RESEARCH PPI EDUCATION

# BETTER CROPS with plant food

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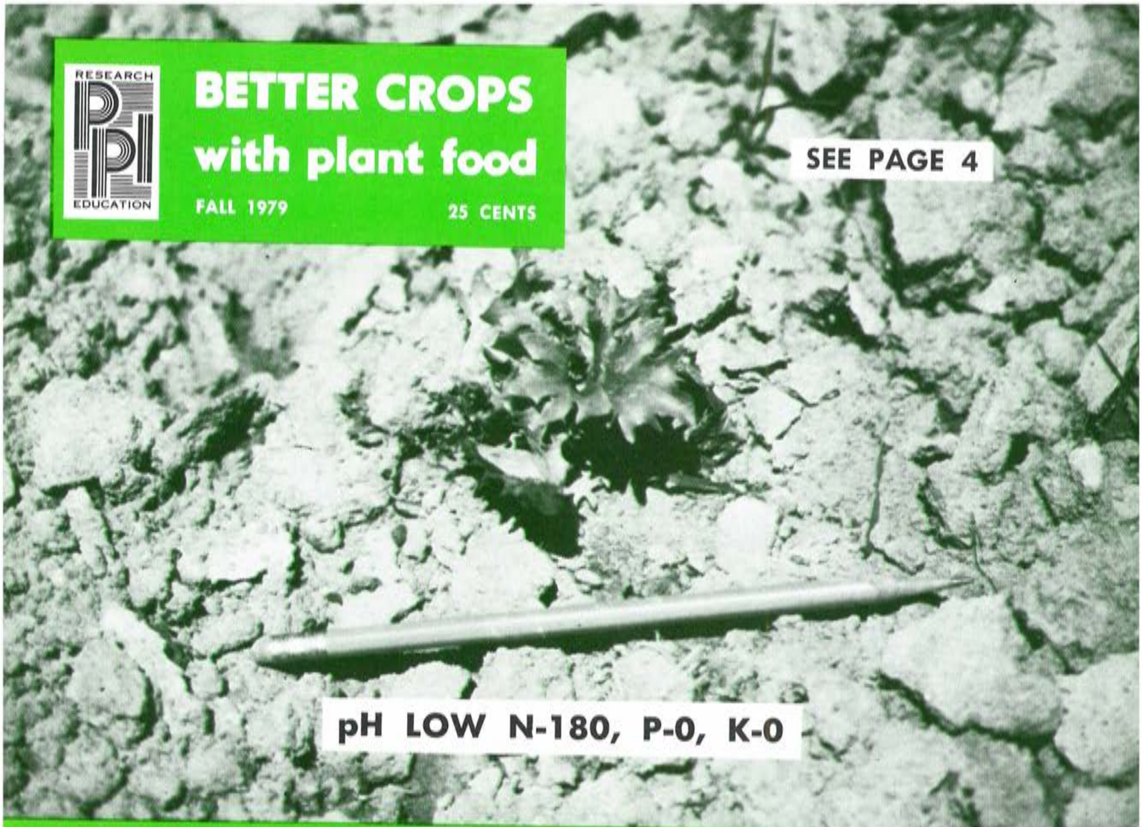

pH LOW N-180, P-0, K-0

pH HIGH N-60, P-100, K-150

**BETTER CROPS with plant food**

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# Contents

# Soil Management for Alfalfa

**L. S. ROBERTSON**
**Michigan State University**

**BARRING AN ACCIDENT** an alfalfa plant will live forever.

As partial proof of this statement, let's consider an alfalfa plant. The crown can have a circumference exceeding 2 feet. The circumference of the top of the root can reach almost 10 inches. The length of the root can penetrate the soil to a depth of 10 to 20 feet.

**SOME PLANTS** are more accident prone than others. Alfalfa grown in Michigan tends to have more accidents from insects, disease, drought, floods, and famine than alfalfa grown in some other parts of the nation.

What can we do to reduce the number and intensity of accidents in Michigan? The answer is basic. Create an environment of LESS STRESS from acid soils, too much or too little water, nutrient deficiencies, diseases, insects. etc.

Alfalfa grown in Michigan, especially on more sandy soils, does not yield well because of inadequate water supply. This explains partially why different soils have different yield potentials, shown in **Table 1.**

**SLOW DRAINAGE** is a problem on some soils. It is important to consider both surface and subsurface drainage patterns. Alfalfa suffocates when water ponds up in the lower parts of a field.

Water should be able to infiltrate surface soil at more than ½ inch per hour, subsurface soil at more than ¼ inch per hour.

If infiltration occurs more slowly than this, alfalfa will not likely survive for an extended period.

The best pH for alfalfa is somewhere between 6.7 and 7.0. While alfalfa grows well above 7.0, it does not pay to use enough lime to bring the pH to a level much above 6.7.

If a soil tests less than 6.7, use adequate lime. And remember lime is most effective applied several months before seeding, because it reacts very slowly with the soil.

**SOME MICHIGAN FARMERS** are producing as much as 8 tons alfalfa per acre. This 8-ton yield is possible only with high fertility levels.

Such a high yield removes tremendous quantities of plant nutrients from the soil. An 8-ton alfalfa crop removes as much as 94 lb phosphate, 401 lb potash, 151 lb calcium, 36 lb magnesium, 26 lb sulfur, and ½ to 1 lb boron.

With such high nutrient removals, alfalfa should be topdressed each year for high yields. Both fertilizer and lime rates should be based on soil test results.

**GOOD SOIL STRUCTURE** is a must for high alfalfa yields. Use minimum tillage. Don't till the soil any more than necessary to control weeds or break up a compact soil horizon.

Finally, band seed. This is the best way to place fertilizer into the soil and is good insurance against planting the seed too deep.

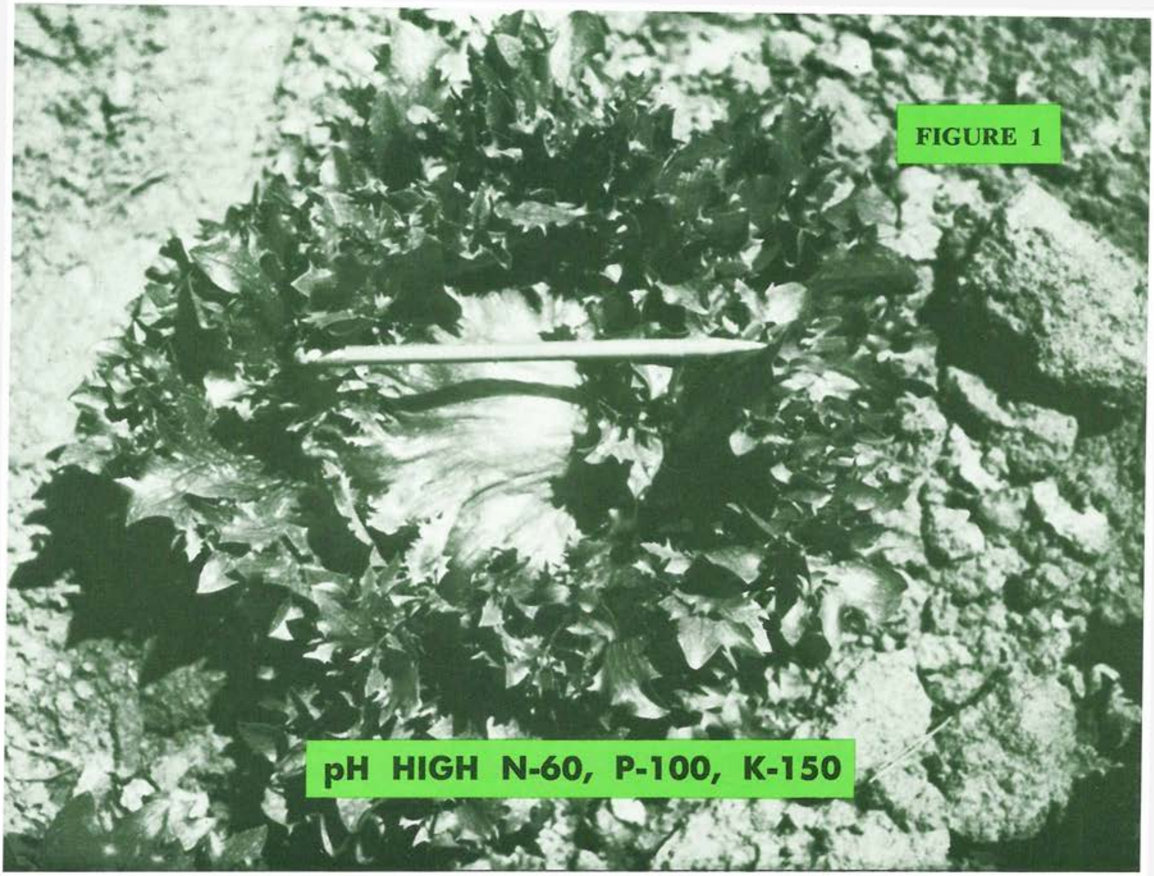
**IN SUMMARY,** grow this crop on good alfalfa soils, those with good water holding capacity. Drain the wet soils. Lime the acid soils. Fertilize the deficient soils. Use band seeding on a minimum tillage seed bed.

If you consider these points, you have taken a big step toward producing high yield over a long period of time. **The End**

**Table 1. Alfalfa Yield Potentials in Southern Michigan.[1]**

| Soil Management Group Soil Texture[2] | Total Yields 3 Cuttings T/A Natural Drainage[3] a | b | c |
|---|---|---|---|
| 0 — clays — 55% + | | | 3.8 |
| 1 — clays | 4.2 | 4.5 | 4.8 |
| 1.5 — clay loams | 5.0 | 5.0 | 6.0 |
| 2.5 — loams | 4.8 | 5.0 | 5.5 |
| 3 — sandy loams | 4.0 | 4.5 | 4.8 |
| 4 — loamy sands | 3.5 | 3.8 | 4.0 |
| 5 — sands | 3.0 | 3.5 | 3.8 |

[1]Long-time average yields.
[2]Texture of upper 3 feet of soil profile.
[3]a — naturally well drained soils — light colored.
b — naturally somewhat poorly drained — medium colored.
c — naturally poorly drained soils — dark colored.




# Liming and Fertilizing Lettuce Profitably

**JAMES W. PATERSON**
**Rutgers Research & Development Center**

**LIME AND FERTILIZER** work hand in hand for a high yield and profitable lettuce crop.

Direct-seeded (1977) and transplant (1978) lettuce trials were conducted at the Rutgers Research & Development Center on long-term fertility plots which had been established in 1970.

