

Maximum Yield Research Sets New Records in the U.S. and Canada

Corn

**338
bu/A**

Soybeans

**109
bu/A**

INSIDE THIS ISSUE:

News on these and other research results...

BETTER CROPS with plant food

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Jesse Davis Romaine: 1901-1982



MR. J.D. ROMAINE, retired vice president of the American Potash Institute, from which the Potash & Phosphate Institute evolved, died November 15, 1982, just seven days after his 81st birthday.

He was born in Philadelphia and died in Silver Spring, Maryland. He earned his B.S. degree in agronomy from Pennsylvania State University, his M.S. from Michigan State University.

He worked seven years as an agronomist for N. V. Potash Export My. out of New York, then helped found the American Potash Institute when it was formed from the N. V. Potash staff in 1935 in Washington, D.C. In 1940, he was named secretary and in 1954 vice president of the Institute. Mr. Romaine retired at the end of 1966.

Survivors include his wife, Rose, of Silver Spring; a stepson, Robert K. of San Antonio, Texas; and three grandchildren.

Jess Romaine became widely known for his development of what is believed to be the world's first mass-produced-and-distributed plant food utilization chart and pamphlet in 1940.

At the time of his retirement, over one million copies of this material had made scientists and growers around the world more conscious of the heavy drain high yielding crops put on soil nutrients.

For many years, he was a familiar figure in American chemical and agronomy circles. He served as chairman of the American Chemical Society's Division of Fertilizer and Soil Chemistry and for years served on the council or "senate" of that body. In the developing years of the American Society of Agronomy, he served on the nominating committee of ASA.

He was also a member of the American Association for the Advancement of Science, the Masonic Order, the University Club of Washington, D.C. and St. Luke's Lutheran Church of Silver Spring.

Jess Romaine was of a conviction that no one owed him a living but he owed the world the best he had in him. And he gave it. His knowledge was broad and deep — and he shared it unselfishly with colleagues. He was recognized as one of the world's foremost authorities on the key role of potash in global food production.

He symbolized the quality of mind the Institute has always sought in its scientists — objective, thorough, optimistic.

Mr. Romaine lived through several recessions in the fertilizer and farming business — and came out of them with his objectivity and optimism intact. No better example could a man set for his younger colleagues. ■

New World Record Corn and Soybean Research Yields in 1982

DR. ROY FLANNERY, New Jersey Extension soils specialist, produced record research yields of 338 bu/A for corn and 109 bu/A for soybeans in his 1982 experiments. This was his third year of cooperating with the Potash & Phosphate Institute in maximum yield research.

Tables 1 and 2 summarize the results for corn and soybeans.

Table 1. Influence of corn hybrid, plant population and macronutrient (NPK) fertilization on field corn grain yields (bu/A)¹ in 1982.

Fertilization			Agway 849X				O's Gold SX5509			
N	P ₂ O ₅	K ₂ O	32,670 ppa ²		37,337 ppa		32,670 ppa		37,337 ppa	
-----lb/A-----			N.I. ³	I. ⁴	N.I.	I.	N.I.	I.	N.I.	I.
300	175	175	185	239	183	264	181	277	183	287
500	350	350	184	258	175	303	160	290	150	338

¹All yields standardized to 15.5% moisture.

²ppa = plants per acre.

³N.I. = Not Irrigated.

⁴I. = Irrigated.



Dr. Roy Flannery

These yields are not flukes. Dr. Flannery has produced high yields consistently in the three years of the project.

Three-year average yields from the top treatment in the study are 312 bu/A corn and 99 bu/A soybeans.

Three-year Summary: 1980-82

Year	Yield from best treatment	
	Corn	Soybeans
	bu/A	
1980	312	94
1981	285	93
1982	338	109
Average	312	99

Table 2. Influence of variety, plant population, irrigation, macronutrients (NPK) and micronutrients on soybean yields.

Plant nutrients applied			Soybean yield, bu/A							
			Asgrow A3127				Hobbit			
			149,349 ppa		224,023 ppa		298,697 ppa		448,046 ppa	
N	P ₂ O ₅	K ₂ O	N.I. ²		I. ³		N.I.		I.	
-----lb/A-----			N.I. ²		I. ³		N.I.		I.	
75	100	125 ⁴	70.7	69.7	62.6	95.5	64.3	66.0	63.1	84.3
75	100	125 ⁵	68.8	75.7	67.8	91.7	65.2	73.2	60.2	89.8
125	200	250 ⁴	62.7	86.4	62.8	108.6	53.1	73.8	58.0	93.0
125	200	250 ⁵	50.1	103.6	49.4	102.7	55.0	96.5	50.4	99.8

¹Yields standardized for 13% moisture.

²N.I. = Not Irrigated.

³I. = Irrigated.

⁴No micronutrients applied.

⁵Micronutrients applied: (B = 1 lb, Cu = 5 lb, Mn = 25 lb, and Zn = 5 lb).

Complete analyses of the 1982 data are not available at this time. However, Dr. Flannery suggests several factors that might have accounted for the excellent 1982 results. He says:

"I had an opportunity to be at the plots almost every day in 1982. This was not the case in 1981 when commitments took away some field time.

"The irrigation schedule was much better in 1982 vs 1981. Again, this is a result of being at the plots each day.

"I continue to look for better varieties and hybrids. The O's Gold hybrid was chosen based on its performance in the New Jersey corn hybrid testing trials.

"We were able to control the corn borer in 1982. They gave us problems in 1981.

"I believe we had more sunlight in 1982 vs 1981. The data on this is available but not analyzed at this time.

"Perfect planting is one key to high corn yields. There was a stalk at every position in a 12 x 14-inch diamond pattern. This is the third consecutive year this pattern has topped others tried.

"There may now be a cumulative effect beginning to show up on the plots. Three years of maximum yield research, where high fertility and high amounts of residue are building soil productivity." ■

Thoughts —

"The secret of happiness is curiosity." — *Norman Douglas*

* * * *

"People can be divided into three groups: Those who make things happen, those who watch things happen, and those who wonder what happened." — *John W. Newbern*

New Record Corn Yield for Canada – 251 bu/A

RESEARCHER C. K. "Ken" Stevenson of Ridgetown College in Ontario has broken all known Canadian corn yield records. In 1982, his first year of a maximum yield corn-soybean rotation, he produced 251 bu/A of corn and 69 bu/A of soybeans.

The experiment was conducted in Chatham, Ontario, on a Clyde loam. Experimental variables included: irrigation (trickle irrigation and non-irrigation); fertility (NPK rates of 250-150-150 lb/A and 500-300-300 lb/A + micronutrients); populations (26,000 and 37,000 plants per acre); and hybrids (DeKalb XL 25A and Pioneer 3707).

Corn was planted on May 3, 1982, in 20-inch rows. Nitrogen (N) was supplied from beef manure (115 lb N/A, preplant) and from inorganic sources.



C. K. STEVENSON, Ridgetown College of Agricultural Technology, harvested 1982 corn research yields of 251 bu/A, the highest ever recorded in Canada.

Some of the N was applied preplant and the remainder was split into four applications during the season.

The top yield of 251 bu/A was achieved by using Pioneer 3707, high fertility, high populations and irrigation. However, the combination of Pioneer 3707, low fertility, high population, and irrigation yielded 249 bu/A.

Overall, there was only a 3 bu/A increase in corn yields due to irrigation because rainfall was adequate throughout the growing season. Increasing population gave the highest yield increase of 25 bu/A when averaged across all treatments. The difference due to hybrids was 22 bu/A.

Plans for the 1983 growing season will include some changes. Row width will be decreased to 15 inches and populations will be increased slightly to 39,000 plants per acre. One new hybrid will be introduced. ■

[illegible]

Dean Rusk:

A World View of Agricultural Markets

DEAN RUSK spent years in top government circles as secretary of state to two presidents and advisor to many world leaders. Now he teaches law at the University of Georgia and shares his analysis of the world with various audiences.

Following are excerpts of a recent article in which Mr. Rusk discusses agricultural marketing and food policies (reprinted with permission of the author, Janet Rodekoher, University of Georgia).

