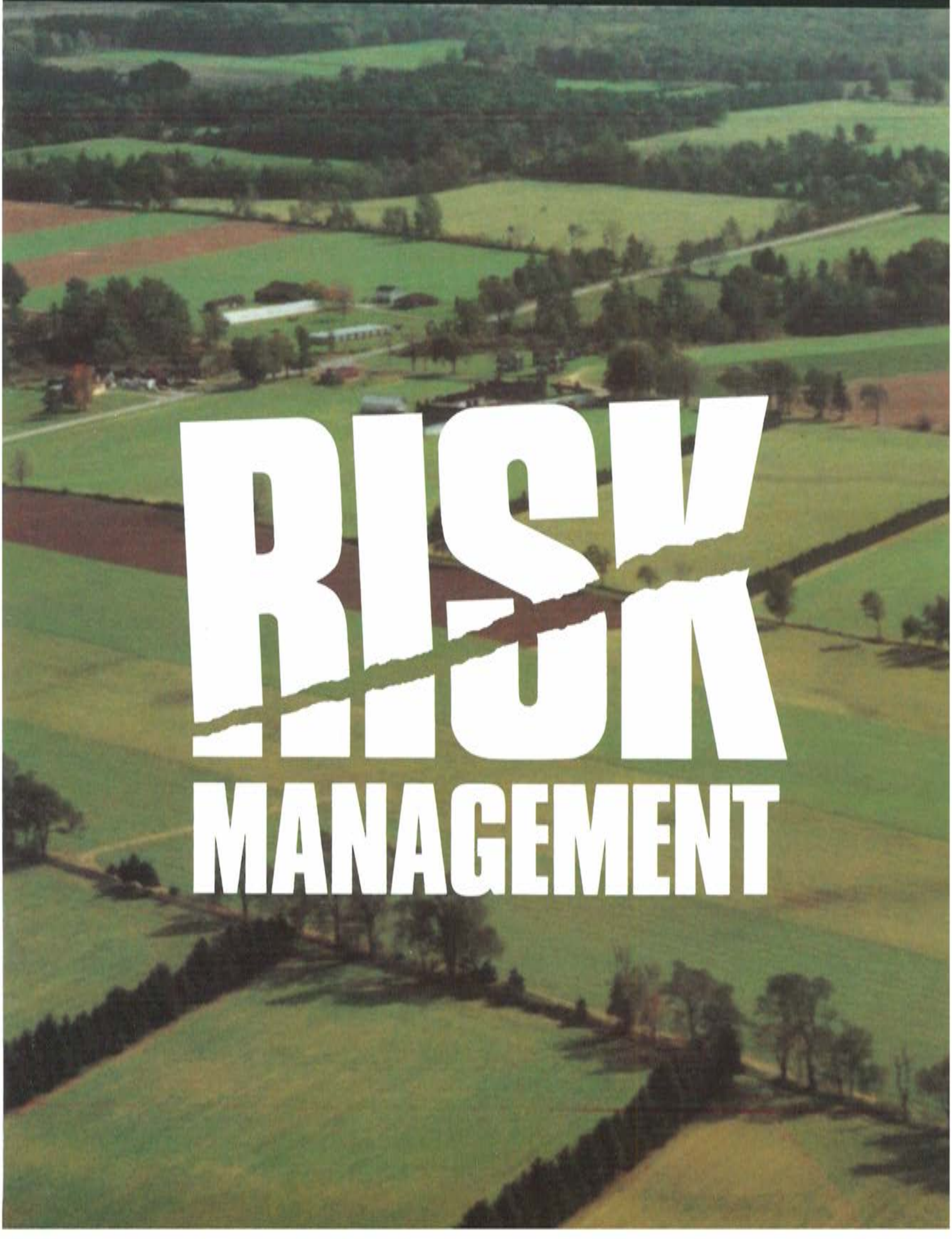
BETTER CROPS

with plant food

WINTER 1987-88



BETTER CROPS With Plant Food

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Our Cover: Although some level of risk is inevitable in agricultural production, there are methods for managing and avoiding potential losses. Risk management is the theme of this issue.
(Cover design by Charles Hamilton.
Photo courtesy of Bob Ball, Ontario.)

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MEY—
What Is It All About?

By R.E. Wagner

I BELIEVE in maximum economic yield (MEY). So do most of you. For those who have doubts, I want to help develop a better understanding of what MEY really means.

MEY is for the common good . . . not just for farmers but for supplying industries as well . . . indeed, good for all who eat! It has been said that MEY is the best thing that has happened to agriculture since hybrid corn; and when history is finally written, MEY will be a major chapter. Where it is being allowed to happen, and especially where there is strong leadership, MEY gives sharp definition to agriculture's direction.

I could give you research data from universities showing how unit costs go down as yields go up, or cite farmer experiences, or talk about MEY workshops or MEY computer software, or show you the wide variety of the media that gives space to MEY, or tell you about the exciting developments with MEY clubs.

Instead, I want to zero in on background and rationale which, hopefully, will contribute to a better understanding of the logic of MEY and where it might be going from here.

Did Not Just Happen

MEY did not "just happen," nor was it developed just to be another gimmick. It happened and continues to happen because of a well conceived, carefully designed plan and strategy. The concept is nothing new. All of us know that.

What is new is the level of MEY awareness and how it is being implemented on the farm. The kind of research that gives it support is new. The amount and kind of production technology and financial information available to farmers and the complexity of their management have changed dramatically. The way MEY is packaged as a multidisciplinary, total, balanced program is new. So is its readiness to accept as a part of the package whatever biotechnological innovations might come along. MEY clubs and MEY computer software as parts of the implementation process are new. Unprecedented support from universities, industry, lending agencies, and from the media is new.

North Dakota State University has emerged as a real driving force with Dr. Ed Vasey in the lead position. He and others involved say MEY has done more to pump up Extension and to get farmers' attention than anything Extension has identified with in years. More than 50 MEY farmer clubs are organized and active in North Dakota. The momentum is spreading to surrounding states and Canadian provinces and well beyond. I could mention other areas where activity is brisk, like North Carolina and Virginia and others.

A Joint Effort

How did MEY get to where it is? PPI had a role . . . but the kind of role that would have gone nowhere had it not been for the strong and direct involvement of key people in universities and industry.

Perhaps PPI's primary contribution was to lift up the concept again, dust it

(continued on next page)

Dr. Wagner is President of the Potash & Phosphate Institute (PPI), Atlanta, Georgia. This article is adapted from a paper which he presented at a symposium during the American Society of Agronomy 79th Annual Meeting, December 1987.

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off, and start moving it into action. That started in the late '70s and early '80s and grew out of some intensive long-range program planning which had as its major challenge, "What can PPI do to be of greatest help to agriculture wherever it might be in the world? What can best be done to prepare for the day when nations finally realize they no longer can obligate themselves to heavily subsidizing and protecting potentially decadent, non-competitive agriculture?"

Again, we did not do this alone. We called on some of the best minds in universities and industry for their ideas and we got meaningful input. Our Advisory Council was part of the process.

Long-Range Plans . . . The Assumptions

Any time one plans programming, assumptions have to be made. Here are the key ones we considered, along with some more recent rationale.

1. There will be a continuing and increasing need for world food production. Experts tell us global population will about double in the next 20-25 years. In that context productive agriculture is both a humanitarian and an economic need.

2. To meet the need, agriculture will change . . . agriculture will have to change. FAO says three-fourths of needed increases in food production must come from present croplands.

3. Balance of "agricultural power" will continue to shift from a clear superiority in North America and other developed countries to an emerging strength in developing nations and the centrally planned economies.

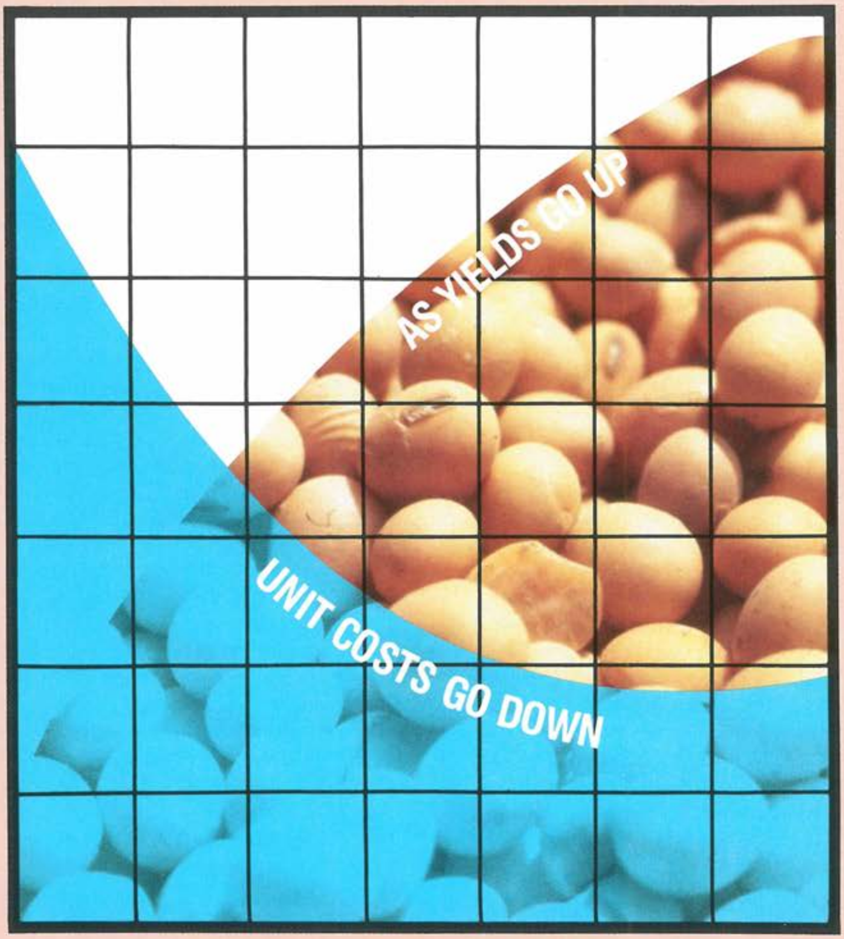
4. The big bill for subsidies in agriculture must be pared down in the United States and other countries, simply because national budgets cannot stand such expenditures on a continuing basis. The U.S. cost per taxpayer for the farm bill in 1981 was $25; in 1987, it was close to $300. In the European community it is even more staggering . . . $470 per taxpayer in 1986. To be well positioned for whatever the future holds, it seems not too early for farmers to plan for less subsidy and low prices.

