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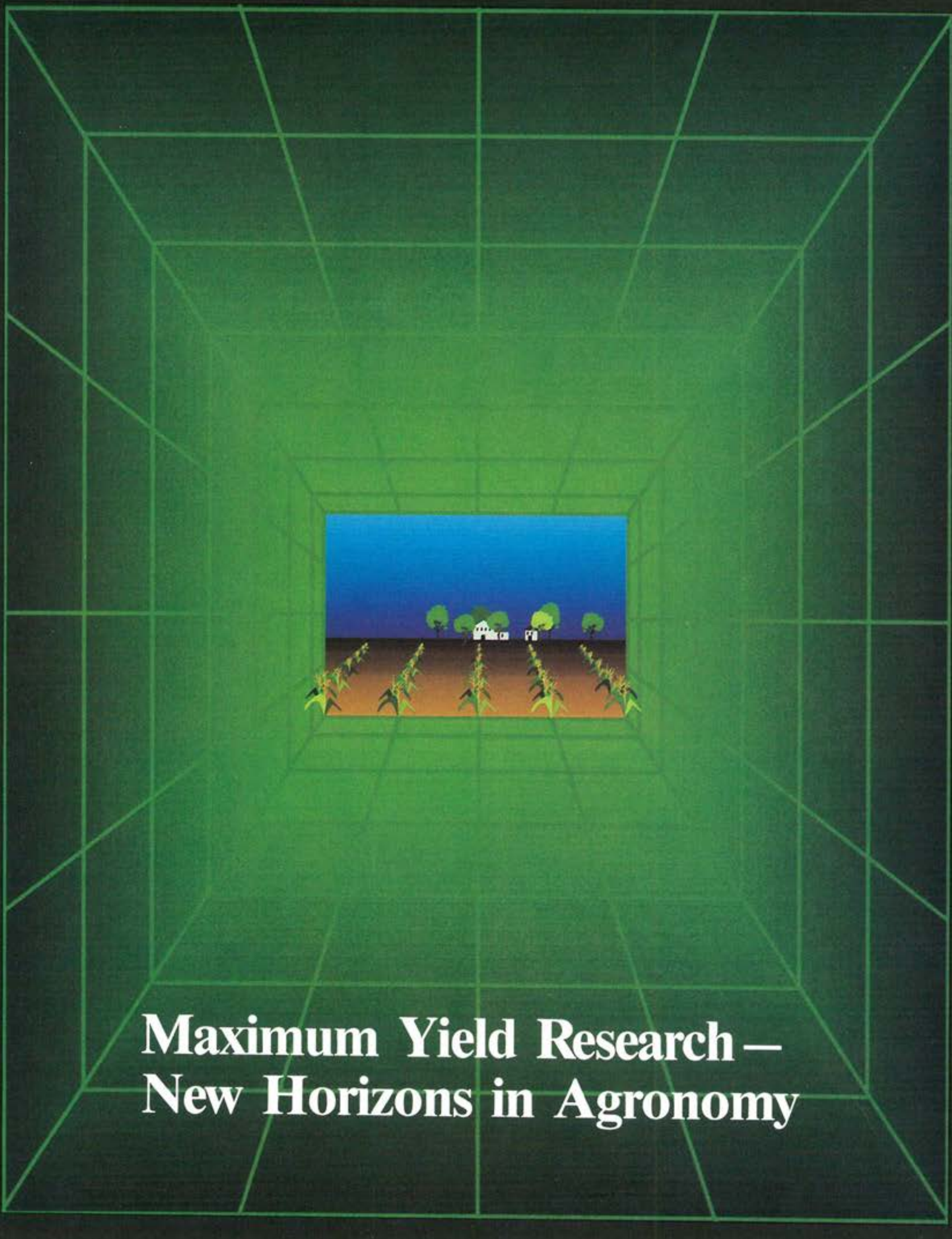
BETTER CROPS with plant food

Winter 1984-85



Maximum Yield Research— New Horizons in Agronomy

BETTER CROPS with plant food

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Our cover: In the relatively short time of a few years, maximum yield research (MYR) has become one of the most positive developments in agronomy today. Our cover and several articles in this issue spotlight some new horizons which offer both challenges and achievements for those willing to set high goals. The cover design is computer-generated by Modernera Photographic Services, Inc., Atlanta, Georgia.

Maximum Yield Research— New Horizons in Agronomy

By R.E. Wagner

TO NO ONE'S SURPRISE and to most people's understanding, industry must take a different view of research support than do publicly supported institutions. Industry's survival depends on selling a product at a profit. Cost of producing and marketing that product. . . including research expense. . . is key, especially when an individual corporation has even less control of product price than of costs.

