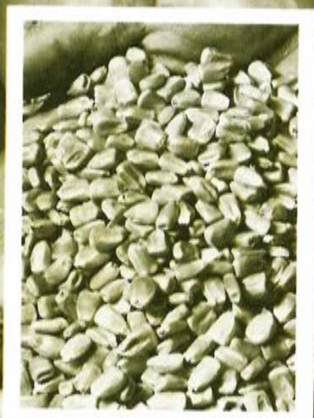
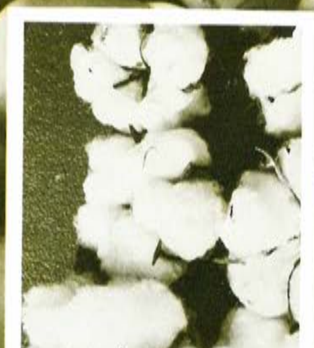
BETTER CROPS with plant food

NO. 2 — 1977

25 CENTS





Fertilizing For Quality Gains Dollars

SEE PAGE 6

Better Crops
WITH PLANT FOOD

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Contents

Old Potash Institute Becomes New Potash/Phosphate Institute

THE BOARD OF DIRECTORS of the Potash Institute, known 42 years for its scientific approach to soil fertility needs, has approved a new phosphate program that brings major U.S. phosphate producers into the organization and changes the name to Potash/ Phosphate Institute.

The first phosphate producers joining the Potash/Phosphate Institute are **Agrico Chemical Company; Borden Chemical, Borden, Inc.; International Minerals and Chemical Corporation; Occidental Chemical Company; Royster Company; and Texasgulf Inc.**

Formation of the new Institute was announced by Institute president, Dr. R. E. Wagner, and Board Chairman, D. R. Gidney, who cited the work of the Board's Phosphate Committee chairman, S. T. Keel, in spearheading the phosphate program.

The potash producers formed their Institute in 1935 through highly trained agronomists from official agriculture and set a simple policy that still stands:

"Seek the whole truth, not selected truth, about fertility needs and help official specialists demonstrate and communicate them."

These potash producers now include: **AMAX Chemical Corporation, Cominco American Incorporated, Duval Corporation, Great Salt Lake Minerals and Chemicals Corporation, International Minerals & Chemical Corporation, Kalium Chemicals, Mississippi Chemical Corporation, Potash Company of America, Potash Company of Canada Limited, Potash Corporation of Saskatchewan, Texasgulf Inc., and United States Borax & Chemical Corporation.**

For 42 years, this Institute of agronomic scientists has supported hundreds of university research grants, participated in thousands of field demonstrations and cooperative projects, and distributed millions of communication tools to find and tell legitimate agronomic needs for potash.

The new Potash/Phosphate Institute will expand this program to seek agronomic needs for phosphate in the way it seeks potash needs in balanced fertility.

"Never before have potash and phosphate producers joined hands in this way to help official agriculture, farmers, and communicators seek out scientific needs for P and K in the world's food production," Dr. Wagner said. **"This agronomic teamwork is unique in the history of both industries."**

The Institute staff will be expanded to help official agriculture and industry pursue many new truths about the potash-phosphate nutrient team under modern farming pressures.

Institute scientists receive many speaking invitations to university short courses, farm field demonstrations, diagnostic workshops, dealer meetings, state plant food associations, national conventions, professional societies, media sessions, etc.

To reach even wider audiences, the Institute is completing this year what will become a regularly issued quartet of publications with four distinct roles:

1. **Better Crops with Plant Food,** the Institute's traditional magazine carrying reports written by official agriculture to leaders in 40 nations since the organization was founded in 1935.
2. **Dealer's Dispatch,** a special

quarterly offering useful agronomic tips to 15,000 fertilizer dealers.

3. **News & Views,** a newsletter rushing brief, timely items of regional interest to key leaders.
4. **Agro-Knowledge,** a journal for researchers and communicators alike, featuring in-depth reports on agronomic trends as they develop.

The Institute is also introducing some new slide sets to its visual aids service this year, plus new radio scripts and tapes and new Fertilegram press releases, a question-answer feature popular with the media.

The new Potash/Phosphate Institute will continue to support its world program, in addition to its regular U.S. and Canadian programs. This includes educational missions in Brazil, Japan, Korea, and Southeast Asia, conducted jointly with the International Potash Institute.

It also includes supportive funds to FAO, close cooperation with international foundations and research institutes, and working tours by Institute scientists into all areas served by Institute cooperation, including India and recently Mainland China.

"This new agronomic teamwork by the potash and phosphate industries should lead to more profitable fertilization by the farmer," Dr. Wagner said. "And that has always been this Institute's goal for the farmer."

Dr. Ellington

WELL KNOWN LEADER JOINS STAFF

The newly appointed Executive Vice President of the Potash/Phosphate Institute was one of the top leaders in the nation's system of Cooperative Extension Services, according to Institute President R. E. Wagner.

Dr. Charles P. Ellington, former Director of the University of Georgia Cooperative Extension Service, assumed the new post this fall.

"We are fortunate to have Dr. Ellington join our organization in this key role," Dr. Wagner said. "He brings to us broad background and experience in agricultural science and education. His leadership is well known and respected at local, state and national levels."

Before coming to Georgia as Extension Director 6 years ago, Dr. Ellington was Director of Programs for the Maryland State Board of Agriculture. He earned his first agronomy degree at the University of Georgia, his Master's at Maryland, and his doctorate at Penn State. He returned to the University of Maryland in 1950 to hold many leadership posts for 13 years before answering the Board of Agriculture call.

University of Georgia President Fred Davison hailed the progressive leadership Dr. Ellington gave their Extension Service, University newsmen reported. It included incorporation of the state's nationally known Rural Development Center into Extension and expansion of Extension's educational communications work, particularly television, radio, and films.

He has held leadership posts on many national, regional, and state boards. The U.S. Secretary of Agriculture asked him to serve on the Secretary's Civil Rights Task Force. And the National Extension Committee on Organization and Policy named him first chairman of their Environmental Quality Subcommittee.

How MUCH Potash For Maximum Economic Yield?

WERNER NELSON
WEST LAFAYETTE, INDIANA

> "An ideal nutritional environment may be one in which all nutrient elements are available to the point of slight luxury consumption at all times."
>
> A. G. Norman, Former President
> American Society of Agronomy

MANY FACTORS increase the amounts of potash needed in fertilizer and soil to gain maximum economic yield. These 15 factors stand out:

1. Cool soil temperature: This decreases availability of soil K and root activity.

2. Dry soil: This slows K movement to roots. Higher K rates speed movement to roots.

3. Wet or poorly drained soil: Shallower root system and less air and oxygen for root activity means less nutrient uptake.

4. Shallow soil: This means less volume for roots to tap.

5. Compact soil: This restricts root penetration and decreases soil oxygen.

6. High exchange capacity: Higher clay content decreases availability of a given level of exchangeable K.

7. High K-fixation soils. Such soils demand very high K rates to affect the soil test.

8. Calcareous soil: In this soil, higher Ca competes with K for entrance into the plant and within the plant.

9. Subsoil K: In some states, K rates are influenced by K level in subsoil.

10. NH_4-N: This may block K release from clays in some soils. May compete with K for entrance into the plant and within the plant. Nitrification inhibitors and acid or wet soils mean more N will be taken up by the plant as NH_4-N.

11. Higher N rates: Today's higher N applications bring higher non-protein N into the plant. This demands more K to help convert the non-protein N into true protein and to neutralize the increased organic acids.

12. Tillage: With deeper plowing, more K is needed in the soil buildup program. With no till, K may be less available in drier and cooler areas.

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Fertilizing For QUALITY Gains Dollars

W. K. GRIFFITH
GREAT FALLS, VIRGINIA

WE CAN CREDIT FERTILIZER with 30 to 40 percent of crop yields. And when we apply enough fertilizer for top production, we can look for a return on our investment as great or greater than any other production cost.

It pays to be fertilWISE—pays in more than extra yield. It pays in **PRODUCT QUALITY.** The extra crop quality can pay for the nutrient in short supply—and often more than pay for it—a bonus above the extra yield.

Quality GAINS are a bonus top farmers have come to expect from a well managed system. Quality LOSSES are often an unnoticed debit ADDED to yield losses when soil fertility levels do not meet the production potential of a farmer's soil. Research and farming many places show how fertilizing for quality gains dollars.