In the 1987 report to the President and Congress of the National Agricultural Research and Extension Users Advisory Board, repeated reference and strong emphasis are given to the need to increase profitability and competitiveness and to decrease dependency on subsidies. To quote directly, " . . . agricultural science and technology can be used to expand markets, reduce production costs and, therefore, enhance profitability for farmers and ranchers while at the same time reducing the subsidy burden on taxpayers."

5. Increasingly, farmer incentive must come less from government payments and more from efficient, low unit cost production so nations and their growers can compete in international markets and so people can afford to buy food. Even China is moving in the direction of private incentives. More recently, the Soviet Union has announced its intentions to let individual initiative have its reward.

All nations will be forced to work toward less propping up of inefficient agriculture. Less efficient producers not willing to change eventually will have to leave farming. Farm suppliers and other industries do not stay healthy by shutting down 40 or 50% of each plant. They either update technology and operating procedures or they eliminate the inefficient ones.

6. The move to a global marketplace is expected to continue. Nations will vie for a bigger slice. Efforts to liberalize world trade and to free up agriculture markets will meet stiff resistance, but will have some effect in time. Those that have low unit cost producers and a good product will have a competitive edge in any market and can find an outlet for what they grow. The World Bank estimates that complete liberalization of agricultural trade by itself would increase world wheat trade 6%, coarse grains 30%, and rice 100%.



To compete in a world of increasing volatility, we've got to pay more attention to the basics . . . and MEY is basic. Those who oppose MEY in the U.S. need to be aware that other countries, such as Brazil, are moving ahead and should think carefully about what this could mean to our competitive edge.

7. Agriculture's overriding goal must be "efficiency" . . . accomplished by attacking unit costs of production. The economic consequences of inefficiency will become increasingly severe.

8. A by-product of low unit cost agriculture is high level production . . . good for those parts of the world where more food is needed but a complicating factor where surpluses already exist. Surpluses will continue to plague parts of the world. Strengthened international trade should be top priority. Short of that, further acreage reductions will be unavoidable . . . but a poor alternative to expanded markets. Backing away from MEY is no alternative for the individual farmer on any of the acreage he continues to farm. Alternatives to MEY are not good whether in times of surplus or shortage.

Can you imagine going to a farmer to tell him that to cope with serious surpluses, he has to cut his yield . . . or certainly not go higher . . . and in the process be prepared to become less efficient and lose more money? And if that's not

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enough, cut his acreage, too. That would be ludicrous, not just for him individually but for agriculture's collectible vitality. Neither is a popular nor a sensible solution to surpluses.

9. High production agriculture can increase environmental risks . . . but not if done the MEY way. Mr. Jim Lake, former Executive Director of the Conservation Technology Information Center emphasizes the point: "Maximum yield or maximum gross return should not be the goal, but rather maximum economic yield with a production system that at the same time protects the natural resources that are necessary to its future success."

10. The wide gap between average and potential yields is a big window of opportunity. Now we know it is even bigger than we thought at the time of initial planning, thanks to recent university research (MYR). For many crops, average yields are about one-third of research-established maximums. MEY is somewhere in between. The key point is that this big gap offers the opportunity . . . and a safety zone . . . to move yields up and unit costs down substantially before risking overuse of inputs that might spill over into the environment.

There were other assumptions, but these were the primary ones that guided our thinking . . . which in all instances led to MEY. All the side roads we took in the thinking and planning process eventually fed into the MEY main highway.

Maximum For Research; Economic Maximum For Farmers

Clearly, first need was to determine maximum yields through research. These then would be the benchmarks. If they turned out to be well above average, as expected, we then would know the potential for moving toward MEY could be good and we would not be going into it blindly. Also we wanted to be sure we would not be talking maximum yields to farmers. Maximum is for research; economic maximum is for the farmer.

To High Profile By Joint Effort

Equally clear was the fact that if we were to launch a sound, strong, lasting, and impactful MEY program, we in PPI could not do it alone. Where would the back-up research be done? Obviously, at universities by highly regarded scientists. Where would the power to put it into practice come from? Industry and Extension commitment and support would be key . . . industry in its broadest sense, not just P and K producers but all farm suppliers and lenders.

So it is in concert that MEY is making such great strides and has been brought into surprisingly high profile in a relatively short time. MYR (maximum yield research) is giving good foundation . . . and much more research is needed. Several key companies in agribusiness have adopted MEY as their market development centerpiece. Key universities and their Extension Services are emphasizing its implementation. Farmers are responding and numbers of MEY clubs are growing. Its prominence in the media has grown dramatically in the past several months; local, regional, national, and international periodicals are giving it good space. As some are saying, MEY appears to be well on its way to becoming a household word.

Compatible With Sound Conservation Measures

MEY's trademark is top profits through low unit costs . . . combined with sound conservation measures. The role of high yields is emphasized in a report of the University of Tennessee's Resource Management Conservation Farm Program where the top one-fourth of the 81 farmers in 1986 had net income of $68,250 while the bottom one-fourth lost $35,971. Tennessee's Dr. Estel Hudson says 75% of the difference was from higher yields. Much of the balance was lower machinery costs.

The Soil and Water Conservation Society says it well in a recent publication: "Manage all elements of crop production, including nutrients other than nitrogen, to meet your yield goals. In this way, low yields that would result in only partial use of nitrogen and increased risk of nitrogen loss can be avoided."

Now, by way of summary, I want to stress these points.

• Obviously, farmers will continue to become more sophisticated and therefore more technology dependent. MEY is technology driven and provides the vehicle to best accommodate new developments. More and more farmers will find that to make only halfhearted use of latest technology is to surrender to their competition, be it global or simply their next-door neighbor.

• Farmers are more in the vise grips of economics with what many believe to be the long-term prospect of flat to lower prices for farm products. **"Economic"** is MEY's middle name.

• Crop production inputs relate and interact differently in modern high yield systems. MEY is designed to fully exploit positive interactions of yield components in a multidisciplinary system.

• Environmental concerns will be with us from now on, even though we don't like to accept it. MEY and a clean environment are compatible. More than that, the fundamentals of MEY are fundamental to sound soil conservation practices and to groundwater quality control.

Finally, as we look ahead, the real question might very well be not whether farmers can afford MEY, but whether they can afford to farm without MEY. Worldwide production expansion and fierce market competition complicated by subsidies, embargoes, etc., make it eminently more difficult to be competitive than in the relatively uncomplicated past.

• MEY stakes are high and so are the rewards. High rewards are never without some risks. Primarily, the risks are in losing some . . . but not all . . . of the inputs in bad years. The rewards are being able to cushion losses in bad years and, most importantly, to take advantage of the good years and added profits through low unit costs.

• MEY is not a low input, high risk system that attempts to defy competitiveness. Low yields become less and less an economic alternative. Those who plant for high yields might not get them every year. But those who fertilize and otherwise manage for low yields are sure to get them.

Good managers are aware and have MEY objectives. That is what will keep them in business . . . and food on tables everywhere.■

"Robert E. Wagner MEY Award" Established by Institute Board

THE BOARD OF DIRECTORS of the Potash & Phosphate Institute (PPI) has established the "Robert E. Wagner MEY Award," with a winner to be selected annually beginning in 1988. Dr. Wagner has served as President of PPI since 1975.

"This Award honors the man who is widely recognized for originating the concept of maximum economic yield (MEY) management systems for more profitable, efficient agriculture," stated Mr. C.C. "Kip" Williams, an executive of IMC Fertilizer, Inc., and Chairman of the Board of PPI and the Foundation for Agronomic Research (FAR). "It is altogether proper that we establish an ongoing tribute to this ideal."

"I am extremely grateful and honored by this action of the PPI Board of Directors. There are many who have championed the MEY approach and who have worked diligently for showing its merits. MEY is truly an idea whose time has come," Dr. Wagner noted.

The Award will be given to a selected individual in recognition of outstanding research, extension, or educational contributions to the enhancement of the MEY concept. The recipient each year will receive a plaque and a monetary award amount of $5,000. Details regarding selection procedure and time and place of the actual presentation will be announced later.■

Our Greatest Risk: The Danger That We May Quit Risking

By Earl L. Butz

Dr. Earl L. Butz is former U.S. Secretary of Agriculture and served as Dean of Agriculture at Purdue University. An agricultural economist, Dr. Butz is now Dean Emeritus of Agriculture at Purdue. He has an office in West Lafayette, Indiana, and travels widely as a speaker and commentator. The remarks presented here are adapted from a recent address.

AGRICULTURE must gear up to feed 20 percent more people in this world by the year 2000, and 60 percent more by another third of a century . . . and do it on less land. And if we feed them better than now in terms of more animal protein, more fresh fruits and vegetables in their diets, it means an 80 percent boost in total food production somewhere on this planet in the next generation. This must be done with no new Western Hemisphere to discover, no more prairie sods to plow, no more water for crops or livestock, no abatement of urban encroachment on prime farmland.

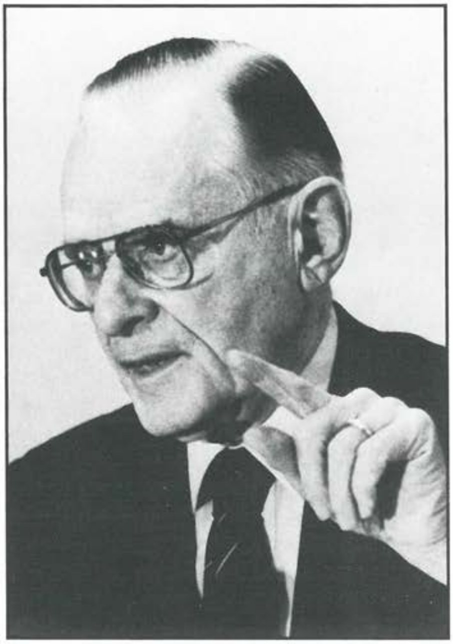
This is Mankind's number one challenge. World peace will be impossible if we fail that mission.

Current grain surpluses mask this lurking problem. In the last 50 years, I've seen us come through two or three cycles of too much and too little. I've seen us attempt to curtail output. I've seen us attempt to expand output. I've seen us try to do both of them simultaneously, as we are really trying to do this year. We send price signals out to our farmers to produce more, and at the same time we send checks out to entice them to produce less.