Another point of concern to industry is that much research has both short and long-term cost. . . but only long-term payoff. Long-term research with delayed payoff is more tolerable done inside than outside.

More and more it looks like if industry wants research, industry is going to have to pay for research. Industry can do it themselves or pay somebody else to do it.

Agricultural Research, A Special Case

Production agriculture is a special case in the world of research in that it has been largely publicly supported. Historically, probably less than 5% of university research in agriculture is supported by industry. This is in stark contrast to other areas such as chemical or electrical engineering.

The new Winrock International Institute for Agricultural Development has just been organized. It merges the Agricultural Development Council, IADS, and the Winrock Livestock and Training Center. Currently, the endowment fund stands at $20 million and there is great hope of moving that to $50 or even $70 million. The focus will be on the developing world.

Biotech and high-tech research are riding the crest of a high wave of interest and can attract sizable grants. Too often, large grants from major funding bodies do little to solve agricultural production problems. Given the few of the right kinds of large grants that are available, production research cannot survive with vigor on these alone.

Research In A More Competitive Climate

The fertilizer industry never has been outstandingly famous for its support of research. For one thing, it grew up depending on the land grant college system, which for so many years heavily favored agriculture. As you know, that has changed and continues to change in many institutions. Further, there is a growing feeling that those who benefit directly should pay the bill. This is interpreted to mean the industry or the farmer himself. . . even though a strong case can be made that the consumer is the major beneficiary.

The fertilizer industry is just coming through a shakeout period and is emerging much leaner than before. The lessons learned the hard way, in many instances, likely have caused most companies to be more discriminating in assuming additional obligations. **(Continued on next page)**

Dr. Wagner is President of the Potash & Phosphate Institute (PPI) and the Foundation for Agronomic Research (FAR), Atlanta, Georgia. This article is adapted from his paper, "Strategies for Improved Support of Agricultural Research," presented at the Agronomic Administrator's Roundtable, American Society of Agronomy Meetings, November, 1984.

That's the kind of climate in which research must compete. Those equipped to respond to a role in biotechnology research are in the driver's seat. The long-term payoff to agriculture from the more basic type looks promising and is much needed. The short term is less likely to be productive.

On the other hand, agriculture will benefit in the short term and in the long term as well, from research with an emphasis on maximum yields and associated biotech aspects. Ultimately, the products and the concepts of even the most basic biotech research must be subjected to the scrutiny of the real world. That can best be done in a maximum yield research program. I submit it is here that proposals for funding will receive their best acceptance in much of agri-industry.

Corporations like to make grants in their own image. On the other hand, they are willing to forego some of that in favor of being a part of a well coordinated and monitored program of research that can best be handled through a reputable, unbiased third party such as the Potash & Phosphate Institute (PPI) or the Foundation for Agronomic Research (FAR). This approach can build a pool of funds to encourage a coordinated approach to research as opposed to the fragmented efforts that sometimes can happen with single grants from individual companies.

PPI Soul Searching

It was with some of these things as background that PPI did some real soul searching and reevaluation of itself about 5 years ago to provide direction on where our organization should be going in research support. We reasoned it was needed: 1) if we were going to be on the right side of the farmer in terms of his economics and what he needs to make a reasonable living or, in too many cases, even to survive; 2) if we were going to effectively promote the use of P and K; and 3) if we were to be a factor in the process of feeding people.

Out of all this came a clear signal. The farmers' struggle to survive in a world of high costs and volatile prices drives them to high yield systems. . . that reduce unit costs. Even with surpluses. . . or perhaps better said, especially with surpluses. . . the individual farmer has little choice. The tragic plight of Ethiopia and other African nations calls into question our definition of surpluses. What is clear is that we have a distribution dilemma. But that's another story.

MEY Is Born. . . And Is Vigorous

And so, the maximum economic yield (MEY) concept was born. Now, the excitement is not just in the fertilizer industry but also in the chemical industry, in the seed industry, and others. Geographically, it is spreading beyond the borders of North America.

Professor Malavolta of the University of Sao Paulo, with whom PPI works closely in our Brazil program, said in his paper at the IFA Conference in Mexico City earlier in 1984, *". . . instead of accepting low input technologies, Latin America must struggle with the concept of maximum economic yields."*

A great strength of the maximum economic yield concept is that it is fully compatible with soil conservation and water use and environmental quality. It is a system of interactions and balances that strives for rapid growth, quick ground cover, large root volume, and efficient pick-up of applied nutrients.

We have hit upon something here that has economic meaning for farmers everywhere, that has soil conserving capabilities, that is the best hope for world food production, that has the attention of the supplying industries. . . and something that is researchable with a clear purpose.