THEY introduced him as a man who has walked with kings, presidents, emperors, generals, princes, and prime ministers. They called him an optimist in a world of strange and dangerous goings on.

Dean Rusk probably wouldn't let you call him a man of world vision, but when he starts talking about the world, you realize he sees it clearly. He doesn't speak of the princes and emperors, he refers to mildewed grain in India and the Japanese beef growers.

* * * *

Says Rusk, "The international market for farm products is very important for the total economic picture. But we have to gnaw at barriers to international markets for the American farmer. The value of the dollar is overpriced right now, our traditional markets like Japan and the Common Market countries are tough bargainers and restrictions are being put on our products."

* * * *

Rusk's experience allows clear hindsight and some foresight. He sees serious developments when the world's population growth outstrips food distribution.

He says, "Major food problems are coming, with needs beyond the imagination. I don't see any shrinkage of agricultural markets, but we can't feed all the hungry of the world. It's just not physically or fiscally possible. But



Dean Rusk

you can't expect people to starve peacefully."

With that sobering thought in mind, Rusk offers some ideas: "One thing we do know how to do is grow food. With the powerful combination of education, research and Extension work, we must do what we can to help other people grow more food."

* * * *

"We need some inventiveness, some ideas that may sound like weird devices, some that might not be acceptable to the financial markets. But we need ideas." ■

In Ohio

Soybeans Topped 100 bu/A in Maximum Yield Research

SOYBEAN YIELDS in a maximum yield research project conducted by Dr. Richard L. Cooper, USDA-OARDC, Ohio State University, reached a new high in 1982. The top replicated yield (two replications) was **102.2 bu/A** with 7-inch rows. All told, 27 of the top 54 entries in the Elite Test at Wooster, Ohio, yielded above 90 bu/A in 7-inch rows. Only nine of the 54 entries were above 70 bu/A in 30-inch rows; none of the varieties in 30-inch rows yielded above 80 bu/A.

These were combine-harvested yields from replicated research plots that were 20 ft long and trimmed to 16 ft at maturity. The middle two rows of a 4-row plot were harvested in the 30-inch rows. The middle six rows of a 10-row plot were harvested in the 7-inch rows.

Several practices unique to the 1982 study may help explain the increase from the previous four years of the experiment. In 1978, the highest yields were around 75 bu/A; in 1979, they were near 80 bu/A; in 1980, top yields were approximately 50 bu/A; and in 1981, highest yields were about 70 bu/A. While the top yields were not significantly different at the .05 level, they do represent positive progress concerning soybean yield potential.

Foliar Diseases

Defoliation by *Septoria* brown spot (perhaps intensified by the frequent sprinkler irrigation) accounted for the low yields in 1980. In 1981, two late applications of the fungicide Benlate reduced the effect of *Septoria*. However, three applications of Benlate in 1982 (July 15, August 2, and August 20) achieved season-long control of the foliar disease and kept the leaves working. (Benlate is approved for two applications. The three applications are for experimental use.)

Fertility Buildup

The cumulative effect from four years of fertility buildup may also have contributed to this difference. Cooper has followed a two-year, corn-soybean rotation on the silt loam soil with annual applications of 1000 lb/A of O-18-36 plus 400 lb/A of nitrogen (N) for corn and 200 lb/A of N for soybeans.

All fertilizer is broadcast and plowed down in the spring. Soil test levels have increased: P₁ from 110 lb/A in 1978 to 205 lb/A in 1982, and K test from 257 lb/A in 1978 up to 483 in 1982. The pH has decreased from 7.1 to 6.4. The cation exchange capacity (CEC) of the soil is 9.

Irrigation

In 1982, an Irometer was used to monitor moisture availability in the soil and maintain soil at field capacity. The amount of water applied through a sprinkler system at each irrigation was doubled, compared to previous years. The normal application in 1982 was 3 inches instead of 1.5 inches per week used in previous years. The irrigation was adjusted to give a combined total of 3 inches per week when rain occurred.

Table 1. Top yielding varieties, 1982 Elite Test, Wooster, OH.

Variety	Yield-bu/A		Maturity Date	Relative Maturity ¹	Height-Inches	Lodging Score ²
	30"	7"				
Beeson 80	56.4	75.0	9/24	-9	41	5.0
Williams 79	63.7	97.6	10/3		46	5.0
Hobbit	66.0	93.1	10/1	-2	24	2.0
Sprite	70.1	97.0	10/1	-2	25	2.2
Pixie	67.8	98.8	10/8	+5	24	2.2
Exp. 1 ³	68.0	100.3	10/4	+1	24	1.5
Exp. 2 ³	66.4	101.6	10/8	+5	25	2.0
Exp. 3 ³	66.7	102.2	10/8	+5	30	3.0
L.S.D. ⁴	8.9	14.6				

¹Number of days to maturity compared to Williams 79.

²Higher number indicates more lodging.

³Experimental determinate semidwarf lines.

⁴Least significant difference.

The increased amount of water continued until physiological maturity of the soybeans. This could have been a key factor. Often, we think that the soybean and corn crop is made at the same time. But this may not be true. It may be necessary to maintain soil moisture at field capacity much later into the growing season for soybeans than for corn to achieve maximum yields.

Seeding Rates

Seeding rates were adjusted to achieve the optimum plant populations for the indeterminate and determinate semidwarf varieties.

- For indeterminate varieties, seeding rates were 150,000 seeds/A in 30-inch rows (8 seeds/ft or 60 lb/A), and 225,000 seeds/A in 7-inch rows (3 seeds/ft or 90 lb/A).
- For determinate semidwarf varieties, seeding rates were 225,000 seeds/A in 30-inch rows (12 seeds/ft or 90 lb/A) and 300,000 seeds/A in 7-inch rows (4 seeds/ft or 120 lb/A).

All seed had 90% or higher germination. Planting date was May 6 for the 54 varieties and determinate semidwarf breeding lines.

Pest Control

For grass and weed control, Lasso herbicide was applied pre-emergence and Basagran post-emergence. The 30-inch rows were cultivated once and plots were hand weeded where necessary to maintain weed-free condition.

There was one application of Pounce insecticide to control a moderate infestation of Mexican bean beetle and Japanese beetle.

Summary

Cumulative buildup of soil fertility, increased irrigation and season-long foliar disease control were main contributing factors in the quantum jump in yields in 1982. Continued close attention to total production systems is essential for continued progress in maximizing soybean yields. ■

The peak years of mental activity are undoubtedly between the ages of 4 and 18. At 4 we know all the questions. At 18 we know all the answers.

Phosphorus Improves Orange Quality

By Bryant R. Gardner and Robert L. Roth

THE SALEABILITY OF ORANGE FRUIT for fresh market consumption depends on fruit quality. Results of a recent study show why phosphorus (P) plays an important role in the production of quality oranges.

The experiment was designed to compare three levels of nitrogen (N), N plus P, and N plus P plus micronutrients. The treatments were imposed on mature thirteen-year-old Campbell (Nu) Valencia orange trees on Rough Lemon rootstock. The trees, growing on Dateland sand, had been irrigated by the border-flood method since planting.

This was part of a larger study of converting to more efficient methods of applying irrigation water on sandy soils. The conversion was made without reducing current production standards of the mature citrus trees.

Irrigation System

The pressurized irrigation system used in the experiment was the spray method. Two spray heads were located under the tree canopy near the base of the tree trunk. Each spray head discharged a 165° fan of water. The spray heads were located on opposite sides of the tree trunk and sprayed water away from the trunk. Approximately 75% of the area under the tree canopy was wetted at a flow rate of 0.3 gallon-per-minute-per-tree. The application rate did not exceed the water infiltration rate of the soil so there was no runoff.

A total of nine nutrient treatments was investigated and replicated 10 times in a split plot design with six trees per block. Nitrogen as liquid ammonium nitrate was injected into the irrigation system weekly during each irrigation starting in November and ending in June.

The irrigation system was designed and plumbed to water each N system separately, so different amounts of N could be applied to the appropriate trees. The P and micronutrients were placed separately each fall six-inches-deep into the area wetted by the irrigation system at six different locations around each tree.