The error we often make in agricultural and food policy is to make long-term projections from short-term situations. Too frequently we have failed to read the history of food policy.

As we face the prospect of producing more and better food on a shrinking resource base, we must come face to face with the troublesome question of using more non-land inputs to get the job done.

This is a world in which we constantly offset risk against benefit. We never completely insure our car against all hazards, our dwelling against total loss, our life for what it is **really** worth, or our health against every hazard. In practically every phase of our activity we take some chance. We are constantly trying to evolve a risk-benefit ratio which satisfies each of us, and which each of us can afford. If we completely insure against every risk, we may end up with nothing left to enjoy our newfound, **safe** position.



Dr. Earl L. Butz

Modern agriculture cannot continue to produce adequate amounts of safe and wholesome food without chemicals or antibiotics. If we were to seriously curtail their use on farms and in the food industry, we would immediately experience a decline in the quantity and overall quality of our food supply. Consumers would quickly experience a rapid rise in food prices, and consequently would have much less to spend for all the other things that go into the fabulous modern standard of living.

We can go back to organic agriculture in this country if we must—we once farmed that way—75 years ago. We know how to do it. However, before we move in that direction, someone must decide which 50 millions of our people will starve. We simply cannot feed, even on subsistence levels, hundreds of millions of people without a large production input of chemicals, antibiotics, and growth hormones.

Our problem today is that two-thirds of living consumers never had the experience of biting into a wormy apple, seeing the wormhole, and wondering "Did I eat that worm or is he still in the apple?" They think that God and Nature made all apples good.

We must decide how much we are willing to pay for a better quality of life beyond that which is truly necessary. And that includes population control. When we quit thinking of these problems as the concern of others and face the fact that they are ours—this nation can move forward with greater effectiveness toward the achievement of a better quality of life for all.

It is completely unacceptable to believe that there is no way out of the problems we have created. Unquestionably, there are risks involved, but none so great as the risk that we may quit risking, try vainly to set the clock back, abjectly surrender the goal of a better world in the mistaken belief that this one is as good as can be.■

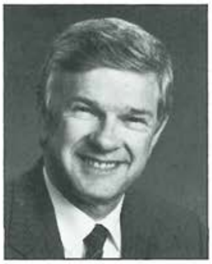
C.C. Williams Reelected Chairman, C.E. Childers Becomes Vice Chairman, New Members Named to PPI and FAR Boards

MR. CHARLES E. CHILDERS, President and Chief Executive Officer (CEO) of the Potash Corporation of Saskatchewan (PCS), is the new Vice Chairman of the Potash & Phosphate Institute (PPI) Board of Directors. He will also serve as Vice Chairman of the Foundation for Agronomic Research (FAR). Mr. C.C. (Kip) Williams, Senior Vice President, Marketing, of IMC Fertilizer, Inc., was reelected Chairman of the PPI and FAR Boards.

"We are very pleased to welcome Chuck Childers to this new responsibility. He is a well-respected leader in the industry and we anticipate his support in continued positive efforts for market development through agronomics," said Dr. R.E. Wagner, President of PPI and FAR.

Mr. Childers was born in West Frankfort, Illinois, and graduated from the University of Illinois with a Bachelor of Science Degree in Mine Engineering. He began his career with Duval Corporation in Carlsbad, New Mexico, and subsequently joined International Minerals & Chemical Corporation (IMC). At IMC, he held various senior positions, including: General Manager at IMC's Esterhazy, Canada, Potash Operations, 1977-79; President, IMC Coal, Lexington, Kentucky, 1979-81; and Vice-President, Potash Operations, IMC, 1981-82. Most recently, he was Vice President, Expansion and Development, at the IMC Executive Office, Northbrook, Illinois.

C.C. Williams



C.E. Childers

In March of 1987, Mr. Childers moved to his current position with PCS in Saskatoon, Saskatchewan, Canada. He was named to the Boards of PPI and FAR in April.

Currently, Mr. Childers serves as Chairman of Canpotex Limited, the offshore marketing company owned by Saskatchewan potash producers. He has also served on the Board of the Saskatchewan Potash Producers Association and in 1987 completed a two-year term as Chairman.

He is a member of the American Institute of Mining Engineers and the Canadian Institute of Mining. In past years he has been active in the New Mexico Mine Association, Saskatchewan Mining Association, Kentucky Coal Association, and the American Mining Association.

New PPI Board Members

Five other individuals were also welcomed to the PPI Board of Directors recently, representing member companies of the Institute. The new members are: **Robert G. Connochie,** President and CEO, Potash Company of America, Inc.; **William J. Doyle,** President, PCS Sales; **R.L. Moore,** Director, Marketing & Distribution, Western Ag-Minerals Company; **R.L. Oliverio,** Vice President & General Manager, AMAX Potash Corporation; and **Jack L. Prins,** Vice President-Sales, AMAX Potash Corporation.

New FAR Board Members

Two individuals have been named to the FAR Board of Directors, representing companies which contribute to the Foundation. They are: **Dr. S.E. Allred,** President, Frit Industries, Inc.; and **Jack D. Satterwhite,** President, ConAgra Fertilizer Company.■

"J. Fielding Reed Fellowships" Named by Potash & Phosphate Institute (PPI)

BEGINNING in 1988, Fellowships granted to graduate students by the Potash & Phosphate Institute (PPI) will be identified as the "J. Fielding Reed Fellowships."

"This decision by the PPI Board of Directors is well deserved recognition of Dr. Reed, who has always encouraged agronomic excellence with great enthusiasm," noted Dr. R.E. Wagner, President of PPI.

Dr. Reed served as President of the Institute from 1963 to 1975, and now resides in Athens, Georgia. Throughout his career and during retirement years, he has continued to work for high standards in research, in teaching, in extension education, and in other phases of agronomic work.

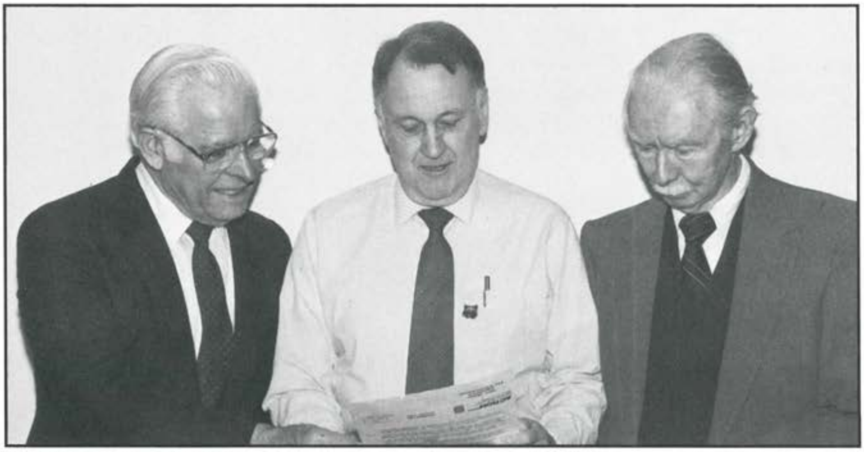
Since the Fellowships have been awarded in their current form, beginning in 1980, more than 55 outstanding graduate students have received the grants. Dr. Reed has served as Chairman of the selection committee since its inception.

"I have been greatly impressed with the quality of the student applicants. Many of them are already assuming a significant role in various areas of agriculture," he stated. "I am proud to be honored by the naming of the Fellowships."

Dr. Reed served as a soil scientist at Louisiana State University and North Carolina State before joining the staff of the Institute. He is considered a pioneer in soil testing and has encouraged greater cooperation between universities and industry.

Names of winners of the Fellowships are announced annually in April. Applications must be submitted to the Potash & Phosphate Institute before February 1, with appropriate transcripts, supporting letters and related information.

Graduate students seeking advanced degrees (Masters or Ph.D.) in soil and plant sciences and related academic fields are eligible to apply for the Fellowships of $2,000 each.■



SANTFORD W. MARTIN, who served as editor for the Potash & Phosphate Institute (PPI) and its forerunner organizations for more than thirty years, was honored recently by the leadership and staff. Mr. Martin, a native of North Carolina and a graduate of Wake Forest, edited *Better Crops With Plant Food* and other Institute publications. With a widely recognized talent for improving the readability of agronomic information, Mr. Martin also wrote a column until 1980, called "Bifocals." Shown left to right in photo are: Dr. R.E. Wagner, President of PPI; Mr. Martin; and Dr. J. Fielding Reed, President of the Institute from 1963-1975.

Soybean Risk Management for Profit

By C. Wayne Jordan

In recent years, soybean farming in the South has become an increasingly risky business. Low prices, combined with low yields, have caused soybean farmers to look for ways to reduce their risks and improve their chances for profitability. But the very nature of reducing risks while improving profitability may be incompatible. Indeed, economists say that profit is nothing more than the reward for taking risks.

TODAY'S SOYBEAN FARMER is in a real squeeze. With a recent history of little or no profits from soybeans and an ever mounting debt load, many farmers find it difficult to obtain adequate production capital. They need to find a way to increase yields, but how can this be accomplished without higher costs and perhaps greater risks?

Unit Costs

One approach is to rethink costs and risks. Rather than dwelling on per acre costs, focus on unit (per bushel) costs. Practices that will reduce the cost per bushel sufficiently to make soybeans competitive and profitable are a part of the answer. The degree of profitability depends on how well the entire production and marketing system works.

Necessary Practices

There are practices that are absolutely necessary to efficient soybean production, but are of relatively high cost. Examples are weed control, plant nutrient availability, adequate pH, seed selection, moisture availability and equipment needs. To indiscriminately reduce or eliminate some of the inputs that provide these necessary ingredients could result in negative impacts on yield or even crop failure. In fact, the investment in certain ''high cost practices'' is essential and, when properly managed, can reduce risks and increase yields with a resultant reduction in cost per bushel. Thus high cost practices may actually facilitate low cost soybeans when figured on a per bushel basis.

No Cost/Low Cost Practices

Another category of practices is no less important and may cost little or nothing. These no cost/low cost inputs can have significant bearing on the outcome of a soybean crop. No cost/low cost management includes timely planting, soil testing, rotation, variety selection, timely weed control, insect scouting, sprayer calibration, and careful harvesting.