MYR Is Born. . . And Is Vigorous

In initial planning stages of how to strategize a MEY program that would have farmer impact, a dilemma emerged. High yield technology was not available. How could we be effective if we didn't know what yield levels were required to maximize profits. Research was needed just as quickly as it could be had to establish maximum yield levels for given soils and climates.

And so maximum yield research (MYR) was born, or at least activated, as we know it today. Let me give you a definition of maximum yield research that seems to have reasonable acceptance. *Maximum yield research is the study of variables and their interactions in a multidisciplinary system that strives for the highest yield possible for the soil and climate of the research site.*

Perhaps most surprising and satisfying is its early acceptance even in developing countries. PPI and FAR now support MYR research in China, Philippines, Peru, Ecuador and Brazil. Agricultural leaders in Bangladesh and in countries of the Middle East are talking about it. So are FAO and IFDC.

The New Direction... A Multidisciplinary System of Positive Interactions

For nearly a half-century PPI and its predecessors have been identified with research. The MEY concept called up a more clearly identified research need than had surfaced for years. It came at a time when the decline in public support for agronomic research disturbed us.

This new direction raised some questions. Should PPI continue to support P and K research only or should it be broadened to include other inputs. . .which would probably end up being better P and K research as well. . . and certainly would be better for the farmer, since he doesn't have just P and K problems. He has a package of crop production problems. . .and opportunities.

The answer to this question came quickly. The search for maximum yields could not be done any other way. A multidisciplinary or systems approach is central to MYR. It requires teams of people and products. It requires positive interactions among components of the total package.

MYR... A Funding Attraction

With the emphasis on a number of inputs and products, MYR enlists the interest of a broad spectrum of industry. If a company is going to support research, it wants its product where the action is and where returns will be greatest for dollar invested. It wants its product tested in a high yield environment.

To help marshall the resources of industry and to put a sharper focus on maximum yield research, PPI organized the Foundation for Agronomic Research (FAR) in 1980.

A Search For Potentials And Economic Realities

Because of MYR, for the first time in agricultural history we are now able to put a major focus on searching for the full potential of farm production and for the economic realities of a high yield agriculture, with or without acreage controls. From that information as it becomes available, one can put numbers on yield levels and on the kinds and amount of inputs that will maximize profit for the farmer. Only by identifying **maximum yields**—which are not for farmers—can we get the necessary information to calculate maximum economic yields which are for farmers.

Already there have been surprises. Leading university researchers are quieting many of the doubters of only 5 years ago who thought that to talk about 300 bushels of corn was to lose credibility. Recently achieved yields of 338 bushels of corn, 118 bushels of soybeans, 140 bushels of wheat are impressive. They get people's attention and they hold out the kind of challenges that point to unparalleled progress in research and on the farm.

The MYR approach is an attractive research direction. It appeals to industry and will attract more funding as the concept becomes better understood. Together we can make it happen. ■

Research Verification Trials Support Production Recommendations

By Woody N. Miley

UNIVERSITY OF ARKANSAS researchers, extension workers and administrators are enthusiastic about a program designed to speed implementation of research findings in a practical manner on farms. Following success with cotton, similar efforts are beginning with soybeans, rice and corn.

Called "Research Verification Trials," the program was conceived by Dr. W.J. Moline, Director of Arkansas Cooperative Extension and previously Head of the University of Arkansas Department of Agronomy.

Dr. Moline had long observed a disturbing time lag between discovery of new research facts and their adoption. He observed that the segmentation of technology and the lack of coordinated implementation were partly responsible.

Declining Yields of Cotton

Cotton acreage in Arkansas had been declining and yields were generally unprofitable. Yet, there was a wealth of research information by university scientists. Dr. Moline saw a potential remedy in getting scientists to cooperate in implementing the recommended technology in a practical manner on selected farms.

After initial three-year funding was secured, Mr. William E. "Gene" Woodall, Extension Cotton Specialist, was selected as coordinator of the project. Mr. Woodall was eminently qualified, with many years of experience. To support him in an advisory role, a committee of researchers and extension specialists representing various disciplines was elected.

These scientists visit the trials periodically to advise, evaluate implementation of technology, and to visit with growers. They have often been surprised at the impact of the coordinated implementation.

In selecting fields for the program, irrigation capability was a prime requirement. From the beginning in 1980, irrigation has served the project well.

Yield Comparisons

The five trials managed in 1980 yielded 816 lb of lint per acre, compared with the state average of 330 lb/A.

In 1981, the five trials produced an average of 861 lb/A, compared with 518 lb/A produced as a state average.

In 1982, seven verification trials produced an average of 959 lb/A compared with 657 lb/A for the state average.

In 1983, yields for the seven verification trials increased to 1,210 lb of lint per acre, while the state average was 500 lb/A.

