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BETTER CROPS

with plant food

Summer 1986

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"FAR in Action" Tour Highlights Implementation of MEY Systems

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P and K for Irrigated Alfalfa

High-Yield-System-In-Place Approach for Soybean Management

Interdisciplinary Cooperation Key for Progress in Wheat Varieties

A Grower's Viewpoint of Successful Information Transfer

. . .and much more

BETTER CROPS with plant food

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A Grower's Viewpoint of Successful Information Transfer

By David G. James

Crop growers are constantly faced with new information and management alternatives. This article describes the sources and methods of information transfer which have worked for a large family farm in Canada.

OUR FARM OPERATION now consists of 4,700 acres of wheat and flax, plus a 2,000-bird egg production enterprise. The climate in our area has an average of 110 frost-free days and average growing-season precipitation of about 33 cm (13 inches). The soil is a lacustrine fine clay which has a very level topography and imperfect to poor internal drainage. At present, we grow only wheat and flax in a continuous cropping program, striving for successful economic production.

High-Yield Information

No matter what the format of the communication, information basically originates at the industry, government, and educational levels. We have found industry, and in particular our **fertilizer dealer**, of considerable assistance.

Whatever the source and whatever the impact of this new information, it is important to scrutinize it: first – to evaluate the validity of the information offered; and second – to decide whether the implementation of such information is possible, given our specific area and growing conditions. Although the following list is not all inclusive it does provide a sampling that is indicative of sources we have drawn upon: **publications; producer meetings; short courses; resource people; and crop clubs.**

One key aspect of the entire information transfer takes place through the interaction of family members and their common drive that spans the years and the generations.

High-Yield Wheat Club

One source of information that has been important to our farm in the transfer and implementation of improved crop management practices is the Landmark Agro Ltd. High Yield Wheat Club. It was formed in 1982 by a leading fertilizer dealer in our area, Landmark Agro Ltd., located in Landmark, Manitoba, in conjunction with 10 of its farmer clients. The reasons behind forming the club were twofold: 1. to evaluate wheat yield potential at the commercial level under more intensive management and, 2. to look at the economic viability of producing wheat at these higher yield levels. If it were proven that higher yields were more profitable, not only would farmers benefit, but so would Landmark Agro Ltd. through increased sales of its products to its farmer clients.

The High Yield Wheat Club has been successful in providing the members with a forum for the exchange of information from varied sources and also a framework to measure accurately the yield and economic results from the use of this information. It is this latter area of measurement that is, in so many cases, lacking. The feedback of these results is needed to know whether the extra effort and expense were warranted.

From the initial number of 10 the membership has grown to 14. A key success factor has been the club's small membership size. This allows indepth study of each member's activities and detailed

(continued on next page)

Mr. James is part of a fourth generation farming operation, James Farms Ltd., located near Winnipeg, Manitoba, Canada. Other members of the enterprise are his parents, Wilfred and Dorothy James, and Gordon Trenholm, partner. This article is adapted from Mr. James' presentation at the "Maximum Wheat Yield Systems Workshop" in Denver, Colorado, in March 1986.

reporting that would not be possible with a larger membership.

We invite producers' ideas and innovativeness with respect to crop management practices. This gives us the opportunity to evaluate all presented possibilities.

The normal business of running the club is carried out at 3 or 4 breakfast meetings during the season. A field (minimum size of 40 acres) is chosen by each member of the club in the fall and it is then soil tested. Any pertinent information, with respect to that field, is recorded by the member in a grower report booklet. During the growing season, leaf tissue analysis is carried out on each member's field at two different growth stages. This analysis may reveal areas of potential improvement within the fertility program carried out by the members.

The members spend a summer day touring the club field where there is an opportunity to question the grower and examine first hand his particular field. A finale of the tour is a barbecue at one of the member's farms.

At harvest time, final yields are determined by processing square metre samples. With the yields then determined and the grower report booklets completed and handed in, a grower summary report is prepared and distributed to all members. This summary contains all pertinent input data and resulting yield and economic information on each grower's field. In November, we conclude the season with a banquet. This banquet is highlighted by the presentation of club achievement awards and an after-dinner speaker. The club awards presented are: Highest Yield; Most Profitable Yield; Highest Protein; Heaviest Bushel Weight.

Table 1 summarizes some key results for the past few years.

Application of High Yield Information

The practical application of higher yield management information on our farm is the ultimate test of successful information transfer.

We pay close attention to all our crop production factors and put together a well-balanced, integrated crop program. We are cognizant of the interaction among the different crop production factors and also of how these interactions change as crop yield goals are increased.