Management of the no cost or low cost practices helps the high cost inputs pay greater returns. Thus overall production risks are controlled more effectively, unit costs are reduced and greater profits accrue.

How much are these risk management factors worth for the soybean farmer? Well, that all depends upon the specific situation. But research and experience teach us that there can be considerable reward for certain practices. **Table 1** gives some examples.

One might ask if improvement in all areas will add another 40 to 50 bu/A in yield. Obviously that is not the case. These are merely examples. Generally

Dr. Jordan is Head, Extension Agronomy Department, Georgia Cooperative Extension Service, Athens, GA.

Table 1. Risk management practices for soybeans.

Practice	Possible Return[1]	Relative Cost To Change
Correct Variety	3-15 bu	None
Timely Planting	3-9 bu	None
Rotation	3-6 bu	Low
Irrigation	10-20 bu	High
Fertilizer	5-10 bu	Moderate
Timely Weed Control	3-6 bu	Low
Insect Souting	2-4 bu	Low
Improved Harvesting	2-5 bu	Low
Correct Pop./ Row Width	2-5 bu	Low
Sprayer Calibration	—	Low

[1]Returns are estimates, but based upon research and the assumption that there is a problem that can be corrected with a change.

there is not a problem in all areas at the same time. The objective is to identify those practices that are in need of improvement and work on them.

If soybean farmers are to improve their competitiveness in the world market, they must become more efficient producers. Risks are a part of farming, but good management can turn these risks into profits. Cost containment or cost reduction should not be the only considerations in the quest for efficiency nor should higher yields. Both of these risk management elements should be improved to result in lower unit costs and greater net returns. Paying more attention to seemingly small details can really pay off and allow expenditures like fertilizer to give a better response.

Utilizing both cost containment and improved practices to enhance yield will drop unit costs more rapidly. **Table 2** provides an illustration.

Table 2. Unit cost relationship to yield level and total costs per acre.

Total Costs per acre	Yield per Acre			
	25 bu	30 bu	35 bu	40 bu
	Cost per Bushel, ($/bu)			
$200	$8.00	$6.67	$5.71	$5.00
175	7.00	5.83	5.00	4.38
150	6.00	5.00	4.28	3.75
125	5.00	4.16	3.57	3.13
100	4.00	3.33	2.86	2.50

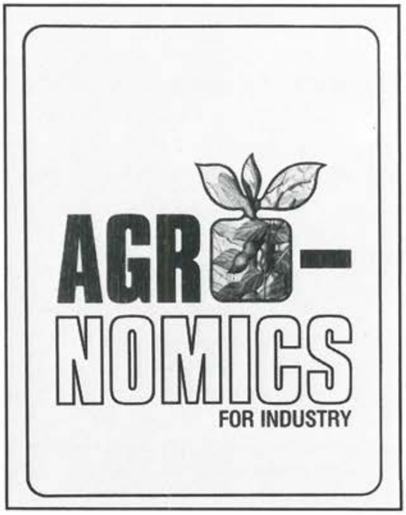
Notice how the combination of lower per acre costs and higher per acre yields dramatically reduce the cost per bushel. It is also interesting to see that one has to find cost savings of approximately $25 per acre to equal the effect of 5 bu/A yield increase. Often increasing yield through better management is more attainable. The challenge is to find a way to do both or to do one without having a counteracting result to neutralize the response.■

AGRONOMICS For Industry—
New Booklet Available from PPI

AN IMPORTANT NEW PUBLICATION, *Agronomics For Industry*, was recently released by the Potash & Phosphate Institute (PPI). In a graphic, colorful format, the booklet highlights the essential role of agronomics in market development for modern agriculture.

Agronomics refers to the diverse range of scientific, economic and practical information which must be considered for profitable crop production systems in today's environment.

Turn to page 31 for details on how to order.■



In Mississippi Research

Deep-Banding Dry Fertilizer Increases Cotton Yields

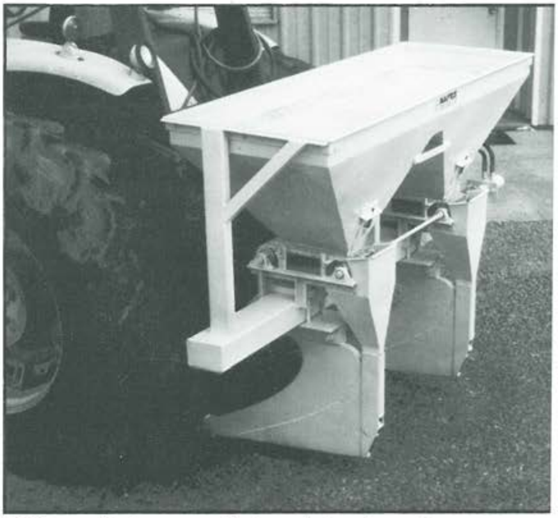
By Gordon Tupper

Placing potash deep into deficient subsoils with a specially designed applicator has produced sizable yield increases for cotton.

BAND PLACEMENT of dry fertilizers to a depth of 6 to 15 inches beneath the drill row effectively increased cotton yields in 1986 tests by the Mississippi Agricultural and Forestry Experiment Station (MAFES), Delta Branch. The study compared cotton yields with no potash, with 80 lb/A K_2O surface-applied, and with 80 lb/A K_2O deep banded.

Table 1. Soil test values before treatment, 1986.

Depth, in.	P_2O_5	K_2O
0-6	47 M	216 M
6-12	27 L	121 L
12-18	24 L	89 VL
18-24	25 L	75 VL



THIS applicator was designed to place dry fertilizer continuously from 6 to 15 inches deep.

Tables 1 and 2 summarize the 1986 results. In an irrigated study with 2 x 2 skip row DES 119 cotton, lint yields increased on a planted acre from 1,457 lb/A in the check with equipment only (no potash) plots to 1,723 lb/A with 80 lb/A K_2O placed 6 to 15 inches deep. Available potash in the subsoil tested low at the 6- to 12-inch depth and very low at the 12- to 24-inch depth before application.

The deep placement of dry fertilizer was accomplished by a dry materials

Table 2. Effect of potash on irrigated 2 x 2 skip-row cotton yields, 1986.

Potash		1st Harvest		2nd Harvest	Total Lint
lb/A	Placement	lb/A	(%)	lb/A	lb/A
0	—	1,330	(91)	127	1,457
80	Deep (6-15 in.)	1,619	(94)	104	1,723
80	Surface	1,573	(95)	75	1,648

DES 119 variety, K soil test = 0-6, M; 6-12, L; 12-24, VL. 5% LSD = 90

Dr. Tupper is Agricultural Engineer at the Mississippi Agricultural and Forestry Experiment Station (MAFES), Delta Branch.

DIFFERENCES in 1986 cotton research plots were dramatic. The plot shown at left was deep-tilled, but received no potash. Plot shown at right was deep-tilled, with 80 lb/A K_2O placed continuously from 6 to 15 inches deep.

applicator built at the MAFES, Delta Branch at Stoneville, MS. Fertilizer flows down a 2- x 4-inch tube attached to the rear of a parabolic super-chisel shank. The material is released in a continuous band from 6 to 15 inches deep in the soil profile, directly below the drill.

In a separate, non-irrigated study with a 2 x 1 and 4 x 1 skip-row pattern DPL 20 cotton, the recommended rates of phosphate (30 lb/A P_2O_5) and potash (60 lb/A K_2O) were surface-applied to all treatments. Both surface and subsoil had a medium level of available P before the surface application. An additional 60 lb/A P_2O_5 was placed in one treatment from 6 to 15 inches deep with the applicator **(Table 3).**

Table 3. Effect of phosphorus on non-irrigated 2 x 1 cotton yields, 1986.

Fertilizer Applied		
Surface	Deep (6-15 in.)	Total lint
140-30-60	—	974
140-30-60	0-60-0	1,083

DPL 20 variety P soil test 0-6, M; 6-12, M. 5% LSD = 87

Based on these preliminary results, the research shows considerable promise. Three additional large-scale tests were initiated in 1987 to help answer some questions raised in 1986. Additional research is needed to identify the economic benefits of deep application of phosphate and potash into subsoils testing low or very low.■

Soil Fertility Workshop Proceedings Available

COPIES of the Proceedings for the 1987 North Central Extension-Industry Soil Fertility Workshop held in St. Louis, Missouri, are available from the Potash & Phosphate Institute (PPI), 1220 Potter Drive, Suite 108B, West Lafayette, Indiana 47906-1334.

The Proceedings volume is 8½ x 11 inches and includes 21 papers totaling 118 pages on topics of current interest in the North Central United States. The topics include: soil compaction as affected by potassium fertility in corn production; plant growth as affected by form of nitrogen applied; current status of nitrogen and water quality issues in several states; corn hybrid differences as affected by nitrogen levels; and differences in tillage systems which may affect fertilizer response.

The papers contain descriptive information and data from current or recently completed research projects.

Copies of the Proceedings cost $5.00 each, plus $2.00 postage and handling ($7.00 total). Checks should be made payable to the Potash & Phosphate Institute (PPI).■

MEY...

FACT

and FALLACY

THE CONCEPT of MEY . . . maximum economic yield . . . is gaining wide recognition. Guided by achievements of maximum yield research (MYR), MEY systems of crop production are being adopted in North America and other parts of the world.

Still, there is a lack of understanding of MEY by some in its use at the grower level. This article is to help clarify what MEY is . . . and is not.

MEY . . . FACT	and FALLACY
MEY IS widely accepted in concept . . . gaining in farmer adoption, in use of computer software and in number of MEY clubs.	MEY IS NOT yet well understood by some in terms of moving the concept into efficient farming systems.
MEY IS the yield level which decreases unit cost to the point of highest net return per acre.	MEY IS NOT maximum yield.
MEY IS an integrated crop production system with the best possible fit and positive interaction of all controllable inputs in the package.	MEY IS NOT a system built around just a single production input or anything short of the total package.
MEY IS the use of balanced proportions of necessary inputs at a high level of efficiency.	MEY IS NOT "throw-on" or "pour-on" indiscriminate use of inputs nor wasteful of natural resources.
MEY IS a product of top management.	MEY IS NOT achieved with average management.
MEY IS a site specific yield for each situation depending on soil and climatic conditions.	MEY IS NOT a single standard management package for all fields.
MEY IS improved through high-yield research . . .especially multidisciplinary maximum yield research (MYR).	MEY IS NOT defined by research at average yield levels.