As a whole, the four-year average net income on the 1,249 acres in the trials was $299 per acre – more than double the state average per acre income during the four years.

Mr. Woodall originally visualized three possible outcomes of the trials:

(1) They would verify that current recommendations based on research are entirely

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Dr. Miley is University of Arkansas Extension Soil Specialist and Section Leader – Agronomy.

SHOWN on a 1983-84 research verification field are, from left, William E. Woodall, Extension cotton specialist; J. Curtis Johnson, county Extension agent-agriculture, Chicot County; and Claude Grubbs, farm owner and operator. The two-year average yield was 1,201 lb of lint per acre.

suitable for production of high and profitable yields of cotton.

(2) The trials would point out the needs for additional refinement of recommendations.

(3) The experience would pinpoint specific opportunities for additional research in some areas of technology.

He believes that all three objectives have been accomplished.

Trials Expanded

In 1984, the Cotton Research Verification Trials were expanded to 11 fields in diverse parts of the state. All the trials emphasize all areas of technology; special concentration goes to irrigation, pest management, and nitrogen management.

Mr. Woodall personally visited each field weekly during the harvest and production season. He provided on the spot advice to the growers for timely management based on the changing situation. (Note: Mr. Woodall will retire in mid-1985, but the program will continue under the direction of other specialists.)

Timeliness of operations, he says, has often proven critical.

With the aid of two research assistants and five county Extension agents assigned to the project, he has obtained insect counts twice weekly.

Irrigation water has been applied on time and adequately.

All the fields have been on the University's cotton nitrate monitoring program. Nitrogen fertilization includes a combination of preplant application, sidedressing and foliar application of urea, as guided by weekly plant tests in mid- to late-season.

In speaking to growers at an Arkansas Cotton Conference recently, Dr. Moline said, "The program has flown not from the office but out in the field where decisions are made and implemented. In the process, the program has served as excellent training for county Extension agents.

"The cotton program spearheaded the way for expansion of the trials to soybeans, rice, and corn. Attracted by reports of success, scientists from other states are now visiting and studying the trials.

"Basically the program is not new. It is an extension of the philosophy of **Seaman A. Knapp,** the originator of the Agricultural Extension Service, who believed that what a person does means more to him than what he sees or hears." ■

Breaking the Yield Barriers in Rice Production

By D.S. Mikkelsen

RICE YIELDS of 10,000 to 15,000 lb/A were never seriously considered until the last decade when researchers and rice growers began to report such achievements. World paddy production in 1981 for all developed countries averaged only 4,700 lb/A, developing countries 2,400 lb/A, and the total world average was 2,500 lb/A. The nine leading producing areas, all in temperate climates, averaged 5,200 lb/A. But even this is only half the maximum potential for rice yields.

Scientists, using recorded maximum photosynthetic efficiency values, predict up to 10,000 lb/A yield for the tropics and 15,000 lb/A for temperate climates receiving up to 600 cal/cm^2 daily incident radiation during the growing season. This assumes that all the photosynthate produced contributes to grain production and that sink size (panicles) is not limiting. With good management and favorable environmental conditions, actual production yields of 14,500, 14,400, 11,800, and 9,800 lb/A have been reported from Australia, California, Japan and The International Rice Research Institute, respectively. These results suggest that good agreement exists between actual yields of well managed rice and yield projections based on scientific theory.

The crop and cultural requirements for these yields, based on crop physiology, environment, mineral nutrition and crop protection suggest the following desirable conditions:

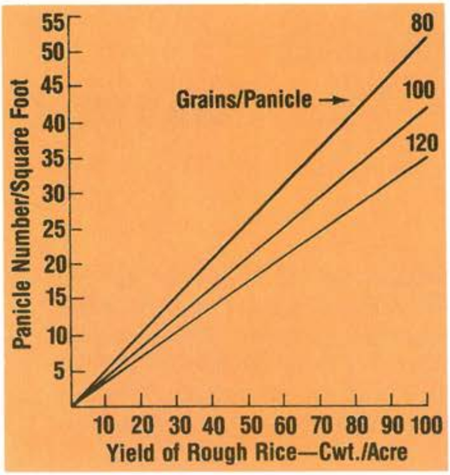
- High yielding varieties should have erect upper leaves but slightly lax leaves in the lower canopy for maximum light interception.
- The LAI (leaf area index) values should approximate 5-6 to maximize photosynthesis. Some leaves should remain physiologically active until the crop matures and grain is filled.
- High solar radiation, above 400 cal/cm^2, is desirable especially throughout the ripening stage, with mean daily temperatures of about 75-85°F.
- High plant densities are needed together with favorable environmental conditions to maximize panicle production, spikelets per panicle, maximum seed filling and minimal spikelet sterility. Spikelet number per unit land area together with a high filled-spikelet percentage is particularly important.
- Soil conditions must be favorable and capable of supplying at least 50 lb N, 15 lb P and 87 lb K per ton of grain produced plus all other nutrient requirements. Leaf levels of all nutrients must be held at high levels through all growth stages for high photosynthetic activity and grain formation.
- Adequate moisture should be provided by continuous flooding during all growth stages through grain filling.
- Crop protection must be provided so the productive potential of the crop does not decline.