CORN STUDIES SHOW IN TABLE 1 . . .

• **NITROGEN and PHOSPHATE** boost yield and lower moisture in grain. This means many things: (1) More grain per acre. (2) Earlier harvesting with less harvest losses. (3) More opportunity for fall field work. (4) Less grain drying costs.

Grain moisture at harvest affects market price. The farmer can lose 1% of the market price for each 0.5% of grain moisture above 15.5%.

• **POTASH AFFECTS** corn quality many ways: Stalk strength and lodging, leaf disease incidence, both starch and protein content of grain, and grain plumpness.

None of these have been discounted at the market place. The amount of grain lodged stalks leave in the field can vividly show the dollar value of quality.

1. FERTILIZER GAINS QUALITY DOLLARS FOR CORN

OHIO: NITROGEN STUDY

N Rate	Yield	Moisture	Dockage	$ GAIN		
lb/A	bu/A	%	$/bu	Yield	Quality	Total
0	65	36	1.03			
240	170	28	.63	154	68	222

COST OF NITROGEN $60.00
QUALITY GAIN 68.00

ILLINOIS: PHOSPHATE STUDY

P_2O_5 Rate	Yield	Moisture	Dockage	$ GAIN		
lb/A	bu/A	%	$/bu	Yield	Quality	Total
0	96	33	.87			
80	132	28	.62	59	33	92

COST OF PHOSPHATE $14.40
QUALITY GAIN 33.00

ILLINOIS: NITROGEN STUDY

N Rate	Yield	Moisture	Dockage	$ GAIN		
lb/A	bu/A	%	$/bu	Yield	Quality	Total
0	104	29.0	.68			
180	191	24.6	.45	159	44	203

COST OF NITROGEN $45.00
QUALITY GAIN 44.00

TENNESSEE: POTASH STUDY

Fertilizer Rate	Lodged	Hand Yield	Machine Yield	$ GAIN		
lb/A	%	bu/A	bu/A	Yield	Quality	Total
150-80-0	80	64	12			
150-80-180	5	146	146	205	130	335

COST OF POTASH . . . . $ 18.00
COST TOTAL FERTILIZER 69.90
QUALITY GAIN 130.00

2. FERTILIZER GAINS QUALITY DOLLARS FOR SOYBEANS

VIRGINIA: POTASH STUDY IN VERY DRY YEAR (1976)

K_2O Rate	Yield	Shriveled and Diseased Seed	Dockage	$ GAIN		
lb/A	bu/A	%	$/bu	Yield	Quality	Total
0	4.2	37.3	2.50			
120	13.1	1.3	0.00	44	33	77

COST OF POTASH $12.00
QUALITY GAIN 33.00

NORTH CAROLINA: POTASH STUDY AT LOW YIELDS

K_2O Rate	Yield	Shriveled and Diseased Seed	Dockage	$ GAIN		
lb/A	bu/A	%	$/bu	Yield	Quality	Total
0	7	37	2.24			
120	27	3	.02	106	59	165

COST OF POTASH $12.00
QUALITY GAIN 59.00

OHIO: POTASH STUDY AT HIGH YIELDS

K_2O Rate	Yield	Shriveled and Diseased Seed	Dockage	$ GAIN		
lb/A	bu/A	%	$/bu	Yield	Quality	Total
0	38	31	.54			
120	47	12	.22	63	15	78

COST OF POTASH $12.00
QUALITY GAIN 15.00

VIRGINIA: FIVE YEAR PHOSPHATE, POTASH STUDY

Fertilizer was applied only once (1969) in a 5-year study.
Data for the third year of the study are shown.

Fertilizer Rate (lb/A)		Yield	Shriveled and Diseased Seed	Dockage	$ GAIN Over Check		
P_2O_5	K_2O	bu/A	%	$/bu	Yield	Quality	Total
0	0	24	20.8	1.18			
400	0	29	12.5	.54	31	19	50
0	400	38	1.8	None	88	45	133
400	400	42	1.3	None	113	50	163

COST OF POTASH ÷ 3 = $13.33
COST OF PHOSPHATE ÷ 3 = 24.00
(QUALITY GAIN (TOP RATE) = 50.00

SOYBEAN STUDIES SHOW IN TABLE 2 . . .

PHOSPHATE and POTASH can reduce the amount of diseased and shriveled seeds while boosting soybean yields. The better beans really pay off when soybean buyers use dockage tables to adjust price based on percent of sound seed.

BARLEY & WHEAT STUDIES SHOW IN TABLE 3 . . .

• **PREMIUMS** are paid for the PERCENT of plump kernels in barley and protein in wheat. The wheat protein increased through the 200 lb N/A rate, but a yield drop made total return most profitable from the 100 lb N/A.

3. FERTILIZER GAINS QUALITY DOLLARS FOR BARLEY & WHEAT

MANITOBA BARLEY: POTASH STUDY

K_2O Rate	Yield	Plump Kernels	Premium	$ GAIN Over Check		
lb/A	bu/A	%	$/bu	Yield	Quality	Total
0	37	37.8	None			
15	53	46.2	.39	40	21	61
30	52	51.1	.79	38	41	79

60 lbs/A N and 20 lbs/A P_2O_5 were applied

POTASH COSTS (30 lbs/A) . . . . . $ 3.00
TOTAL FERTILIZER COST 21.60
QUALITY GAIN 41.00

ILLINOIS WHEAT (Hard Red Spring): NITROGEN STUDY

Nitrogen Rate	Yield	Protein	Premium	$ GAIN Over Check		
lb/A	bu/A	%	$/bu	Yield	Quality	Total
0	56.8	11.0	None			
50	72.6	12.9	.16	43	12	65
100	77.4	15.6	.30	57	23	80
200	64.3	18.6	.49	21	32	53

Adequate K_2O and P_2O_5 applied

NITROGEN COSTS (100 lb/A) $25.00
QUALITY GAIN 23.00

ALFALFA STUDIES SHOW IN TABLE 4 . . .

• **ADEQUATE, BALANCED FERTILITY** are vital for top yields and long-living stands of good quality alfalfa.

Why is stand persistence so important to quality? Because hay containing high amounts of alfalfa brings $20 to $50 more per ton than mixtures carrying only grasses or weedy grasses. So, stand life or persistence is a big quality key to market value.

4. FERTILIZER GAINS QUALITY DOLLARS FOR ALFALFA

NEW JERSEY: FIVE-YEAR PHOSPHATE AND POTASH STUDY

Annual Fertilizer Rates P_2O_5 lb/A	K_2O	5-Yr. Average Yields T/A	Persis-tence (Years 50% Alfalfa or More) Years	5-Yr. Produc-tion Returns $/A	5-Year Dollar Gain Over Check Yield	Quality	Total
0	0	4.64	2	$1,578			
0	300	6.69	4	2,542	697	267	964
75	300	7.21	5	2,884	873	433	1,306

5-YEAR COST OF FERTILIZER (Top Rate) . . . $217.50
QUALITY GAIN OVER CHECK 433.00

COTTON STUDIES SHOW IN TABLE 5 . . .

• **POTASH INCREASES** the size (micronaire readings) of cotton fibers, an important measure of cotton quality. Cotton prices are discounted for readings below or above the 3.5-4.9 range.

When potash fertilization increases total yield, micronaire, and amount of lint, we can accurately say: Fertilization blends all factors into greater profits.

5. FERTILIZER GAINS QUALITY DOLLARS FOR COTTON

MISSOURI: THREE-YEAR POTASH STUDY

K_2O Initial lb/A	Annual Rates	3rd-Yr. Cotton Seed Yield lb/A	Micro-naire Read-ing Index	Micro-naire Dis-count $/A	Lint %	Gross Return %	$ GAIN Over Check Yield	Quality
0	0	1,140	2.6	43.43	36.7	268		
100	0	1,856	2.9	49.76	38.3	424	149	7
400	50	2,621	4.9	0.00	39.7	761	448	45
800	50	3,204	4.6	0.00	40.7	949	585	96

COST OF POTASH (3-Yr. Ave. Top Rate) $31.70
QUALITY GAIN 96.00

POTATO STUDIES SHOW IN TABLE 6 . . .

• **PHOSPHATE and POTASH** increase the percent of No. 1 potatoes and yield. Return per acre can be improved sharply by keeping these two nutrients in adequate supply.