MEY . . . FACT and FALLACY

MEY . . . FACT	and FALLACY
MEY IS an upward moving target that increases as new technology is developed.	**MEY IS NOT** a constant target yield that ignores quality research.
MEY IS best implemented a step at a time through target yield goals.	**MEY IS NOT** a program that seeks to double or triple farmer yields in one step.
MEY IS striving for the highest level of efficiency, based squarely on hard economic principles.	**MEY IS NOT** a system that disregards the "E" (Economics) in MEY.
MEY IS the way for farmers to be competitive.	**MEY IS NOT** a low input, high risk system that attempts to defy competitiveness.
MEY IS commitment to being a low unit cost producer of high quality farm products.	**MEY IS NOT** surrender to a highly subsidized and potentially decadent, non-competitive agriculture.
MEY IS needed increasingly if government programs call for less subsidy and fewer crop acres.	**MEY IS NOT** at disadvantage in any government program with or without acreage restrictions.
MEY IS high production farming that spreads fixed costs . . . the only practical way to low unit costs and high returns.	**MEY IS NOT** deemed successful simply because of high yields, especially in surplus situations . . . but decreased yields are not an economic alternative.
MEY IS the best long-term system for farmers in good times or bad.	**MEY IS NOT** just for times of high prices . . . even more needed with low prices.
MEY IS good for farmers large or small anywhere in the world.	**MEY IS NOT** restricted to large farmers of developed nations only.
MEY IS compatible with a clean environment.	**MEY IS NOT** a production system that increases environmental risks.
MEY IS a production system that enhances water use efficiency and erosion control.	**MEY IS NOT** a luxury consumer of water nor a soil depleter.
MEY IS a sustainable and profitable agricultural system.	**MEY IS NOT** a high risk system that is economically vulnerable or environmentally damaging.
MEY IS taking advantage of "low-cost" or "no-cost" management factors.	**MEY IS NOT** simply using more of high-cost inputs.
MEY IS good for agribusiness in its broadest sense.	**MEY IS NOT** just for the fertilizer industry, but for all farm suppliers and lenders.
MEY IS a system that combines sound conservation practices and top profits.	**MEY IS NOT** for profit at the expense of the environment.

This message is available as a 4 × 9-inch folder suitable for mailings, meetings, and many other purposes. For details, turn to page 31.

Potash for Coastal Bermudagrass Increases Hay Yields, Saves Stands

By Marcus M. Eichhorn, Jr. and Michael C. Amacher

A six-year study in Louisiana determines potassium (K) requirements for forage yield, stand persistence, and soil exchangeable K levels for Coastal bermudagrass on deficient Coastal Plain soils.

COASTAL BERMUDAGRASS is the most productive warm season perennial forage crop grown for hay on Coastal Plain soils in the southern U.S. The root system developed by the grass is capable of absorbing plant nutrients from the entire profile of sandy soils. Because of this ability to absorb nutrients from such a large volume of soil, researchers have had considerable difficulty determining fertilizer requirements, especially potassium (K), for maximum and optimum hay production.

A fertilization study was initiated in 1979 to determine the K requirements for Coastal bermudagrass hay production, stand persistence, and recovery and maintenance of recovered stands. Also, the study measured effects of K fertilization and forage production on soil K reserves. An existing planting on a fine sandy loam soil was chosen for the experimental site. Hay yields from the site had declined to an estimated 60% of yield and severe stand-loss problems were evident. Initial soil K measurements were classified as very low in K fertility.

Rates up to 600 lb/A of K_2O were applied annually and in two and four split applications for 5 years, 1980-84. Each year, fertilizer N-P_2O_5-S-B was applied at 400-150-90-2 lb/A. Dolomitic agricultural limestone was applied at two ton/A in 1979 and at one ton/A in 1983 to adjust soil reaction to pH 6.5-7.0. Forage was managed for four hay cuttings annually.

Forage yields

Rainfall was highly erratic among years for the production of Coastal bermudagrass. Forage yields were reduced by frequent periods of drought during the 1982, 1984, and 1985 growing seasons and by severe drought during the 1980 and 1983 growing seasons. Yet, Coastal bermudagrass responded favorably to annual application of K fertilization.

Across years, splitting K applications had no significant effect on forage yields at each and over all rates. Forage yields were maintained generally at maximum mean level (14,611 lb/A) of production where 600 lb/A of K_2O was applied annually. Results showed that forage yields declined 1,715 lb/A annually where K fertilizer was not applied, while mean annual optimum forage production (at least 95% of maximum) occurred where 400 lb/A of K_2O was applied annually **(Table 1).**

Forage yield data indicated that annual forage yield decline on established fields of Coastal bermudagrass was associated with improper K fertilization, especially where fields had been fertilized with adequate levels of N, P_2O_5, S, and B. Annual optimum yield of 16,000 lb/A (8 ton/A, 2 ton/A per cutting) required 400 lb/A of annually applied K_2O.

Stand loss and recovery

Previous research at this and other locations on Coastal Plain soils found that stand loss of Coastal bermudagrass was

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Table 1. Effects of K fertilization on forage yields and stand persistence of Coastal bermudagrass and soil K.

K_2O [1]	Yield, lb/A (Dry Matter)			Stand Persistence/ Recovery Estimated Density in Spring			Soil Test K, 0-6 inches			
rates lb/A	1980	1984	Mean 1980-'84	1980	1983	1985	Initial (1979)	Spring 1984	Mean 1980-'84	Residual 1985
0	12,135	6,733	8,919	57%	43%	29%	47 ppm	11 ppm	15 ppm	9 ppm
100	11,773	11,892	11,806	24	76	66	31	12	17	10
200	12,691	14.450	13,279	35	84	84	37	16	20	11
400	12,533	16,060	14,313	42	91	93	41	22	29	17
600	12,085	16,417	14,611	37	92	92	30	42	43	23

[1]Applied annually in one spring application

associated with K nutritional deficiency. Several K deficiency symptoms have been reported: (a) leaf-spot disease associated with the fungus *Helminthosporium speciferum;* (b) leafspot disease and/or subsequent winterkill of crowns and rhizomes associated with toxin production from a variant of the fungus *Helminthosporium cynodontis;* and (c) winterkill of crowns and rhizomes associated with abnormally low temperatures.

Potassium fertilization had a considerable effect on recovery and maintenance of the recovered stand of Coastal bermudagrass following hay cropping.

Stands required 3 years (1980-1982) of K fertilization to achieve optimum spring recovery (1983) following winters with normal temperatures. Stands diminished an additional 14% where K fertilizer was not applied.

The winter of 1983-84 was unusually cold, with a mean minimum temperature 5°F below normal. Stands diminished from the 1983 level. Stand loss was highest (28%) where K fertilizer was not applied. By the spring of 1985, stands had recovered to 1983 levels following K fertilization and cropping in 1984.

Across years, stands that received 600 lb/A of K_2O were maintained at maximum recovery level. Stand recovery was favored by split application of rates when compared with one application in the spring. In absence of applied fertilizer K, stands diminished 6.4% annually.

Stand density data revealed that Coastal bermudagrass stand-loss problems on Coastal Plain soils were strongly related to a deficiency of K nutrition. Stands recovered each year in the spring after annual K fertilization, despite cropping.

Further evidence of the critical role that K nutrition plays in maintenance of Coastal bermudagrass stands was discovered when K concentration in harvested forage from the final cutting was related to stand density estimated the following spring.

Stands diminished over the winter when K concentration in harvested forage of the final cutting the preceding year was less than 2.1%.

Soil-exchangeable K

Soil-exchangeable K level was substantially affected by annual K fertilization and Coastal bermudagrass cropping.

Results showed that cropping the soil with Coastal bermudagrass for 5 years without applied K fertilizer reduced soil-exchangeable K below initial 1979 levels at a 0 to 6 inch soil depth. Exchangeable soil K level also diminished over sampled depths after cropping where annual potash rates of 100 and 200 lb/A of K_2O were applied at each application frequency and where 400 lb/A of K_2O was applied in one application in the spring. Annual application of either 400 lb/A of K_2O in split applications or 600 lb/A of K_2O in either single or split applications was required for conservation of soil K where Coastal bermudagrass was grown and harvested.

Levels of soil-exchangeable K in all measured soil depths decreased to levels that were lower than the initial 1979 levels following one year cropping of residual K fertilizer, irrespective of previous rate or application frequency of K_2O.

(continued on next page)

Bermudagrass...from page 19

Soil-exchangeable K data strongly indicated a need for an annual application of K fertilizer to prevent soil K depletion by Coastal bermudagrass cropping. Where optimum hay yield of 8 ton/A was produced across years, annual split applications of 400 lb/A of K_2O were required to prevent soil K depletion while meeting optimum production requirements.

The wide range in exchangeable soil K levels found after 5 years of annual K fertilization and Coastal bermudagrass cropping presented a unique opportunity for determining the relationship between forage yields of Coastal bermudagrass and soil-exchangeable K levels.

Seasonal forage yield per cutting was maximized when the soil-exchangeable K level was 50 ppm at 0 to 6 inch depth, 130 ppm at 6 to 12 inch depth, and 90 ppm at 0 to 12 inch depth. Annual split application of 600 lb/A of K_2O for 5 years was required for soil-exchangeable K levels to adjust to levels that would produce maximum seasonal yield of Coastal bermudagrass for one year. Thereafter, soil-exchangeable K levels were reduced to deficient K levels by one year of Coastal bermudagrass cropping.

Summary

Annual applications of K fertilizer at 400 lb/A of K_2O were required for optimum seasonal production of 8 ton/A of Coastal bermudagrass hay on Coastal Plain soil previously cropped to a K deficient level. At this rate of annual K fertilization, previously diminished Coastal bermudagrass stands recovered and were maintained at near maximum level (**Table 1**). Soil-exchangeable K was conserved but soil K deficiency was not corrected even after 5 years of application.

Maximum spring stand recovery and maintenance, after K fertilization and cropping, occurred where 600 lb/A of K_2O was annually applied across years and when K concentration in harvested forage of the preceding final seasonal cutting was at least 2.1%.