**Soil test results indicated high to very high soil phosphorus levels regardless of the previous treatments, while the K levels ranged from low to high, depending on previous potash applications.**

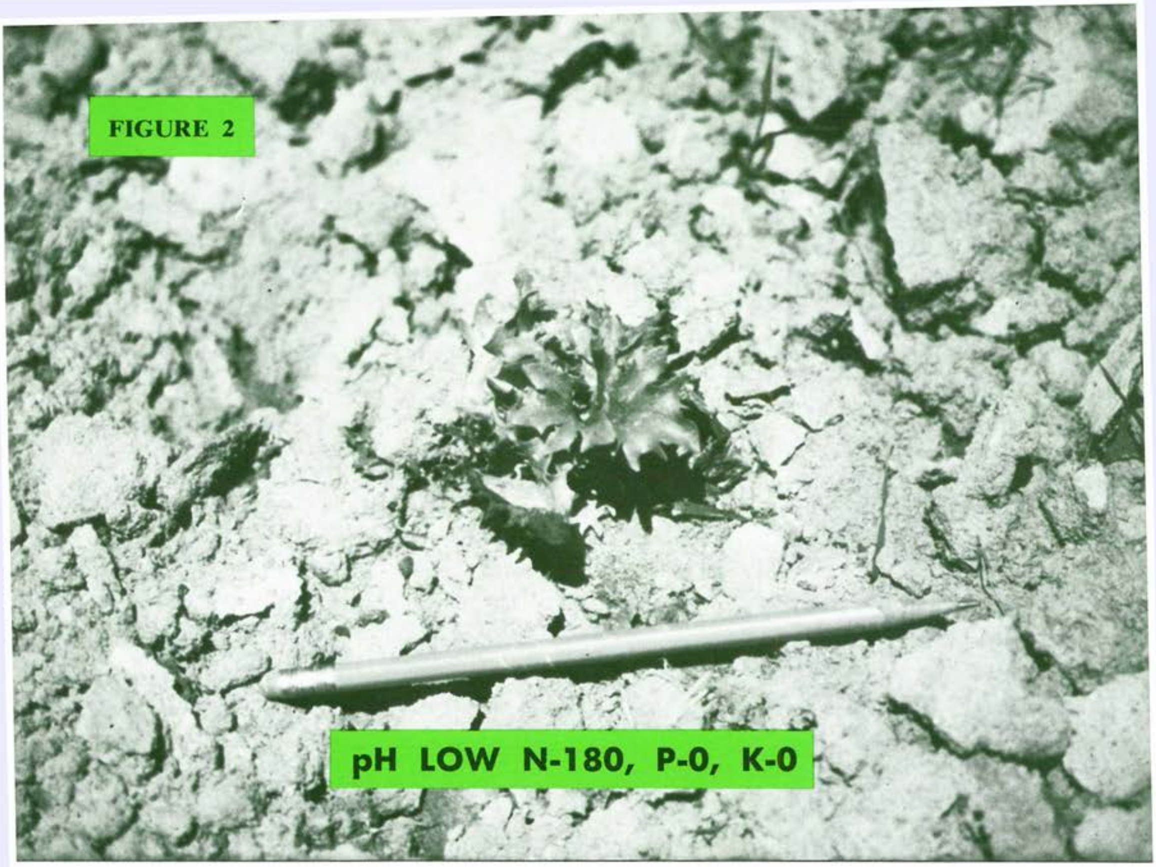
The pH ranged from 6.1 to 6.5 on limed plots and 4.8 to 5.7 on the unlimed areas.

Four rates of nitrogen, two rates of phosphorus, and three rates of potassium up to 180, 100, and 300 pounds per acre, respectively, were used.

Table 1 shows that 60 lbs/A nitrogen, 100 lbs $P_2O_5$ and 150 lbs $K_2O$ with lime was the optimum treatment in the 1977 direct-seeded experiment.

Balanced fertilization is essential for this high value crop. The optimum program returned $2,367.50 **per acre above the cost of the lime and fertilizer.**

**When phosphorus was omitted, even on these soils which tested high to very high, returns per acre dropped more than $1,000 per acre. Phosphorus not**




**only increased yields but also encouraged early plant responses and improved the quality of the lettuce.**

Yield differences due to phosphorus were not as large in the transplanted lettuce experiment in 1978, but it certainly would have been to the grower's advantage to supplement the soil with P.

**When potash was omitted from the fertility program, marketable lettuce yields dropped 8.1 tons from the optimum.** Thus, growing lettuce on soils testing low in potassium and then omitting K when everything else was adequate, would be a costly mistake.

It did not pay to add potassium above the 150 lb/A rate on soils already testing high.

Nitrogen rates above 60 lbs/A were not profiitable, as both the yield and

**Tab!e 1. Influence of Lime and Fertilizer on Seeded Head Lettuce Yields, Quality and Returns in 1977.**

| Treatment Selected | N | Pounds Per Acre $P_2O_5$ | $K_2O$ | Lime | Total Yield | Percent Harvestable | Marketable Yield | Return* Over Fertilizer & Lime |
|---|---|---|---|---|---|---|---|---|
| | | | | | T/A | % | T/A | $/A |
| Optimum | 60 | 100 | 150 | yes | 17.0 | 90 | 15.3 | 2,367.50 |
| Omit P | 60 | 0 | 150 | yes | 10.7 | 74 | 7.9 | 1,208.50 |
| Omit K | 60 | 100 | 0 | yes | 8.2 | 88 | 7.2 | 1,094.00 |
| Omit lime | 60 | 100 | 150 | no | 5.5 | 46 | 2.5 | 334.50 |
| Increase N | 180 | 100 | 150 | yes | 8.6 | 70 | 6.0 | 843.50 |
| Increase K | 60 | 100 | 300 | yes | 17.1 | 90 | 15.4 | 2,361.00 |

*Prices and costs used were: Nitrogen = $.30/lb; $P_2O_5$ = $.25/lb; $K_2O$ = $.15/lb; lime = $15/ton. Lettuce price = $8.00 cwt.

**Table 2 .Influence of Lime and Fertilizer on Seeded Head Lettuce Production, 1977.**

| Main Effects Across All Treatments | Total Yield | Percent Harvestable | Marketable Yield |
|---|---|---|---|
| | T/A | % | T/A |
| No lime | 2.5 | 30 | 0.75 |
| Lime | 9.6 | 71 | 6.82 |
| No phosphate | 4.2 | 40 | 1.68 |
| Phosphate | 8.0 | 61 | 4.88 |
| No potash | 4.7 | 50 | 2.35 |
| 150 potash | 7.1 | 54 | 3.83 |
| 300 potash | 6.4 | 48 | 3.07 |

quality of direct-seeded lettuce decreased above this rate.

**Liming practices had the greatest influence on yields and returns. When lime was omitted from an adequately fertilized area, yields were less than one-third of optimum and returns decreased more than $2,000 per acre.**

**Table 2** shows again the tremendous effect of lime and phosphorus on lettuce production. This table shows the main effects of lime, phosphate and potash as they are averaged across all treatments in this factorial experiment.

The low lime plots were almost devoid of marketable lettuce. Note the much lower yields in Table 2 versus Table 1. This points out the importance of putting the lime and fertility practices together in a balanced program (as shown by the optimum rate in Table 1) for top yie!ds and profits.

The limed plots were re-limed early in 1978 and soil sampled immediately after the lettuce was harvested in the middle of the year. As shown in Table 3, the pH of the soil was reduced as the rate of nitrogen was increased.

This reaction was much more dramatic on the unlimed soils, which have not received any lime since the establishment of the experiment. But if recommended amounts of lime are applied, as was done on the limed plots, you can correct and maintain a desirable pH of 6.0 to 6.5 with periodic lime applications on nitrogen fertilized soils.

Also noted in this table is the reduction in yield of head lettuce on unlimed soils as the rate of nitrogen increased and the soil pH decreased. The lower N rate, 60 lb/A, provided the best production of transplanted lettuce, just as was observed in the 1977 direct-seeded experiment.

**Figures 1 and 2** show what these lettuce plants looked like when extreme of high nitrogen and no lime is compared to the optimum balanced fertility plant.

Even though lime and fertilizer work hand in hand, it is much more preferable to lime first and then fertilize. Lime reacts slowly in the soil and should be applied well ahead of a lettuce crop, especially if the soil is quite acid.

By properly adjusting the soil pH initially the grower provides a medium for better plant nutrient utilization both from that already in the soil and from those applied.

**Balance is the key. Without it, a grower stands to lose not only the cost of all his inputs, but he could lose the entire crop. The End**

**Table 3. Influence of Preplant Nitrogen Applications on Soil pH and Transplanted Head Lettuce Production, 1978.**

| Applied | Soil Acidity, pH | | | Total Yield, T/A | | |
|---|---|---|---|---|---|---|
| Lb N/A | No Lime | Lime | Ave | No Lime | Lime | Ave |
| 0 | 5.7 | 6.5 | 6.1 | 6.0 | 7.1 | 6.6 |
| 60 | 5.4 | 6.3 | 5.8 | 6.1 | 9.9 | 8.0 |
| 120 | 5.0 | 6.3 | 5.6 | 3.6 | 8.9 | 6.3 |
| 180 | 4.8 | 6.1 | 5.4 | 2.7 | 9.0 | 5.9 |

# Alfalfa Yields and Stand Survival With Three Rates of Phosphorus and Potassium

**DALE SMITH and R. D. POWELL**
**University of Wisconsin**

**VERNAL ALFALFA** was seeded in the spring of 1972 on low K Plano silt loam soil at the Arlington Exp. Farm.

And potassium and phosphorus were topdressed that autumn. The rates were zero, 200, and 600 lbs/A of K (as KCl) in all combinations with zero, 20, and 40 lbs/A of P (as concentrated superphosphate).

No additional P was added, but the K rates were applied annually each autumn. The initial soil test of the top 6 inches of soil before topdressing showed 120 lbs/A of exchangeable K, 51 lbs/A of available P, and a pH of 6.7.

Other soil elements were sufficient for growing alfalfa, including sulfur and boron.

The plots were harvested three times at first flower in 1973 and in 1974. Fertilization with P had no significant influence on hay yields, but **yields were increased significantly with K.**

In the first harvest year, maximum hay yield was obtained with the first increment of K (200 lbs/A).

In the second harvest year, yields were increased significantly with each increase in K applied and maximum yield was obtained with 600 lbs/A of K applied annually.

