treble superphosphate (46%) were rototilled into the top 4 to 6 inches. The areas were brought to finish grade and limestone applied. The areas were then treated with seed, fertilizer, insesticide, fungicide and Turfiber in one slurry.

In every case the hydroseeder is left in the street and the slurry pumped through as much as 200 feet of 1½-inch canvas fire hose. The stands of turf obtained have been exceptionally deep-rooted, dense, uniform and vigorous.

Costs, including soil additives, rototilling, final grading, and hydroseeding have ranged from 3 to 5½ cents per sq. ft., depending on the amount of additives and soil preparation required.

Use of the wood cellulose fiber mulch, even on flat or loamed areas, holds the materials firmly in place, conserves moisture, and produces a very rapid cover of grass.

This method is certainly a valuable adjunct to the small landscaper, for small areas as well as for the large seeding contractor for big acreage. The operations would lend themselves very well for housing developments. Municipalities might do well to look into the advantages of acquiring a hydroseeding unit for city and park seeding and fertilizing.

Additional cost of less than $150 can convert a hydroseeder into a good low pressure sprayer for insecticide spraying, and for MH-30 applications, regularly known as chemical mowing.

THE END

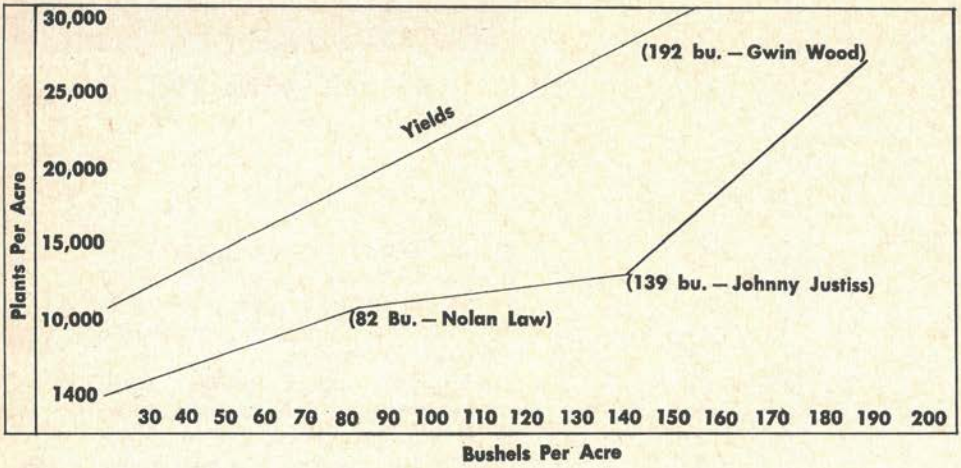
EAR SIZE

. . . corn yield clue

If you harvest big corn ears this fall, you may be losing as much as 12 to 40 bushels of yield per acre. These high ear weights might easily show that you have too low a plant population. Low ear weights, on the other hand, usually indicate low fertility levels. This chart can help you attain the right balance of plant population and fertility to produce maximum yields:

Average Ear Weight	Factors Affecting Ear Weight	Estimated Yield Loss
.60–.75 lb.	Stand much too low	12 to 40 bushels
.52-.60 lb.	Stand too low	0 to 12 bushels
.48-.52 lb.	**Stand balanced, fertility adequate**	**0 bushels**
.40-.48 lb.	Fertility limiting or stand high	0 to 6 bushels
Below .40 lb.	Fertility severely limiting or stand too high	6 to 20 bushels

Soil Fertility News



MORE PLANTS . . . MORE BUSHELS

in CORN future

By Roudell Byrd

WHAT makes high corn yields—100 to 200 bushels per acre?

There are three steps (called High Profit Trio by some) that directly affect yields of corn.

1. Plant a high capacity hybrid variety.
2. Plant a thick stand—a plant every 8 inches or closer.
3. Apply extra plant food to feed the extra plants.

A closer look at C. S. Bazemore's Wetumpka Vocational Agriculture class reveals that producers in the group's corn growing contest showed a direct correlation between yields and the three-step concept referred to earlier.

Note from the graph, elsewhere on this page, the direct correlation between plants per acre and yield per acre. Of course, the fertilizer or plant food must be increased as the plant number is increased or the correlation could become a zig-zag yield line caused from too many plants and/or lack of fertilizer.