Maximum seasonal yield per cutting was achieved when soil-exchangeable K was: (a) 50 ppm at 0 to 6 inch soil depth; (b) 130 ppm at 6 to 12 inch depth; and (c) 90 ppm at 0 to 12 inch depth.■

Clarification for Summer 1987 Issue

THE SUMMER 1987 issue of *Better Crops With Plant Food* included an article titled "Improving Wheat and Grain Sorghum Profits With Starter Phosphorus". The illustration in **Figure 4** on page 19 of the issue might be confusing because of wording in relation to graph lines.

The graph is presented again here as a clarification. It shows two-year average yields of irrigated grain sorghum and effects of starter phosphorus (P) on the yields. Significant yield responses to starter P (20 lb P_2O_5/A) occurred at soil test levels below 8-12 ppm Bray P_1. Responses between 8-12 ppm P were variable or marginal.

As discussed in the original article, yield responses and economic returns are most dramatic with starter P applications in low soil test conditions. However, yield responses to starter may also be affected by planting date, tillage method, and other conditions.■

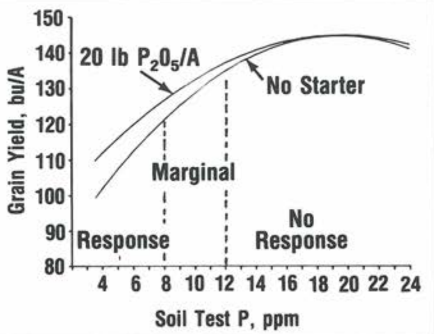


Figure 4. Irrigated grain sorghum responses to starter P were influenced by soil test P levels.

Economics Look Favorable for Alfalfa Production in the South

By Donald M. Ball

Although alfalfa is not generally considered a major crop in the southern United States, there are signs now that the forage crop could be a profitable alternative.

ALFALFA ACREAGE in the South has never been as large or as concentrated as in other parts of the United States. Southern acreage did reach respectable levels in the early 1960s, but the alfalfa weevil invaded the region and acreage dropped quickly.

Today there is reason for optimism regarding alfalfa production in the South. New, disease-resistant, Southern-adapted varieties are available and insecticides are labeled which effectively control the alfalfa weevil.

Alfalfa offers some attractive attributes. It is a potential high-yielder, a perennial, a legume, and a high quality forage. However, before a producer decides to grow the crop there is a serious question to consider: Will it be profitable? The next question might be: If so, what determines how much profit it will make?

A review of alfalfa budgets from various Southern universities showed similar figures. The average cost of establishment was $245 per acre with a cash or out-of-pocket cost of $185. The maintenance cost, which includes the establishment cost prorated over a three-year period, averaged $375 per acre with a cash cost of around $300 per acre.

It is interesting to consider a breakdown of these production costs. **Figure 1** shows major cost items by category as identified in the Auburn University alfalfa budget. Note that the largest expense categories pertain to machinery, with total fixed and variable costs accounting for 58% of the total expense of producing the crop.

Another point worthy of mention is that seed amounted to only 5%, with fertilizer and lime accounting for 21% of the total annual cost. **It is regrettable that attempts by producers to cut costs on these items are among the most common reasons for poor production from alfalfa.** Yet, they comprise a relatively small portion of the cost of producing the crop. Consider the fact that a 20% cut in fertilizer, lime and seed costs would result in less than a 5% savings in total production costs. What is the potential for lost yield with such costs? The message is clear: **It doesn't pay to cut costs with variety or seed selection or with fertilization and liming.**

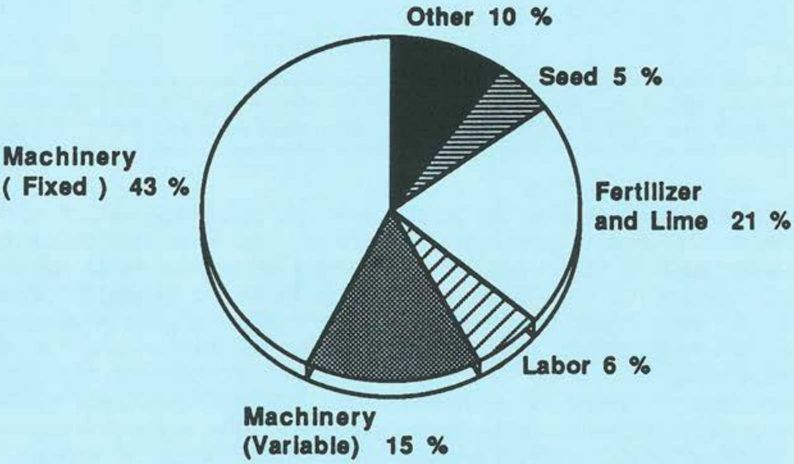
Comparison to Other Crops

Southern producers considering alfalfa will want to compare the economics of alfalfa production with other crops they could grow. Many producers are currently in a position in which they not only want to make a profit, but also desperately want to avoid losing money.

A review of 1987 Auburn University budgets shows the break-even yields per acre for various crops to be as follows (assuming current costs and crop commodity prices): alfalfa- 3.2 tons; corn- 85 bu; grain sorghum- 87 bu; soybeans- 29 bu; and cotton- 607 lb. A producer interested in reducing his risk can ask himself, "On which of these crops would I be most likely to make the break-even yield?" The answer will be different on different farms, but it seems clear that at least on many farms in the Southeast, with good management, it would be more likely that a producer would make 3.2 tons of alfalfa per acre than the break-even yields for other commonly-grown crops. **(continued on next page)**

Dr. Ball is Extension Forage Crops Agronomist, Auburn University, Alabama.

Figure 1. Production costs for growing alfalfa (by category). Based on 1987 Auburn University Alfalfa Production Budget.



Drought is the production problem with which southern producers are most concerned. Yet, the drought risk with alfalfa may be less than it is for other crops. First, alfalfa is a deep-rooted crop which can withstand moisture stress better than most annual crops. In addition, its production season is spread over a long period. Thus, a four-week drought during the grain filling period of corn may devastate corn yields, while the same drought reduces the yield of only one or two cuttings out of four or more made in an alfalfa field.

Alfalfa has additional advantages which are not offered by other crops. One of these is nitrogen fixation. A crop planted behind alfalfa may obtain 100 pounds or more of residual nitrogen per acre at no extra cost to the producer. This is in addition to the fact that no nitrogen (N) need be applied during the productive life of the alfalfa stand. It is also beneficial to use a legume like alfalfa in rotations with grass crops because of the benefits of reducing weed, insect, and disease problems. Last, but not least, it is a simple fact that the amount of erosion in an alfalfa field is far less than that in conventionally-tilled row cropland.

Effect of Yield on Profit

The previous discussion centered on the negative aspect of trying to minimize losses. A more interesting approach is to consider what happens when the yields of alfalfa are increased well above the break-even point.

Table 1 provides the expected profit per acre for alfalfa at various yield levels with various lengths of stand life. These data are calculated from figures presented in the Auburn University budgets for alfalfa. Either increasing yield or increasing stand life increases profitability. However, it is of particular interest to note that increasing the tons of alfalfa

Table 1. Estimated profit per acre from alfalfa at various yields and lengths of stand life.[1]

Yield (Tons/Acre)	Stand Life (Years)			
	2	3	4	5
3	−95	−56	−39	−28
4	15	53	71	82
5	125	163	180	192
6	235	275	291	301

[1]Based on Auburn University Alfalfa Budgets

Table 2. Estimated net returns per acre per year[1] to land and management for alfalfa hay at various value and yield levels.[2]

Yield (Tons/A)	Value of Hay (Dollars/Acre)						
	$90/ton	100	110	120	130	140	150
3	−117	−87	−57	−27	3	33	63
4	− 26	13	53	93	133	173	213
5	63	113	163	213	263	313	363
6	153	213	273	333	393	453	513
7	243	313	383	453	523	593	663
8	333	413	493	573	653	733	813

[1]Assumes three-year stand life
[2]Adapted from: Jerry R. Crews and Donald M. Ball. Economics of Producing Alfalfa Hay as Cash Crop in Alabama. Auburn University Extension Timely Information Sheet. June, 1985.

produced per acre increases profit at a much more rapid rate than adding extra years to the stand life. This clearly emphasizes the fact that **when growing alfalfa, it pays to strive for high yields!** The reason is that many of the costs associated with producing alfalfa are **fixed costs** which are much the same regardless of yield.

Effect of Forage Quality on Profit

Forage quality is affected by many factors, especially stage of maturity at harvest. If proper production practices, including good harvest management, are followed, hay quality will be good, resulting in good animal performance.

The specific value of a given quantity of alfalfa as a feed source varies with the value of alternative sources of nutrition. The main value of alfalfa is its high protein content. An example of the truth of this statement is that when soybean oil meal, a common source of protein in livestock rations, is selling for $210/ton, the comparative value of the protein in a ton of 18% crude protein alfalfa hay is $77. In addition, alfalfa contains a substantial quantity of energy. In fact, the energy in four tons of good alfalfa hay is approximately equivalent to that in 100 bushels of corn! It is also high in minerals and other nutrients as well, making it a valuable feed source. The "bottom line" is that the value of the nutrients in alfalfa is usually competitive with other crops even when the price of alternative feed sources is low; when they are high, alfalfa becomes extremely attractive from a value standpoint.

Summary and Conclusions

Alfalfa cannot be grown on every farm in the Southeast, nor should it be grown on every farm where it is possible to grow it. Nonetheless, it is clear that alfalfa offers a choice with clear economic advantages. In fact, budgets for growing alfalfa show it to be highly competitive with most other commonly-grown southern crops.

The effects of higher yield on profit and forage quality on profit have been reviewed. Now consider the effect of simultaneously increasing both yield **and** profit. **Table 2** is based on Auburn University budgets for producing alfalfa hay and assumes that forage quality, and thus value, remains constant as yield increases (although in reality hay quality usually tends to increase as yields increase).

Increasing either alfalfa yield or increasing alfalfa quality increases profits. However, the real payoff, which increases profits to almost unbelievable levels, comes from increasing both!

The acreage of alfalfa in the South has been steadily increasing for several years. In view of the dismal economic outlook for many row crops, it is likely that many other southern producers will consider alfalfa, and that they will have particular interest in the potential profitability of growing the crop.