Moisture Management – Our farm is located in an area where adequate moisture is usually received. This allows us to target for and achieve excellent wheat yields. More often than not, excess moisture can be one of our major problems.

Seedbed Preparation – With the minimum tillage program on our farm, the fields are deep tilled once in the fall, after harvest. Our crops are then directly discer seeded into these fields in the spring.

Varietal Choice – Our targets for wheat yields now are 75 to 80 bu/A. The selection, then, of a variety which has excellent yield potential as well as disease resistance and maturity characteristics forms the foundation for our high yield program. This past growing season we planted 2 varieties of American semidwarf spring wheat. As well as having the characteristics mentioned above they were also chosen because of their excellent resistance to lodging.

Seed Quality – We are cleaning and selecting our seed more rigorously with respect to plumpness and uniformity of kernel size.

Seeding Considerations – Higher yields require closer attention to the importance of early seeding. The last two years our highest yielding wheat crops have been those that have been sown in

Table 1. Economic Returns—Landmark Agro Ltd. High Yield Wheat Club.

Year	Highest Yields bu/A	Production Costs $/bu	Net Profit $/A
1982	67.4*	2.73	65.64
1983	48.2	3.83	20.14
1984	75.5*	2.22	146.05
1985	96.8*	2.00	145.37

*Also most profitable yield

April. Also more attention is going to be focused on our seeding rates in 1986 (not in bushels/acre but in seeds/sq. meter) and we would like to determine what seeding rates will be required to more consistently obtain our yield goals.

Through shallower fall tillage and careful seeding equipment setting we have improved the uniformity of seed placement resulting in improved crop emergence.

Fertility Program — The fertility program is an important part of our crop production plan. We look at our yield goals; take into account our past experiences; and, most importantly, make use of our extensive soil testing program. It forms the foundation of our fertility program. We have been soil testing since 1967 and in the last 7 years virtually every field on our farm is soil sampled every year. These samples are then sent to a private lab for analysis.

Our starter N and all of our phosphate requirements are applied through the discers when seeding. The remainder of the required nitrogen (and possibly other nutrients) is then floater applied the following day and harrowed in. This system of fertilizer application has, to date, worked very effectively for us. Leaf tissue analysis is also being conducted on a number of our fields.

We are attempting to understand the interaction of plant nutrients in a high yield crop production program.

Weed Control — We carry out a pre-emergence grassy-weed control program on our wheat crop. Avadex and Treflan are mixed with the liquid N that is being floater applied. Early elimination of grassy weed competition is essential and I believe this preventative approach has worked very effectively for us. An effective broadleaf weed control program then becomes possible.

Insect Control — Insect presence is always a consideration. In this past season we used a dual purpose seed treatment on some of our wheat seed to combat a wireworm problem. During the growing season fields are monitored for any potential insect problem and if one develops, we take the required action to protect our potential yield.

Disease Control — There are two areas of concern. All of our seed is treated, to protect the growing plant from potentially damaging seed- or soil-borne diseases. Secondly, in changing the way we till our land, rotate our crops and increase our yields, crop diseases may become more of a concern. We are just beginning to learn more about disease identification, levels of disease infections (and resulting yield losses) and the role that foliar-applied fungicides may play in the control of them.

Harvesting — By harvest-time we have invested a great deal of money and effort and it is imperative that we harvest the crop as quickly as possible so that it is under our control.

In 1984 and 1985 we had some wheat fields yielding 75 bu/A. Six or seven years ago, in our area, I would not have thought this possible. For 1986, we will be striving for overall average wheat yields of 75 bu/A. We will also be setting a yield target of 100 bu/A of wheat for one field.

Future

High-yield wheat systems research is underway and even more of this integrated type of research work will have to be carried out in the future. Industry may have to take a stronger leadership role because government research funding for agriculture appears to be very tight. Also, closer ties may have to be developed between researchers and farmers with input from the farm community on the type of research required for each area. Funding by the grower is one option to consider in support of this research.

Growers will be bombarded with ever-increasing amounts of high yield information and will have to be very careful in the selection and interpretation of this information as to how it may apply to their particular farm.

However, all the supportive information that modern technology can provide will be of little value if the grower's attitude is not optimistic, progressive, and somewhat adventurous. The grower who is prepared to accept the risk, and who is successful in the assimilation and implementation of this information into his cropping program, will be rewarded with **higher** and more **profitable** yields. ■

Potash and Phosphate Increase Yield and Profits from Irrigated Alfalfa

By C.R. Thompson, D.L. Dodds, and B.K Hoag

North Dakota research shows good economic returns from P and K fertilization for irrigated alfalfa. Good nutrition also improves longevity of alfalfa stands.