6. FERTILIZER GAINS QUALITY DOLLARS FOR POTATOES

OREGON: PHOSPHATE AND POTASH STUDY

K_2O Rate lb/A	Field Yield T/A	Culls %	Quality Losses $/A
0	12.5	58	1,440
100	19.2	27	1,040
200	21.8	21	920
400	22.1	19	840

P_2O_5 Rate lb/A	Field Yield T/A	Culls %	Quality Losses $/A
0	19.8	24.8	982
80	21.3	19.5	831
160	23.2	19.0	882

COST OF POTASH (Top Rate)	**$ 40.00**
QUALITY GAIN	**600.00**
COST OF P_2O_5 (Top Rate)	**28.80**
QUALITY GAIN	**100.00**

TOMATO STUDIES SHOW IN TABLE 7 . . .

• **POTASH INCREASES** the percent of marketable fruit. This greatly increases return per acre from this high-value crop.

7. FERTILIZER GAINS QUALITY DOLLARS FOR TOMATOES

NEW JERSEY: POTASH STUDY

K_2O Rate lb/A	Field Yield T/A	Culls %	Quality Losses $/A
0	10.3	81	2,086
100	17.3	40	1,730
200	19.9	30	1,493

COST OF POTASH (Top Rate)	**$ 20.00**
QUALITY GAIN (Over Check)	**593.00**

PRICES USED:

Corn	= $2.50/bu	50% or more alfalfa	= $80/ton
Soybeans	= $7.50/bu	Less than 50% alfalfa	= $60/ton
Malting Barley	= $2.50/bu		
Wheat	= $2.75/bu		
Cotton	= $.6404/lb lint, $.06/lb seed	Nitrogen	= $.25/lb applied
Potatoes	= $200/ton	Phosphate	= $.18/lb applied
Tomatoes	= $250/ton	Potash	= $.10/lb applied

Coastal Bermuda RESPONDS To Potassium

JOHN E. MATOCHA
TEXAS A & M

MANY SOILS in east Texas are low in minerals because of intensive chemical and physical weathering processes.

Highly leached surface soils need N-P-K fertilizers for maximum forage grass production. But plant response to one or more of these nutrients can vary from soil to soil.

At the Texas A&M Agricultural Research and Extension Center at Overton, crop response was studied to different P-K fertilizer rates in two soils:

1—**Darco:** A fine sand with deep surface (0-72″), usually testing very low in extractable K.

2—**Cuthbert:** A sandy loam with shallow surface (0-7″), usually testing low to very low in extractable K.

ON THE DARCO SOIL:

Nitrogen (NH_4NO_3) was applied annually at 400-500 lb N/A rates on the Darco soil—split into three applications. These rates continued during the last seven years of the study.

Phosphorus was applied as a single treatment, while potassium was split into two applications.

In 1973-76, 40 lb S/A (as granulated gypsum) was applied to all plots each year.

Five clippings of Coastal bermudagrass were made each season, except 1969.

Table 1 shows dry matter yields of Coastal bermudagrass for selected treatments in the 8-year study on the Darco soil.

Response to K varied from 9 to 15% in 1969, depending on K rate. Significant yield increases came only from the highest K rates applied in 1969. Because 1969 was a short season (only three harvests), no P and K were applied in 1970.

The crop responded to residual K in 1970 about like it did to fertilizer K the year before.

In 1971, response to applied P was high, but slight to K. A similar lack of response occurred again in 1972.

No P or K was applied to the plots in 1974, in order to study residual P and K. Although differences were not statistically significant, plants responded to residual K.

Fertilization was resumed in 1975 and continued through the 1976 season. The forage responded well to 120 lb K_2O/A, regardless of P applications. But it did not respond to additional K unless P was also applied.

In the seventh year (1975), disease symptoms were observed in the zero K plots. It was diagnosed as Helminthosporium. Only a slight evidence of the disease was apparent in 1974.

Applying P without K seemed to aggravate the disease problem—but K fertilizer reduced its severity.

Degree of severity followed graded levels of applied K. Where N, P and S were applied without K, visual spotting on the foliage was quite evident.

Some stand thinning was observed. But overall plant stunting, not stand thinning, caused most yield loss.

The disease was even more severe in 1976, when the greatest response to K occurred. Conditions were generally favorable for high yields in 1976.

Effects of the disease—and its control by potash fertilization—are apparent from 1976 yields. With 120 lb K_2O/A, the forage yielded over 47% MORE dry matter, both with and without P_2O_5 fertilizer.

ON THE CUTHBERT SOIL:

A similar study started in 1974 on a Cuthbert sandy loam soil, used a double crop of oats and Coastal bermudagrass (Data not presented).

Table 1. Dry matter yields of Coastal bermudagrass as influenced by applied P and K, Darco fs.

Treatment (lb/A) P_2O_5-K_2O	Year 1969	*1970	1971	1972	1973	*1974	1975	1976
0–0	4298	10,041	5885	13,612	13,690	10,945	9263	11,669
0–120	4286	10,554	6216	13,469	14,587	11,670	11,111	17,169
140–120	4662	11,309	8667	14,983	14,721	10,984	11,212	17,255
0–240	4604	10,794	6582	13,639	15,433	12,064	11,445	16,553
280–240	4974	11,627	10,087	17,518	16,074	12,061	12,589	18,563
LSD .05			1,072	1,152	1,291	1,622	1,385	2,282
% increase Due to P. or K.								
0–0								
0–120	−0.3	+5.1	+5.6	−1.1	+6.5	+6.6	+20.0	+47.1
140–120	+8.5	+12.6	+47.3	+10.1	+7.5	+0.4	+21.0	+47.9
0–240	+7.1	+7.5	+11.8	−0.2	+12.7	+10.2	+23.6	+42.0
280–240	+15.7	+15.8	+71.4	+28.7	+17.4	+10.2	+35.9	+59.0

*No P or K applied—residual P and K studied.

Oats were sodseeded in the Coastal bermudagrass during the first week of October and grown for forage (via clippings) until about May 1, 1975.

The Coastal bermudagrass was then fertilized with N, P and K, and three clippings made in the summer.

Dry matter yields for Coastal bermudagrass generally showed no response to K during the 1974 season. **However, Helminthosporium invaded, stunted plant growth and reduced dry matter yield sharply in 1975 where no K was applied.** Results in 1976 (third season) substantiated those of 1975.

The reason the plants took 6 years on Darco and only 2 years on Cuthbert soil to contract the disease and respond to potash fertilizer is due to mineralogical and morphological differences between the soils.

The Cuthbert soil is shallower than the Darco. And the Darco soil contains significant quantities of fine silt-size and clay fraction mica. (Soil Sci. Soc. Amer. Proc. 40:370-373).

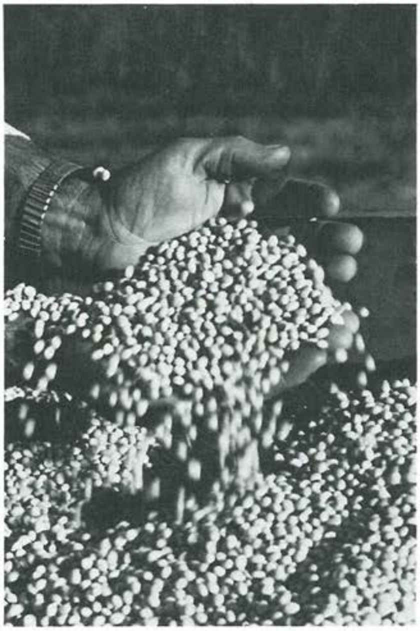
These K-rich micas slowly release K for plant growth—not detectable by ordinary soil tests.

The lower mica level and shallow surface layer in Cuthbert soil explain why it took a much shorter time for the disease to invade and the plant to respond to K.

Our work and similar studies by Dr. Marcus Eichhorn at Homer, La. (see 3/76 **Better Crops**) demonstrate the vital way K maintains adequate yield levels and controls the spread of Helminthosporium disease on Coastal Bermudagrass.

They also point up the importance of long-term research—because short-term results can often be misleading.

The End.



Dr. Robert W. Rinne cultures soybean tissues in solutions containing radioactive compounds. He follows the pathways these compounds take in the growing tissue to study how the plant produces protein and oil. This information is used to develop new soybean varieties with desired levels of protein and oil.

OVER 4,000 YEARS ago the soybean was one of the five sacred crops of China.