Shown in the graph, Nolan Law averaged 10,560 plants per acre and applied 80 pounds of N; 44 pounds of P; and 48 pounds of K (nitrogen, phosphate, potash). Law's yield was 82 bushels per acre. Johnny Justiss averaged 14,622 plants per acre and applied 123 pounds of N; 48 pounds of P; and 48 pounds of K. His yield was 139 bushels per acre. Gwin Wood (Alabama's champion Future Farmer corn grower) averaged 26,956 plants per acre and applied 184 pounds of N; 128 pounds of P; and 64 pounds of K. Wood produced 192.7 bushels per acre. Note that the charted yield line runs in direct correlation with plants per acre.

Many of the other eight growers in the contest found their yields were in the same perspective as that of the three shown on the graph. However, a few failed to put extra plants or extra plant food and should these have been charted, the yield line would have formed a zig-zag pattern.

So, it is important that corn producers consider, first, a top quality, high capacity hybrid, second, thicker spacing, and third, extra plant food for the extra plants.

Alabama Farmer

"You Ain't Seen Nuthin, YET!"

IN PER ACRE YIELDS

Illinois field crops have shown phenomenal increases in per acre yields during the past 25 years. Corn and winter wheat show this agricultural technological advance.

Average wheat yields have climbed from the 15- to 20-bushel level to 40 bushels. Central Illinois county yields have consistently exceeded 40 bushels per acre in recent years.

Corn yield curves for the state and on individual farms are approaching the trajectory of a moon shot.

As agronomists we wonder what the yield potential is for winter wheat and corn in our climate? What factors hold yields back? Why do we not get as high wheat yields as those in parts of Europe and our Pacific Northwest?

WHEAT POTENTIAL—BRIGHT

We know there is a limit to how much fertilizer, especially nitrogen, we can apply to wheat. While some fertilizer is essential, excessive amounts will:

1 Cause early lodging, which in turn results in poor yields and quality.

2 Increase plant diseases, especially the foliar diseases.

To eliminate these two adverse effects of heavy fertilization on fertile corn-belt soils, wheat plants in small plots are being supported artifically by wires to eliminate lodging and sprayed weekly with a fungicide to control disease.

In 1962 the plots receiving fertilizers and sprays and supported by wire averaged 88 bushels of wheat per acre. In 1963 our yields were 81 bushels.

This is an impractical way to grow

. . . OF WHEAT OR CORN

winter wheat. But such results give high hopes for future wheat yields in Illinios, indicating *our present upward trend in wheat yields will continue.*

This increase can be accomplished by developing varieties with better standing ability and disease resistance. These are two prime objectives of the Illinois wheat breeding program.

CORN POTENTIAL PROBED

Recent potential yield experiments in the corn field have been concerned with irrigation, maximum plant nutrients, light, carbon dioxide, and air movement.

. . . with high nutrient levels

Yields in the 175 bushel range are becoming common in these experiments. When we reach such high yield levels, additional large amounts of plant nutrients have so far not increased yields **with present hybrids.**

. . . with air movement

Illinois is noted for fertile soils and an excellent corn growing climate. One favorable environmental factor that has perhaps been overlooked is air movement or turbulence in and over our corn fields during the growing season. Experiments using large fans in corn plots have resulted in higher yields.

. . . with carbon dioxide

Corn yields do not appear to be limited by CO_2, for adding CO_2 to plastic houses surrounding corn plants have shown no yield increases.

. . . with light usage

Theoretically, corn plants in narrow rows and high populations will capture more of the incoming light energy. This should mean more for photosynthesis and less soil water evaporation.

But this situation does not always produce higher corn yields with our present varieties. The paradox is that corn loves light and each leaf needs full sunlight for top production.

Lower leaves are in shade and their efficiency is reduced. Recent studies show that the two top leaves growing in light are five times more efficient than the lower leaves per given area of surface.

Both University and Industry corn breeders are seeking hybrids with shade tolerance. Many new exotic sources of corn are being bred into present Cornbelt material. As corn combines come in the size and shape of ears will cause less attention. Corn ears of the future may look like a baseball or an elongated fountain pen.

"BUT NUTHIN—YET"

Illinois wheat and corn yields will continue to climb. There will be occassional adverse growing seasons, but these will be fewer and the yield dips lower than in the past.

It now seems likely that average state wheat yields will reach 50 bushels and corn 100 bushels before 1970. Top farmers will be harvesting 75 bushels of wheat and 175 bushels of corn.