Each tree received 0.25 lb of P each year. Nitrogen rates were 0.75, 1.5 and 3.0 lb-per-tree-per-year. Orange yields and fruit quality measurements were taken for four years.

Quality Measurements

Fruit quality measurements were made each year prior to the fruit harvest. Fruit harvest normally took place between February and early April, depending on the fruit ripeness and the market prices. Ten fruit were selected from two trees in each treatment and replication. The fruit selected were located about eye level; size was about 3.25 inches diameter. Fruit quality measurements were percent solids; acid content; peel thickness; total volume of juice; and total sample weight.

Dr. Gardner and Mr. Roth are with the University of Arizona Experiment Station at Yuma.

Table 1. Fruit Quality, 1978

Treatment lb/tree	Solid-Acid Ratio	% Juice by weight	Peel Thickness
Nitrogen Rate Effects			
0.75 N	100%*	100%*	100%*
1.50 N	93%	100%	109%
3.00 N	93%	100%	111%
Phosphorus and Micronutrient Effects			
N***	100%**	100%**	100%**
N+P***	106%	107%	92%
N+P+M***	105%	107%	92%

*0.75N = 100%

**N = 100%

***N, N+P, N+P+Micronutrients

The principal effects of the nine treatments on these measurements are presented in Table 1. The results are summarized as six effects, the three nitrogen rates and the effects of the additional phosphorus and the addition of phosphorus plus micronutrients.

Applications of P increased the solid-acid ratio. High N rates tended to decrease this ratio. A high ratio of solids to acids indicates a sweeter, more desirable fruit as well as a possible early harvest. The P application increased percent juice by weight, while rates of N had little effect on the percent juice in the fruit.

Higher N rates increase peel thickness. The addition of P reversed the effect of peel thickness and resulted in more desirable, thinner peeled oranges.

Fruit was harvested from two trees in each plot each year and was sorted into eight commercial sizes and graded to fresh market quality.

Table 2 presents the fruit yield data as averages for the four harvest seasons.

Table 2. Fruit Yield Data, Average 1976-1979

Treatment lb/tree	Marketable	Fruit Yield Culls	Total	Fruit Culled by weight
Nitrogen Rate Effects				
0.75 N	100%*	100%*	100%*	100%
1.50 N	99%	138%	110%	122%
3.00 N	101%	148%	114%	122%
Phosphorus and Micronutrient Effects				
N***	100%**	100%**	100%**	100%
N+P***	116%	96%	109%	88%
N+P+M***	116%	97%	109%	88%

*0.75N = 100%

**N = 100%

***N, N+P, N+P+Micronutrients

Higher N rates increased total fruit yields. However, there were no increases in marketable fruit due to increased N rates. The higher levels of N resulted in more fruit culled. This in turn would increase the harvest costs per marketable fruit.

P applications increased both total and marketable fruit, and decreased the amount of fruit culled. Thus, phosphorus improved both the yield and quality. There were no effects of micronutrient applications detected for yield or quality. ■

Weather and Technology

Trend in Soybean Yields

By Louis M. Thompson

IN MY ARTICLE on "Weather and Technology Trend in Corn Yields," which appeared in the Spring, 1982, issue of this publication, I called attention to a distinct increase in corn yields beginning in 1960, with a curvilinear trend indicating a declining increase by 1980. This change in trend was due primarily to increased use of fertilizer, particularly nitrogen (N).

In this article I show that soybean yields have been increasing steadily and at about the same rate since 1930. There is no indication of a declining rate of increase in the five states including Illinois, Indiana, Iowa, Missouri and Ohio.

In order to show the technology trend one has to separate effects of weather. The procedure for the separation was published by the author in 1970! In simple regression analysis with one variable plotted against another (let us say yield on years) the regression line passes through the means.

In multiple regression, the trend line does not pass through the means, but may be tilted because of the changes in impact of variables over time. The accompanying graph, **Figure 1**, shows that in the decade of the thirties the trend line runs along the years of highest yields. Yet in the decade



Dr. Thompson is Professor of Agronomy and Associate Dean of Agriculture, Iowa State University, Ames, IA 50010.

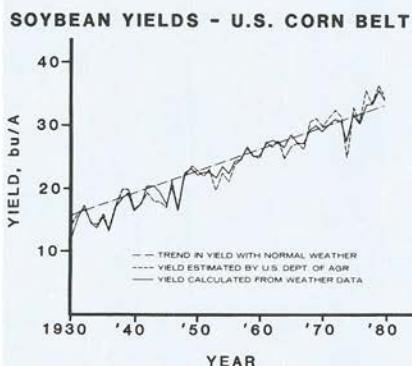


Figure 1

Thompson, Louis M. 1970. Weather and Technology in the Production of Soybeans in the Central United States. *Agron. J.* 62:232-236.

of the seventies the trend line runs through about the middle of the fluctuations in yields. This is because the weather was unfavorable so much of the time in the thirties.

Note also that yields were below the trend line nearly every year in the decade of the fifties. Again, this was because of lower summer rainfall and higher summer temperatures in the fifties compared to the forties and sixties. If one were to run a simple regression line through yields from 1930 to 1980 without regard to weather, the trend would appear steeper than shown in this analysis.

The trend in yield, which has been 0.36 bu/A/year was calculated from the equation by assuming zero departures from normal for each weather variable. An important feature is that normal weather is good weather for soybeans, just as it is for corn.

The Technology Trend

There are many factors that have interacted to keep soybean yields moving upward for the past 50 years. Perhaps the one most agronomists will defend is the influence of plant breeding, which has been continuous and gradual improvement.

Another just as important is the rising level of fertility of soils on which soybeans are grown. Soybeans are grown in rotation with corn and benefit from fertilizers added primarily for the benefit of corn. The increased plant population per acre has been another factor. Then credit must be given to better cultural methods, including weed, insect and disease control, and to timeliness in operations.

The Weather Variables

The crop/weather model used in this analysis includes: (1) preseason precipitation (from September through June), (2) June temperature, (3) July rainfall, (4) July temperature, (5) August rainfall and (6) August temperature.

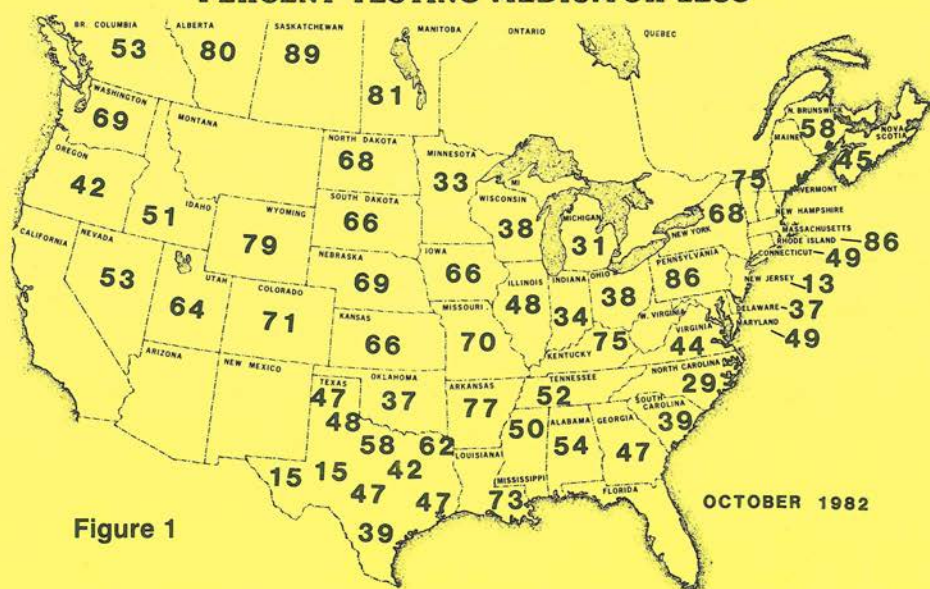
The reason June rainfall is considered preseason is that more moisture falls as rain than is removed by the crop. Moisture is generally being accumulated in the soil up to about July 1. Each variable is treated as a curvilinear relationship using a linear and squared term. The linear term is the departure from normal. The curve for each variable plotted against yield is a parabola and when plotted on a graph the optimum condition would be the top of the curve.