**ALFALFA STANDS** were injured badly during the winter of 1974-75 because of a lack of snow cover. As a result, only a first harvest was taken in 1975 at first flower in June. And stand estimates were made on the recovery growth.

Again, fertilization with P had no significant influence on residual yields or stands. The influence of K fertilization was dramatic.

Alfalfa stands with no K fertilization were killed completely **(Table 1).** Residual yields and stands increased with each increase in K applied.

These data continue to confirm that high levels of soil K are needed for stand survival as well as for high hay yields.

Wisconsin recommendations now call for an herbage tissue test of K of near 3.00% at first flower and a soil test for exchangeable K of no less than 350 to 400 lbs/A at the end of the crop season where high yields of quality herbage are expected. **The End**

(Wisconsin Agric. Exp. Sta. Bull. R1741, 1977)

**Table 1. Residual Herbage Yields Harvested at First Flower in June of the Third Harvest Year (1975) and Final Stand Estimates.**

| Applied K | Applied P | Herbage Yield | Stand Remaining[1] |
|---|---|---|---|
| Lbs/A/Yr | Seeding Yr. | Tons/A | % |
| 0 | 0 | 0 | 0 |
| 0 | 20 | 0 | 0 |
| 0 | 40 | 0 | 0 |
| | Avg. | 0 | 0 |
| 200 | 0 | 0.15 | 14 |
| 200 | 20 | 0.74 | 21 |
| 200 | 40 | 0.71 | 22 |
| | Avg. | 0.53 | 19 |
| 600 | 0 | 0.74 | 36 |
| 600 | 20 | 1.09 | 38 |
| 600 | 40 | 1.20 | 38 |
| | Avg. | 1.01 | 37 |
| LSD, 0.05 | | 0.71 | 21 |
| 0.10 | | 0.59 | 17 |

[1]Based on a full stand as 100%.

# The Value of Soil Testing to Mississippi Growers

**L. E. GHOLSTON & F. P. RASBERRY**
**Mississippi State University**

**FARMERS WHO PRACTICE** soil testing regularly can improve their soil fertility management, generally get greater crop yields and higher returns per acre. And the fertilizer industry has grown to meet their needs.

In its first 30 years, the Mississippi Extension Soil Testing Department analyzed 899,791 soil samples from 8,888,371 acres of 130,933 growers—from 1948 through 1978.

During this 30 years of soil testing work, commercial fertilizer use increased 74%. But phosphorus and potash use increased much more rapidly as farmers turned to more and more high analysis fertilizer—nitrogen use up almost three times (280%), phosphate more than doubled (105%), and potash about quadrupled (380%).

**Table 1** summarizes the soil test data for the 30-year period. These samples represent about 9 million acres of cropland. It may be further noted that the annual average soil sample load during this period amounts to about 25,000 samples.

This compared with an average annual soil sample load of almost 53,000 during the last five years. Growers serviced and crop acreage tested have respectively tripled and quadrupled.

Over the years what have these numbers meant to fertilizer usage and farm receipts?

**FERTILIZER USAGE HAS SOARED. Table 2** shows commercial fertilizer tonnage increased approximately 74% in the 30 years. But this is only a small part of the fertilizer usage story during that 30-year period.

Low analysis fertilizers, such as 5-10-5, 6-8-4, and 6-8-8 have largely given way to higher analysis grades, such as 13-13-13, 12-24-24, 5-10-20, and 5-15-30.

The heavy use of commercial fertilizer has not only helped growers to increase crop yield, but has also helped them to build the fertility of agricultural soils.

**Table 1. Summary of Soil Test Data for the Thirty-Year Period**
**July 1, 1948-June 30, 1978**
**By the Extension Soil Testing Department**

| Years | Total Samples | Total Growers | Total Acreage | Mean Samples | Mean Growers | Mean Acreage |
|---|---|---|---|---|---|---|
| 1948-72 | 636,328 | 87,563 | 4,898,498 | 25,453 | 3,503 | 195,940 |
| 1973 | 29,752 | 6,263 | 497,070 | | | |
| 1974 | 48,642 | 8,749 | 515,905 | | | |
| 1975 | 49,145 | 9,122 | 481,373 | | | |
| 1976 | 75,704 | 8,991 | 1,291,125 | | | |
| 1977 | 60,220 | 10,245 | 1,204,400 | | | |
| 1972-77 | 263,463 | 43,370 | 3,989,873 | 52,693 | 8,674 | 797,975 |
| 1948-77 | 899,791 | 130,933 | 8,888,371 | 29,993 | 4,364 | 296,279 |

**Table 2. Fertilizer Usage on Mississippi Farms for Indicated Five-Year Periods**

| Years | Amount of Fertilizer Tons | Mean | Change |
|---|---|---|---|
| 1943 | 509,000 | | |
| 1944 | 456,000 | | |
| 1945 | 537,000 | | |
| 1946 | 477,000 | | |
| 1947 | 532,000 | | |
| 1943-47 | | 502,200 | |
| 1973 | 899,000 | | |
| 1974 | 966,000 | | |
| 1975 | 763,000 | | |
| 1976 | 842,000 | | |
| 1977 | 904,000 | | |
| 1973-77 | | 874,800 | +74 |

**SOIL FERTILITY LEVELS** are helped. In the early 50's cotton and corn were the major row crops grown in the state. In the meantime, a majority of the corn acreage and some of the cotton acreage had been diverted to soybeans.

**Table 3** shows at the end of the 5-year period, 1951-55, about 60% of the cotton and corn soils were rated low in phosphorus and potash by soil tests. The fertility status of cropland soils improved during the following 22 years ending in 1977, as the table shows.

Note the primary need for the 1:1 P-K ratio in mixed fertilizers for the principal row crops during the early to mid-1950's. Then note how this need has changed in favor of 2:3, 1:2, and 1:3 P-K ratios for today's fertilization of the row crops—especially for forage, hay, and silage crops now produced in the state.

The Extension Soil Testing Department deserves primary credit for pointing up the changing need in kinds of commercial fertilizer for agricultural production in the state during the mid to late-1970's.

**Table 4. The Value of Agricultural Production in Mississippi for Indicated Five-Year Periods**

| Years | Value of Farm Production* ($1,000) | Mean | Change % |
|---|---|---|---|
| 1943 | 423,151 | | |
| 1944 | 473,466 | | |
| 1945 | 438,362 | | |
| 1946 | 426,797 | | |
| 1947 | 630,104 | | |
| 1943-47 | | 478,376 | |
| 1973 | 1,679,421 | | |
| 1974 | 1,535,027 | | |
| 1975 | 1,375,615 | | |
| 1976 | 1,771,579 | | |
| 1977 | 1,774,579 | | |
| 1973-77 | | 1,627,315 | +340 |

*Dollar value of farm production includes estimated value of products consumed at home and cash receipts for crops, livestock, and government payments.

**WHAT ABOUT DOLLAR VALUE** of farm production? **Table 4** shows how the value of Mississippi farm production increased 340%, about three and a half times, during the 30-year period of 1947-77.

The average value of farm income amounted to just over $478,000,000 during the period 1943-47 and increased to $1,627,000,000 for the 5-year period ending in 1977.

It is interesting to note the increase in the value of farm production seems to parallel closely the improvement in soil fertility practices. This resulted in the rapid increase in use of mixed fertilizers and fertilizer materials by growers during the 1960's and 70's. **The End**

**Table 3. Percentage of Soil Samples According to Crops Occurring in Various Phosphorus and Potash Response Ranges for Indicated Five-Year Periods**

| Years | Crop | Phosphorus | | | Potassium | | |
|---|---|---|---|---|---|---|---|
| | | L | M | H | L | M | H |
| 1951-55 | Cotton | 64% | 19% | 17% | 59% | 28% | 13% |
| | Corn | 60% | 17% | 13% | 67% | 20% | 13% |
| 1973-77 | Cotton | 9% | 26% | 65% | 19% | 33% | 48% |
| | Feed Grain | 26% | 29% | 45% | 48% | 28% | 24% |
| | Soybean | 21% | 27% | 52% | 29% | 28% | 43% |

# What About The Quality of Soil Samples?

**SOIL TESTING** may be divided into four phases: **(1) Collecting the sample. (2) Extracting and determining the available nutrients. (3) Interpreting the analytical results. (4) Formulating the fertilizer recommendations.**

The quality of the first phase—**collecting the soil sample**—will determine whether the other three phases are really useful. The error potential in taking a soil sample is usually far greater than that associated with chemical analysis.

Today, especially where fertilizers have been band-applied or broadcast by tailgate spinner trucks, large differences are often found in the nutrient levels taken from different parts of the same field.

These differences are usually variations in fertility patterns, not in sampling or testing errors. Wide test variations within a field pose the problem of determining or judging whether a single fertilizer can be prescribed for the entire field or whether the variations are so great that different recommendations are required for different parts of the field.

**THE TABLES** are a summary of the Soil Testing laboratory's results as obtained from samples collected by Dr. Lyle E. Nelson's Agronomy Soils laboratory class at Mississippi State University.

Two cores were taken from each of ten locations in the field. One core was placed in the composite sample and the other core was boxed individually for analysis. This meant each composite sample was ten cores. And there were either forty or sixty individual cores among sampling days.

**Table 1. Soil Sample Core Collections — pH**

| Procedure | No. of Cores | pH — Lab Section M1 | T1 | T11 | W1 | W11 | TH1 | Ave. |
|---|---|---|---|---|---|---|---|---|
| Recommended Composite | 10 | 5.2 | 5.3 | 5.3 | 5.45 | 5.65 | 5.45 | 5.39 |
| Individual Cores | 1 | 5.4 | 5.4 | 5.4 | 5.65 | 5.4 | 5.7 | |
| | 1 | 5.2 | 5.4 | 5.3 | 5.45 | 5.4 | 5.4 | |
| | 1 | 5.4 | 5.4 | 5.4 | 5.4 | 5.8 | 5.65 | |
| | 1 | 5.2 | 5.4 | 5.45 | 5.55 | 5.7 | 5.7 | |
| | 1 | 5.4 | 5.7 | 5.3 | 5.7 | 5.7 | 5.7 | |
| | 1 | 5.25 | 5.3 | 5.4 | 5.4 | 5.1 | 5.45 | |
| | 1 | 5.2 | 5.2 | 5.3 | 5.4 | 5.8 | 5.7 | |
| | 1 | 5.45 | 5.3 | 5.4 | 5.45 | 5.65 | 5.4 | |
| | 1 | 5.65 | 5.65 | 5.3 | 5.4 | 5.2 | 5.4 | |
| | 1 | 5.4 | 5.4 | 5.3 | 5.65 | 5.1 | 5.65 | |
| Means for Individual Cores | | 5.35 | 5.41 | 5.35 | 5.50 | 5.48 | 5.57 | 5.44 |

**Table 1** shows no significant differences in the day means. The range for the six days combined is from pH 5.1 to pH 5.8. The mean pH was 5.44. Of the 60 individual samples, 27, or 45%, were within $\pm$ 0.1 pH units of the mean. The composite samples compared well to the means for the individual cores.