Less than half a century ago the United States hardly knew the soybean outside of Illinois, and farmers considered it little more than a forage and green-manure crop.

Today, it is well on its way to becoming "sacred" in the United States.

This zoom to fame began with farmers discovering soybeans were a source of high protein animal feed. By the 1960's soybeans had become the chief poultry feed in the U.S., as well as a cattle and hog feed, and an important source of vegetable oil here and abroad.

Food processors found soy protein could be substituted for many foods—beef, bacon, pork and poultry, to name a few.

Scientists are taking a closer look at soybeans, and, among other things, are finding they have much to offer as human food.

SOYBEANS HAVE about 38 percent crude protein which makes it a valuable protein supplement in animal feed rations. Beef and fish contain about 18 percent protein.

THE GOAL...

As demand for protein grows, a continuing strain is placed on soybean producers.

Soybean production techniques are currently under study by scientists at the U.S. Regional Soybean Laboratory, Urbana, Ill., in cooperation with the Illinois Agricultural Experiment Station, Urbana. USDA's Agricultural Research Service (ARS) administers the laboratory.

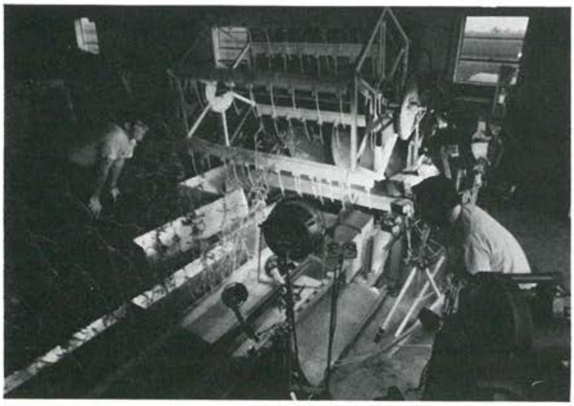
One puzzle ARS scientists are tackling is how to make more nitrogen available to soybean plants.

ABOUT 400 LBS. of nitrogen are

Against a background of modern soybeans, geneticist Richard L. Bernard (above) examines one of their vine-like wild ancestors. Grown from seed collected in the Orient by Dr. Bernard, these ancient plants may provide new varieties with genetic resistance to disease, insects, and nematodes.

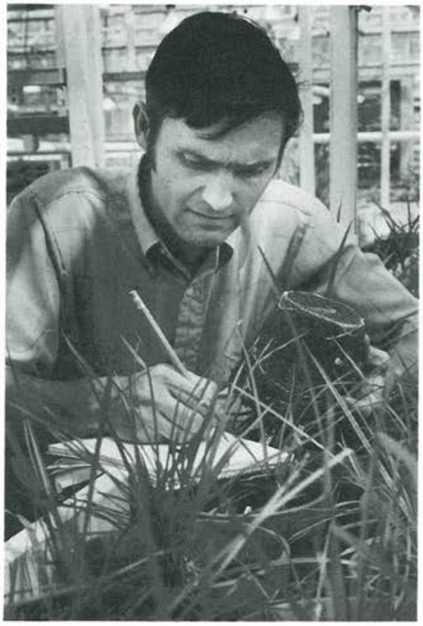
Nitrogen utilization by the soybean plant is a hydroponics system, in which roots develop in water instead of soil. The hydroponics system permits precise control over the amount of nitrogen available to the plant. Here, plant physiologist James E. Harper observes the effect of nitrogen fertilizer on nodule formation in the root system.

is higher-yielding soybeans



From USDA Picture Story 280

A high-speed motion picture camera records the feeding of soybean stalks into a harvester reel and experimental cutterbar mounted on a laboratory test stand. When analyzed in slow motion, the film record will enable agricultural engineer W. Ralph Nave to determine reasons for harvest losses and, hopefully, lead to better designs for harvesters.



Nutsedge is a major weed problem of soybeans. Resistant to several current herbicides nutsedge flourishes when competition from other weeds is removed. To further frustrate control, nutsedge spreads through underground stems, or tubers—as well as by seed. Dr. Edward Stroller, plant physiologist, is shown analyzing tuber growth on test plants in research aimed at developing combinations of improved culture methods, and new selective herbicides to control this costly pest of one of our most important crops.

needed to produce a 70-bushel per acre soybean crop.

Scientists are seeking ways to make this nitrogen more available, either through fertilizer nitrogen or more efficient strains of root nodule bacteria which take nitrogen from the air and convert it to a form soybean plants can use.

OTHER PROBLEMS confronting the scientists include discovering why lodging soybeans yield less than those that don't.

Soybean breeders are working to develop semi-dwarf varieties that will be high-yielding, as well as resistant to lodging, diseases and pests.

A trait of soybean varieties grown in the Northern United States is that they increase in height throughout the growing season because they are indeterminate in growth habit meaning the stem growth continues after flowers develop. This growth habit often causes the plant to lodge, or fall over, before harvest, thus resulting in reduced yields.

Once the flower bud is formed in this experimental strain of soybeans the plants stop increasing in height—hence reducing the tendency to lodge. ARS scientists are attempting to develop new semi-dwarf varieties incorporating this characteristic, which is called determinate growth habit.

Soybeans planted in 7-inch rows (below) and not cultivated may be one way to increase production. Current research suggests a 10-15 percent yield advantage over conventional 30-inch rows. The key to success will hinge on a satisfactory weed control system. Researchers Richard L. Cooper, W. Ralph Nave, and Loyd Wax compare the two row spacings.

A long-term project is being conducted to find the effects of crop rotation and herbicide treatment upon weed seed population in the soil and upon soybean yields.

Developing a control method for yellow nutsedge, which is becoming a major weed problem in soybeans, is also a primary objective.

SOYBEANS DO NOT use sunlight efficiently. If scientists can find a way to improve their efficiency, yields could theoretically increase 50 percent.

Developing varieties with more oil and protein and finding ways to cut harvest losses are other research areas ARS scientists are exploring.

Research will provide the know-how for farmers to get higher soybean yields, which will help maintain a steady and growing supply to meet world demands for the protein rich soybean. **The End.**

ORDER NEW AIDS

ON BACK COVER

From PPI News Release . . .

BATTERED MYTH

THE OLD IDEA that soybeans do not respond to fertilization is a battered myth today. Experience has shown a good phosphate-potash fertilizer program can add 5 to 10 bushels per acre with good practices.

Few growers probably realize what a small slice a good phosphate-potash fertilizer program takes out of the soybean cost pie—barely 8% of the total production cost.

High yields pay a bonus many overlook—the more bushels per acre the less production cost per bushel, usually. This has been proved by trials showing cost per bushel declining 39% as yield increased 67%.

Both research and farming experience have shown phosphate and potash add extra bushels working alone, but give best yield and dollar return working together as a balanced team. That balance often means 2 to 4 times more potash than phosphate, depending on soil, weather, and other conditions. Soybeans are greedy for potash.

ONE 3-YEAR TRIAL showed a 26-bushel yield running $26 in the red with 30 lb phosphate but no potash. The crop moved to 37 bu/A and $21 profit with 120 lb potash but no phosphate. Then up to 45 bu/A and $54 profit with "the team" of 0-30-120 lb/A. And one of the years was dry. Another report showed an $80 profit and a 556% return on the potash investment.

This principle has been repeated in many areas. A recent survey of champion soybean growers in 14 states showed all but two maintaining high to very high phosphorus and potassium levels.

Researchers have learned P-K fertilization can double the number and triple the size of those nitrogen-producing nodule "factories" on soybean roots. This is good news in an energy-crunch age, because soybeans leave behind one lb nitrogen for each bushel they produce.

CROP QUALITY is another bonus from P-K fertilization. The real test of quality is in the marketplace. While potash was adding 9 bu/A in a major trial, it reduced moldy beans sharply. This decline in moldy beans reduced market dockage or penalty from 58¢ to 22¢ a bushel. In other words, adequate potash fertilization added 36¢ quality value to each bushel.

The many ways fertilization helps a crop through stress periods are widely documented. In some areas, soybeans draw 75% of their moisture from below 5 feet in critical growth periods. Fertility helps roots explore more soil for more moisture.

Above ground, researchers report, potash reduces plant wilting by causing leaf pores to close more rapidly and lose less moisture in respiration. It also increases maturity speed of beans, helping grain fill before summer drouth hits.