Advances in agricultural technology and its acceptance by Illinois farmers has been just as spectacular as that of any other industry in this space age. And in the vernacular—"you ain't seen nuthin yet".

J. W. Pendleton,
University of Illinois

OVERHEAD VIEWGRAPH is modern tool for teaching soil management clinics. Such concepts as cation exchange and phosphate exchange can be demonstrated on a viewgraph.

BY LEO M. WALSH
UNIVERSITY OF WISCONSIN

MODERNIZE your meetings

Top farmers want to know WHY things happen today.

The top 10 to 25% are looking for good soil management programs that not only tell them WHAT to do, but also WHY.

Such farmers are better than average managers regardless of their farm size—usually younger than the average farmer, quicker to adopt new practices, eager to make the *business* of farming pay off.

Do you offer such farmers a soil management program that tells them why? If you do nothing but reel off recommendations, you might well exit the scene in a few years, along with the inefficient farmer.

If farmers understand good soil management principles, they can make better decisions—can interpret research results and fit recommendations to their local situation. They are equipped to evaluate future technological developments. And they have the personal satisfaction of knowing WHY they are following recommended soil management practices.

HEADING TOWARD "DEPTH"

The trend in all subject matter fields today is toward "in-depth" training programs for farmers and agri-business representatives. Many states—including Iowa, Minnesota, South Dakota, Oklahoma, Wisconsin—have developed successful SOIL MANAGEMENT CLINICS.

TABLE 1. FARMER'S OPINION OF EACH SESSION OF THE SOIL MANAGEMENT CLINIC (WISCONSIN, 1963 AND 1964)[1]

Subject	% of farmers indicating the session to be:			
	much value	some value	little value	no value
Soil formation and soil and water conservation	45%	50%	5%	«1%*
Soil chemistry, and fertilizing and liming materials	63%	35%	2%	0%
Soil testing, and lime and fertilizer recommendations	80%	19%	1%	0%
Economics of fertilizer use	48%	46%	6%	«1%**

[1] Approximately 800 farmers completed the questionnaire.
* Four farmers reported this session to be of no value.
** Two farmers reported this session to be of no value.

For many years, top farmers have wanted to learn why things happen. But *for too long,* we have geared our work to the average or below average farmer. A participant in our soil management clinic recently said, "This is one of the few times I really learned something *new* at an extension meeting. In the past, I only heard what I already knew most of the time."

Don't underestimate the desire or ability of the top farmer to *learn.* Good visual aids can clarify such difficult concepts as cation exchange and phosphate fixation. Good farmers *like* to be challenged—by corn yields, milk production, soil management principles, etc!

Good teachers can present scientific principles of soil management in a way farmers can understand. Of course, the teacher must understand the subject thoroughly. Agents and vo-ag teachers may need a "refresher" course in Soil Science before conducting a soil management clinic.

To be successful, the teacher must be able to "communicate" with farmers—must develop a rapport with farm audiences. This takes much planning and preparation.

SETTING UP A CLINIC

Most states have 3 to 5 meetings in successive weeks for either a half day or a full day. More intensive or comprehensive clinics require more time.

In Wisconsin, we hold four two-hour sessions in either the afternoon or evening—to avoid conflict with morning chores on a dairy farm. We have also found farmers more receptive in the afternoon than in the evening.

A four-session clinic is *not* too long. In fact, many farmers said they wanted more, or longer, sessions. And attendance held up very well—about 60% attending all four sessions.

We (specialists from Soils, Agricultural Engineering, and Agricultural Economics) planned our agenda well in advance. This gives each teacher time to prepare his part of the program. Generally, we took the following approach:

1. Soil formation and soil and water conservation.

2. Soil chemistry and fertilizers and liming materials.

3. Soil testing and lime and fertilizer recommendations.

4. Economics of fertilizer use.

We conduct soil management clinics in 8-10 counties each year, at the county agent's request. We provide an illustrated brochure explaining the course. The agent writes in the place and date of the clinic in his county—then uses the brochure to INVITE students to take part in the clinics.

The invitations go to farmers suggested by county agents, vo-ag teachers, SCS, ASCS, FHA, and others. We try to select farmers keenly interested in taking a detailed look at their soil. About 60% of those invited enroll in the course.