The curves plotted from the analysis show that temperature in June is optimum, but show that optimum yields occur with lower than normal temperature in July and August. Normal preseason precipitation is optimum, but yields are highly correlated to rainfall in July and August. All of these relationships are portrayed in the 1970 paper referred to above. The relationship of soybean yields to July and August rainfall is almost linear — the higher the rainfall in these months the higher the yields generally.

Soybeans respond to August rainfall much more than corn does. There were areas that produced good soybean yields in 1974 and 1977 where corn failed because of hot July weather. Soybeans continue blooming long enough so that the crop can recover in August if conditions become favorable. ■

PHOSPHORUS SOIL TEST SUMMARY

PERCENT TESTING MEDIUM OR LESS



Soil Test Summaries for P and K

SOIL TEST SUMMARIES on a soil area or state basis have often been used to call attention to broad nutrient needs and to help motivate educational and action programs.

The Potash & Phosphate Institute (PPI) staff recently made a summary for North America. The summary maps (**Figures 1 and 2**) show the approximate percentage of soils analyzing medium or less in phosphorus (P) and potassium (K) as tested by university laboratories. Wisconsin, where a combination of samples from state and commercial labs was used, is an exception. The most recent summary available was obtained. "Medium" was selected as an arbitrary break point realizing that interpretation varies among crops, soils and states.

It is of interest to note the relatively high percentage of soils west of the Mississippi River which test medium or less in P. Conversely, a relatively high percentage of soils along or east of the Mississippi River test medium or less in K. This, of course, is related to soils, climate and cropping patterns.

Accuracy of summaries? This question is often raised. Studies in Wisconsin, North Carolina, Kentucky, Alabama, Indiana, and other states have indicated that the summary of soil samples coming into the laboratory agrees reasonably well with the overall situation.

POTASSIUM SOIL TEST SUMMARY

PERCENT TESTING MEDIUM OR LESS

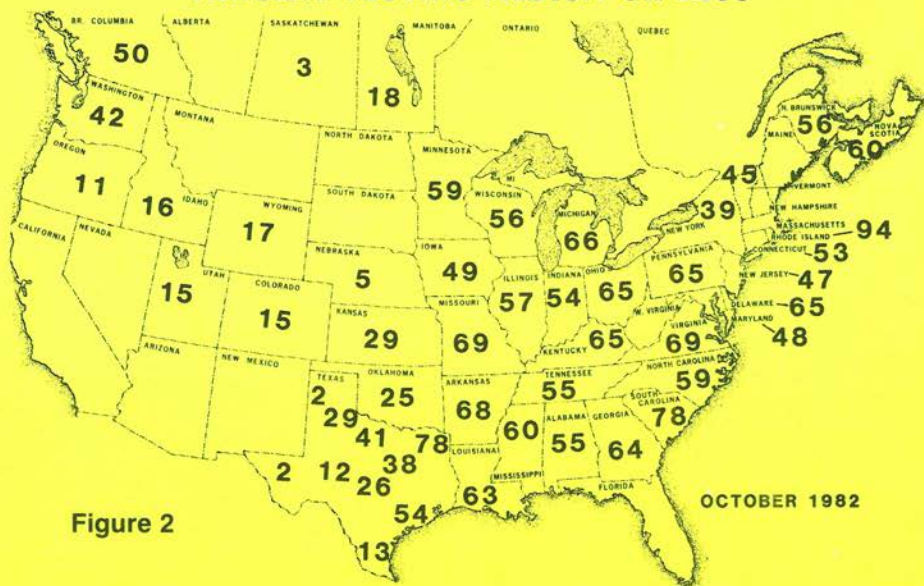


Figure 2

High soil tests. It is generally recognized that as we strive for higher yields, soils should test in the high range for P and K. A soil test is only one factor in fertilizer recommendations. Management history, plant tests, soil type, climate, yield goal and experience should also influence decisions.

Crop production has always entailed considerable risk because of such factors as floods, droughts, insects and diseases. There will always be risk in crop production but the grower can reduce risks through superior management. Having the soil test level high in P and K helps to reduce the risk of having inadequate fertility reducing yields and profits.

Probability of responses. As soil test levels increase, the probability of a response decreases. But even with a very high test there may be a response under some conditions.

The following information from Purdue and Minnesota illustrates the concept of probabilities.

Soil test P or K	Purdue — Probability of profitable response	Minnesota — Probability of response to row P and K
Very low	95 to 100%	—
Low	70 to 95%	95 to 100%
Medium	40 to 70%	65 to 95%
High	10 to 40%	30 to 65%
Very high	0 to 10%	10 to 30%

Looking ahead. As farmers push for sustained high yields and quality, the soil test as related to crop response to added nutrients will come under increased scrutiny. Maximum yield research over the years should result in an upward shift in soil test levels considered adequate. ■

New Chairman and Vice Chairman for Potash & Phosphate Institute and Foundation for Agronomic Research

DR. GINO P. GIUSTI, President and Chief Executive Officer of Texasgulf Inc., and Mr. Douglas J. Bourne, President and Chief Operating Officer of Duval Corporation, have been elected Chairman and Vice Chairman, respectively, of the Potash & Phosphate Institute (PPI) Board of Directors. Dr. Giusti also serves as Chairman of the Foundation for Agronomic Research (FAR) Board of Directors, and Mr. Bourne serves as Vice Chairman.

In welcoming the new leaders, Dr. R. E. Wagner, President of PPI and FAR, expressed appreciation for the dedicated service of Board Members whose terms were recently completed.

The new PPI and FAR Chairman, Dr. Giusti, is a recognized leader in the fertilizer industry. He began his career with Texasgulf Inc. in 1948 on a research fellowship at the Mellon Institute of Industrial Research. During his nearly 35 years with Texasgulf, he has served in technical research, marketing research, personnel, and in administrative areas, as well as President of the Texasgulf Chemicals Company.

In 1979, he was elected President of Texasgulf Inc. and in 1981 was appointed Chief Operating Officer. On July 1, 1982 he became President and Chief Executive Officer of Texasgulf Inc. The company is a major producer of phosphates, potash, sulfur and soda ash, with headquarters in Stamford, Connecticut.

In addition to B.S. and M.S. degrees in chemical engineering, Dr. Giusti holds a Ph.D. degree in business and economics from the University of Pittsburgh. He is a past Chairman of The Fertilizer Institute and of the Phosphate Chemicals Export Association, and is a Director of The Sulphur Institute. He is a member of the American Chemical Society, the American Economic Association, the American Institute of Chemical Engineers, the Chemical Market Research Association, and the American Institute of Mining, Metallurgical and Petroleum Engineers.

In Connecticut, Dr. Giusti is a Director of Northeast Bancorp, Inc. and the Union Trust Company, as well as a Trustee of Fairfield University.



Dr. Gino P. Giusti
Texasgulf Inc.

Chairman, Board of Directors
Potash & Phosphate Institute
Foundation for Agronomic Research



Mr. Douglas J. Bourne
Duval Corporation

Vice Chairman, Board of Directors
Potash & Phosphate Institute
Foundation for Agronomic Research

Mr. Bourne, Vice Chairman for PPI and FAR, joined Duval Corporation in 1946 as Assistant Chemist at its Orchard, Texas, sulphur property. He was transferred to Carlsbad, New Mexico, and served in an engineering capacity during potash exploration and plant construction. He later held positions with responsibility for operations, research and planning, sales, and management. In 1977, Mr. Bourne was appointed to his present position. Based in Houston, Texas, the company is a diversified producer of potash, sulphur, magnesium, and other minerals and metals.

Mr. Bourne has authored a number of technical papers and was granted five U.S. patents. A Director and past Chairman of The Sulphur Institute, he is also a member of the American Institute of Mining, Metallurgical and Petroleum Engineers. Mr. Bourne holds a B.S. degree in Chemical Engineering from the University of Oklahoma and completed the Advanced Management Program at Harvard Graduate School of Business. He is a Director of Anderson, Greenwood & Co., an international valve manufacturing concern.