WITH ALL THIS evidence favoring soybean fertilization less than one third of this major cash crop receives any fertilizer. And the soybeans that do get fertilized average only 33 lbs N, P_2O_5, K_2O COMBINED. Six bushels remove more than this just in the beans.

Why this neglect? Probably because soybeans are often grown after corn and growers figure enough NPK fertilizer is left over for the beans. This is risky figuring when we look at what a 150-bushel corn and 50-bushel soybean rotation removes just in the grain —90 lb P_2O_5 (50 in the corn, 40 in the beans) and 115 lb K_2O (42 in the corn, 73 in the beans) per acre!

THIS SUMMARY shows high wheat yields obtained over the last few years, as reported to our survey.

1. High yield wheat requires adequate nutrition. Most of the sites tested high or very high in P and K, and adequate N was added. In every case where P or K soil tests were less than high or very high, that nutrient was added—to reduce its probability as a limiting factor.

That may seem rather obvious. But a farmer will often take time to soil test, then fail to apply enough of the needed nutrient—or nutrients.

Or, he might not be soil testing and a nutrient will be limiting yields without his knowledge, even though he is supplying other nutrients in adequate amounts for high yields.

There may even be a potential response to a nutrient even though the soil test level reads high.

Special Wheat Survey

DAVID W. DIBB

2. After supplying adequate nutrition, variety selection became extremely important for high yields—in both Indiana and Ohio trials.

At a given location, a difference in variety meant a 20-bushel difference in yield.

Almost every wheat growing state has variety trials in their wheat areas. This helps the farmer make his variety selection.

Most wheat is grown in areas of limited rainfall. This makes efficient use of available moisture very important.

Data from 9 Kansas locations show how adequate fertility improved water use efficiency. Soil test K was HIGH at all locations:

	Wheat Yield Bu/A	Water Used Inches	Bu/ Inch
No fertilizer	31	22.95	1.37
40-23-0	44	24.01	1.83

HIGH WHEAT YIELDS—RESEARCH AND FARM

Contributor	Name	Location	Variety	Class	Soil Test	Fertilizer Program	Irrigated	Other Mgmt.	Yield/A
Prairie Farmer Sept. 18, 1976	Ray Tielemann	Oakdale Illinois			*	300# 9-23-30 Fall 50# N topdress		88 acres	63 bu
Marshall Christy Univ. of Mo.	Frank Bush	Clinton Missouri	Monon	Soft Winter	pH 6.3 p H K-VH	18-50-50 at planting 80 N topdress		plots	88 bu
Wayne Cránkfill Ext. Agent	Frank Norris	Bonham Texas	Abe		pH 7+ P-M K-H	210# NH_4NO_3 March 1, 1976	No	6 acres	96 bu
Fred Patterson Purdue	Wheat Perform. Trial	Porter Co. No. Indiana	Ave. of 7 varieties	Soft Red Winter wh.	pH 6.5 P-V.H. K-low	250# 8-32-16 drilled 60# N topdressed	No	1972	76 bu
"	"	Randolph Co. E.C. Indiana	Ave. of 6 Varieties	"	pH 6.8 P-V.H. K-V.H.	250# 8-32-16 drilled 66# N topdressed	No	1972	74 bu
H.N. LaFever OARDC	Wheat var. Perform Trials	Several Loc. Ohio	Many	Soft Red Winter	Many	400# 5-20-20 Fall 30# N topdressed			Many entries produced over 75 bu
Russell Schneider N.D.S.U.	Bob Nowatzki	Park River No. Dakota	Prodax	Hard Red Spring	*	125# 23-23-5	No		73.1
"	Jim Quick	Langdon No. Dakota	D7266	Duram	pH 7.3 P-V.H. K-High NO_3-N-V.H.	None	No		87.0
"	Joe Zubriski	Oakes No. Dakota	Kitt	Hard Red Spring	pH-7.2 P-High K-High NO_3-N-Low	140# N broadcast 0-50-24 with seed	Yes		65.1
"	Joe Caroline	Oakes No. Dakota	W525B		pH-7.4 P-V.H. K-High NO_3-N-low	240# 0-25-25 403# 34-0-0 plowed down	Yes		73.7

HIGH WHEAT YIELDS—RESEARCH AND FARM

Contributor	Name	Location	Variety	Class	Soil Test	Fertilizer Program	Irrigated	Other Mgmt.	Yield/A
Kenneth Morrison Ext. Agronomist Washington St. Univ.	George Nagasaka	Basin City Washington	Gaines	Soft White Winter	*	*	Yes	6 acres	190
"		Kittitas Co. Washington	Gaines	Soft White Winter	*	150-50-60	Yes	2.2 acres	216
"	Jack Clark	Pullman Washington	Gaines	Soft White Winter		85# NH_3 12 lbs liquid S	No	40 acres	136.6
"	John Blaine	Quincy Washington	Gaines	Soft White Winter	*	*	Yes	11 acres	155
"	Otis Helsley		Gaines	Soft White Winter	*	75# N	Yes	26 acres	168.8
Earl Skogley Dept. Plant & Soil Science Mont. St. Univ.	Milo Todd	Bozeman Montana	Crest	Hard Red Winter	pH-7.0 p-H K-H	60# 18-46-0 Fall 150# 30-10-0 Spring	No	Plots Fallow during 1974	61
"	Sime Ranch, Inc.	Gallatin Gateway Montana	Cheyenne	Hard Red Winter	pH6.8 p low K high	60-50-0	No	Fallow previous yr.	60
"	"	"	"	"	"	60-50-80	No	"	66
Billy Tucker Okla. St. Univ.	Panhandle Res. St.	Goodwell Oklahoma	Palo Duro	Hard Red Winter	pH 8.2 p-high K-V. high	240# N	Yes	1973	100.4 b
"	"	"	Osage	"	"	160# N	Yes	1976	71.0 b
"	No. Central Agron. Res. State	Lahoma Oklahoma	Experi- mental	H.R.W.	pH 6.6 P M K-H	80-40-0	No	1973	74.0 b
"	Othol Bond	Colony Okla.	Osage	H.R.W.	pH 6.4 p-H K-H	100# 18-46-0 preplant 60# $NaNH_4NO_3$ topdressed	No	1976 80 acres	83.0 b

*Not reported

BIG HUGH was grubbing a stump the afternoon I wandered down his lane across the Potomac from Washington to see if there might be a yarn in him in 1958.

What presumption!

To see if there **"might be"** a story in the man who founded the U.S. Soil Conservation Service.

A man recommended for the Nobel Peace Prize by the Inter-American Conference of Natural Renewable Resources in 1948.

A man the New York TIMES said would require "3 volumes to tell all he did for his nation and the world." And the Milwaukee JOURNAL said would be memorialized in more than metal or marble, but "carved in the earth itself."

A man the most powerful President ever to occupy the White House would call day or night to worry about "that dust in the Panhandle."

A man who turned down one nation's $50,000 salary in 1940—not 1977, but 1940—to stay at his $9,000 U. S. post.

The first thing I liked about Hugh Hammond Bennett was that his eyes did not roam to my frayed shirt collar without a tie or to the holes in my sweater. His eyes bored into mine and spoke of things with substance.

I have a good K-Mart shirt, unfrayed. And one "Sunday sweater" without a hole. But I like the worn-out ones, especially to learn WHAT I am meeting.

A colleague from Bennett's prime days once told me his office was as unadorned as he. No wonder so many American newspapers memorialized the man when he died.

The next thing I liked about Big Hugh was his attitude toward the little journal we call Better Crops with Plant Food.

I was new on the job, having succeeded Editor Ross Stinchfield in 1956, his 31st year of editing this journal.

The U. S. Soil Conservation Service was born April 27, 1935, delivered by Public Law 46, the first soil conservation act in the history of mankind.

Just 31 days later this magazine reported American potash producers had "announced the organization of the American Potash Institute to be established in Washington, D.C."

So, the organization of which Big Hugh spoke were those early Potash Institute stalwarts who built a reputation for integrity still reaped by today's staff. Roswell Stinchfield was one of them.

Ross died this August at 85 years of age. A man whose roots went back to Waupaca, Wisconsin. A graduate of a little business college called Nichols Expert School. A graduate of the great University of Wisconsin.

But, most of all, a graduate of more than 3 decades of solid editing that never smelled of self-serving frills and furbelows. An editing style strongly endorsed by one of history's renowned agricultural figures.