Table 2. Soil Sample Core Collections — Lime.
Lime Requirement #/Acre X 1000

| Procedure | No. of Cores | Lime — Lab Section M1 | T1 | T11 | W1 | W11 | TH1 | Ave. |
|---|---|---|---|---|---|---|---|---|
| Recommended Composite | 10 | 4.1 | 3.5 | 3.5 | 3.9 | 3.4 | 3.8 | 3.7 |
| Individual Cores | 1 | 4.7 | 4.8 | 3.2 | 3.8 | 4.3 | 3.5 | |
| | 1 | 4.9 | 4.3 | 3.2 | 3.5 | 4.1 | 4.4 | |
| | 1 | 5.8 | 4.4 | 3.2 | 4.7 | 3.9 | 4.1 | |
| | 1 | 3.6 | 5.3 | 3.4 | 2.8 | 4.1 | 4.2 | |
| | 1 | 5.4 | 4.0 | 4.6 | 3.7 | 4.5 | 4.6 | |
| | 1 | 4.6 | 4.2 | 5.0 | 4.8 | 3.6 | 4.0 | |
| | 1 | 5.6 | 4.6 | 5.9 | 4.5 | 3.6 | 3.8 | |
| | 1 | 3.9 | 4.9 | 5.4 | 3.6 | 4.4 | 3.7 | |
| | 1 | 3.8 | 5.4 | 6.5 | 4.2 | 6.9 | 4.8 | |
| | 1 | 4.9 | 4.3 | 6.2 | 4.3 | 4.9 | 5.2 | |
| Means of Individual Cores | | 4.72 | 4.54 | 4.66 | 3.99 | 4.43 | 4.23 | 4.43 |

**Table 2** shows lime requirements for the composite and individual cores. The range is from 2,800 to 6,900 lbs/A. Of the 60 individual cores, 32, or 53%, fell within the 4,000 to 5,000 lbs/A range. The mean for this group was 4,430 lbs.

There seems to be a difference between the means of the individual cores and the corresponding composite samples. Due to the large variance within the 4-day samples, no significant differences could be found between days.

Table 3. Soil Sample Core Collections — Phosphorus.

| Procedure | No. of Cores | Available $P_2O_5$ — Lab Section M1 | M11 | TU | WED | Ave. |
|---|---|---|---|---|---|---|
| Recommended Composite | 10 | 165 | 69 | 141 | 77 | 112 |
| Individual Cores | 1 | 294 | 110 | 33 | 55 | |
| | 1 | 53 | 86 | 96 | 212 | |
| | 1 | 92 | 149 | 126 | 18 | |
| | 1 | 61 | 161 | 102 | 114 | |
| | 1 | 39 | 77 | 185 | 92 | |
| | 1 | 45 | 88 | 385 | 55 | |
| | 1 | 61 | 161 | 110 | 47 | |
| | 1 | 169 | 29 | 26 | 139 | |
| | 1 | 114 | 33 | 51 | 159 | |
| | 1 | 393 | 26 | 263 | 100 | |
| Means for Individual Cores | | 132 | 92 | 138 | 99 | 115 |

**Table 3** shows the phosphorus results. The range is from a low 26 lbs to a high of 393 lbs $P_2O_5$/A. The mean is 115 lbs $P_2O_5$/A or **medium.** Of the forty samples, 17, or 43%, were found to be in the medium range. The means for the individual cores compare well with the composite samples.

Table 4. Soil Sample Core Collections — Potassium.

| Procedure | No. of Cores | Exchangeable K Lab Section M1 | M11 | TU | WED | AVE. |
|---|---|---|---|---|---|---|
| Recommended Composite | 10 | 134 | 138 | 134 | 127 | 133 |
| Individual Cores | 1 | 78 | 151 | 138 | 124 | |
| | 1 | 96 | 82 | 207 | 127 | |
| | 1 | 170 | 140 | 127 | 167 | |
| | 1 | 138 | 227 | 190 | 104 | |
| | 1 | 114 | 151 | 190 | 104 | |
| | 1 | 114 | 127 | 82 | 116 | |
| | 1 | 54 | 207 | 108 | 116 | |
| | 1 | 216 | 157 | 134 | 170 | |
| | 1 | 154 | 127 | 192 | 89 | |
| | 1 | 248 | 116 | 112 | 183 | |
| Means for Individual Cores | | 138 | 149 | 148 | 127 | 141 |

**Table 4** shows the potassium results. The rate for the 40 individual cores is from 54 to 248 lbs/A of exchangeable potassium. The mean is 141 lbs/A or **low.** Of the 40 samples, 24, or 60%, are in the low range. The composite samples compared well with the means for individual cores.

These data suggest a minimum of 20 cores should be taken to represent 10 to 20-acre fields, when considering possible plant nutrient variation among individual cores.

When samples are taken from larger fields, the large field should be divided into 10 to 20-acre portions. Dividing large fields into smaller acreage and sampling by soil type are two important points to remember when soil sampling. As the number of cores in a soil sample increase, the more likely the sample will truly represent the field from which it was taken.

**IN SUMMARY.** Because of the variation of soil fertility patterns within a field, the soil test values of individual cores may vary widely.

For example, among 60 individual cores collected over a 6-day period, the soil pH's ranged from 5.1 to 5.8. The lime requirement on the same individual core samples varied from 2,800 to 6,900 lbs/A.

The phosphorus values among 40 cores collected over a 4-day period ran as low as 26 lbs/A to a high of 393 lbs per same area.

Soil test potassium varied from a low of 54 to a high of 248 lbs/A.

So, the data collected by Dr. Lyle E. Nelson's agronomy classes really shows the variation found in otherwise apparently uniform fields.

These data point to the need to keep recommended maintenance rates of P and K, especially for hay and silage crops, even at medium to high soil test values. **The End**

# Soybean Petiole Is Best for K Quick Test

**CLYDE EVANS**
**Auburn University**

**W. R. THOMPSON, JR.**
**Starkville, Mississippi**

**DURING SEVERAL YEARS,** soybean tissue tests have been evaluated in soil fertility experiments. Some of these results were reported in the Spring 1979 issue of **Better Crops** on page 10.

Those tests for both P and K were made on the pulvinis portion of the petiole. Results for P were well correlated with P treatments and yields but were not for K. The K appeared to be too high in K deficient plants. In a follow-up of this, the paper test for K was made on both the pulvinis and the midsection of petioles for comparison.

Results are given in **Table 1.**

The test on the petiole gives a wider range of values for the varying K treatments and appears to be rather well correlated with soil K treatment and with yields.

In all cases, the lower K rates showed "low" K in the petiole and it increased to "medium" or "high" where soil K was not limiting yields. In the previous tests, the pulvinis test for K indicated "medium" or "high" even when low soil K was limiting yields.

Apparently K accumulates in the pulvinis so that it is not a suitable plant part to test for K with the standards now being used. The spot concentrations in the papers either need to be adjusted for the pulvinis test or the mid portion of the petiole should be selected. **The End**

**Table 1. Petiole-Pulvinis Comparisons for Soybeans**

| | Soil Fertility Experiment | | | | | | Potato-Soybean Double Cropped | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8-6-75 | | | 7-27-76 | | | 7-27-76 | | | 8-6-75 | | |
| $K_2O$ Rate | Pulvinis | Petiole | Yield | Pulvinis | Petiole | Yield | Pulvinis | Petiole | Yield | Pulvinis | Petiole | Yield |
| 0 | H | L+ | 20.2 | M | L | 33.5 | M | L | 35.9 | H | L | 35.8 |
| 25 | M | L+ | 21.2 | H– | M– | 31.1 | | | | | | |
| 50 | H | M+ | 24.6 | H– | M | 28.5 | H– | L– | 39.2 | | | |
| 100 | H– | H | 30.7 | H | H | 28.4 | H | M | 42.7 | | | |
| 150 | | | | | | | H | M | 44.2 | H | H | 40.4 |

*Table 1. Residual and Annual Phosphorus, Black Belt Substation.

| $P_2O_5$ Applied 1968 | $P_2O_5$ Applied Annually 1969-71 | Soil Test P 1971 | Tissue-Tests Early Bloom | Tissue-Tests Late Bloom | Soybean Yields Bu. |
|---|---|---|---|---|---|
| 0 | 0 | Very Low | L | L— | 21 |
| 0 | 25 | Very Low | L+ | L+ | 33 |
| 0 | 90 | Low | M | M— | 36 |
| 275 | 90 | Medium | M+ | M | 39 |
| 550 | 90 | Medium | H— | H— | 44 |

Table 2. Annual Application of Phosphorus and Potassium, Gulf Coast Substation.

| Rate Applied $P_2O_5$ | Tissue Tests Early Bloom | Tissue Tests Late Bloom | Soybean Yields Bu. |
|---|---|---|---|
| 0 | VL | L— | 8 |
| 25 | L— | L | 24 |
| 45 | L | M— | 37 |
| 90 | H— | H— | 49 |
| $K_2O$ | | | |
| 0 | M | H | 34 |
| 25 | H | H | 36 |
| 50 | H | H | 41 |
| 100 | H | H | 49 |

Table 3. Residual Phosphorus on Hartsells Fine Sandy Loam, Sand Mountain Substation.

| Soil Test P | Tissue Tests Mid-bloom | Yield Bu. |
|---|---|---|
| Low | L | 24 |
| Low | M+ | 45 |
| Medium | H | 50 |

***Editor's Note:** In the Spring issue of this magazine, we featured an article on "Tissue Tests for Soybeans," by Drs. Clyde Evans and W. R. Thompson, Jr. At that time, three tables were inadvertently omitted. They are presented here. See *Better Crops,* Spring 1979, p. 10 for article.


**WHAT A SHAME!** A class of bright high school students, receiving thousands of dollars in collegiate scholarships among them, were told to be happy with their limitations in this 7th decade of the 20th century.

The father who told me this was unhappy with such advice to his promising son. The son was unhappy with such counsel at this point in his life.

A few years ago I sat through a similar monotone that lifted young graduates nowhere, indeed pressed them and all of us parents further into our seats with boredom.