WITH A SHORT GROWING SEASON and cool climate, alfalfa may be one of the more profitable crops under irrigation in North Dakota and similar areas. Moisture is often the limiting factor in production, but with irrigation, fertility becomes limiting.

North Dakota has about 65,000 acres of irrigated hayland. Alfalfa requires an estimated 5 lb of phosphorus (P) and 50 lb of potassium (K) per ton of forage yield.

This article reports results from three years of study (1983-1985) at the Karlsruhe Irrigation Research Site. The soil is a Clontarf sandy loam with approximately 2 ft. of sandy loam soil over a medium coarse sand, with sand and gravel layers at lower depths. Organic matter ranges from 2.0 to 3.0% and soil pH ranges from 7.5 to 8.0. Water-holding capacity of the soil is approximately 4.5 inches in the top 4 ft. of soil, very suitable for irrigation.

Alfalfa variety "DeKalb brand 120", which is winterhardy, bacterial wilt resistant and possesses resistance to phytophthora root rot, was seeded at 18 lb/A on the study area in June 1982. Eptam at 3 lb/A was applied preplant incorporated for weed control. An excellent stand was established.

A 3-cut harvesting system was used with harvests occurring in June, July and August of 1983, 1984, and 1985. All fertilizer, 0-0-60 (KCl) and 0-46-0 (triple superphosphate), was applied according to treatment in late April of 1983, 84, and 85. Experimental units were soil sampled in April 1983 and October 1983, 84, and 85. Soil samples were analyzed by NDSU soil testing lab.

Soil Test Levels

Initial levels of soil P and K were quite variable among experimental units with P ranging from 8 to 37 lb/A and K from 120 to 300 lb/A (data are not presented). When soil testing levels were averaged over replicates by treatment, P ranged from 13 to 16 lb/A and K from 164 to 244 lb/A. Based on NDSU soil testing procedures, soils testing 0-9 lb/A of P are rated low, 10-19 medium, 20-29 high and 30+ very high. In contrast, soils testing 0-99 lb/A of K are rated low, 100-199 medium, 200-299 high and 300+ very high. Initial soil P test levels were medium; soil K test levels were medium and high.

Phosphorus and K levels in the soil had a major influence on alfalfa yield during the first year of the study; forage yields between fertility treatments were not significantly different under a 3-cut management system, the first production year following establishment. Alfalfa yields ranged from 4.94 tons of 15% moisture forage on the unfertilized treatment to 5.38 tons at the highest fertility treatment the first year of study.

Annual soil test levels of P and K indicate fertility levels were influenced by application of fertilizers and alfalfa yields. Phosphorus levels at the 0 to 6-inch depth of the unfertilized treatment were reduced from 13 to 5.3 lb/A the first harvest year and then tended to stabilize; however, phosphate levels at the 6 to 24-inch depth dropped significantly from 4.0 to 1.8 lb/A during the three harvest seasons. Unfertilized treatment K levels fell from 244 to 125 lb/A from April 1983 to October 1985.

Alfalfa yields from the unfertilized

Mr. Thompson is Assistant Agronomist and Mr. Hoag is Superintendent at the North Central Experiment Station at Minot; Dr. Dodds is Grassland Specialist, North Dakota State University, Fargo.

Table 1. Irrigated Alfalfa Forage Yields by Fertilizer Treatment.

Treatment		Alfalfa yield			
P_2O_5	K_2O	1983	1984	1985	Avg.
-----lb/A-----		---ton/A at 15% moisture---			
0	0	4.94	4.63	3.89	4.49
50	0	5.04	5.11	4.18	4.78
0	100	5.06	4.85	4.04	4.65
50	100	5.09	5.33	4.85	5.09
100	250*	5.38	5.45	5.11	5.31
	Avg.	5.10	5.07	4.41	

* 200 lb K_2O applied 1983. (Karlsruhe, ND)

treatments have fallen significantly from 4.94 ton/A in 1983 to 3.89 ton/A in 1985, indicating a shortfall of available soil phosphate and potash. **(Table 1).**

Soil P levels for the 50 lb/A P_2O_5 treatment remained constant over the 3-year period; however, K levels fell significantly and yields were reduced from 5.04 to 4.18 ton/A from 1983 to 1985, indicating a shortfall in K_2O availability. When 100 lb/A of K_2O was applied with 50 lb/A P_2O_5, the soil test levels of P were lower than the 50 lb/A P_2O_5 treatment alone and the soil test levels of K were lower than the 100 lb K_2O treatment alone. Alfalfa yields from the 50 lb P_2O_5 plus 100 lb K_2O treatment were reduced from 5.09 to 4.85 ton/A from 1983 to 1985, respectively; however, forage harvested from this treatment was significantly greater than the unfertilized, 50 lb P_2O_5 or 100 lb K_2O treatments, indicating a better utilization of both applied and soil available nutrients when fertility is balanced.