Most agents also make a general announcement and accept a few students not contacted by personal invitation. This brings in some students who may have been overlooked—and protects the agent from the critic who objects to our working with a "selected" audience.

A class of 50-60 students is about the right size. It's hard to give a larger group personal attention.

Students pay a nominal registration fee, used primarily to cover the cost of a special clinic "text." Some agents also collect money for refreshments at enrollment time.

The registration fee did *not* discourage enrollment. In fact, most agents welcomed it. Farmers then have an "investment" in the course. It makes the clinic different from our general extension meetings.

TEACHING THE FACTS

Most subject matter covered in the course was included in a 65-page multilithed manual, "Profitable Management of Wisconsin Soils." (This manual is available from College Printing and Typing Inc., 453 W. Gilman Street, Madison, Wisconsin at a cost of $1.25 per copy.)

"In-depth" training programs need some kind of reference materials or "text." Many farmers read the manual between sessions. Most students said it helped them understand the material being taught. Nearly all said it would be valuable reference for future problems.

We used a local situation or example farms to explains our subject matter, whenever possible:

1. A SCS plan from a local farm was used to determine the alternative cropping and conservation practices that could be followed.

2. Crop production under average and high management conditions was determined—with fertilizer and lime recommendations based on actual soil tests.

3. SCS maps, soil type information, field layouts, and soil test information from the example farms were mimeographed and distributed to each student during the first class.

If possible, you should also relate the scientific principles you're teaching to a practical situation on the example farm. This helps farmers see how their "in-depth" training can be used on everyday problems.

EVALUATING THE CLINIC

How many farmers participated? What interest did they show? These questions help evaluate a clinic.

In 20 counties over a 2-year period, our clinics averaged 50 farmers for each session. Sixty percent of the stu-

dents attended all four sessions, about 85% attended at least 3 out of 4 sessions.

Each farmer gave his opinion of the clinic at the end of the last session. Over 90% preferred a series of meetings over single-session soil meetings of previous years. Less than 1% *did not* like a series of meetings. So, the clinic approach was overwhelmingly chosen.

We also asked each farmer to evaluate each session in terms of its benefit to him. The results are shown in Table 1.

Most farmers voted all sessions of our soil management clinics of much or some value. But such a survey should be carefully interpreted. When a farmer says a session was only of some or little value, he doesn't mean the session was uninteresting or poorly taught. He means that in his particular situation, the information did not apply to his soil management problem.

For example, in Western Wisconsin many farmers have applied up-to-date SCS farm plans. So, farmers in this area of the state reported the first session to be of only some or little value.

The real test of a clinic is how it changes or influences future decisions of the farmer.

To get at this, Dodge County agent, Ed Bergstrom will survey the participants of our 1964 clinic in 1965 and 1966. He will try to determine what practices the farmer has changed—especially what interest and action, the clinic stimulated in alfalfa topdressing.

Alfalfa topdressing is probably the most neglected fertilizer practice in his county—and throughout Wisconsin.

We need more such follow-up work. A truly successful clinic should stimulate needed management changes and clearer understanding of the principles involved.

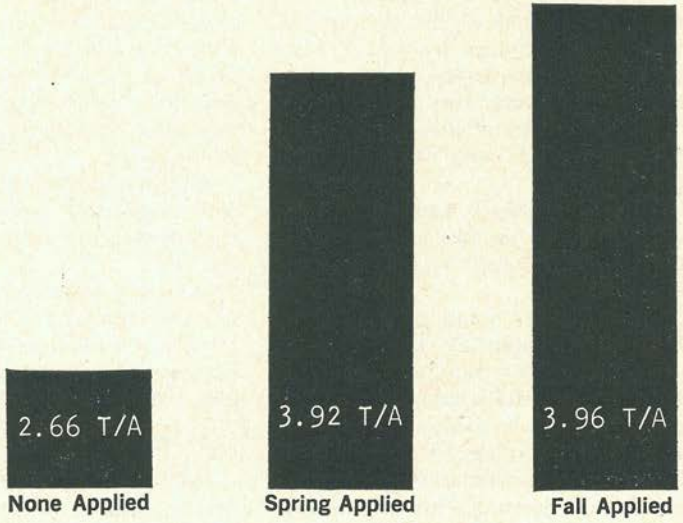
WHERE TO FROM HERE

Well-planned intensive training programs are, and will be successful in all fields. This does not mean we should drop all existing programs to promote principles-oriented clinics.