We went away that night with a vague, uneasy feeling about the future—not our future, but their future, those career-bound youngsters.

There ought to be a law against such a speaker on such an occasion. A monotonous peddler of pessimism to eager young minds, many of them more talented in their tender years than the tired old peddler.

**Such peddlers remind me of the speaker nature gave silver hair to look distinguished and hemorrhoids to look concerned.**

They also remind me of the breed who would have us go back to the "good old days."

As everyone knows, the "good old days" are a relative time to each generation—usually a younger, earlier day.

There are some, including speakers to high school students apparently, who must think our civilization is in the winter of its time. I can't believe that. I think spring has just begun—and that I was born 57 years too soon.

Besides, who really wants to go back, when they think of it?

**In agriculture, specialists tell us, it would take 20 years to produce 61,000,000 horses and mules to carry us back to the good old days. Not to mention half the present farm land to feed them and 27,000,000 additional farm workers to use them.**

We can't go back—in agriculture—not with 250,000,000 mouths soon to feed.

Again, who really wants to go back with the greatest harvest in history flowing in.

America's ultimate wealth is in its food supply. There has never been anything to match it in the history of man. It is so successful and so mammoth that when people talk about it, the figures loom so large that a humble mind like mine can't take them in fully.

For example, it has been said some of those $100,000 combines can cough up $118,000 worth of soybeans in a day. And the corn would fill 2,000,000 jumbo hopper cars, stretching across the nation.

For example, it has been said all those great harvesting machines, if lined up wheel to wheel, could harvest Iowa in a day.

And it has been estimated the U.S. crop will be worth $61 billion this year, or 17% more than last year's record.

**American agriculture uses only 3% of our energy to produce this massive supply of food and fiber. And exports enough to pay for more than two-thirds of our energy imports in a recent year.**

Maybe high school students need more speakers in whom the spark of enthusiasm for such accomplishments burns fervently.

Many years ago—in the depressed 30's—I learned to drive by driving a remarkable speaker hundreds of miles, sometimes down unpaved roads, to high schools where his speeches to the students and their parents filled the auditoriums.

Twenty years later I met a leader who remembered being on the student committee to invite that speaker to his high school in the dark hours of the Great Depression.

He remembered the speaker and some of the points—in a day when going to college seemed out of the question.

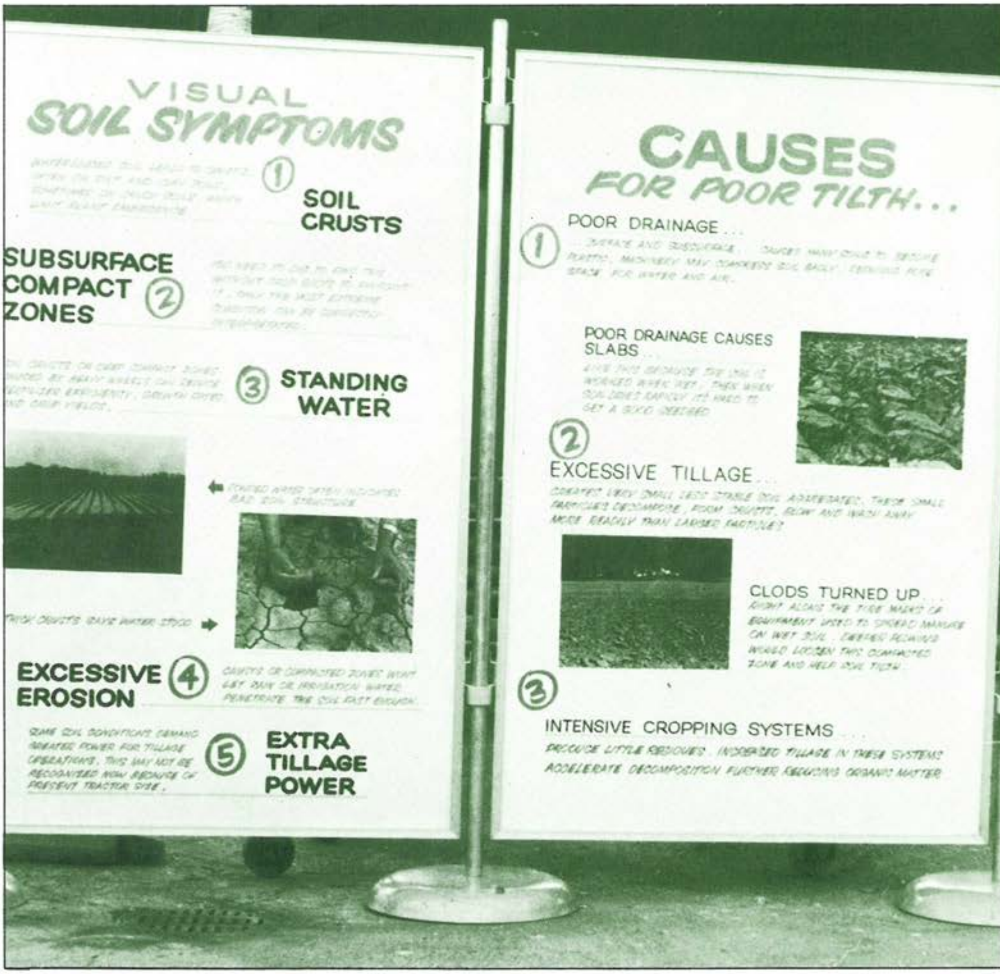
Yet, many of the students and parents went away from that speech in that dark hour believing there might be a way, just might be a way to get into college.

I came to know that speaker well on those trips. **And WHAT he said was half of his secret. The WAY he said it was the other half.**

I realize we have speaking aids today. Sophisticated tools to help the speaker.

But today's youngsters may be hungry for speakers who can hold them spellbound for 30 minutes with only two tools—WHAT they say and HOW they say it.

The speaker I had the opportunity to drive never mentioned their limitations, only their expectations. The impossible being possible. And the evidence of it all in both history and around them in their day.




# Poor Soil Tilth: Visual and Plant

This is an adaptation of a Michigan State University exhibit designed by Dr. Donald R. Christenson. The narrative is based on the writings of Dr. L. S. Robertson.

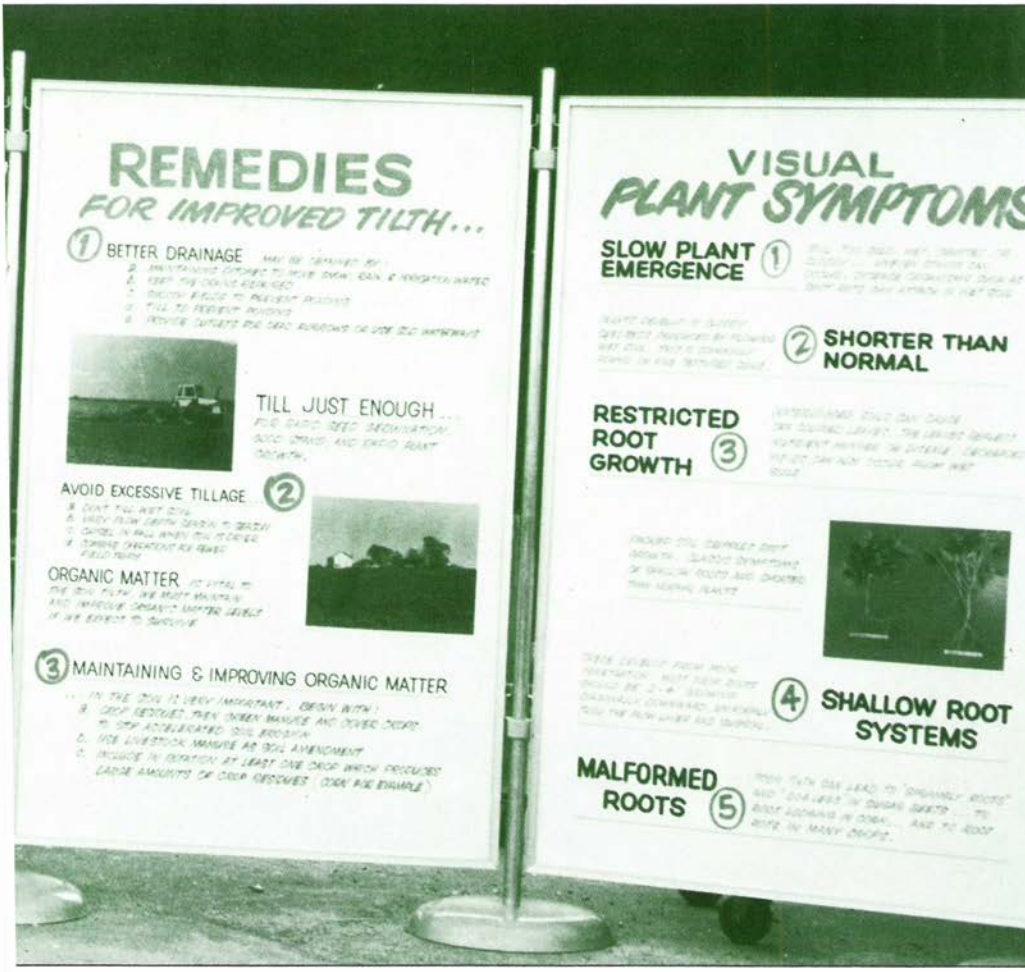
**VISUAL SOIL SYMPTOMS:**

1. **Soil Crusts.** Waterlogged soil leads to crusts, often on silt and clay soils, sometimes on sandy soils, which limit plant emergence.

2. **Subsurface Compact Zones.** You need to dig to find this. Without crop roots to pinpoint it, only the most extreme condition can be correctly interpreted.

3. **Standing Water.** Soil crusts or deep compact zones caused by heavy wheels can reduce fertilizer efficiency, growth rate, and crop yields. Ponded water often indicates bad soil structure. Thick crust says water stood.

4. **Excessive Erosion.** Crusts or compacted zones won't let rain or irrigation water penetrate soil fast enough.




# Symptoms, Causes, and Remedies

5. **Extra Tillage Power.** Some soil conditions demand greater power for tillage operations. This may not be recognized now because of present tractor size.

**CAUSES FOR POOR TILTH:**

1. **Poor Drainage** . . . surface and subsurface . . causes many soils to become plastic. Machinery may compress soil badly, reducing pore space for water and air. Poor drainage causes slabs because the soil is worked when wet. Then when soil dries rapidly, it's hard to get a good seed bed.