Potassium levels from the 6 to 24-inch depth were not influenced by fertilizer applied or alfalfa yield, indicating that K uptake occurred primarily in the top 6-inch soil layer and that K was not being leached downward into the sandy loam soil.

Yield Analysis

Alfalfa yield data were analyzed on the basis of individual cuttings. The greatest yield reductions from 1983 to 1985 appear to have occurred at the third harvest. The two treatments with P_2O_5 and K_2O combination yielded more forage in the first two cuttings in 1985 than in 1983; however, the third cutting of the 50 lb P_2O_5 plus 100 lb K_2O and 100 lb P_2O_5 plus 250 lb K_2O treatments were reduced 0.65 and 0.36 ton/A from 1983 to 1985, respectively. The first three treatments, which are short one or more nutrients, appear to have reduced yield from 1983 to 1985 at all cuttings; however, greatest yield reductions occurred with the third cuttings.

Economic Returns

The dollar return to fertilizing irrigated alfalfa on coarse textured soil in the Karlsruhe area are provided in **Table 2.** The data were calculated by using the average annual forage yield at 15% moisture, \$60/ton alfalfa hay, P_2O_5 at 17.5 cents/lb, K_2O at 7 cents/lb and a \$3/acre application charge.

Returns to fertilizer were negative in 1983, the first year of the study. The negative returns resulted when average soil P levels were medium and K levels were medium to high as determined by soil test. Positive returns resulted in 1984 and 1985 at all fertilizer treatment rates, although returns to K_2O application alone were a breakeven situation.

Summation of the annual returns by fertilizer treatment indicate a 3-year return above fertilizer costs of more than \$50/A when a combination of 50 lb P_2O_5 and 100 lb K_2O was applied per acre annually.

Table 2. Fertilizer Cost and Return Summary by Treatment and Year.

Treatment		Return (\$/A) compared to unfertilized treatment			
P_2O_5	K_2O	1983	1984	1985	Total
-------lb/A-------					
0	0	\$296.40	\$277.80	\$233.40	\$807.60
50	0	− 5.15	+ 17.05	+ 5.65	+ 17.55
0	100	− 2.80	+ 3.20	− 1.00	− 0.60
50	100	− 9.75	+ 23.25	+ 39.45	+ 52.95
100	250*	− 7.50	+ 11.20	+ 34.60	+ 38.30

* 200 lb K_2O applied in 1983. (Karlsruhe, ND)

Summary

The results of this study indicate the necessity of high nutrient levels prior to alfalfa establishment and that producers must soil test and apply P_2O_5 and K_2O to maximize yields of aging alfalfa stands. ■

DRIS Proves Useful for Diagnosing Nutrient Deficiencies in Coastal Bermudagrass

By D.L. Robinson and M.L. Tarpley

Results indicate that DRIS norms can accurately diagnose nutrient deficiencies over a wide range of conditions by minimizing the effects of soil and environment on nutrient ratios and nutrient balance in high-yielding bermudagrass.

THE DIAGNOSIS and Recommendation Integrated System (DRIS) has been developed for diagnosing nutrient deficiencies using mineral analyses of crops. The system appears especially useful for crops that are harvested several times per year because multiple opportunities exist for correcting nutrient deficiencies in subsequent harvests. DRIS norms were developed and evaluated for the six macronutrients (N, P, K, Ca, Mg and S) in Coastal bermudagrass in Louisiana.

Table 1 contains norms that were developed from soil fertility experiments conducted on Olivier silt loam soil at Baton Rouge. The norms were developed from forage that yielded at least 2.25 tons per acre at 30 days of age. Accuracy of the norms was evaluated by diagnosing nutrient deficiencies in forage samples harvested from N, P, and K experiments on the same soil during a six-year period. If N, P, or K in a sample was diagnosed to be the most limiting nutrient, the yield of that plot was compared to the yield of the plot receiving the highest rate of N, P, or K. If yield was increased by the high nutrient application rate, the diagnosis was considered to be accurate.

Table 1. DRIS norms for diagnosing macronutrient deficiencies in Coastal bermudagrass.