An analysis of factors contributing to rice yields reveals that four components basically determine economic production and that management practices must be designed to optimize each one. These components are: 1) panicle number, 2) spikelet number/panicle, 3) percent filled spikelets, and 4) 1,000 grain weight.

Figure 1 illustrates how panicle number and grain per panicle contribute to yields up to 10,000 lb/A of paddy rice

Dr. Mikkelsen is Professor of Agronomy, Department of Agronomy and Range Science, University of California-Davis.

Figure 1. Rice Yield per Acre Affected by Number of Filled Grains per Panicle and Panicles per Square Feet of Land Area.



under California (medium grain type) conditions.

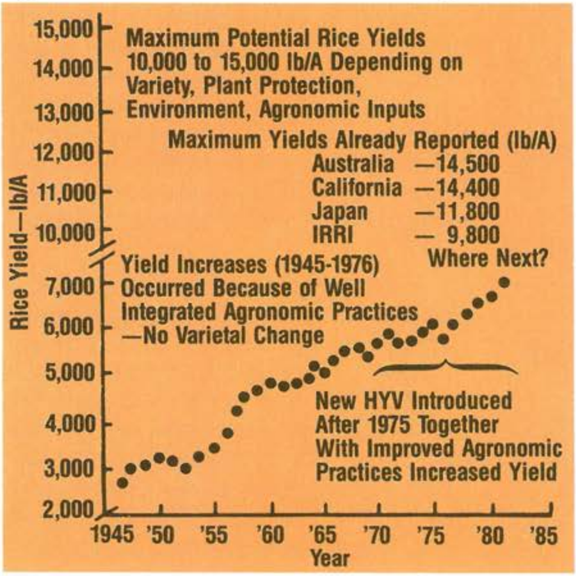
Average California rice yields have increased steadily from 1945 to the present **(Figure 2).** The increase in California paddy rice yields from 2,800 in 1945 to 5,600 lb/A in 1976 was accomplished entirely by maximizing agronomic practices such as fertilization, water management, weed and pest control, improved land levelling and harvest practices. No new varieties were introduced during this period and, fortunately, traditional varieties possessed high yield potential.

Beginning in 1976, the first improved California short-statured rice varieties were released. In 1979 about 50% of the California production had changed to high yielding short-statured varieties and by 1982, short-statured varieties were grown on nearly the total California rice area. Obviously during the period of 1945-1976 California rice growers utilized every research advance in rice production technology to remain economically competitive in American rice production.

Fertilization, especially nitrogen, phosphorus, zinc and, increasingly, potassium played an important role in this increased production. Fertilization is responsible for at least 45% of the California rice production as measured by field experiments.

Since 1976, California rice yields have continued to climb largely due to the release of improved short-statured, more lodging resistant varieties. Statewide rice yields in 1981 exceeded 7,000 lb/A and it is anticipated that with continued refinements in varieties and cultural practices new records will be set. While statewide yields recently averaged 7,200 lb/A, enterprising growers report yields in excess of 10,000 lb/A and yields from field experiments conducted by the University indicate potential yields of 14,000 lb/A.

Figure 2. California Rice Yields—5-Year Moving Averages



Weather conditions, cultural practices, nutrient supplies and high yielding varieties must be combined in an optimum manner to influence the plant components required for maximum yields. Our ability to integrate all the interrelationships involved is the challenge for the future and the key to producing rice yields approaching the theoretical potential. ■

D.J. Bourne Elected Chairman of PPI and FAR Boards— R.R. Johnson New Vice Chairman

MR. DOUGLAS J. BOURNE, Chairman and Chief Executive Officer (CEO) of Duval Corporation, and Mr. R.R. Johnson, Executive Vice President, Agrico Chemical Company, have been elected Chairman and Vice Chairman, respectively, of the Potash & Phosphate Institute (PPI) Board of Directors. Mr. Bourne also serves as Chairman of the Foundation for Agronomic Research (FAR) Board of Directors, and Mr. Johnson serves as Vice Chairman.

In welcoming the new leaders, Dr. R.E. Wagner, President of PPI and FAR, also expressed sincere appreciation for the dedicated service of outgoing Chairman Dr. Gino P. Giusti and other Board members whose terms were recently completed. Dr. Giusti, President and CEO of Texasgulf Inc., had served as Chairman since 1982.