Dr. Giusti and Mr. Bourne expressed continuing support for the unique programs of agronomic research and education developed by the Potash & Phosphate Institute and the Foundation for Agronomic Research.

"While our industry and the general economy have been weathering some difficult times, we're confident that better days are ahead. The concepts of maximum yield research and maximum economic yields for agricultural producers are forward-looking and offer the best hope for meeting future challenges," Dr. Giusti noted. ■

Fertibull: How to Make Forgotten Land Productive

By Donald K. Myers

SHOWING is one of the oldest methods of teaching. A demonstration to show good pasture management was initiated in Ohio and given the name "Fertibull." This term was selected to denote the use of fertilizers in the beef cow herd demonstrations.

The Tennessee Valley Authority (TVA), the Potash & Phosphate Institute (PPI), and many Ohio businesses contributed to the project by providing part of the needed corrective limestone, phosphorus and potassium for the 15 demonstration units.

The primary agronomic factors in the demonstration were:

- Application of corrective fertilizer and limestone to achieve these soil test levels:

pH 6.5 for clovers, pH 7.0 for alfalfa;

Phosphorus (P_1) 40 to 60 lb/A;

Potassium (K) 220 to 260 lb/A.

- The seeding of cool season grasses and legumes (orchardgrass for summer grazing and tall fescue for winter grazing — both in combination with alfalfa or red clover).
- Rotational grazing.
- Annual fertilization of 40 lb P_2O_5 /A and 100 lb K_2O /A. Nitrogen (N) was applied when the pasture was less than 30% legumes.

The summer pasture production on Fertibull farms exceeded 200 animal unit grazing days per acre. In addition, on most farms some hay was stockpiled from the summer pasture. These results compare favorably with research at the Ohio Agricultural Research and Development Center, indicating a range of 90 animal unit grazing days per acre for unimproved pasture to 184 days for improved pasture.

**Summer pasture animal unit grazing days —
Ohio-Fertibull demonstration farms 1975-1979**

Animal unit grazing	1975	1976	1977	1978	1979
Days per acre	182	203	217	200	211

Winter pasture yields of 3.5 tons/A were obtained by the end of the demonstration project.

The average number of beef cows per unit was increased from the initial 25 up to 36 cows per unit, with a stocking rate of 1.8 acres per cow and calf for the 12-month period. Calf weaning weights increased from 377 lb to 475 lb during the project, with 264 lb of feeder calf produced per acre.

These results are particularly significant because much of the land was low yielding, forgotten land prior to the program. The Fertibull program demonstrated forgotten land can be productive land. ■

Dr. Myers is extension agronomist, The Ohio State University, Columbus, OH 43210

No-till Corn Highest Yield with Nitrogen and Potassium

By Morris Bitzer

THE SOIL CONSERVATION benefits of no-till corn are well known. More farmers need to adopt no-till to help protect their soil from erosion.

Farmer acceptance of no-till depends on its profitability. Of the three components of profit — yield, price received and cost of production — most farmers use yield to judge the success of no-till.

No-till has a yield advantage over conventional tillage on most well-drained soils due to moisture conservation. A good fertility program is essential for this advantage. The higher yield potential of no-till can require more fertilizer.

Research on a farm in Jefferson County, Kentucky, demonstrated how important fertilizer management is for no-till corn. The site was a well-drained Crider silt loam — a soil well suited to no-till — which had been in a fescue-clover sod for two years. The conventional tillage was spring plowing followed by two discings.

Table 1 shows that without N no-till performed poorly compared to conventional tillage: corn yields were 32 bu/A less with no-till. But with adequate N and K no-till corn outyielded conventionally tilled corn by 19 bu/A.

Table 1. Corn yield response to nitrogen, potash and tillage.

	No-till	Conventional	Advantage to No-till
	Corn yield bu/A		
NITROGEN rates			
0 lb/A N	112	144	- 32 bu
150	165	146	+ 19 bu
Response to N	53 bu	2 bu	
Profit from N*	87 \$/A	0 \$/A	
POTASH rates			
0 lb/A K ₂ O	133	133	0 bu
60	140	142	- 2 bu
120	165	146	+ 19 bu
Response to K	32 bu	13 bu	
Profit from K*	55 \$/A	13 \$/A	

* Profit from increased yield over check: corn = \$2.50/bu; N = 20¢/lb; K₂O = 13¢/lb; 30¢/bu harvesting cost deducted. Both N rates received 120 lb/A of K₂O and all K rates received 150 lb/A of N. Plant population: 23,100 to 24,300 plants/A. Very high P, medium K soil test. University of Kentucky.

The fertilized no-till corn yielded a respectable 165 bu/A. The response to the 150-0-120 fertilizer rate was 53 bu/A. Much of this response was likely due to the interaction of N and K although a true control treatment (0 N, 0 K₂O) would have been necessary to evaluate the interaction. The soil test was very high P, medium K.

The return on fertilizer investment was best with no-till. The profit from applying 150 lb/A of N was \$87/A. Applying 120 lb/A of K₂O gave a profit of \$55/A on no-till corn. ■

Dr. Bitzer is in the Department of Agronomy, University of Kentucky, Lexington, KY.

No-Cost Inputs for High Yields

By Joe T. Touchton

MAXIMUM YIELD is a goal that all growers and researchers would be pleased to obtain, but the cost of some inputs discourages most producers from attempting to obtain this goal. It is unfortunate, however, that we often fail to recognize that some inputs required for maximum yield cost little or nothing.

Currently, many management systems operate at, or above, maximum levels for some inputs and at yield-limiting levels for others. Too often, high-cost inputs are optimized while low-cost inputs are ignored. For maximum economical yield, all inputs must be optimized.

The cost of inputs for a maximum economical system can be divided into three broad classes: (1) no cost, (2) low cost, and (3) high cost.

The no-cost inputs would include such items as timeliness, equipment adjustments, and crop rotations. Timeliness includes such items as planting, harvesting, and pesticide applications. To delay planting beyond optimum periods for any reasons other than weather is a poor management practice. The optimum planting period varies among crops and locations. Data in **Table 1** are for corn in south Alabama, but information on optimum planting periods is available for most crops within the major agricultural regions of most states.

Harvest date can be critical for most crops. Allowing a crop to remain in the field well past its maturity can result in yield losses through shattering, lodging, insect damage, and poor quality. It is not very profitable to produce a crop and then leave it in the field. **Adjusting and repairing equipment** during the off-season does not cost any more than waiting until it is needed. Waiting to adjust and repair equipment when needed often results in delayed planting and harvesting.

Table 1. Effect of planting dates on yield of irrigated and non-irrigated corn in south Alabama.

Planting date	Irrigated	Non-irrigated
	----- yield, bu/A -----	
April 12	158	64
May 3	146	44
May 14	120	48
May 25	108	42

C. G. Currier, Auburn University.

Rotating crops is one of the most valuable tools available for increasing crop yields. Rotating crops is a cost-free input, which can not only reduce weed, disease, and insect problems but also improve general soil conditions. We will probably never obtain a maximum yielding system without using proper crop rotations. There is much information available on the benefit of crop rotations.

Data from Alabama, Illinois, and Florida are presented in **Tables 2 and 3** and **Figure 1**. The yield differences due to the rotations alone (663 lb/A/year for peanuts, 24 bu/A/year for corn, and approximately 10 bu/A/year for soybeans) resulted in sizeable increases in income. It should be noted that increases in peanut and soybean yield increased considerably with time.

Dr. Touchton is Associate Professor of Agronomy at Auburn University, AL.

Table 2. Yields of continuous peanuts and peanuts following corn.¹

Years ²	Peanut yield		
	Continuous	Rotated	Difference ³
	----- lb/A -----		
65-69	1400	1650	250
70-74	1780	2650	870
75-79	2200	3090	870

¹Data were provided by J.T. Cope and were published in *Highlights of Agriculture Research*, Vol. 28, No. 1, Spring, 1981.

²Peanut yields are averaged over the 5-year reporting period.

³Difference is increase in yield due to rotation.