2. **Excessive Tillage** creates very small, less stable soil aggregates. These small particles decompose, form crusts, blow and wash away more readily than larger particles. Clods turn up right along with the tire marks of equipment used to spread manure on wet soil. Deeper plowing would loosen this compacted zone and help soil tilth.

3. **Intensive Cropping Systems** produce little residues. Increased tillage in

these systems accelerate decomposition, further reducing organic matter.

**REMEDIES FOR IMPROVED TILTH:**

1. **Better Drainage** may be obtained by maintaining ditches to move snow, rain, and irrigation water . . . keeping the drains repaired . . . smoothing fields to prevent ponding . . . tilling to prevent ponding . . . providing outlets for dead furrows or using sod waterways. Till just enough for rapid seed germination, good stand, and rapid plant growth.

2. **Avoid Excessive Tillage.** Don't till wet soil. Vary plow depth season to season. Chisel in fall when soil is drier. Combine operations for fewer field trips. Organic matter is vital to the soil tilth. We must maintain and improve organic matter levels if we expect to survive.

3. **Maintaining and Improving Organic Matter** in the soil is very important. Begin with crop residues, then green manure and cover crops to stop accelerated soil erosion . . . use livestock manure as soil amendment . . . include in rotation at least one crop which produces large amounts of crop residues (corn for example).

**VISUAL PLANT SYMPTOMS:**

1. **Slow Plant Emergence**. Soil too cold, wet, crusted, or cloddy . . . uneven stands can occur. Disease organisms such as root rots can attack in wet soil.

2. **Shorter Than Normal.** Plants develop in cloddy seedbeds produced by plowing in wet soil. This is commonly found on fine textured soils.

3. **Restricted Root Growth.** Waterlogged soils can cause off colored leaves. The leaves reflect nutrient hunger or disease. Decreased yields can also occur from wet soils.

Packed soil cripples root growth. Classic symptoms are shallow roots and shorter than normal plants.

4. **Shallow Root Systems.** These develop from poor penetration. Most crop roots should be 2-4′ growing diagonally downward, uniformly through the plow layer and subsoil.

5. **Malformed Roots.** Poor tilth can lead to "sprangly roots" and "dog legs" in sugar beets . . . to root lodging in corn . . . and to root rots in many crops.

**The End**

# BOOST PROFITS

## UPDATE YOUR 1980'S DECADE FERTILIZATION NOW!

# in 1980!

**"I notice a consistent pattern among the highest profit farmers. They use production practices that are at least 5 years ahead of the average farmer."**

**Economist John Marten**

WEST LAFAYETTE, IN—To boost 1980 profits, farmers must be sure they use updated 1980's fertilization practices, Dr. John Marten, Staff Economist of Farm Journal, emphasizes.

Dr. Marten says strong grain prices, more nutrient removal because of 1979 record yields, higher yield potential, related cuts in cost per bushel, and more efficient energy use justify this approach in 1980.

He expects average U. S. farm prices of at least \$2.50 for corn, \$6.50 for soybeans, and \$3.50 for wheat.

In a candid discussion, Dr. Marten and Dr. Werner Nelson, Senior Vice President of the Potash & Phosphate Institute, faced some vital agro-economic questions for today's growers. And they did not hedge.

**1. What do you think is the picture in 1980 for grain demand and its effect on fertilizer use?**

Good. World demand and prices for U. S. grains will remain strong in 1980. New yearly export records for corn, wheat, cotton, and soybeans seem likely in the current marketing year.

John F. Marten
Staff Economist
FARM JOURNAL

"Sharp growers recognize higher yields mean higher profits. Extra fertilizer boosts profits by cutting costs per bushel—not cost per acre."

"Sharp growers recognize fertility buildup programs will be cheaper today than tomorrow in our inflationary economy."

"Sharp growers plan higher yields. They know fertility is probably the easiest yield limiting factor to change, and tomorrow's higher yields will require even more soil nutrients."

So, the grain surplus problems which depressed prices in 1977 and 78 are behind. Profit prospects look good in the years ahead for top managers who recognize high fertility as a cornerstone of crop profits. High yields from fertilization cut cost per bushel and boost profits.

**2. How do you feel about the increased yield potential?**

Crop yields could and should be much higher than they are. Many farmers consistently produce yields well above their neighbors. Many are in the 180-200 bu corn and 50-65 bu soybean range.

The Fayette County, Ohio Corn and Soybean Clubs tell the story. Compare their 1976-78 average with the Ohio average:

| | Fayette County Corn Club | Ohio |
|---|---|---|
| **Yield, bu/A** | 161 | 104 |
| **$N$-$P_2O_5$-$K_2O$, lb/A** | 182-95-139 | 126-85-91 |
| **Plants/A** | 23,100 | 19,900 (1978) |
| **Soil test** | 86 P, 338 K | 41 P, 216 K (1976) |

| | Fayette County Soybean Club | Ohio |
|---|---|---|
| **Yield,bu/A** | 52 | 34 |
| **$N$-$P_2O_5$-$K_2O$, lb/A** | 7-28-81 | 12-41-48 |
| **Soil test** | 65 P, 328 K | 41 P, 216 K (1976) |

Many factors cause these differences. But soil fertility and fertilizer are important keys.

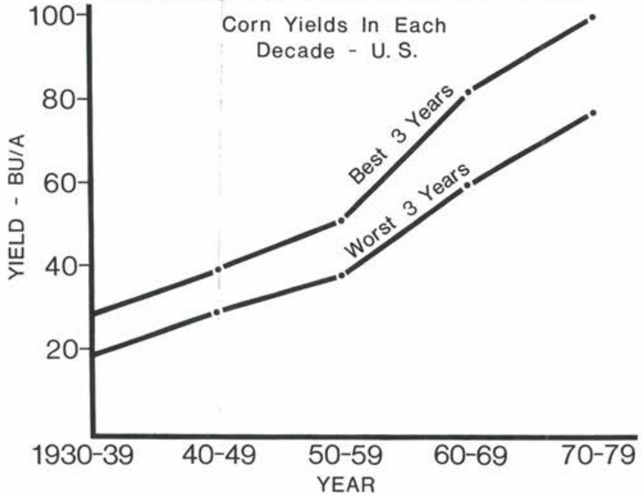
**3. Do good management practices prepare the farmer for good and bad years?**

Yes. Look at the U. S. chart for average corn yields, comparing the 3 best years with the 3 worst years in each decade, prepared by Dr. David Dibb of PPI.

Management has improved over the years. The farmer must be ready to take advantage of those good years and do better in poor years. Strong fertilization doesn't guarantee high yields, because many other factors enter in. But a weak fertility program guarantees low yields.

Average managers are probably using less fertilizer than they should. But even good managers are generally using less than they should.

Be Ready For Best & Worst Years



**4. What do you consider to be the main limiting factors in corn production?**

High yields demand many steps. But recent high yield surveys have shown higher yields were associated especially with higher plant populations and higher N rates. Here is an example from a Florida experiment. Increasing plant population necessitated a higher N rate. Population and fertilizer work together to give higher yield.

| Plant population | Optimum rate of N | Corn yield |
|---|---|---|
| plants/A | lb/A | bu/A |
| 12,000 | 135 | 159 |
| 24,000 | 160 | 202 |
| 36,000 | 240 | 231 |

A survey of 549 top farmers growing over 200 bu/A corn showed the following averages: Yield, 218 bu. Plant population, 25,500. Fertilization, 220 lb N, 95 lb $P_2O_5$, 109 lb $K_2O$/A. This gave .99 bu per lb of N. The U. S. has averaged .85 bu/lb the last 15 years.

As yields are increased, a greater stress is placed on the P and K soil supply and need for P and K increases. Inadequate water is potentially the most limiting factor, but good management helps overcome short term moisture stress.

**5. What are the main limiting factors in soybean production?**

Narrower rows, 7 to 10 inches, will usually give a quick 5 to 10 bu extra. Ohio found earlier planting helps just like corn: May 10, 49 bu; May 25, 43 bu; and June 10, 34 bu.

Better weed control, tillage, varieties, and lime levels all enter in. Once all these factors are taken care of, probability of response to fertilizer is even greater. I would fertilize soybeans with P and K just about like corn and work toward building P and K soil levels.

**6. What would you advise farmers thinking about reducing fertilizer rates because of higher prices?**

They should be thinking about the reverse: Increasing fertilizer rates because of increased yield potential and the relative price of fertilizer and corn and beans.

Fertilizer is a great buy today. For example, in the late 1960's, 80 bu of $1 corn would buy one ton of $80 $NH_3$. Today 80 bu of $2.50 corn will buy a ton of $200 $NH_3$.

Also, grain prices really don't affect optimum fertilizer rates very much. If the corn price drops from $3 to $2.50, the optimum rate drops very little, closer than most applicators can be set. A N test from Illinois and one on K from Iowa prove this point. Also note that doubling the N price from 12¢ to 24¢ drops the optimum rate only 16 lb/A:

| Corn price $/bu | Optimum N rate 12¢ N | Optimum N rate 24¢ N | Optimum $K_2O$ rate 10¢ $K_2O$-LM soil test |
|---|---|---|---|
| | lb/A | lb/A | lb/A |
| $3.00 | 192 | 178 | 140 |
| 2.50 | 189 | 172 | 130 |
| 2.00 | 182 | 166 | 115 |

**7. Do you mean farmers should forget about cutting costs?**

Not at all. I'm urging farmers to cut costs. Not cost per acre, but cost per bushel. This requires more bushels per acre. Let's look at some examples of how higher yields affected net return per acre and cost per bushel:

| N | Corn yield | Prod. cost | Net return | Cost of prod. |
|---|---|---|---|---|
| lb/A | bu/A | $/A | $/A | $/bu |
| 0 | 67 | $285 | -$117 | $4.25 |
| 60 | 100 | 301 | - 51 | 3.01 |
| 120 | 135 | 318 | 20 | 2.35 |
| 180 | 158 | 332 | 63 | 2.10 |
| 240 | 169 | 344 | 79 | 2.03 |
| 300 | 171 | 354 | 74 | 2.07 |

Corn $2.50 bu, N 16¢ lb, 20¢ bu for extra yield harvested. A typical guideline for the $285/A production cost includes $25 for $P_2O_5$, $K_2O$, lime; $20 for pesticide; $40 machine operation; $20 store, dry; $12 seed; $13 interest, $35 labor and management and $120 land.