Mr. Bourne, of Houston, Texas, was Vice Chairman of the PPI and FAR Boards since 1982 and is a veteran leader in the fertilizer and chemical industries. Mr. Bourne became President of Duval in 1977 and was promoted to his present position in 1983. He also is a member of the Board of Directors and member of the Executive Committee of Pennzoil Company. Duvall Corporation is the wholly owned subsidiary of Pennzoil Company.

Following service in the U.S. Navy, Mr. Bourne joined Duval in 1946 as assistant chemist at its Orchard, Texas, sulphur property. He transferred to Carlsbad, N.M., in 1947 and served in an engineering capacity during potash exploration and plant construction. In 1951, Mr. Bourne became process engineer at Carlsbad and in 1954 was promoted to chief metallurgist. Subsequently, he served as

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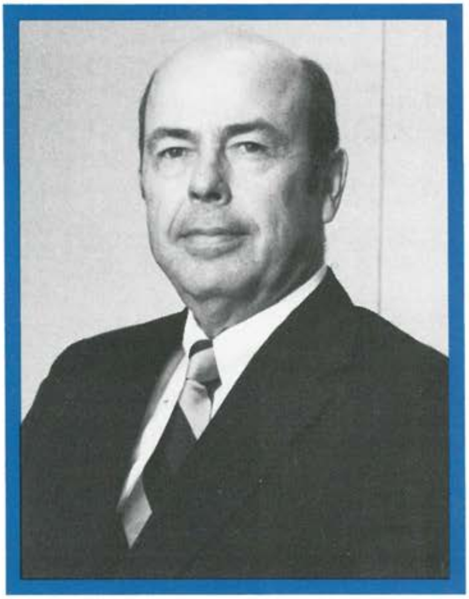

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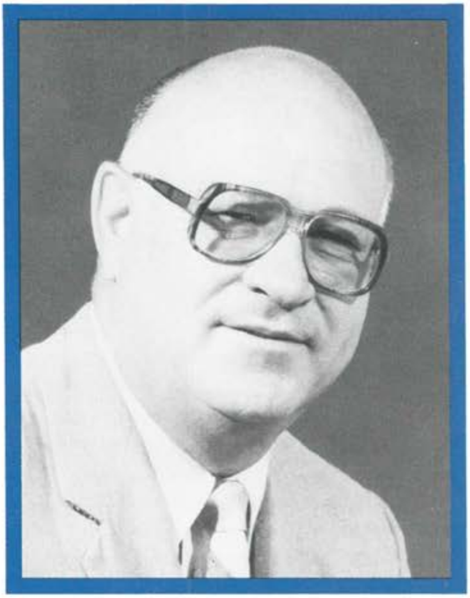

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Agrico Chemical Company

Vice Chairman, Board of Directors
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refinery superintendent and director of research prior to being named Duval's Vice President of Research and Planning in 1964. Mr. Bourne became President of Duval Sales Corporation in 1968. In 1972, he was named Executive Vice President of Duval Corporation and in 1975 was given additional duties as Pennzoil's Group Vice President for Management.

The author of several technical papers, Mr. Bourne holds five U.S. patents. He is a Director and past Chairman of The Sulphur Institute, and a Director of the American Mining Congress and of Anderson Greenwood & Company, Houston. Mr. Bourne earned a bachelor's degree in chemical engineering at the University of Oklahoma and completed the Advanced Management Program at Harvard Business School.

Mr. R.R. Johnson, of Tulsa, Oklahoma, has served on the PPI Board of Directors since 1977 and was Chairman of the Finance Committee. He has been an Agrico employee since his graduation from the University of Missouri in 1950. The Columbia, Missouri, native served in various functions in field and middle management prior to being elected a Vice President in 1972. He was promoted to Senior Vice President in 1975. In 1979, he became Executive Vice President of Agrico Chemical Company, one of the Williams Companies.

Mr. Johnson is a member of the boards of Crop Production Services, Inc., Phosphate Rock Export Association, and Phosphate Chemical Export Association. He is also a council member of the International Fertilizer Industry Association (IFA) and Chairman of the Farm Policy Committee of The Fertilizer Institute (TFI). Mr. Johnson also serves on various other committees of the nitrogen and phosphate industry. ■

Corn Hybrid and Plant Population Interactions in Maximum Yield Research

by C.K. (Ken) Stevenson

MAXIMUM YIELD corn research at Chatham, Ontario, produced another record in 1984—257 bu/A is the highest produced in Canadian research. The 257 bu/A was produced with: Pioneer 3707 hybrid; high fertility (300 lb N/A, 91 lb P_2O_5/A, 246 lb K_2O/A); very high plant populations (39,490 ppa); and with seasonal irrigation. Row spacings were 15-inches, with plants spaced 10.6 inches apart.