Standing beside a stump behind his Virginia home, with a mixture of sweat and dust turning to mud down his huge forehead, Hugh Bennett said to me:

The American farmer never had a better friend than the Potash Institute. Many places we went to set up districts, we found that journal they get out. Among teachers, agents, some of the best farmers, even newspaper folks. Using it!

It influenced me because it understood our (SCS) cause from the start. With truth! And it never used tinsel to make nothing look like something.

Those Institute folks were influential because they KNEW their science. Solid workers blending in with us without show or sham. When pushing hard on a project, we could often find Institute scientists right beside us, cooperating, shoulder-to-shoulder, sweating right with us to help the farmer. (**Better Crops** published 5 of Bennett's major articles between 1927 and 1944.)

The enthusiasm of the great old giant by the stump was contagious. It was easy to see how he had persuaded the world his little 1928 Bulletin, **Soil Erosion, A National Menace,** was true, after all.

It was also easy to see that Ross Stinchfield had not wasted his life staying at the same post over 3 decades. A working editor. Of a little journal that helped influence one of history's legendary men of agriculture.

Ross Stinchfield's 54-year-old pocketbook of agriculture has seen glossy outfits come, shine lavishly, and wither away —for some reason.

My hope is that Ross has now arrived in that Land of Big Hugh-like neighbors FREE of overstuffed chairs supporting understuffed craniums of hire-it-done "executditors."

A Land that once sent a remarkable Teacher to this planet to show us why it is so important to walk with simplicity —or, by God, try.

FROM NELSON, PAGE 5

13. Rotation: Corn-soybean rotations are common, but little K is applied for the beans. So more K must be applied before corn. And the possibility of a double crop changes K recommendations on the first crop.

14. High crop yield: The soil must deliver the K faster and fuller, because the plant needs a higher K level at every growth stage.

15. Forage use: Taking off all the above-ground crop removes big amounts of K. And earlier cutting demands higher K in the younger, more succulent plants.

THE BEST INSURANCE is to apply a little more K than thought needed to make sure the crop has enough K under most conditions. **Remembering** potassium does not leach from most soils, though it may leach from organic or very sandy soils. **Remembering** the K not used during current cropping season may be there for the next crop. **Remembering** potassium costs the least per pound of the three major elements, N, P, and K.

Potash fertilization has almost always boosted crop yields on low-K soils, generally on medium-K soils, and sometimes on high-K soils. Let's look at a few examples where other nutrients were adequate:

CORN

4-year avg., Sable silty clay loam — high K test (Illinois)

K_2O lb/A	Yield bu/A	Increase bu/A	Net value of increase from K*	% return on K investment**
0	127	—	—	—
40	142	15	$23.70	376
80	145	18	25.56	246
120	149	22	29.24	199

*Corn $2.00/bu, harvest cost 18¢/bu, K_2O including application 9¢/lb

**Cost of K + extra harvest

7-year avg., Conestoga loam, high-K test (Ontario)

K_2O lb/A	Yield bu/A	Increase bu/A	Net value of increase from K	% return on K investment
0	90	—	—	—
24	105	15	$25.14	517
48	108	18	28.44	376
96	111	21	29.58	238

THIS IS A SOIL with a higher cation exchange capacity than average and imperfectly drained. Though it tested high K, the crop used added potash profitably up to 120 lb K_2O.

Ordinarily 20 lb K_2O/A would be suggested with this high-test, but the most profitable rate was 96 lb K_2O. By applying just the low rate, $4.00 extra profits is lost.

With a production cost of $250/A about 125 bu of corn is required to break even. The highest average yield in U.S. has been 97 bu. Only two Corn Belt states have averaged over 110 bu in any one year.

Conclusion: Many corn growers are losing money with current management practices and land costs. ARE YOU?

SOYBEANS

3-year avg., Davidson clay loam, medium K test (Virginia)

K_2O lb/A	Yield bu/A	Increase bu/A	Net value of increase from K*	% return on K investment
0	28	—	—	—
30	39	11	$60.66	1135
60	42	14	75.24	858
120	46	18	92.88	614

*Soybeans $6.00/bu, harvest cost 24¢/bu

THE HIGHEST POTASH rate (120 lb K_2O) returned 614% on the K investment—or $92.88 net from K. This demonstrates the importance of adequate K.

With a good New Jersey soil, the yield was 51 bu with no applied potash, but 200 lb K_2O increased yield to 58 bu/A. Increasing K soil test level from 270 to 450 in Illinois increased yield from 50 bu to 70 bu/A.

High K_2O rates as well as high K test levels in the soil increase yields . . . which means more profit.

The U.S. average is about 28 bu/A soybeans. At $6.00 per bu, this equals $168 per acre. Production costs about $200 per acre. Only 6 of the 14 major soybean-producing states have averaged above 28 bu any one year.

Conclusion: Many soybean growers are losing money with current management practices and land costs.

ARE YOU?

MALTING BARLEY

Fargo clay, high K test (North Dakota)

K_2O lb/A	Yield bu/A	Increase bu/A	Net value of increase from K	% return on K investment
0	75	—	—	—
15	79	4	$10.69	462
30	83	8	21.38	462

*Malt barley $3.25/bu, harvest cost 24¢/bu

THIS SHOWS CROPS can respond to K on a high K soil—in this case, largely because of low temperature early and dry conditions later in the growing season. Barley may be planted when frost is still in ground.

ALFALFA

3-year avg., Freehold sandy loam, medium K test (New Jersey)

K_2O lb/A	Yield T/A	Increase T/A	Net value of increase from K*	% return on K investment
0	5.8	—	—	—
150	6.7	.9	$43.20	177
300	7.2	1.4	61.20	139

*Alfalfa $75.00/T, harvest cost $12/T

ON THIS SOIL, even 300 lb K_2O gave an excellent return on the investment. What would a higher rate give on this alfalfa and on other crops when yields are still going up at our highest K applications?

On a low K soil in Wisconsin, researchers determined optimum K_2O rate to be 443 lb K_2O/A, assuming 8.3¢ K_2O and $60/T alfalfa.

Conclusion: High yields are the key to high profits. The 7.2-ton yield netted a total $302/A with adequate fertilization. A 4.3 ton yield in Tennessee netted $90.50/A—or $210/A less than the higher 7.2 T/A.

COTTON

3-year avg., fine sandy loam, high K test (Arkansas)

K_2O lb/A	Yield - lb/A Lint	Seed	Net value of increase from K*	% return on K investment
0	739	1,156	—	—
30	783	1,225	$17.87	109
60	828	1,295	36.21	110
90	877	1,375	56.28	110

*Lint, 65¢; seed, 8¢; harvest, gin and haul, 12¢/lb.

Conclusion: Add ENOUGH potash so K will not be limiting at any time during the growing season.

RAPID PLANT GROWTH

RAPID PLANT GROWTH helps insure high yields and profits. And EXTRA potash may speed plant development. For example:

CORN on high K soil in Illinois: The more rapid emergence of silks may increase corn yield by lengthening grain filling time. It may also help prevent pollen shed and silking times getting mismatched, particularly during hot, dry weather.

Rate of K_2O lb/A	% silked on a given date
0	14
60	34
120	38
240	67
480	65

CORN on medium K soil in Kentucky: Grain filling period was lengthened from 55 days with no potash added, to 62 days with 240 lb K_2O. Bushels of grain produced/A per day was increased from 2.58 to 2.74 bu.

ALFALFA in Virginia: The faster regrowth may make another cutting possible. Too, the quality of the hay is improved.

Rate of K_2O lb/A	Regrowth in 32 days lb/A
0	1,575
40	1,933
80	2,229
160	2,350
320	2,445

SMALL GRAIN in Montana: Added potash on K-responsive soils advanced heading date one to three days.

REMEMBER

1. At least 15 factors beyond the K soil test must be considered when deciding how much potash to apply.

2. Less than 25% of the acres are soil tested even when recommendations from one soil test can be used for 3 or 4 years on a given field.

3. Knowing the latest results from those high-yield experiments in your area can pay you in helpful tips.

4. Slight over-fertilization with potash pays better than under-fertilization. It helps keep the crop READY for good growing seasons. It helps insure against stresses from weather, soil, & crop. And the unused amounts remain in most soils for the next crop.

5. Repeat strips of extra potash through your fields for 3 or 4 years. And watch what happens to the yield and quality of crop in those extra-K strips.