With $2.50 corn, at 120 lb N the grower would realize $20/A profit and have a $2.35 cost per bu. Increasing N to 240 lb on this soil pushes profit to $79/A and cuts costs of production to $2.03/bu. Not only are there more bushels at the optimum rate, but the profit on each bushel is greater. **The average N rate on corn in U. S. in 1978 was only 120 lb/A!**

Soybean fertilization proved the same point. Higher potash rates increase net returns and cut costs/bu. On this medium K soil the highest rate, 120 lb $K_2O$, gave the highest yield. **The average $K_2O$ rate on soybeans in U. S. in 1978 was only 22 lb/A!**

| $K_2O$ | Bean yield | Prod. cost | Net return | Cost of prod. |
|---|---|---|---|---|
| lb/A | bu/A | $/A | $/A | $/bu |
| 0 | 49 | $250 | $ 69 | $5.10 |
| 40 | 52 | 255 | 83 | 4.90 |
| 80 | 54 | 260 | 91 | 4.81 |
| 120 | 57 | 266 | 105 | 4.66 |

Soybeans $6.50/bu, $K_2O$ 11¢/lb, 30¢ bu for extra yield harvested. Med. K soil.

Phosphate on Kansas wheat proved the same point. On this low P soil, the optimum rate was 40 lb $P_2O_5$/A. **The average $P_2O_5$ rate on wheat in U. S. in 1978 was only 13 lb/A!**

| $P_2O_5$ | Wheat yield | Prod. cost | Net return | Cost of prod. |
|---|---|---|---|---|
| lb/A | bu/A | $/A | $/A | $/bu |
| 0 | 35 | $150 | -$27 | $4.28 |
| 20 | 44 | 157 | - 3 | 3.56 |
| 30 | 49 | 160 | 12 | 3.26 |
| 40 | 57 | 164 | 36 | 2.85 |
| 50 | 57 | 167 | 33 | 2.91 |

Wheat $3.50/bu, $P_2O_5$ 22¢ lb, 25¢ per bu for extra yield harvested. Low P soil.

Much is made over the low returns in farming. The profit-boosting effect of adequate fertilizer speaks for itself.

**8. Should farmers be concerned about cutting energy costs?**
Of course. Less trips over the fields reduce fuel needs. But fertilizer influences energy efficiency, also. Not by cutting fertilizer or fuel use per acre, but by decreasing energy needs per bushel.

For example, $P_2O_5$ on this low P Kansas soil reduced moisture in the corn grain at harvest as well as increased yields. The reduced moisture reduced the cost of drying 3.6¢/bu in a two-year average:

| $P_2O_5$ lb/A | Yield of Corn bu/A | $H_2O$ in grain % | Drying cost ¢/bu |
|---|---|---|---|
| 0 | 149 | 23.3 | 15.6¢ |
| 40 | 176 | 21.5 | 12.0 |

Think of how adequate N rates increase the bushels of corn produced per gallon of fuel used in plowing, shown in this Illinois work:

| N lb/A | Corn yield bu/A | Bu/gallon of diesel fuel used in plowing bu/gal |
|---|---|---|
| 0 | 79 | 72 |
| 60 | 117 | 106 |
| 120 | 142 | 129 |
| 180 | 154 | 140 |
| 240 | 152 | 138 |

It takes just as much fuel to plow an acre for 117 bu as for 154 bu. Similar relationship could be shown for certain other inputs.

Dr. Nelson encourages dealers to work with a few customers who will set aside a few acres or part of a field for a few years to use all the best known crop production practices.

This helps establish the yield potentials. He feels both dealers and customers will be surprised at the yields obtained within five years. Management practices interact to affect each other. And effects are cumulative.

Dr. Marten emphasizes the farmer can increase his profits in 1980. And using 1980's fertilizer practices is an important key to get a big jump on his competition.

**Extra copies of the John Marten interview are available in popular folder form. 10¢ ea. for member companies, universities, and government agencies. 15¢ ea. for others. Write address on back cover.**

# Buildup Soil K Levels Before Shifting To Minimum Tillage

E. E. SCHULTE
University of Wisconsin

**CONSERVATION TILLAGE** is tilling just enough to prepare the soil for seeding or planting.

The whole idea of conservation tillage is to minimize the tillage needed to prepare the seedbed. So, it is sometimes called minimum tillage. Usually, it conserves energy, labor, soil and water, as well as dollars needed in land preparation.

Do minimum tillage practices change soil fertility or fertilizer requirements? This question is often asked. In early research on conservation tillage, soil fertility variables were not included.

So, we sought answers from a site where an NPK soil test calibration study had been conducted on corn from 1959 through 1965—7 years—using 0, 80, and 160 lbs of N, $P_2O_5$, and $K_2O$ per acre, in all combinations, with and without 40 + 40 + 40 lbs per acre of row fertilizer.

Corn was grown on these plots from 1966 through 1971—6 years—without additional fertilizer.

**TREATMENTS IN CURRENT WORK.** In spring, 1972, levels of nitrogen and potassium ($K_2O$) were broadcast at 0, 80, and 160 lb/A rates on the same plots as in the original study. No additional P was added because P soil tests were high.

The 40 + 40 + 40 row fertilizer was omitted, except in 1975, leaving twice the number of plots with 0, 80, and 160 lb N and $K_2O$ rates. From 1973 through 1976 one replicate was left unplowed, while the other was plowed conventionally.

In 1975, half of the plowed and unplowed plots was treated with 40 lb/A each of N, $P_2O_5$ and $K_2O$ applied in the row to determine the benefits of row fertilizer on corn yields and nutrient concentration of corn leaves when used with conservation tillage.

Each year both the plowed and unplowed areas were planted with a buffalo till planter.

The initial and final P and K soil test levels are shown in **Table 1.** The soil is a Plano silt loam.

**Table 1. Initial and Final P and K Soil Test Levels After Five Annual Applications of $K_2O$.**

| Annual Rates of $P_2O_5$ or $K_2O$* | Soil Test Level 1972 P | 1972 K | 1976 P | 1976 K |
|---|---|---|---|---|
| Lb/A | —Lb/A— | | | |
| 0 | 47 | 130 | 44 | 128 |
| 40 | 56 | 130 | 42 | 161 |
| 80 | 70 | 140 | 54 | 178 |
| 120 | 86 | 140 | 64 | 203 |
| 160 | 96 | 152 | 74 | 252 |
| 200 | 111 | 164 | 82 | 272 |

*40, 120 and 200 lb rates were applied in 1975.

**HOW DO TILLAGE AND N** affect corn yields and ear leaf N? **Table 2** shows how we can look at the effects of plowing and N on corn yields by averaging yields for a given level of N over all levels of other nutrients in the plowed and unplowed blocks.

Yield advantage from plowing and till planting is lowest on the plots without added N and increased with added N.

This indicates N did not decrease the yield-reducing effects of not plowing.

The N concentration of corn ear leaves at silking was significantly higher in the plowed plots only at the highest N rate (2.81 vs 2.64% N) in 1976.

**Table 2**

**Yield Differences Between Plowed and Unplowed Till-planted Corn with Added N.**

| N Applied Annually | Yield Loss from Not Plowing (plowed minus unplowed 4-yr. avg.) |
|---|---|
| Lb/A | Bu/A |
| 0 | 20.3 |
| 80 | 28.1 |
| 160 | 27.5 |

**HOW DO TILLAGE AND POTASH** affect corn yields and ear leaf K? **Figure 1** shows yield losses from reduced tillage were less with applied potash.

This indicates the unplowed soil reduced potassium availability and higher soil K levels were needed under minimum tillage conditions. Note these effects are unlike N which is a more mobile nutrient than potassium in soils.

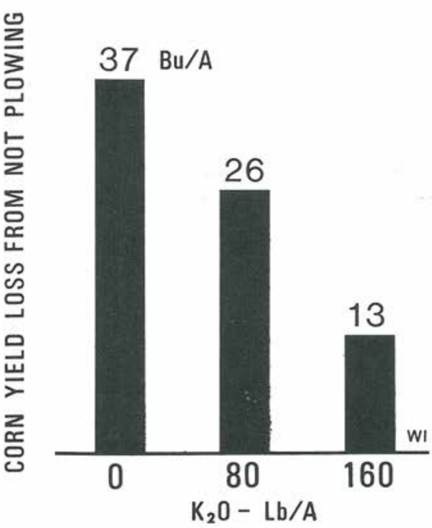



**FIGURE 1**

Remember the potash treatments were applied from 1972 through 76, so a total of 400 and 800 lbs of N and $K_2O$/A had been applied to these treatments over the 5-year period, although we are considering only a 4-year period for the yields.

**Table 3** shows yield losses the last year of the period.

**Table 3. The Corn Yield Losses Caused By Not Plowing and Till-planting with Increasing Rates of Potash in 1976.**

| $K_2O$ Applied Annually in 1972-1976 | Corn Yield Losses from Reduced Tillage (plowed minus unplowed fields) |
|---|---|
| Lb/A | Bu/A |
| 0 | 51.4 |
| 80 | 28.8 |
| 160 | 18.1 |

Potassium leaf analyses each year indicated the unplowed, till-planted treatment had significantly lower K levels and that even the highest treatment was still relatively low in K.

**Table 4** shows results for 1976, averaged over all applied N and soil test P levels. If 1.75% K is accepted as the critical concentration for ear leaf K at silking, it is apparent that severe K deficiency occurred in all but the plowed plots fertilized annually with 160 lbs of potash per acre. Some researchers use 1.9% K as the critical concentration.

**Table 4. Effect of Tillage and Added Potash on Corn Ear Leaf K—1976 Results.**

| $K_2O$ Applied Annually 1972-1976 | % K in Ear Leaf Plowed | % K in Ear Leaf Unplowed |
|---|---|---|
| Lb/A | | |
| 0 | 0.73 | 0.59 |
| 80 | 1.40 | 1.04 |
| 160 | 1.71 | 1.42 |

**ROW FERTILIZER** benefits reduced tillage crops. In 1975, a sidebanded row fertilizer treatment of 40 + 40 + 40 lbs of N, $P_2O_5$, and $K_2O$ was applied to half of each plot that had received the 0, 80, and 160 lbs of N and $K_2O$ per acre annually.