Table 3. Yields of continuous corn and corn following soybeans, Morrow plots, Urbana, Illinois.¹

Year	Corn yield		
	After corn	After soybean	Difference ²
	----- bu/A -----		
1969	136	145	9
1971	146	169	23
1973	149	180	31
1975	161	191	30
1977	113	142	29
Average	141	165	24

¹Data were provided by L. F. Welch and were published in Univ. of Illinois, Agric. Exp. Stn. Bulletin 761.

²Difference is yield increase due to the rotation.

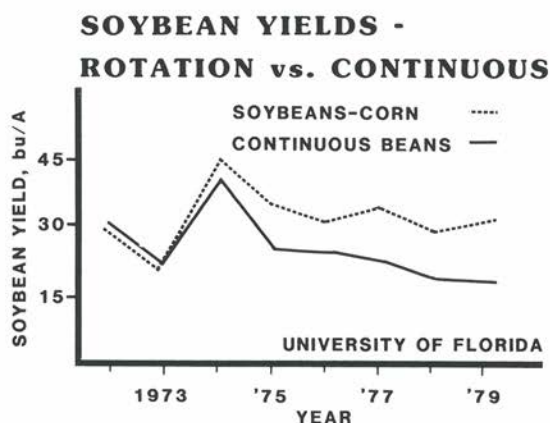


Figure 1.

Yields of susceptible soybeans grown continuous and in a two-year rotation with corn in soil infested with *Meloidogyne incognita*. Information provided by R.A. Kinloch, published in *Nematorpica* 10(2):141.

(continued on next page)

The data in **Table 4** were not from studies designed to illustrate the benefits of crop rotations, but the decrease in yield over time may have been due to detrimental effects of continuous cropping. The crops in each of these studies were irrigated so difference in yields among years were probably not due to poor rainfall distribution in a particular year.

Table 4. Soybean, wheat, and corn yields 1, 2, and 3 years after changing to a continuous cropping system.

Previous crop	Current crop	Year		
		1	2	3
-----yield, bu/A-----				
Fescue	Soybeans	47	45	34
Fescue	Wheat	46	35	31
Corn	Soybeans	47	39	35
Soybean	Corn	170	159	127

Low-cost inputs include such items as tillage and pest control. A poor management system often consists of excessive tillage prior to and after planting. Just one more tillage operation than is needed is a costly and unneeded expense. Data in **Table 5** illustrate the approximate cost of various land-preparation practices and the effect of these practices on soybean yields. The unneeded tillage operations did not decrease yield, but it doesn't take excessive calculations to determine profit reductions due to the excessive tillage.

Table 5. Effect of land preparation on soybean yield.

Primary tillage	Estimated cost	Yield
	\$/A	bu/A
No tillage	0	54
Disk	4	52
Chisel	6	51
Turn	7	53
Chisel-Disk	11	53
Turn-Disk	12	52

Research data, taken from many soils and several crops, have proved that reduced tillage systems will maintain or even increase yield. Data in **Table 6** are from tillage studies conducted in Alabama in 1981. With yield difference of the magnitude shown in **Table 6**, there is no doubt that no-tillage can be profitable. Large yield differences between no tillage and conventional tillage are not always obtained, but with properly managed weed control systems, no tillage can be profitable even if it doesn't result in higher yields than the conventional tillage system.

Table 6. Conventional and no-tillage corn, soybean, and grain sorghum yield, Auburn University, 1981.

Crop	Conventional	
	No-tillage	tillage
-----yield, bu/A-----		
Corn	103	78
Soybeans	38	30
Grain sorghum	90	78

A properly managed pest control system can definitely be a low-cost input. Scouting for insects and spraying only when necessary is a very economical approach to insect control.

A poorly managed **weed control** program can include insufficient herbicide rates, excessive rates, poor selections, and application methods. There is no need to apply herbicides to control weeds that do not exist. A good example of this is the use of grass herbicides in fields where grass problems are not common. The use of post-directed, nonselective herbicides to control weeds between rows instead of over-the-top herbicides is a management practice that can cut chemical cost by \$10 to \$15/A per application. The best approach to an economical herbicide program is to apply the most economical recommended herbicides, but the only way for this to work is to know the potential weed problems. We should never forget that the most expensive herbicide system is one that doesn't control the weeds or one that controls weeds that do not exist.

High-cost inputs include such items as fertilizer, fertilizer application, variety selections, plant populations, row widths, and irrigation. Although optimizing these inputs may increase costs, they actually should be considered no-cost items, because of increased net returns that accompany their proper use.

Data in **Table 7** illustrate how additional weed control increased production cost when needed phosphorus was omitted. In this study, soybean growth was delayed when phosphorus was not applied, therefore two post-directed applications of herbicides were required to control weeds that normally would have been controlled by a closed canopy. By omitting phosphorus fertilizer, it took \$8/A more to produce 35 bu/A bean yields than it did to produce 55 bu/A yields.

Table 7. Omitting needed phosphorus fertilizer results in higher cost production and lower soybean yields.

Item	Treatment	
	1	2
Phosphorus, \$/A	0	4
Post emergence herbicides, \$/A	12	0
Yield, bu/A	35	55

Data in **Table 8** illustrate the importance of choosing the proper fertilizer and its method of application. Solid ammonium nitrate cost more than urea-ammonium nitrate (UAN) and it cost more to incorporate than to surface-apply, but the added cost of ammonium nitrate or of incorporating UAN was profitable.

Table 8. Selecting higher cost nitrogen sources or application methods can be beneficial in no tillage corn production.

Applied nitrogen lb/A	Nitrogen sources and application method		
	Ammonium nitrate	Urea-ammonium nitrate	
	surface applied	soil incorporated	surface applied
		----- corn yield, bu/A -----	
80	130	135	80
160	160	160	100
240	170	160	115

J. T. Touchton and W. L. Hargrove. 1982. Agron. J. 74 (823-826).

Fertilizer rates should be based on soil test results, and the complete recommendations for a specific crop and cropping system should be followed. Applying 300 lb/A of nitrogen to irrigated corn can be a useless input if a deficient, low-cost nutrient, such as zinc, is allowed to limit yield.

It may cost more to plant at optimum plant populations with proven high-yielding varieties, but the returns should justify the inputs. Optimum plant spacing

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High Yields —

A Solid Route to Higher Profits

By William K. Waters, John E. Baylor, Joseph M. McGahen

CORN AND ALFALFA are King and Queen of Pennsylvania's livestock oriented agriculture. This royal couple annually occupy some 2.6 million acres in the Keystone State yielding products worth \$540 million or more.

Farmers have not been excluded from economy-wide depressed conditions. Many are suffering from severe cash flow problems that will undoubtedly affect management decisions for years to come. So it is appropriate to take a close look at corn and alfalfa, mainstays of livestock agriculture.

On-the-Farm Studies

Important crops deserve special attention by extension and research groups and they do in Pennsylvania. Penn State University extension agronomists organized the Five Acre Corn Club in the early 60's and the Alfalfa Grower's Program in 1977 for the purpose of gathering data on production practices leading to high yields. Production cost data was an added option for corn growers beginning in 1968 and for alfalfa producers in 1977.

With 419 farmers cooperating in the two programs, 1981 was a banner year. Participants receive yield and cultural practice data about their crops; over half of the farmers participate in the production cost option giving them a detailed crop cost and return analysis. Collection of data along with yield checks are done by county extension personnel; agronomists and farm management specialists verify, process, and analyze the data.

Data from these two studies afford an opportunity to take a close look at the economics of growing corn and alfalfa and the financial results of these farmers with high yields.

A Profile of Differences

A brief profile of the two crops based on composite 1979-81 data shows some important dissimilarities other than the obvious differences of annual vs. perennial, and energy vs. protein crop.

Corn is a high variable cost crop: a full two-thirds of the total cost in this category. Alfalfa on the other hand is a crop of one-half variable and one-half fixed costs. The fixed cost of the perennial stand prorated over stand life is the primary difference.

The total production costs per acre for alfalfa averaged about 13% more than corn. However, corn is a higher cash expense crop. About 63% of total corn expenses are cash-out-of-pocket costs while only 44% of alfalfa costs are cash expense.

Most obvious is the difference in grower's labor (custom operator's labor excluded). Alfalfa requires 2.5 times the number of hours per acre: 2.9 hours for corn vs. 7.3 hours for alfalfa.