We still need general meetings that discuss WHAT to do—for average and below-average farmers. In fact, a "clinic" might interest this group of farmers—if you stress practices rather than principles.

THE END

ALFALFA RESPONDS TO FALL FERTILIZATION
(400 lb. 0-20-20/A, University of Maryland data — 5 year average)



Fall Fertilization PAYS

A problem that has plagued farmers and the fertilizer industry alike for many years has been the historic and generally accepted practice of applying most fertilizer during a very short period of time in spring.

In many areas, 75% to 80% of the total fertilizer used is applied in a 1 to 2 month period.

This practice has increased the cost of farming by causing many problems of fertilizer manufacture, distribution, and application:

1 Farmers often have to rush their spring work, requiring more labor than necessary.

2 Frequently, the desired quantity of plant nutrients is not applied because time has run out, or fertilizer is not available when planting or other operations must be done. As a consequence, farm profits suffer.

3 Inefficiencies in fertilizer manufacture have been brought about because factories built large enough to supply spring needs stand idle for much of the remainder of the year.

4 The flood of fertilizer movement in the spring, followed by a mere trickle the rest of the year, temporarily overtaxes transportation facilities causing difficulties in on-time delivery of fertilizer materials.

Although the "one season" problem has always been with us, the

THE EFFECT OF FALL AND SPRING FERTILIZATION ON FOUR CORN FIELDS
(4 Plot Average—15.5% Moisture)

Field	Yield in bushels per acre Time of treatment Untreated	Fall 40-40-40	Spring 40-40-40
Stillwater	60.5	75.2	78.9
Winthrop	76.9	96.5	94.2
Walnut Grove	79.8	98.1	99.6
Sleepy Eye	111.1	131.5	131.0
Average	**82.1**	**100.3**	**100.9**

Univ. of Minn. data

THE EFFECT OF FALL AND SPRING FERTILIZATION ON FIVE OAT FIELDS
(Average of 4 Plots)

Field	Yield in bushels per acre Time of treatment Untreated	Fall 40-40-40	Spring 40-40-40
Stillwater	26.1	38.9	41.0
Rosemount	37.6	59.1	50.0
Morgan	44.3	59.8	58.4
Sleepy Eye	39.0	61.8	67.1
Walnut Grove	27.4	46.0	49.0
Average	**34.9**	**53.1**	**51.4**

Univ. of Minn. data

Condensed From ***Cynagrams,*** By H. H. Nau

manufacturing and transportation problems are steadily becoming more serious as consumption of fertilizer increases. For greater economy, farmers and industry alike should work to level out the spring peak and make crop fertilization a "full season" program.

● ARE WE NEGLECTING TO SAVE LABOR AND MONEY?

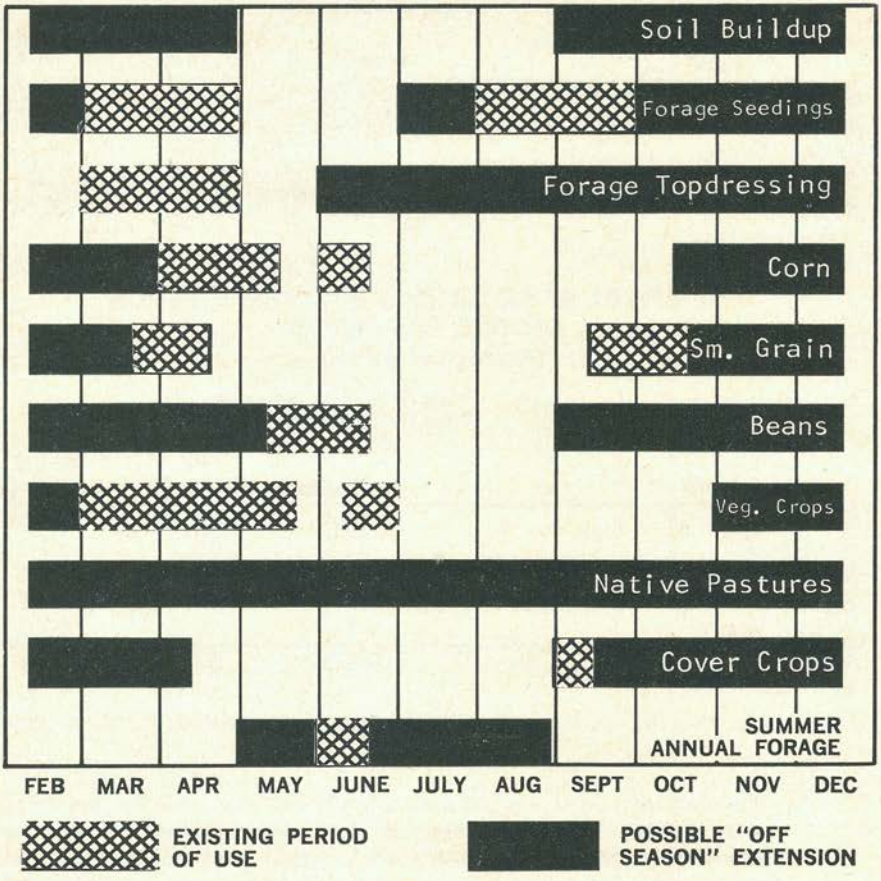
The reason for the popularity of spring fertilization is not difficult to find. Research has shown that the greatest efficiency per unit of fertilizer applied is obtained on many soils and crops by applying it as close to the time of maximum plant growth as possible.