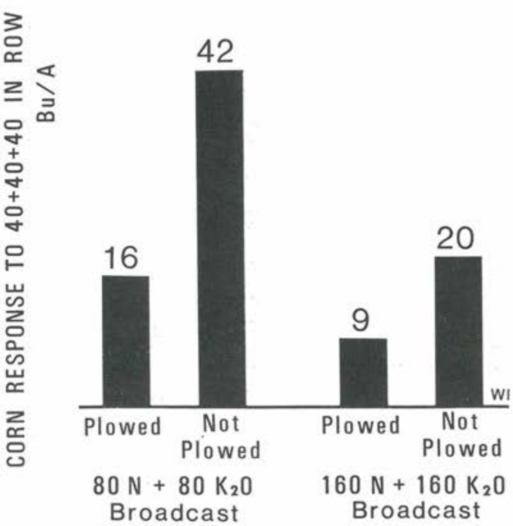



**FIGURE 2**

**Figure 2** shows yield increases from the row fertilizer for 1975. Note that even where the total amount of N and potash ($K_2O$) that had been applied as broadcast fertilizer was up to 640 pounds each per acre, row fertilizer was still increasing yields 9 and 20 bu/A on the plowed and unplowed treatments.

Yield increases from row fertilizer were consistently greater on the unplowed till-planted system, although actual yields were lower. When 160 lb/A of potash was broadcast annually, yields with row fertilizer on the unplowed plots equaled those of the plowed plots.

Row fertilizer, also, consistently gave higher ear leaf potassium. The increase in ear leaf K due to row fertilizer was greater on the unplowed than the plowed plots. But actual K concentration in the ear leaf was higher in the plowed plots and exceeded the critical level where no potash was broadcast.

**WHAT DO THESE RESULTS MEAN?** Before farmers make a shift to conservation or reduced tillage, we believe it is important that soil test levels be built up to higher levels than would be required under conventional tillage systems.

This appears to be especially important in the case of potassium.

Our results also indicate that under reduced or conservation tillage systems, row fertilizer is more important. On the soils with which we were working, potash was one of the most important components of the row fertilizer.

In any reduced tillage systems, unless you have a way to place your fertilizer down into the soil, it may be important to plow fertilizer down initially and every three to four years thereafter to redistribute plant nutrients in the soil profile and/or incorporate applied potash and phosphate fertilizers. **The End**

**U.S. Undersecretary of Agriculture Dale E. Hathaway, left, opens discussions in Guangzhou (Canton), China with Hao Shiangqen, deputy director of the Kuangtung Provincial Bureau of Agriculture. Darwin E. Stolte, U.S. Feed Grains Council, is at Hao's right.**

# CHINA: Emerging Market for U. S. Farmers?

**SHOULDN'T** a country with a billion people and a shortage of land fit for cultivation be a bonanza market for U.S. farm exports—exports which would create jobs for Americans, lower unit costs for farm products, and bolster the dollar?

On a recent trip to China, officials of the U.S. Department of Agriculture (USDA) and representatives of several agricultural commodity groups — the first U.S. agricultural team to visit China since normalization of diplomatic relations—sought to find out.

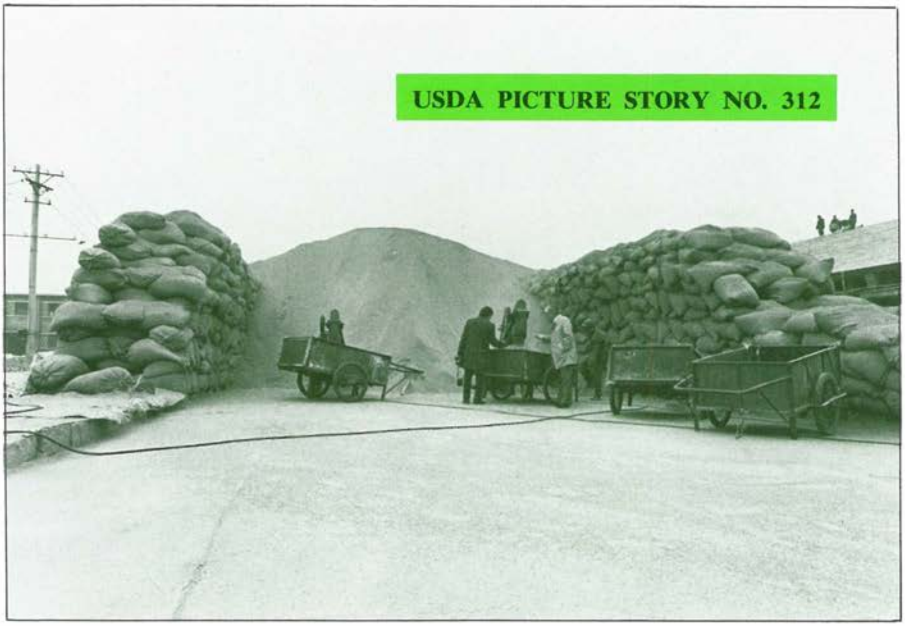
**Their post-trip prognosis: a cautious, and patient, "Yes."**

Increased exports to China, the team learned, must dovetail with China's modernization plans.

China's appetite for U.S. wheat, for example, is limited by its port capacity, its milling and baking capacity, its transportation system, and its dietary habits with traditional dependence on vegetable protein.

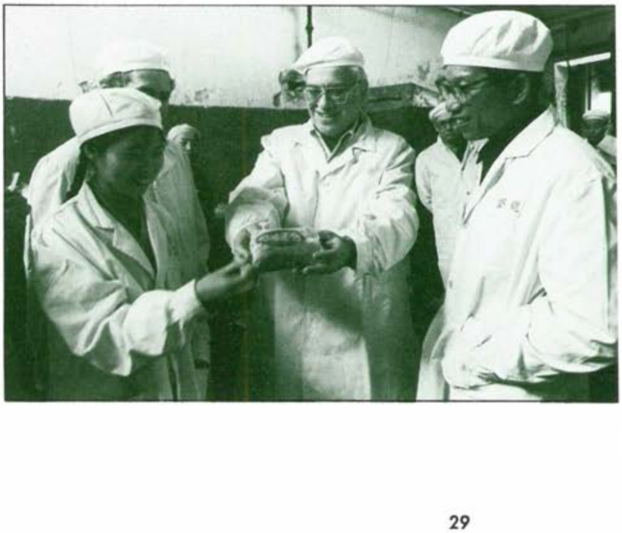
Feed grain, soybean, and feed supplement demand is likewise limited.

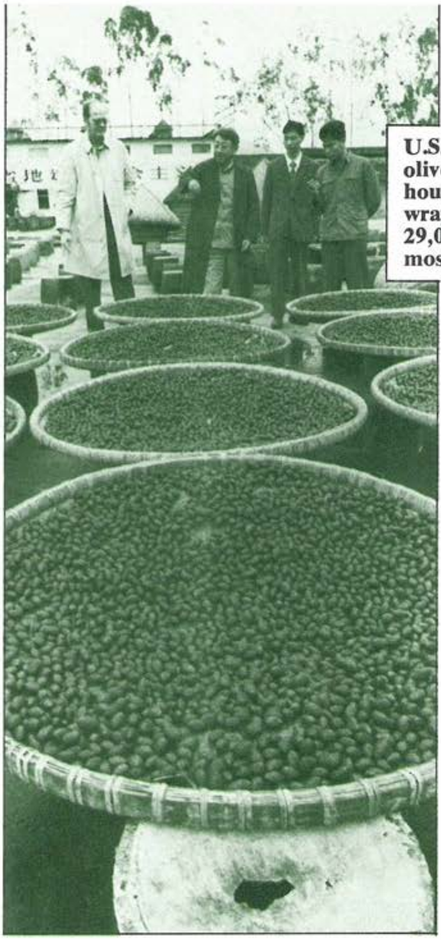
This emerging China market cannot be expected to develop overnight. It took 10 years from the first similar visit to Japan—in 1956—for that nation to become a billion-dollar customer. To-




The Chinese agricultural system tries to extract the most from limited resources. At the Red Star People's Commune near Beijing (Peking) rice hulls, after milling, are processed and bagged for use as animal feed. Chinese leaders consider animal husbandry the most backward phase of their agriculture and feel that progress must be made to improve the Chinese diet. Most of China's livestock, largely poultry and swine, has to scavenge for feed. Once feed supplies—much of which will have to be imported—are assured, China hopes to establish large-scale animal confinement facilities.

Eugene B. Vickers, Western Wheat Associates, is presented a loaf of Chinese-baked bread. As the Chinese refine their bakery technology they can increase their people's appetite for bread and—increase their market for imported wheat. U.S. team members offered to establish a model bakery and help train Chinese bakers in the U.S.





**U.S. Agriculture team members inspect olives drying at a commune near Guangzhou. The olives are dried and spiced before wrapping for retail sale. On this commune, 29,000 people raise 32 varieties of crops—mostly fruits and vegetables.**

**Rice-hulls for animal feed are loaded by workers. Agricultural work in China is done largely by hand; perhaps three-fourths of all Chinese are involved in agriculture compared with 4 percent of all Americans. Modernization of Chinese agriculture does not necessarily mean mechanization—China's immense labor supply argues against displacing large numbers of people with machines.**

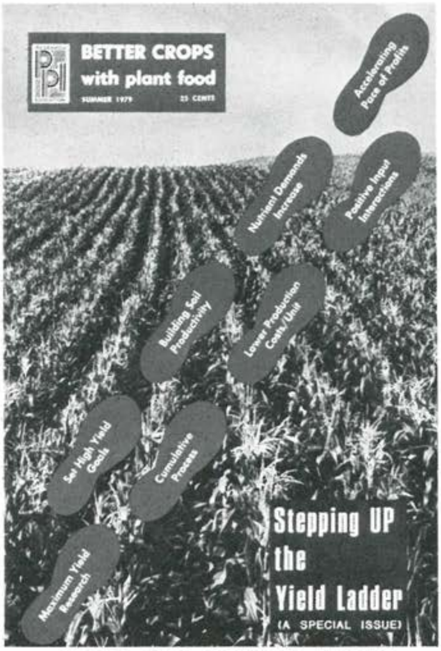
day, 22 years later, Japan buys 4.4 billion dollars worth of U.S. farm products a year.

Those who direct China's agricultural modernization, and those in the United States who seek an expanded market for our farm products, recognize that progress often does not come in giant leaps but in slow and careful steps.

For both countries, the visit was an opportunity to learn. By U.S. standards, Chinese agriculture is inefficient. But the notion that it is hopelessly backward vanishes before the realization that she provides a decent diet for most of her billion people on about half the arable land the U.S. has.

Measured on standards of energy efficiency or productivity per unit of land, China probably leads the world. Our increasing energy problems underscore the fact that the U.S. may stand to learn something about agriculture from the Chinese.

**Posters placed on walls along well-traveled streets are much-used devices for communication in China. The "Sino-American Friendship Association," an unofficial Chinese group which formed spontaneously when normalization began, maintains this wall on one of the principal streets of Beijing (Peking) to post developments in U.S.-Chinese relations.**

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