The main treatments in the experiment over the past three years have been hybrids, fertility, plant population and irrigation. The hybrid-plant population interaction has been significant each year and has accounted for most of the increases in corn yields. The soil tests for phosphorus (P) and potassium (K) are very-high and high respectively; therefore, there has been little response to the very high rates of fertilizer (600 lb N/A, 191 lb P_2O_5/A, 403 lb K_2O/A) over the high fertility treatment (300 lb N/A, 91 lb P_2O_5/A, 246 lb K_2O/A).

The summer rainfall (May—September) has ranged from 12.7 to 18.1 inches over the three years. The 1984 growing season was the driest of the three years, particularly in June and July, and is the only year that a significant yield increase (10 bu/A) from irrigation has been obtained.

Table 1. Maximum yield treatments at Chatham, Ontario, from 1982 to 1984 for irrigated and non-irrigated corn.*

Year	Irrigated	Non-Irrigated
	bu/A	
1982	251***	246***
1983	249**	235**
1984	257**	251***
Average	252	244

*Reported yields were obtained with Pioneer 3707 at 36,600 to 39,490 ppa. Yields at 15.5% moisture.
**High fertility (250 to 300 lb N/A, 100 lb P_2O_5/A, 250 to 300 lb K_2O/A).
***Very high fertility (550 to 600 lb N/A, 200 to 300 lb P_2O_5/A, 300 to 400 lb K_2O/A, plus secondary and micronutrients).

Although maximum yield research has produced very high corn yields for this area of Ontario, it may be even more important to note the consistency of the high yields. It appears that the genetic potential for Pioneer 3707 under these conditions may have been reached considering the fact that fertility and irrigation do not appear to be limiting factors.

Figure 1 shows the effects of high (25,560 ppa) and very high (39,490 ppa) plant populations on the yields of Pioneer 3707 and P.A.G. 2890 in maximum yield research (MYR) during 1984. The hybrid-plant population interaction has been highly significant each year, with other

Mr. Stevenson is a researcher with Ridgetown College of Agricultural Technology in Ontario, Canada.

Figure 1. Effects of Plant Population on Corn Yields in Maximum Yield Research (1984).

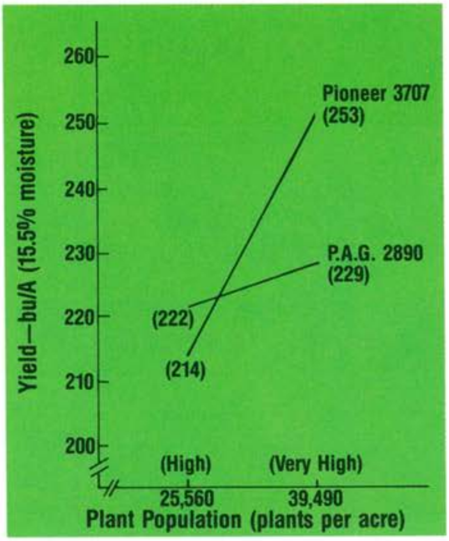
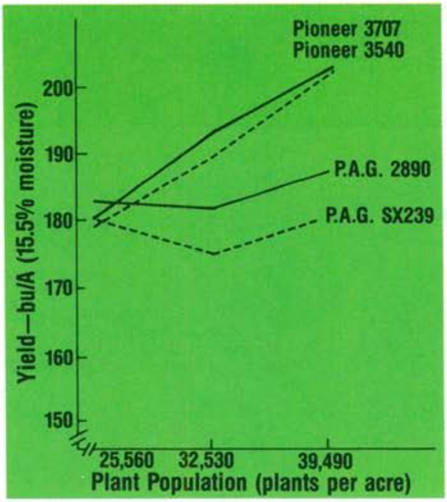


Figure 2. Effects of Plant Population on Yields of Four Corn Hybrids in 15-inch Rows (1984).



hybrids being substituted for P.A.G. 2890 during the 1982 and 1983 growing seasons. On the average, for each extra 1,000 ppa of Pioneer 3707 harvested, there was a yield increase of 2.8 bu/A. For each extra 1,000 ppa of P.A.G. harvested, there was a yield increase of 0.5 bu/A.

A satellite experiment was implemented during the 1984 growing season to evaluate the interaction of corn hybrids and plant population. The experiment was not managed as intensively as the maximum yield research project and corn borers were a problem that may have lowered yields. These plots were not irrigated, but they were fertilized with the same high fertility treatment rate used in the MYR plots.