Nutrient Ratio	Mean	C.V.	Std. Dev.
NP	10.11	11.92	1.21
NS	11.85	16.59	1.97
NCa	7.61	11.60	0.88
NMg	14.94	14.75	2.20
KN	0.71	17.74	0.13
PK	0.14	21.87	0.03
SP	0.87	17.57	0.15
PCa	0.76	9.65	0.07
PMg	1.48	11.37	0.17
SK	0.12	21.82	0.03
KCa	5.37	17.54	0.94
KMg	10.70	25.10	2.69
CaMg	1.97	11.92	0.23
SCa	0.65	15.02	0.10
SMg	1.29	18.78	0.24

Table 2 summarizes the results for the six-year period. Nitrogen (N) was diagnosed to be the most limiting nutrient in as many as 83 samples in 1978 and in as few as 31 samples in 1976, for a total of 386 diagnoses. A yield increase due to N application was obtained in 92% of the cases in which N was diagnosed to be most limiting. During the same period P was diagnosed to be the most limiting element in 93 samples and yield was increased by P applications in 80% of those cases. Similar values for K were 433 and 82%, respectively. Since all N, P, and K fertilizers were surface applied, the higher degree of accuracy for N could be due to more rapid movement of N into the root zone.

The DRIS norms were also evaluated for accuracy by diagnosing forage samples of Coastal bermudagrass from soil fertility experiments conducted by Dr. M.M. Eichhorn, Jr. on Shubuta and Ruston fine sandy loam soils in north Louisiana during 1982. **Table 3** indicates that P was diagnosed to be the most limiting nutrient in 148 samples at two locations. Yield was increased by P applications in 80% of the cases. At the same locations, S was identified as the most limiting element in 88 forage samples, and S applications increased yields in 83% of the cases. Applications of Mg did not increase yields in any plots and the DRIS did not diagnose Mg to be the most limiting element in any samples. This result is reported as 100% accuracy.

Dr. Robinson is Professor and M.L. Tarpley is former Graduate Student in the Agronomy Department, Louisiana Agricultural Experiment Station, LSU Agricultural Center, Baton Rouge.

Table 2. Accuracy of the DRIS for identifying Coastal bermudagrass yield increases from applied N, P, and K on Olivier silt loam soil.

	N		P		K	
Year	No. of obs.[1]	Accuracy %	No. of obs.	Accuracy %	No. of obs.	Accuracy %
1974	71	97	26	81	93	78
1975	72	93	10	100	57	91
1976	31	84	13	69	116	76
1977	70	91	10	80	48	94
1978	83	93	22	73	77	73
1979	59	97	12	75	42	81
6-yr avg.	—	92	—	80	—	82
Total	386	—	93	—	433	—

[1] No. of observations is the number of times the element was diagnosed by DRIS as the most limiting macronutrient.

These results indicate that DRIS norms can accurately diagnose nutrient deficiencies over a wide range of conditions by minimizing the effects of soil and environment on nutrient ratios and nutrient balance in high-yielding bermudagrass.

A computer program was developed to give a visual interpretation of the nutrient indexes in plant samples diagnosed by DRIS. The program is useful as an educational tool for presenting relative deficiencies of plant nutrients. **(Figure 1.)** ■

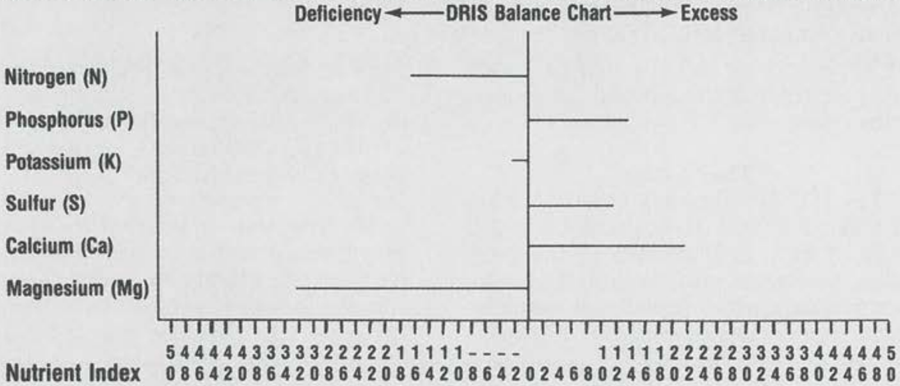
Table 3. Accuracy of the DRIS for identifying Coastal bermudagrass yield increases from applied P, S, and Mg on Shubuta and Ruston fine sandy loam soils, 1982.