6. A very small amount of crop will pay for an extra 60 lb K_2O—about 2 bu corn, one bu soybeans, 10 lb cotton lint and seed, 150 lb alfalfa, or 1.5 bu barley.

A PROFIT-MINDED FARMER CANNOT AFFORD LOW FERTILITY!

The End.

REPRINTS OF THIS ARTICLE ARE AVAILABLE. ORDER ON BACK COVER.

"Production cost per bushel is decreased and profit per bushel increased by higher yields from fertilizer."

ORDER HIGHEST RETURN INPUT BROCHURE ON BACK COVER

PREVENT
Manganese Deficiency in Soybeans

**M. E. KROETZ, W. H. SCHMIDT,
J. E. BEUERLEIN, AND G. L. RYDER
OHIO AGR. RES. & DEV. CENTER**

MANGANESE DEFICIENCY often reduces soybean yields on lakebed soils of Northwestern Ohio and on other dark-colored, fine-textured soils.

These soils have high pH in both topsoil and subsoil. The deficiency usually occurs because of a low level of available manganese.

A 50-bushel/A soybean crop needs only about 1 ounce of manganese per acre. Although total levels in the soil greatly exceed 1 ounce, manganese available to soybeans grown on these soils is often insufficient.

A pH of 6.5 or above throughout the root zone usually accompanies manganese deficiency. But deficiencies have occurred on Paulding clay with a pH as low as 5.8.

Organic matter, clay content, soil temperature, and soil moisture affect manganese availability.

IN RESEARCH AT the Northwestern Branch Station, 200 lb 0-20-20 fertilizer per acre in the row increased soybean yield from 17 to 31 bushels per acre.

Adding manganese sulfate to the row fertilizer did not further increase yield. Superphosphate was used as the phosphorus source. And the acidifying effect of the row fertilizer increased availability of soil manganese.

Manganese sulfate applied as a foliar spray increased soybean yield at the Northwestern Branch from 23 to 29 bushels per acre in a previous trial.

Several different sources of phosphorus and manganese are available to soybean growers today. So field studies were initiated to evaluate some of the new materials.

FIVE YEARS of replicated studies were conducted on several Northwest Ohio soil types known to be low or deficient in manganese.

A manganese soil test of 40 or above is desirable for soybean production. The manganese soil tests ranged from 9 to 19, indicating all test sites were deficient in manganese.

Soil phosphorus levels were medium to high while potassium levels ranged from low to high for good soybean production. The pH ranged from 6.0 to 7.0.

The row applied 0-20-20 fertilizer was made by mixing concentrated superphosphate (0-46-0) and muriate of potash (0-0-60).

The liquid 4-10-10 was made from ammoniated polyphosphate and muriate of potash. Granular manganese sulfate and liquid manganese EDTA chelate were used as the manganese sources.

Foliar manganese treatments were applied at the 2-3 trifoliate leaf stage with some treatments receiving a second spray at the 5-6 trifoliate leaf stage.

Eight (8) pounds of manganese sulfate (2 pounds Mn) or 1 quart of liquid manganese EDTA chelate (0.13 pounds

Table 1—Effect of Manganese Sources on Soybean Yields Applied in Row Fertilizer or as Foliar Spray.

Lb./A.	ROW FERTILIZER Analysis and Mn Source		P*	1972 O	H	1973 H	1974 O	W	1975 U	O	Avg.
						Bu./A.					
	Check		46.7	41.0	44.3	54.4	33.3	58.8	40.7	50.3	46.2
200	0-20-20**		51.2	49.3	53.9	57.7	40.7	61.7	47.1	56.5	52.3
200	0-20-20-4 Mn (Mn SO_4)		49.4	50.3	57.4	55.6	39.9	62.1	52.5	56.6	53.0
200	4-10-10-.26 Mn (EDTA chelate)		47.2	46.7	52.2	49.9	35.5	61.3	44.9	53.1	48.8
	FOLIAR SPRAY										
Lb. Mn/A.	No. Sprays	Material									
2	1	$MnSO_4$	46.7	45.0	54.6	56.6	35.2	60.8	46.8	51.6	49.7
4	2	$MnSO_4$	46.6	47.3	55.0	55.5	36.8	60.3	46.8	51.7	50.0
0.13	1	EDTA Chelate	46.6	41.4	51.3	52.3	32.5	60.6	42.7	50.5	47.2
0.26	2	EDTA Chelate	45.4	42.8	50.8	54.6	37.1	61.2	43.0	52.7	48.4
L.S.D.	.05		3.2	2.5	3.8	3.2	3.4	NS	4.2	3.9	

*Test sites: P = Paulding, O = Ottawa, H = Huron, W = Wood, U = Union counties.
**Does not contain manganese; however, the acidifying reaction of this fertilizer in the soil makes manganese more available to the soybean plant.

Mn) plus surfactant in 20 gallons of water per acre were applied each time.

RESPONSE TO ROW FERTILIZER varied among locations. Yields increased 6 bu/A average from 200 lb 0-20-20 row fertilizer, shown in **Table 1.**

Phosphorus and potassium levels in the leaves suggest this response was not due to increased concentrations of these nutrients.

The lowest phosphorus level found in any treatment was 0.35 percent while the lowest potassium level was 1.83 percent. Both concentrations are considered adequate for optimum growth.

This yield response is thought to come from the acidifying effect of the row fertilizer which increases manganese availability.

The 200 lb row-applied 4-10-10 yielded two bushels per acre less than 200 lb 0-20-20.

Adding 8 lb manganese (Mn) as manganese sulfate in row fertilizer did not increase yield above that from 200 lb 0-20-20 in the row.

Adding manganese to the phosphorus and potash increased manganese level in the plant, suggesting this practice might give the crop manganese through a longer manganese stress period than phosphorus and potash alone.

Adding manganese EDTA chelate to a liquid row fertilizer did not increase yield and was less effective than manganese sulfate in increasing manganese content of the soybean plant, shown in **Table 2.**

Plots treated with manganese EDTA chelate in the soil often appeared more manganese deficient than the check treatments from 2 weeks before until 2 weeks after flowering. New growth appeared normal later in the growing season.

Plant analysis showed manganese level increasing in leaves when it was applied in the row fertilizer or foliar spray, shown in **Table 2.** Twenty ppm is considered a sufficient concentra-

Table 2—Effect of Row Fertilizer and Foliar-applied Manganese on the Manganese Content of Soybean Leaves in late July

Treatment		1972			1973		1974	1975	
Rate (lb./A.)	Source	P	O	H	H		O	W	Avg.
						PPM Mn			
	Check	21	21	15	12		21	14	17
200	0-20-20	26	32	26	19		25	17	24
200	0-20-20-4 Mn ($MnSO_4$)	44	53	44	20		38	17	36
200	4-10-10-.26 Mn (EDTA chelate)	24	30	20	16		21	15	21
2	Mn-1 $MnSO_4$ Spray	24	21	25	14		23	16	20
4	Mn-2 $MnSO_4$ Sprays	28	24	34	18		24	17	24
0.13	Mn-1 EDTA Chelate Spray	17	18	21	10		25	12	17
0.26	Mn-2 EDTA Chelate Sprays	17	20	21	14		24	13	18

tion of manganese in the leaves.

Visual manganese deficiency symptoms were common in check plots during June but seldom occurred in plots treated with 200 lb 0-20-20 fertilizer.

Ammonium phosphate (18-46-0) and ammoniated polyphosphate (15-60-0) gave results similar to concentrated superphosphate.

Similar yields were achieved when a fine manganese oxide was substituted for manganese sulfate at the same rate of manganese.

No combination of phosphorus and manganese sources gave results different from those reported in **Table 2.**

ONE OR TWO FOLIAR SPRAYS of manganese sulfate increased yield about 4 bushels per acre, shown in **Table 1.** Foliar-applied manganese increased yields at 4 of the 8 locations.

Average yield for foliar applied manganese EDTA chelate was lower than manganese sulfate and not different from the check.

Yields from foliar-applied manganese EDTA chelate were more erratic than from sulfate, responding to one and two sprays at one location and to two sprays at another location.

EDTA chelate sprays "greened up" the soybeans about the same as the manganese sulfate spray did.

Manganese concentration in soybean leaves, shown in **Table 2,** was related to yields. Manganese sulfate sprays increased leaf manganese level above the check, while manganese EDTA chelate sprays did not.