In summary, for southern producers who have suitable land, the willingness and ability to manage alfalfa properly, and a need or a market for high quality forage, alfalfa offers great economic promise.■

P and K Applications Needed to Maintain Soil Test Levels in Doublecrop System

Gary M. Lessman

Doublecropping has become a popular, reliable production practice in some areas of the U.S. There are two important reasons. First, it gives the grower an opportunity to increase the productivity of his land and to increase profits. Secondly, it can help reduce soil erosion.

IN THE MID-SOUTH REGION of the U.S., doublecropping usually denotes production of wheat and soybeans on the same land in the same year. This article reports results of a long-term study at the Milan Experiment Station in west Tennessee that investigated the phosphorus (P) and potassium (K) requirements of wheat grown in a doublecrop system. The soil in the area is loess-derived silt loam.

Whenever cropping systems change, there may be a need to investigate the fertility requirements of the new system. In this case, simply summing the individual fertility requirements of the soybean and wheat crops to arrive at an annual fertilizer recommendation did not seem to be a satisfactory management solution. Also, one might reason that P and K utilization would be improved if the two crops, which are normally grown over a two-year period, have their nutrient requirements partially supplied from a single application in one year.

In view of these conditions, variable rates of P and K were broadcast in the fall prior to seeding the wheat. Nitrogen (N) application to the wheat included 30 lb/A at seeding with an additional 60 lb/A broadcast in late February or early March. The treatments and yields for the seven-year experiment can be seen in **Table 1.**

After 1976 wheat yields were increased by the addition of at least 30 lb/A of P_2O_5 in four of the six remaining years of the study. Yield response to K was not found for wheat and is often difficult to demonstrate for small grain crops on these loess-derived soils.

In four of the seven years, it was necessary to have a combination of P and K with at least 60 lb/A of P_2O_5 to cause a significant yield increase in soybeans **(Table 2).**

Soybean yields reported here cannot be considered particularly high. The main

Table 1. Wheat yields (bu/A) grown under selected levels of P and K in a wheat-soybean doublecrop system.

Rate, lb/A		1976	1977	1978	1979	1980	1981	1982	Avg.
P_2O_5	K_2O	Yield, bu/A							
0	0	58.8	42.5	39.1	58.4	51.4	50.7	36.0	48.1
0	90	56.2	44.4	42.8	54.2	48.1	49.6	34.7	47.1
30	90	56.3	52.1	47.7	55.2	61.9	56.7	46.2	53.7
60	90	51.9	58.7	52.9	56.6	62.9	58.4	48.2	55.7
90	90	55.1	53.5	54.3	53.6	67.4	56.2	46.0	55.2
120	90	58.8	64.4	52.3	53.2	69.2	57.9	49.2	57.9
90	0	57.1	62.3	49.9	55.4	61.6	55.1	45.3	55.2
90	30	53.6	57.3	50.1	56.0	66.8	57.0	50.4	55.9
90	60	51.8	61.6	50.4	53.6	65.4	57.9	44.1	55.0
90	120	40.6	52.9	52.9	50.6	69.5	60.5	47.3	53.5
LSD (.05)		7.2	8.0	6.1	NS	4.7	NS	9.3	

Dr. Lessman is with the Department of Plant and Soil Science, University of Tennessee.

Table 2. Soybean yields (bu/A) grown under selected levels of P and K in a wheat-soybean doublecrop system.

Rate, lb/A P_2O_5	Rate, lb/A K_2O	1976	1977	1978	1979	1980	1981	1982	Avg.
		Yield, bu/A							
0	0	26.2	34.2	25.8	29.3	17.4	29.9	32.2	27.8
0	90	30.1	36.1	25.1	33.6	19.1	36.4	33.7	30.6
30	90	25.2	35.4	26.1	31.2	19.6	37.2	35.5	30.1
60	90	27.3	35.9	28.4	38.3	21.4	37.4	35.9	32.5
90	90	30.6	36.2	30.1	38.0	19.6	34.1	39.2	32.5
120	90	30.2	38.1	30.7	38.7	23.0	37.6	39.8	34.1
90	0	28.5	35.5	27.1	34.6	22.3	34.3	39.7	31.8
90	30	26.6	35.7	29.0	36.5	20.9	34.3	36.9	31.4
90	60	28.7	35.2	30.0	37.2	22.4	33.8	36.8	32.0
90	120	26.8	34.8	29.9	36.9	22.4	34.3	41.0	32.3
LSD (.05)		NS	NS	3.3	6.0	3.3	NS	5.4	

reason is that beans could not be planted until after the wheat was harvested, usually in late June. This late planting date limits optimum soybean production. Also, limited available soil moisture is often a yield-reducing factor. The wheat removes much of the soil moisture early in the Spring, hence rainfall must be timely after seeding the soybeans.

When the study was initiated, the soil test value on this site averaged 22 lb of P_2O_5 and 150 lb of K_2O/A. After seven years of annual applications of the selected fertilizer treatments listed in **Table 3,** there were pronounced changes in soil test levels.

Without fertilizer P or K, the available levels of both of these nutrients fell into the "low" category. An annual application of 60 lb of P_2O_5 was required to maintain the soil test P at the medium level while 60 lb/A of K_2O caused the available K to be increased just into the high level. Medium to high soil test levels were usually achieved when 90 lb of P_2O_5 or K_2O was added. Given the treatment levels used in this experiment, application rates lower than 60 lb/A of either P_2O_5 or K_2O would not maintain the soil fertility levels at their initial values.

For most farmers today, the economic aspect of crop management is more important than ever. **Table 4** presents a hypothetical example, based on the results of this study.

Looking at the data given in **Table 4,** it would be easy to suggest that in four of the seven years of the experiment, the most economical level of fertilizer to apply would be 120 lb/A for P_2O_5 and 90 lb/A for K_2O. Interestingly, in 1981 when no significant yield differences from either crop were obtained as a result of any

Table 3. Soil test levels (Mehlich I) after seven years of annual applications of selected levels of P and K.*

Rate, lb/A P_2O_5	Rate, lb/A K_2O	Mehlich I soil test levels (lb/A) P	K	Rating	P	K
0	0	10	90			
0	90	14	200	Low	0-18	0-90
30	90	14	180			
60	90	25	180	Medium	19-30	90-160
90	90	28	185			
120	90	48	190	High	31-120	161-320
90	0	25	120			
90	30	33	110	V. High	120+	320+
90	60	36	175			
90	120	39	240			

***Initial levels were 22 P and 150 K**

Doublecrop from page 25

fertilizer treatment, the largest return was obtained at the 120-90 combination.

What does this mean for the farmer?

In any replicated experiment, statistical analyses are used to show real differences resulting from a treatment or treatment combinations. Crop yields are a result of many inputs, fertilizer being only one of them.

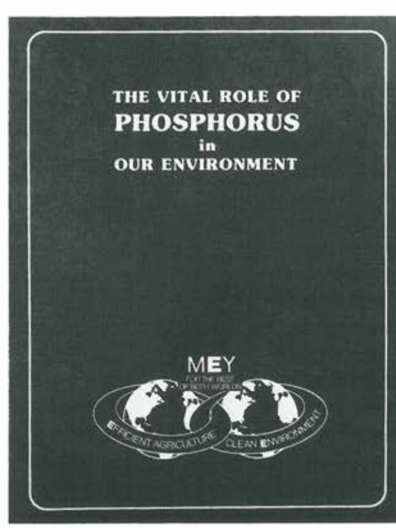
Yields that are numerically higher at higher fertilization levels, yet cannot be shown to be statistically higher at the normally accepted level of significance employed here ($\leq .05$), may not be a result of the added fertilizer itself, but may be a function of other factors. Once again these data indicate that a farmer should carefully assess his individual situation when a fertilization program is selected.■

Table 4. Crop income above fertilizer cost based on prevailing prices of crops and fertilizer.

Prices	1976	1977	1978	1979	1980	1981	1982	
Wheat $/bu	3.50	3.50	3.50	4.00	4.20	3.25	3.00	
Soybeans $/bu	7.00	6.00	7.00	7.00	7.80	6.50	5.75	
P_2O_5 $/lb	.20	.20	.22	.22	.22	.23	.25	
K_2O $/lb	.09	.10	.10	.10	.11	.12	.13	
	Wheat + Soybean income above fertilizer cost							
Fertilizer	1976	1977	1978	1979	1980	1981	1982	7 yr. avg.
0-0	359	368	318	435	347	374	291	356
30-90	357	395	334	421	400	401	292	371
60-90	351	419	359	467	405	397	303	386
90-90	383	396	370	453	407	400	287	385
120-90	384	438	364	450	432	409	301	397

New Publications on Environment Now Available

A SERIES of three new publications relating to agronomic crop production and environmental concerns has been released by the Potash & Phosphate Institute (PPI) and the Foundation for Agronomic Research (FAR). Turn to page 31 for more details.■



Starter Fertilizer for Cotton Reduces Risks

By Eddie Funderburg

A three-year study shows favorable yield response and other benefits with nitrogen-phosphorus starter fertilizer for cotton in Mississippi. This article explains conditions where response might be expected.

STARTER FERTILIZERS mean different things to different people. For purposes of this paper, a starter fertilizer is defined as, **"An amount of nitrogen-phosphorus (N-P) fertilizer banded near, but not on, the seed at the time of planting."**

The Mississippi Cooperative Extension Service conducted demonstrations on starter fertilizers on cotton in 18 locations during the time period of 1985-87. All locations were replicated, harvested, and statistical analyses were run. The yield figures from these demonstrations are listed in **Table 1.**

The fertilizer rate at these demonstration sites was 150 lb/A (12 gallons) of 10-34-0 or 11-37-0 solution liquid fertilizer. The two materials are very similar. Dry N-P fertilizers can be used if a suitable application method is available.

The most common method of application used was: (1) sprayed in a narrow (3″x4″) band on top of the ground directly over the seed drill and behind the press wheel. This was used at 13 locations. Another method of application used was: (2) injected into the soil 2 inches deep and 2 inches to the side of the seed. The third method of application used was: (3) dribbled on the soil surface 2 inches to the side of the seed drill.

There are at least five advantages to using starter fertilizers on cotton. Some of these are merely observed and some have hard data to support them. These are:

- Enhances development of a better early root system
- Helps plant overcome early adverse conditions
- Initiates earlier fruiting
- Hastens maturity
- Increases yield

Development of a better early root system. Phosphorus has long been known to be essential in root development. Adding a large amount of a soluble form of phosphorus near the young root can result in better early root systems. This has been observed on many of the demonstrations by digging up different plants.