	P		S		Mg	
Site	No. of obs.[1]	Accuracy %[2]	No. of obs.	Accuracy %	No. of obs.	Accuracy %
1	103	84	49	77	80	100
2	45	76	39	89	—	—
3	—	—	—	—	64	100
Average	—	80	—	83	—	100
Total	148	—	88	—	144	—

[1] No. of observations is the number of times that either P or S was diagnosed by DRIS as the most limiting macronutrient or the number of observations where Mg was applied.

[2] Accuracy is the percentage of times that P and S applications increased yield or Mg applications decreased or had no effect on yield.

Figure 1. Relative deficiency or sufficiency of macronutrients in a Coastal bermudagrass sample.



High-Yield-System-In-Place (HYSIP) Approach Shows Good Results for Soybeans

Source: R.L. Cooper

Research in Ohio shows that soybean growers can take advantage of favorable rainfall years by having a high-yield-system-in-place every year, with no penalty in low-moisture years.

LONG-TERM AVERAGE soybean yields of 75 bu/A can be produced with a carefully planned management system on soils with good water-holding capacity. That's the conclusion of soybean breeder Dr. R.L. "Dick" Cooper after eight years of tests at two locations in Ohio.

He emphasizes the importance of the management approach called "High-Yield-System-In-Place" (HYSIP). Its yield advantage over normal management averaged 14 to 15 bu/A at the two locations, with a range of minus 5 to plus 32 bu/A. The largest yield advantage came in the wet years with top yields ranging from 80 to 85 bu/A with the HYSIP approach.

Differences

There are three key differences between the HYSIP approach and normal management:

1) Determinate semidwarf varieties such as Sprite, Pixie and Hobbit are used in place of indeterminate varieties such as Williams;

2) Seeding rates of 300,000 per acre are used, compared to 225,000 per acre;

3) Soybeans are solid-seeded in 7-inch rows, compared to standard 30-inch or wider rows.

The System

The HYSIP approach allows farmers to take advantage of the good years with little, if any, yield penalty in the poor years. Yields and profits are higher on the average. Dr. Cooper says that all management factors must be carefully controlled and "in place" every year to maintain a consistently high soybean yield potential and take advantage of the good years:

- **Planting Date** – Plant as early as possible, preferably during the first week of May, to take advantage of the longer days in midsummer and early fall and to avoid late season cool weather.

- **Variety** – Select varieties with known high yield potential and excellent lodging resistance such as the determinate semidwarf varieties Sprite, Hobbit, Pixie or Gnome which were developed specifically for high yield environments. Short, lodging resistant indeterminate varieties with high yield potential may also be satisfactory.

- **Solid Seeding** – (7 to 10-inch row spacing). This is a must for record yields. There is a row width barrier to higher soybean yields. The yield advantage to solid seeding is greatest in the good years which produce the greatest yield potential. The higher the yield, the greater the yield advantage of solid seeding.

- **Seeding Rate** – Use as high a seeding rate as possible without causing lodging. With solid seeding plant 4 seeds/ft of row (300,000 seeds/A or approximately 120 lb/A) for semidwarf varieties and 3 seeds/ft of row (225,000 seeds/A or approximately 90 lb/A) for indeterminate varieties. Use high quality seed (certified) to insure good stands. Consider use of seed treatment for control of diseases to give better

This article is adapted from information provided by Dr. R.L. Cooper, USDA, ARS and Department of Agronomy, Ohio Agricultural Research and Development Center, Wooster, Ohio 44691.

DR. R.L. COOPER has achieved soybean yields over 100 bu/A with management systems adapted to new varieties.

stands in cold soils. When following a sod crop, consider the use of an insecticide to control the seed corn maggot.

- **Fertility** — Soil test levels should be built up to high and very high fertility for phosphate and potash. Consider up to 500 lb/A of 0-18-36, broadcast and plowed down to achieve this objective. Soil pH should be maintained in the 6.0 to 6.5 range.

- **Nitrogen** — The need for nitrogen in maximum soybean yields is still uncertain. The yield response to nitrogen is likely to be a function of yield level (greater than 70 bu/A) and soil type (low organic matter soils). An option is to apply 50 to 100 lb of N/A preplant or at early podfill on some of your more productive soils to see if you can get a yield response.

- **Water** — Use tillage practices that increase the soil's infiltration rate and water holding capacity. Also consider the use of no-till drilling as a means to conserve moisture and increase soybean yields.