Although this well established fact is not subject to much question, we must ask ourselves whether we have not "over accepted" this premise. By so doing, have we neglected to recognize opportunities to save labor and money which may be greater than the extra efficiencies gained from spring fertilization?

Fertilizers today are much lower in cost, as compared to the general price level than ever before. In the last 20 years, fertilizer cost has increased only approximately 10%, while feed costs have gone up 100%, farm machinery 116%, farm labor 346%!

Lower cost fertilizer means a farmer has much greater flexibility in the time and rate of fertilizer use. It means fertilizer can be substituted for labor or other cost items to a much greater extent than ever before. So even if it requires 10% more fertilizer in fall to grow

TYPICAL CROP FERTILIZATION PERIODS AND OPPORTUNITIES TO EXPAND "OFF SEASON" USE



the same yield, it may still be much more profitable if it will allow the farmer to hire less labor the following spring.

This does not mean eliminate all spring fertilization such as starter fertilizers or sidedressing. However, higher rates of fertilizer use each year are a statistical fact. Many top farmers are reaching the point where it is no longer possible to apply all the fertilizer in the row without danger of crop injury, even with modern equipment. Some of this fertilizer must be applied before planting, and fall applications should be seriously considered in many areas.

SPOON-FEEDING CONCEPT NOW OLD-FASHIONED

More farmers today are also looking at crop fertilization in a new light. The concept of "feeding the soil" is replacing the old fashioned idea of "spoon-feeding the crop." Farmers find that if the soil is well supplied with nutrients, the crops growing on that soil will usually be well fed.

Uniform distribution throughout the soil increases accessibility of

SOME ADVANTAGES OF FALL FERTILIZATION

1. Fertilizer supplies are adequate and reasonably priced.
2. Minerals and lime have time to react and distribute through soil.
3. Weather and soil conditions are usually good.
4. Custom operators are less busy.
5. Spring labor peak is reduced thereby saving time and money.
6. Grain and forage crops are strengthened to withstand the effects of winter.
7. Soil laboratories are less busy, thereby giving better and quicker soil testing service.
8. MOST IMPORTANT—*The nutrients to grow a profitable crop will be there when needed, if for some reason fertilizer cannot be applied in the spring.*

Here are a few specific places where fall fertilization works best:

1. Preparing seedbeds for winter grains.
2. New seedings of alfalfa and grass forage.
3. Topdressing existing pasture and forage fields.
4. On crop residue to be fall plowed.
5. Before seeding winter cover crops.
6. Any land going into field crops or forage next spring.

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nutrients to the roots, particularly during droughts and certain other adverse weather conditions—providing a base for consistently higher, more profitable yields year after year.

Application of fertilizer for almost any crop grown can be shifted to fall and extended in length of time on all but light sandy soils if the "soil feeding" concept is followed.

● BULK APPLICATION BOOSTS SOIL BUILDING CONCEPT

The development of all types of bulk application equipment and custom services also makes fertilizer costs more reasonable and the soil building concept more practical.

With larger labor saving custom bulk spreading equipment available, the physical condition of the soil becomes as much a factor to consider in application as the time of year. Fall is usually ideal for bulk spreading equipment. Crops have been harvested, soil is dry and firm, and fertilizer is available in any quantities whenever needed.

THE END