Tests studied the effect of time of applying foliar manganese. Single sprays applied at the 2-3 trifoliate, 4-5 trifoliate, and early flowering produced similar yields.

Yields produced by row fertilizer plus foliar applied manganese were not different from yields produced by row fertilizer alone.

In 1976 tests, 50 lb 5-20-20 did not increase yield above the check (no treatment), while 100 or 200 lb 5-20-20 increased yields around 5 bu/A.

In 1976 fifty percent of the soybeans in Ohio were fertilized with an average of 11 lb N, 39 lb P_2O_5 and 47 lb K_2O.

But the concentration of row fertilizer presently used in solid planted soybeans (7-12 inch rows) may not prevent a manganese deficiency.

No combination of the various sources of foliar applied manganese and additives was better than manganese sulfate alone.

IN SUMMARY, row fertilizer supplied manganese better than foliar feeding in these trials.

Ohio soybean growers with manganese problems are advised to use a row fertilizer to prevent deficiency.

Adding granular manganese sulfate to a blended row fertilizer, or using a manufactured fertilizer with 3 to 5 percent manganese, will give additional protection against a manganese deficiency. The End.

ESTIMATING CROP YIELDS FOR SOILS

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ATTAINABLE YIELDS are greatly influenced by changes in agricultural technology:

1. Improved crop cultivars and seed quality.

2. A more complete knowledge and understanding of fertilizer and lime requirements and responses of specific crops.

3. Breakthroughs in chemical weed control and other cultural practices.

4. A broader understanding of soils, soil interpretations and land selection.

5. More effective and efficient farm machinery.

6. Greatly improved concepts and systems of management.

All these have contributed to steadily increasing crop yields.

Crop yield estimates for the major crops grown on the soils of an area have long been an important and useful reference and guide to the crop producer.

Such estimates traditionally have been included in soil survey reports and other publications not readily adapted to periodic revision. So, rapidly changing agricultural technology outdates such published estimates very rapidly.

Bulletin 561 of the Tennessee Agricultural Experiment Station, "Yield Estimates for the Major Crops Grown on the Soils of West Tennessee," updates yield estimates for the major crops presently grown on the soils of West Tennessee to levels now attainable.

It uses contemporary technology and production practices currently recommended by the University of Tennessee Institute of Agriculture.

FOUR FACTORS are known to influence crop yields most profoundly:

1. The characteristics and genetic potential of the crop and its cultivars.

2. The climatic conditions under which the crop is grown.

3. The physical and chemical properties of the soils in which the crop is grown.

4. The level of management applied in producing the crop.

New cultivars, variations in growing season weather, and changing management practices and systems affect yield levels across all soils, but have less effect on the relative differences in crop yields among soils.

Unlike other factors, soils that have reached a dynamic equilibrium with their environment undergo little change over time.

Soils with different properties offer different environments for crop growth. Crop yields measure interaction among (1) the genetic potential of the crop, (2) the environmental requirements of the crop, and (3) the capacity of individual soils to satisfy those requirements when management does not limit yield.

PROPERTIES AFFECTING the soil's capacity to supply water to actively growing plants are the primary influence on crop yields during any cropping season.

The amount of water the soil holds available to plants depends greatly on **(1) texture of soil material, (2) structure of arrangement of soil particles,** and **(3) depth of soil favorable for root development.**

Soils with high available water-holding capacity do not necessarily have high water-supplying capacity.

Water-supplying capacity considers not only available water-holding capacity of the soil but also the effects of certain factors on the soil's capacity to supply water to crop plants: **(1) infiltration rate, (2) percolation rate, (3) landscape position, (4) slope gradient,** and **(5) drainage characteristics of the soil.**

TABLE 1. Mean corn yields by physiographic position, drainage, slope gradient, erosion, and parent material at the West Tennessee Experiment Station, 1957-1972.

	Bu/A
A. Physiographic positions	
Terrace and upland soils	91
Young alluvial soils, not subject to flooding	95
Young alluvial soils, subject to flooding	89
B. Drainage class	
Somewhat excessively drained	49
Well drained	108
Moderate well drained	100
Somewhat poorly drained	99
Poorly drained (artificially drained and surface leveled)	101
C. Slope gradient	
0-2% — Level	94
2-5% — Gently sloping	91
5-12% — Sloping	81
D. Degree of erosion	
Uneroded	105
Eroded	98
Severely eroded	71
E. Parent material	
Memphis catena — silty material	119
Dexter catena — mixed silty and sandy material over sand	104
Eustis — sandy material	26

Bulletin 561 attempts to estimate crop yields on different soils based primarily on their ability to supply water to the crop.

A broad base of facts was used to reach the estimates. Yield data were not available for many of the soil mapping units presently recognized in West Tennessee.

The most recently reported yield data for key soil mapping units were used directly in establishing and cross-checking the relative yield differences among the soil mapping units.

YIELD ESTIMATES for soil mapping units without yield data were developed through a process of interpolation between soil mapping units with similar soil characteristics and available yield data.

The basis for interpolation was the kind and degree of soil differences between soils with established yields and soils needing yield estimates.

An example of the data used as a guide is shown in **Table 1.**

It is not possible to present individual yield estimates for all 550 plus soil mapping units included in the bulletin. But we can give a summary of the yield estimates by major soil groups.

When slope and erosion are constant, the West Tennessee soil series included in the bulletin can be placed into 13 groups based on similarity in soil profile characteristics, water-supplying characteristics, drainage, and consequently estimated crop yields.

THE SOIL SERIES were grouped as follows:

Uplands and Terraces

Excessively-drained or cherty soils—Example—Eustis

Deep, well-drained soils—Example—Memphis

Moderately deep, well-drained soils—Example—Brandon

Moderately well-drained soils with fragipans—Example—Grenada

Moderately well-drained clayey soils—Example—Colbert

TABLE 2. Estimated yields for major crops grown on representative soil types on a 0-2% slope and none to slight erosion from each of 13 Major Groups.

Soil Types	Corn Bu/A	Soybeans Bu/A	Cotton Lint Lb./A	Wheat Bu/A	Fescue DM Tons/A
Uplands & Terrace					
Eustis loamy fine sand	—	—	—	—	.9
Memphis silt loam	120	44	900	56	3.5
Brandon silt loam	85	38	700	48	3.1
Grenada silt loam	95	40	750	53	3.2
Colbert silt loam	—	—	—	35	1.5
Calloway silt loam	95	42	750	50	3.4
Center silt loam	95	38	750	50	3.4
Henry silt loam	75	34	625	42	2.8
Bottomland					
Crevasse loamy sand	—	—	—	—	.5
Vicksburg silt loam	125	46	900	54	3.5
Collins silt loam	120	46	875	52	3.5
Falaya silt loam	100	38	775	36	3.4
Waverly silt loam	55	32	450	—	2.5

Somewhat poorly-drained soils with fragipans—Example—Calloway

Somewhat poorly-drained soils without a fragipan—Example—Center

Poorly-drained soils with fragipans—Example—Henry

Bottomlands

Excessively-drained soils—Example—Crevasse

Well-drained soils—Example—Vicksburg

Moderately well-drained soils—Example—Collins

Somewhat poorly-drained soils—Example—Falaya

Poorly-drained soils—Example—Waverly

Yield estimates for representative soil types from each of the above groups were tabulated at the same slope gradient (0-2%) and degree of erosion (none to slight).

These estimates are shown in **Table 2.**

The estimated yields reported are believed to be realistic estimates of the average yields attainable with current technology.

THE FOLLOWING ASSUMPTIONS were used in reporting all estimated yields:

1. Crops to be produced under natural rainfall conditions without irrigation.

2. Crops to be produced using all production practices recommended by the University of Tennessee Institute of Agriculture.

3. Crops to be produced in cropping systems that would hold soil losses within tolerance limits set for individual soils by Tennessee Agricultural Experiment Station Bulletin 418, "Predicting Soil Losses in Tennessee Under Different Management Systems."

MANY FACTORS affect crop yields. Some are known and relatively well understood. Some are known but not yet well understood. Some are yet to be recognized. This makes it hard to isolate and define factors or interaction of factors that are limiting higher yields.

But within the bounds of the contemporary knowledge and applied technology we know the amount of water available for plant growth is a yield-limiting factor most years.

If this were not so, crop yields would not be so well correlated with the water-supplying capacity of soils and with the wet and dry cycle characteristics of the climate. **The End.**

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