- **Soil** — The soil's water holding capacity and infiltration rate has a large impact on soybean yield potential. In general, well-drained darker (higher organic matter) soils have higher yield potentials than sandy soils. The yield response to the high-yield-system-in-place will be less frequent on sandy soils because water will be the overriding limiting factor more often.

- **Weeds** — For maximum yields, the goal should be a weed-free environment. Select the best herbicide combinations, spot spray and use hand weeding if necessary to accomplish this goal.

- **Diseases** — Use Phytophthora-resistant or tolerant varieties. For foliar disease control consider at least 2 fungicide applications, one in early August and another in early September, either aerially or by ground sprayer using drive paths left at planting.

- **Insects** — Scout fields regularly and contact the Cooperative Extension Service for the levels of damage that justify spraying. With higher yield potentials the potential yield reduction from insects becomes greater.

- **Management** — This is a key factor. Once the major factors are taken care of, the details make a big difference in yield. Interactions between the big and little things determine success and profitability. By having the high-yield-system-in-place every year, growers can take advantage of the high moisture years and not be penalized in low-moisture years. ■

"FAR in Action" Tour Highlights Implementation of MEY Systems

Information gained from maximum yield research (MYR) since 1980 is now in the implementation phase of maximum economic yield (MEY) systems on farms.

"THOSE MAXIMUM YIELDS in research are okay, but the real test is how well the technology can be put to use in a field on my farm." That comment from a North Carolina grower echoes the thoughts of thousands of farmers across the country. Farmers want information and systems that will match the agronomic and economic needs of today.

More than 100 agriculture leaders, agribusiness executives, university administrators, and innovators recently participated in a two-state tour organized to show how maximum yield research information is being implemented on farms. The event was sponsored by the Foundation for Agronomic Research (FAR) in cooperation with North Carolina State University (NC State) and Virginia Polytechnic Institute and State University (Virginia Tech).

"The implementation phase, including field-scale demonstrations, represents an essential link from maximum yield research to maximum economic yields (MEY) for farmers. Focus on *low unit cost* of production is key. The interdisciplinary research and extension teams at NC State and Virginia Tech are leaders in transfer of research technology into farm production systems," said Dr. R.E. Wagner, President of FAR and of the Potash & Phosphate Institute (PPI).

NORTH CAROLINA State University Extension Agronomist John Anderson, right, and Mr. Hassel Thigpen discussed results of the maximum economic yield (MEY) demonstration plot on the Thigpen farm. The corn plot with normal management yielded 171 bu/A and showed net revenue of $44.29 per acre. The MEY plot yielded 214 bu/A and had net revenue of $59.98 per acre.

North Carolina

In North Carolina, the "FAR in Action" tour concentrated on maximum economic yield corn studies. Dr. John Anderson, NC State extension agronomist, described the evolution from maximum yield research (beginning in 1980) to on-farm efforts now.

"Our efforts have centered on irrigated corn production. Pest control was an early concern. Then it became clear that ample water application is needed at critical crop growth stages. We saw the need for crop monitoring so that the additional inputs used in pursuit of high yields would

INDUSTRY LEADERS are shown during videotape interview on the "FAR in Action" tour. From left are: Mr. Ron Johnson, Agrico Chemical Company; Mr. Sid Keel (retired), International Minerals & Chemical Corp. (IMC); Mr. C.C. "Kip" Williams, IMC; and Dr. Noble R. Usherwood, PPI.

not be wasted by management error," Dr. Anderson explained.

In 1985, an on-farm demonstration field produced a two-acre average of 214 bushels per acre, the highest recorded irrigated corn yield in North Carolina for the year. The comparable commercial corn yielded 171 bushels per acre. The FAR tour visited demonstration fields on the J.F. Scott Farm near Kenly, and the Hassel Thigpen farm in the Tar River Valley.

Virginia

In Virginia, the FAR tour learned about work by the Virginia Tech Wheat Research group, headed by Dr. Mark M. Alley, Research Agronomist, and Dr. Dan Brann, Extension Agronomist. The team is composed of agronomists, plant pathologists, an entomologist, a plant breeder, and weed scientists, all working toward the goal of managing resources to produce wheat at the least cost per bushel. This approach, which requires more management time in crop scouting and critical decision-making in the use of inputs, is referred to as Intensive Wheat Management.

Research plots in eastern Virginia which used intensive management practices produced non-irrigated winter wheat yields of 105, 123, 103, and 101 bushels per acre from 1982 through 1985, respectively. These yields, which exceed the state average by nearly threefold, clearly demonstrate that a package of practices is needed to boost yields and lower unit costs.

The research and demonstration work in Virginia focuses on development and subsequent implementation, on a field-scale basis, of management practices that will increase wheat production efficiency.