Mr. Waters is an Area Farm Management Specialist; Dr. Baylor and Dr. McGahen are Extension Agronomists; all are staff members of the Pennsylvania State University.

Table 1. Yield, Crop Value, Production Cost, Net Return, and Break-even Yield; Pennsylvania Five Acre Corn Club, 1979-81

	1981	1980	1979
Measured yield, bu/A ¹			
All participants	137.8	129.6	138.1
Cost record participants ²	135.8	122.8	135.5
Crop value \$/A	\$356.00	\$445.00	\$393.00
Production cost \$/A	244.00	241.00	216.00
Net return \$/A	\$112.00	\$204.00	\$177.00
Price \$/bu	\$2.62	\$3.62	\$2.90
Total cost \$/bu	1.80	1.96	1.59
Break-even yield, bu/A	97.9	70.1	78.4

¹Yields calculated at 15.5% moisture.

²Cost record participation is an option.

³Estimated standing yield per acre to cover all costs allowing for 5% harvest loss.

Corn Price Drop Pushes Break-even Yield

Corn production cost per acre advanced from \$216 to \$244 from '79 to '81, **Table 1**. The increase of only \$3 from '80 to '81 is interesting and due to a shift among growers to less costly tillage. Total production costs for no-till farmers averaged 90% of those costs for conventional tillage growers during the period. In 1979 only 12% of the Five Acre Club growers practiced no-till. By 1981, 23% of the growers used no-till, hence the dampening affect on total costs when all were averaged together. While not implying a similar shift in tillage methods for all growers in the state, the move does suggest possibilities for cost reduction, where no-till is feasible.

The production cost per bushel was \$1.80 in 1981. Included were variable cash costs, operator's labor at \$6.40 per hour, machine ownership costs, annual lime costs, and land charges averaging \$45 per acre. Cost per bushel was erratic over the period due to an 8 bu/A drop in average yields in 1980 due to lower rainfall conditions over much of the State.

The harvest season price per bushel had dropped by \$1 from 1980 to 1981. The depressed price along with increased costs propelled the break-even yield to about 98 bu/A, 2 bu/A above the state average yields for 1981.

The near outlook for corn price and ever rising production costs call attention to the importance of gearing production practices for yields above the up-trending break-even yield level.

Alfalfa Costs Begin Slowdown

Alfalfa production costs were climbing by 15% per year from 1977 to 1980. In 1981 fuel and fertilizer costs stabilized somewhat and total costs increased by only 5.3%, a welcome change. Total cost per acre in 1981 was \$276, **Table 2**. Costs include machine operating costs, materials for fertility, pest control and harvest, labor, machine ownership, land charges, lime and a prorated share of the stand establishment based on stand life expectancy.

Higher yields in 1981 compared to droughty 1980 resulted in lower cost per ton (\$48) in spite of higher total cost per acre. Net return averaged \$183 for program participants, an increase of \$69 over 1980.

Break-even yields, an estimated yield to cover all costs allowing for harvest losses, rises about one-tenth of a ton each year due to rising total costs. The 1981

(continued on next page)

**Table 2. Yield, Crop Value, Production Cost, Net Return, and Break-even Yield;
Pennsylvania Alfalfa Grower's Program, 1979-81.**

	1981	1980	1979
Measured yield, T/A ¹			
All participants	6.68	5.80	5.90
Cost record participants ²	6.50	5.25	5.92
Estimated net yield, T/A ³	5.74	4.70	5.32
Crop value \$/A	\$459.00	\$376.00	\$372.00
Production cost \$/A	276.00	262.00	227.00
Net return \$/A	\$183.00	\$114.00	\$145.00
Price \$/T	\$80.00	\$80.00	\$70.00
Total cost/net yield ton	48.08	55.75	42.67
Break-even yield, T/A ⁴	3.9	3.7	3.6

¹Yields calculated at 90% DM.

²Cost record participation is an option.

³Dry matter loss estimates are applied against each cutting for harvest loss depending on product harvested (hay, haylage, etc.) and whether field cured or treated.

⁴Estimated standing yield to cover all costs allowing for harvest loss.

break-even yield was 3.9 tons, a full ton above the average yield for all farmers statewide. This one ton is roughly equivalent to the cost per acre for labor and land charge. Thus, the "state average" farmer is sacrificing returns to land and labor.

Yield Levels — A Togetherness with Return and Unit Costs

Cropping is the keystone to successful livestock farming; yield levels are equally important to crop and livestock farmers. Poor crop plans and average to low

**Table 3. Summary of Yields, Production Costs, and Net Returns at Various Yield Levels;
Alfalfa Grower's Program and Five Acre Corn Club, 1981.**

Range Yield/A	Average Yield/A	Production Cost \$/A	Cost Per Unit	Net Return Per Acre ¹
ALFALFA (53 growers)				
3.0 - 3.9 T/A	3.45 T/A	\$259.85	\$85.97/T	\$ 15.64
4.0 - 4.9	4.63	242.34	59.84	81.71
5.0 - 5.9	5.39	252.65	54.35	124.46
6.0 - 6.9	6.59	292.05	49.84	181.30
7.0 - 7.9	7.38	285.36	42.73	251.46
8.0 - 8.9	8.24	312.78	42.77	277.86
CORN (121 growers, conventional tillage)				
80 - 99 bu	91.2 bu	\$220.09	\$ 2.41/bu	\$ 18.79
100 - 119	110.4	225.57	2.04	64.83
120 - 139	128.9	239.56	1.86	98.23
140 - 159	148.5	261.25	1.76	127.75
160 - 179	167.9	266.92	1.59	173.10

¹Crop values based on: Alfalfa - \$80/T, Corn - \$2.62/bu

yields may well be a prime income limiting factor on many farms.

What happens to net returns and unit costs at high yield levels vs. low levels? Results by yield level for alfalfa and corn in the 1981 Pennsylvania programs are shown in **Table 3**. The trends shown are identical to analysis of previous years results. The producers with high yields have lower unit costs and higher net returns per acre compared with low yield producers.

The results in **Table 3** indicate that for each one ton increase in alfalfa yield per acre, cost per ton is \$9 lower and net return is \$61 per acre higher. For each 10 bu/A increase in corn yield level, cost per bushel was 10.7¢ lower and net return per acre was \$20 higher.

Yield levels are a function of a host of factors: weather, variety selection, seed quality, seeding technique, soil fertility, pH, drainage, pest control, tillage and harvest systems, rotations, and timely field operations. Of these 11 factors, 10 are controllable by the farmer with MANAGEMENT.

The Five Acre Corn Club yields for 1981 were 42 bu/A above state average yields while the Alfalfa Grower's Program yields exceeded state average yields by 3.78 T/A. This is a sufficient indication that higher yield levels with resulting lower unit production costs and higher net returns per acre are feasible goals for many farmers. ■

(No-Cost Inputs . . . from page 23)

within rows and between rows should be practiced. Planting in narrow rows may be more costly than planting in wide rows, but the use of narrow rows often eliminates a need for cultivation and/or post herbicide applications. In the southeastern U.S., many of the residual herbicides are good for only 6 to 10 weeks, and if the crop canopies are not closed during this time period, late season weeds can be a severe problem.

There is conflicting information available on the yield responses to narrow rows. Some reports show higher yields with narrow rows than with wide rows, but other reports show no yield advantages for narrow rows. A key point to remember, however, is that we seldom find lower yields with narrow rows.

Seeding at excessive rates is costly and can reduce yield of some crops. Lower-than-optimum seeding rates will result in excessive yield losses. Irrigation is definitely a high-cost input, but it can be profitable if properly used. Investing \$300 to \$600/A in an irrigation system would, however, be a costly blunder if such simple items as inadequate plant populations, fertilizer programs, and timeliness are not optimized.

Obtaining maximum economic yields is highly dependent on management. These yields probably cannot be obtained with luck alone. In our efforts to obtain high yields, we often include expensive inputs such as irrigation and too often forget to optimize the no-cost or low-cost inputs that should not be ignored even if irrigation is not available. ■

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For a free catalog, contact the Potash & Phosphate Institute, 2801 Buford Hwy., N.E., Atlanta, GA 30329. Phone (404) 634-4274.