Helps plant overcome early adverse conditions. A trait noted in many of the demonstrations was that plants treated with starter fertilizer grew off better in low "drown-out" type areas. In two locations, severe herbicide damage was noted. In both areas, much better stands were present where starter fertilizers had been applied. The advantage of having a better root system could help explain much of this.

Initiate earlier fruiting. Phosphorus has been proven by many researchers to initiate earlier fruiting on some crops. At three locations (Coahoma, Webster, Attala Counties), cotton plants were mapped and the node position of the first square initiated was noted. On plants treated with starter fertilizer, the average first fruiting mode occurred at node 4.8. On plants not treated with starter fertilizer, the average first fruiting node was 5.8; i.e., plants with starter fertilizer fruited an average one node earlier.

Hastens maturity. Phosphorus has been proven to hasten maturity in many

(continued on next page)

Dr. Funderburg is Extension Agronomist-Soils, Mississippi State University.

crops. Some farmers visually observed a difference in maturity in our demonstrations. George Alley, Carroll County Agent, made square, bloom, boll, and open boll counts on a weekly basis at one demonstration location. His open boll data strongly indicated a 5 to 7 day earlier maturity in the treated plots than in the untreated plots.

Increases yield. This is the most important characteristic of any fertilizer treatment. **Table 1** contains yield comparisons.

A trend has been noted that, in most cases, the yield increases with starter fertilizer are more pronounced on higher yielding cotton than on lower yielding cotton. Very little yield increase was noted when yields were less than 850 lb lint per acre, and yield increases were highest when yields exceeded 2 bales per acre. This technology will not make poor cotton into good cotton, but will only make good cotton a little better.

Since the fertilizer used contained both nitrogen and phosphorus, it was necessary to determine if the yield responses were originating from the nitrogen alone, or from the phosphorus in combination with the N.

At two locations in 1987, both N-P fertilizers and N alone in a narrow band were compared to determine whether the yield increases were due to merely nitrogen or to a nitrogen-phosphorus combination.

In **Table 2,** addition of N alone slightly decreased yields compared to the check plots, while N-P together significantly increased yields over the check plots. This indicated that the yield increases were due to phosphorus.

Table 2. Effect of no starter fertilizer (check), N starter, and N-P starter on cotton yield 1987. Yields expressed as lint cotton per planted acre.

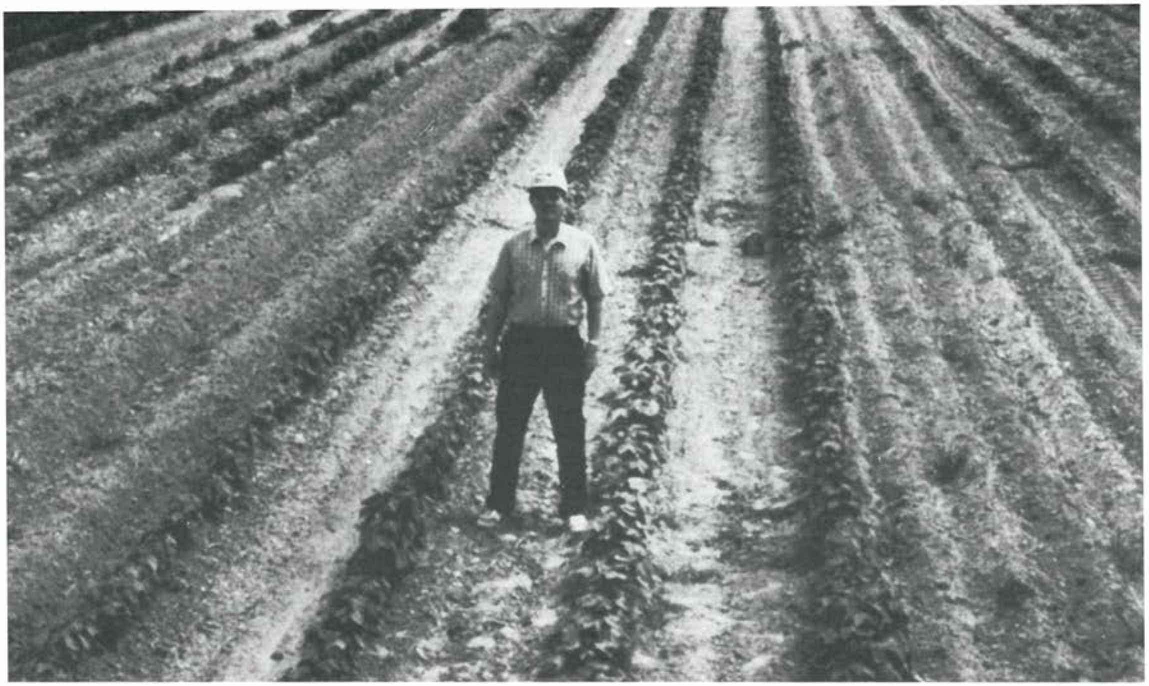
	--------- Lint Yield, lb/A ---------		
Location	No Starter	N Only	N-P Starter
Webb	815	796	905
Glendora	1,033	975	1,170

In our demonstrations, spraying the fertilizer in a narrow band on the soil surface and injecting the fertilizer 2 inches deep and 2 inches to the side of the

Table 1. Effect of application of starter fertilizer on lint cotton yields in eighteen Mississippi locations (1985-87).

		Lint Cotton Yield, lb/A		
Year	Location	With Starter	No Starter	Yield Increase Due to Starter
1987	Goodman 1	522	413	+109**
1987	Hernando	741	762	− 21
1987	Clarksdale	825	775	+ 50**
1987	Mantee	846	805	+ 41**
1986	Webb	852	804	+ 48
1987	Webb	905	815	+ 90*
1987	Goodman 2	1,017	958	+ 59
1987	Yazoo 1	1,061	1,036	+ 25*
1987	Holly Springs	1,109	1,030	+ 79*
1987	Tunica	1,133	1,043	+ 90
1987	Yazoo 2	1,143	1,006	+137*
1987	Glendora	1,170	1,033	+137*
1986	Vaiden	1,211	998	+213**
1987	Sumner 1	1,268	1,185	+ 83**
1986	Yazoo City	1,286	1,129	+157**
1987	Sumner 2	1,301	1,216	+ 85**
1985	Yazoo City	1,375	1,259	+116
1987	Grenada	1,916	1,733	+183**
Average		1,093	1,000	+ 93

* Difference was statistically significant at the .05 level of probability.
** Difference was statistically highly significant at the .01 level of probability.



STARTER FERTILIZER enhanced the stand of cotton in the four center rows of this photo. Four rows to left and to right had no starter. Herbicide damage was more severe where starter was not applied.

seed gave consistent yield increases. Dribbling the fertilizer on the soil surface gave very inconsistent yield increases, and in one case resulted in a yield decrease, the only yield decrease noted in the three years of demonstration plots. Therefore, we have the most confidence in the narrow band sprayed on the surface and the 2 x 2 methods of application.

Summary

In brief, the following points have been noted:

(1) This practice seems to work across soil types, with yield being the primary factor in obtaining a profitable response. When total yield exceeds 850 lb lint cotton per planted acre, prospects of a profitable response to starter fertilizer are increased.

(2) Starter fertilizers do not work in every year. Much research is still needed to pinpoint where good responses are most likely.

(3) Under adverse early conditions, starter fertilizers can improve stand vigor.

(4) Sometimes visual responses, such as plant height differences, are noted; sometimes they are not. Yield increases have occurred even when no visual response was noted.

(5) Starter fertilizers are not a "miracle product." However, under many situations, they can make good cotton a little better.■

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THE PROBLEM: Soil compaction limits corn growth.

Plant Problem Insights

for Maximum Economic Yields (MEY)

COMPACTION reduces yield in many crop production systems. Farmers with large acreage find it difficult to wait for ideal soil moisture conditions to get field work finished. The combination of larger, heavier equipment and working soil when it is too wet results in increased compaction.

While care should be taken to avoid compaction when possible, it cannot be eliminated entirely. **However, research indicates that potassium (K) fertilization can substantially reduce corn yield loss due to compaction.**

The four ears of corn (at left, above) show the benefits of K fertilization on heavily compacted soils. The ear on the left received no K, the ear next to it received only row K. The third ear received a high-rate broadcast treatment, and the ear on the far right got the high broadcast K rate plus row K.

In this Wisconsin study, both row-applied and broadcast potash were effective in overcoming yield loss due to compaction even when soil test K was at medium to high levels.

Compacted fields can be brought to near normal yield levels by maintaining a high K soil test level and/or row application of K fertilizer.

High levels of available K increase root weight and reduce root diameter, increasing the effective root area for absorbing water and nutrients, and thus help to sustain growth during periods of dry weather. With a high soil K test, yield loss due to compaction is much less than with low soil K test.

The small photo of corn roots (at right, above) shows how root growth can be restricted in compacted soil.

Row application of K fertilizer on compacted soils can increase plant growth and grain yields even when soil K tests are in the high range. **Potash fertilization does not remove soil compaction,** but it can help maintain near-normal crop growth and yield potential in situations where compaction cannot be avoided.■

Photos of field scene and ears of corn courtesy University of Wisconsin.
Photos of corn roots courtesy Purdue University.

This message is available on a 3½ x 7½ information card. See page 31 for order form. Other topics also available.

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FATE

SOME SAY one's fate is determined *regardless* of how one acts—others believe in a fate that befalls one *unless* one acts.

What fate awaits agriculture? The ag colleges? The teaching, research, and extension? The farmers and agri-business?

In 1987 70 million acres of U.S. farmland was left unplanted under government programs. It appears that 70 to 80 million acres will be left fallow in 1988. Agriculture is chained to high-cost government meddling. We are in the process of giving away another industry.

Will we in agriculture ever control our own destinies, our own fate, again? Can we adapt to an era of high technology and revolutionary social changes?

We can affect our fate—in the colleges—by rethinking some of our outdated concepts of curriculum—of research—of extension.

We can affect our fate—in agri-business—by working hard, learning, changing, building, creating ideas.

Often a new idea is an old idea whose time has come—like producing crops at the lowest production cost per unit (MEY)—a concept that is vital today because it embraces everything that new technology, skills, and planning have to offer.

No longer can agriculture tolerate the fate that will result from letting others do our planning and making our decisions.

—J. Fielding Reed

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