Figure 2 reports the effects of three plant populations on four hybrids in 15-inch row spacings. Both Pioneer hybrids averaged about 1.7 bu/A yield increase for each extra 1,000 ppa harvested, however, the P.A.G. hybrids showed very little response to increasing plant population. At the lower plant populations which a farmer might plant, both Pioneer and P.A.G. hybrids yielded similarly.

Based on the results over the first three years of this project, it appears that if soil fertility, soil moisture, insect control, disease control, planting date and other management factors are not limiting, then corn yields can be significantly increased by increasing plant population of some selected hybrids. Obviously, not all hybrids respond to increased plant populations under intensive management. However, the importance of identifying these hybrids for MYR and for future use in farm management cannot be overstated.

Since increased yields and profits produced from higher plant populations are a low cost input it has paramount importance in determining "maximum economic yields" for farmers. In the case of corn, still more research is needed to investigate the interactions of hybrids under integrated management systems. ■

Editor's Note: Mr. Stevenson's three-year average yield of 244 bu/A for non-irrigated corn is considered as the highest three-year average in North American research.

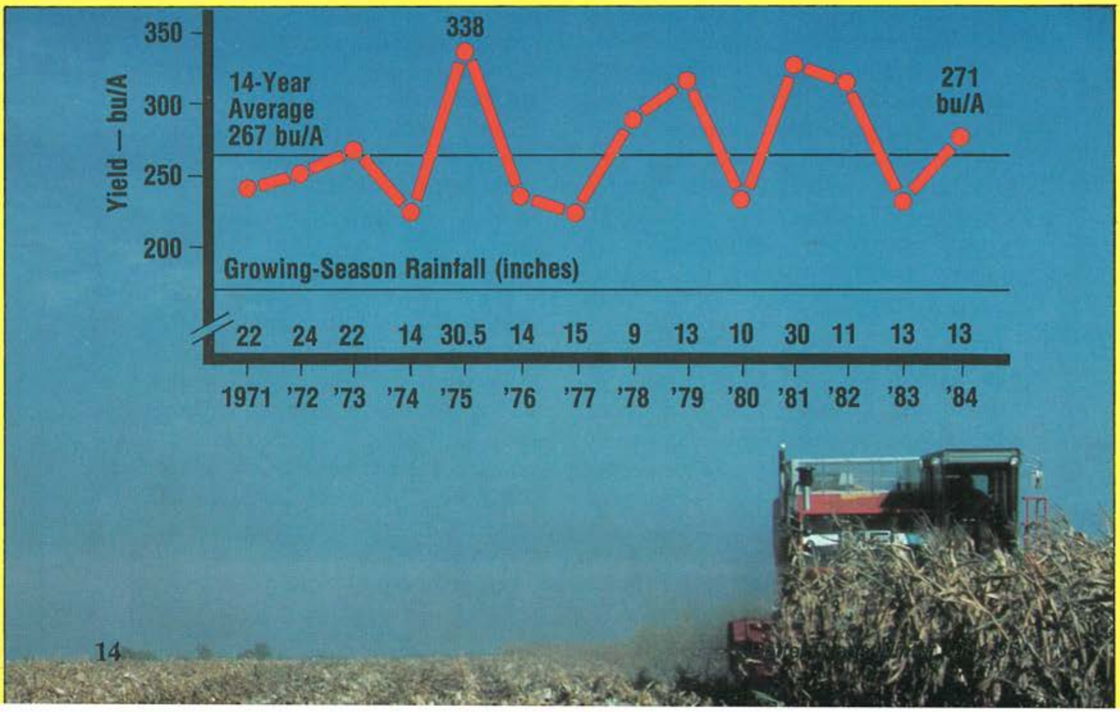
Herman Warsaw Has 267 bu/A Corn Yield Average Over Past 14 Years

HERMAN WARSAW continued a high-yield tradition in 1984 on his Saybrook, Illinois farm. With a yield of 271 bu/A of corn on his test plot, Mr. Warsaw produced more than 200 bu/A for the 14th consecutive year. His yield average on the plot during that time is 267 bu/A.

The table and graph shown here illustrate the yields and rainfall during each growing season from 1971 through 1984.

Warsaw Yields and Rainfall (Growing Season) For High-Yield Plot. Saybrook, IL.

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Yield bu/A	242	250	267	224	338	235	222	288	312	231	325	307	228	271
Rainfall inches	22	24	22	14	30.5	14	15	9	13	10	30	11	13	13



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Farming Will Be Profitable

"The sufferings of this present time are not worthy to be compared with the glory which shall be revealed in us."
—Romans 8:18

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The "sufferings of this present time" can only go so far. We could well be on the threshold of a great change in the entire farming world—"the glory that shall be revealed."

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