Soil Compaction: A Hidden Problem

By Gary C. Steinhardt

SOIL COMPACTION, whether on the surface or in the subsoil, can reduce yields and profits. One of the unfortunate aspects of this problem is how few people are aware of the effects of compaction and how to diagnose it.

Symptoms of Soil Compaction

Recognition of the symptoms of compaction is an important first step in trying to deal effectively with the problem. The characteristics of compaction can be grouped into those symptoms related to the plant and those related to soil.

Plant growth can be significantly reduced. In a recent Purdue University study, overall plant height was reduced 20% by compaction. In a conventional field, compaction may vary somewhat in degree, and the result is called the "tall corn-short corn syndrome." This refers to the irregular nature of crop growth.

Nutrient deficiency symptoms are also a common problem on compacted soils. Nitrogen (N) deficiency is the most common in Indiana. This is due to the excess moisture held in the plow layer by the very slowly permeable plowpan. Other nutrient deficiency symptoms can also develop because of reduced rooting or decrease in the movement of nutrients. Some recent work has shown that the effects of some herbicides are enhanced by soil compaction. The cause of herbicide injury symptoms may well be soil compaction rather than the misapplication of herbicide.

Symptoms of compaction are also present in the soil itself. Roots grow horizontally on top of compacted layers in the soil. There are, of course, varying degrees of this problem as well as varying depths, depending on the type of implement or traffic that caused the problem. These compacted layers are easy to find under reasonably dry conditions with a soil sampling tube, spade or tile probe.

Soil Compaction Research

We have been studying the effects of compaction at Purdue over the past few years. In 1982 we initiated a study to learn the effects of surface compaction on corn growth and yield after soybeans. The plots are shown in these photos.

The soil compaction in test plots was caused by sixteen passes with a large two-wheel drive tractor. We plowed the plots following compaction, made one pass with a power harrow, and planted. The photo of a compacted plot shows one-third to one-half reduction in plant height and 20 to 30% reduction of stand. This resulted in a 30 bu/A difference in final yield: compacted plots yielded 130 bu/A, uncompacted plots yielded 160 bu/A.

Our goal is to find how long the effects of compaction will last under Midwest weather conditions. Many farmers develop similar compaction problems during wet harvest operations.

Soil Compaction Effect — 130 bu/A



COMPACTION RESEARCH plots at the Purdue University Agronomy Farm showed differences in corn growth during the 1982 season. In these photos, crop consultant

No Soil Compaction — 160 bu/A



Lance Murrell of Idaville, Indiana, observes effects. Compacted plots (at left) yielded only 130 bu/A, while uncompacted plots yielded 160 bu/A.

Table 1. Corn yields in soil compaction study at Purdue University.

Year	Soil Condition	Yield (bu/A)
1979	Uncompacted	200
	Moderately compacted	152
	Compacted	90
1980	Uncompacted	106
	Compacted (chiseled to 10")	80
	Compacted	82
1981	Uncompacted	174
	Compacted (subsoiled to 18")	180
	Compacted	158
1982	Uncompacted	187
	Compacted (subsoiled to 18" in 1981)	185
	Compacted	162

Freeze-Thaw

Many would feel that freezing and thawing in a severe winter will break down compacted soil, either on the surface or in the subsoil. Yields from our plots with intentionally compacted subsoils do not bear this out.

Table 1 presents the results of four years of corn grown on a soil with a compacted subsoil. While the percentage yield decrease has been improving each year, the effect has not been eliminated.

The number of freeze-thaw cycles at plow depth has been studied at the Purdue Agronomy Farm and other weather stations in Indiana for the last several years. The pattern shows that the West Lafayette, Indiana, station has more freeze-thaw cycles at plow depth than any station to the north or south. This means that the effects of freeze-thaw cycles on soil compaction shown in **Table 1** are probably the most pronounced of any area. Regions to the north of West

(continued on page 30)

Small Grain Silage Removes Much K

By Ken Wells

DOUBLECROP production of small grains and corn for silage is an important forage production system for dairymen in Kentucky and other areas. Advantages include high annual dry matter yields and overwinter protection of the soil from erosion by the small grain crop.

Little is known about nutrient removal and fertility requirements of the small grain component of this silage system. An initial survey of several production fields indicated higher potassium (K) removal of small grains than anticipated.

A study was conducted with barley and oats to determine nutrient and dry matter accumulation in different plant parts at different stages of maturity. Since the nutrient accumulation of the two crops was similar, the results from the barley crop will be discussed here.

Table 1 shows that barley contained 120 lb/A of K_2O at the soft dough stage of silage harvest. The amount of K in the crop declined from soft dough to maturity while dry matter, nitrogen (N), phosphorus (P), calcium (Ca) and magnesium (Mg) increased.

Table 2 shows that K loss from the leaves accounted for the decline in the total amount of K in the plant which occurred between the soft dough

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(Soil Compaction . . . from page 29)

Lafayette are colder with fewer freeze-thaw cycles at plow depth, and regions to the south are warmer, with fewer cycles.

Correcting soil compaction is a slow process. It appears that natural processes will break up soil compaction, but it is very slow. As shown in **Table 1** subsoiling compacted soils can help to restore yield, but care is needed in utilization of this practice. While we were successful in this case, subsoiling has not been an advantage for soils that are not compacted. Also, there is some evidence that if soils are worked wet following subsoiling, there is a tendency to pack at the level of subsoiling, causing a greater problem.

It appears that subsoiling is only one part of a larger management system to avoid compaction. **Some of the principles of such a management system would include: avoiding tillage when soil is wet, controlling unnecessary traffic, reducing the number of trips through a field, less use of the disk-harrow, larger tires, and monitoring soil conditions to look for compaction problems.**

Soil compaction will probably continue to be one of the factors which is limiting yields. It is an unfortunate by-product of larger farms, larger equipment, and a more intensive management system. New methods of conservation tillage may provide needed relief.

Soil compaction is causing many problems that resemble other problems in crops. Unless the soil compaction problem is correctly identified and controlled, these problems will become more widespread and damaging. ■

Table 1. Dry matter and nutrient accumulation by barley.

Growth Stage	Date	Dry Matter	N	P ₂ O ₅	K ₂ O	Ca	Mg
		lb/A	Total	Plant			
Immature	April 19	2243	67	21	101	6	3
Soft Dough	May 18	5538	88	39	120	13	5
Mature	June 13	7159	95	50	113	18	8

Variety: Barsoy

Soil tests: pH 7, high P and K.

Fertility: 30 lb/A N in fall and 30 lb/A N in spring, no P or K applied.

Average of three replications per treatment.

stage and maturity. During this interval, amount of K in the stems increased while the amount of K in the heads stayed about the same.

Table 2. Potassium accumulation by barley.

Plant Part	Growth Stage		
	Immature	Soft Dough	Mature
	lb/A	lb/A of K ₂ O	
Leaves	101	50	20
Stems	—	50	71
Heads	—	20	22
Total	101	120	113

Conclusions:

1. Actively growing small grains accumulate large quantities of K.
2. Total plant content of K decreases at physiological maturity due to loss of K from the leaves.
3. Harvesting small grain as a silage crop will result in a greater removal of K from the soil than harvesting as grain after maturity. ■

On the Lighter Side

In an effort to display her business proficiency in bookkeeping, the woman gave her husband a detailed account of expenses for the month. Asked to explain an entry marked ESP-\$26.98, she replied, "ESP means 'error some place'."

* * * *

If the paper clip were invented today, it would probably have six moving parts, two transistors and require a service man twice a year.

* * * *

Four high school boys, afflicted with spring fever, skipped morning classes. After lunch, they reported to the teacher that their car had had a flat tire. Much to their relief, she smiled and said, "Well, you missed a test this morning so take seats apart from one another and get your notebooks."

Still smiling, she waited for them to settle down, then she said, "First question, which tire was flat?"

* * * *

A city girl was visiting her grandfather on the farm and saw a cow chewing her cud. "That's a fine looking cow," she said to her grandfather, "but doesn't it cost a lot to keep her in chewing gum?"

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