The FAR tour visited historic Westover Plantation, on the James River, where standard management and maximum economic yield management were compared. Fungicide, insecticide, herbicide, growth regulator, fertilizer, and variety needs were demonstrated. Equipment for narrow rows, tramlines, and precision application of chemicals and fertilizer was on display.

"THE FARMER and his supplier have a stake in managing for maximum economic yields," said Mr. Waddy Garrett, President of Alliance Fertilizer, Mechanicsville, Virginia

VIRGINIA TECH has used a "team" approach with interdisciplinary cooperation to implement intensive wheat management for field-scale plots.

Dr. W.E. Lavery, President of Virginia Tech, addressed the tour group in Virginia. Dr. Lavery stressed the importance of developments in agriculture to enable U.S. farmers to be low cost producers of quality products to compete in international markets.

Mr. Waddy Garrett, President of Alliance Fertilizer, Mechanicsville, Virginia, described how the maximum economic yield concept has helped his company better serve farmer-customers. He outlined a list of twenty components for a successful program. "This program can increase the profits of farmers who know how to use it. And that means the supplier of inputs also benefits," Mr. Garrett noted.

Dr. Roy L. Flannery, a pioneer in maximum yield research, appeared on the program with Dr. W.K. Griffith, Eastern Director of PPI, discussing implementation of maximum economic yield systems for soybeans in New Jersey. After achieving consistently high soybean yields in five years of research, Dr. Flannery is now concentrating on implementation of the technology in field-scale plots. ■

Interdisciplinary Cooperation Essential for Progress in Wheat Varieties

By F.L. Patterson

Cooperation among departments and individuals has been the key to much of the success of a wheat breeding and research team at Purdue University.

THE WHEAT BREEDING and research interdisciplinary team at Purdue University has been active for about 36 years. The team involves plant breeder-geneticists, plant pathologists, entomologists, and food scientists from four departments and the U.S. Department of Agriculture. A special effort was made in 1950 to strengthen the team approach in three departments by hiring two new young staff members and merging two existing programs. A food scientist was added in 1975. All team members had assignments of a combination of plant breeding, research, and graduate student training. Some had classroom teaching responsibilities, also.

The team has been remarkably successful in releasing 23 soft red winter wheats that occupied more than 75% of the U.S. acreage of this wheat class during the 1970's. An economic analysis in 1985 indicated that the benefits of the new varieties to farmers and consumers exceeded research and breeding costs by over 101 million dollars (1984 price level) annually in the period 1950 to 1984. (J.C. Gardiner, "An economic evaluation of the Purdue soft red winter wheat breeding program," M.S. Thesis, Purdue University, 1985.)

DR. PATTERSON at recent field day, Purdue University Agronomy Farm.

From 1950 to 1985 the genetic potential for yield has been increased about 70% under optimum culture. **To realize this potential the wheat plant had to be modified for growth at higher densities and at higher levels of nitrogen, phosphorus, and potassium fertilization** (nitrogen especially). Shorter plant height and improved lodging resistance were required. Under dense stands and higher fertilization, resistance needed to be added or improved for diseases and insects. Changes in quality needs of industry meant changing milling and baking characteristics of the grain to match changing industrial products and processes. **Average wheat yields for Indiana have increased from about 28 bu/A to 53 bu/A during the 1950 to 1985 period.** Farmers using the best production technology are capturing the additional genetic potential. Yields of 80 to 100 bu/A are frequent.

Plant breeding provided materials and ideas for the more basic research and basic research provided materials and ideas for plant breeding. This joint assignment of breeding and research for all team members allowed rapid transfer of new ideas and materials from research to the breeding program. This team brought many firsts to soft red winter wheat breeding including new sources of disease resistance, early wheats which permitted double cropping with soybeans, day neutral wheats for wide adaptation, Hessian fly resistance, concepts of and varieties with general resistance to disease, and yield potentials in excess of 100 bu/A.

Dr. Patterson is Professor, Department of Agronomy, Purdue University, West Lafayette, Indiana.

Administration was applied with good understanding to allow the opportunity for maximum cooperation among team members across department lines. A small-grain improvement committee was formed for recommending variety and germplasm releases and for discussions of problems. In general the team operated as supportive colleagues with much individual initiative.

Supporting funds from state appropriations, Hatch-formula funds, USDA project line items, and private industry grants have been modest but dependable. Plant breeding is a long-term endeavor. It would be difficult to keep a research and breeding team together without prospects for long-term support.

What are the elements of this team organization that have allowed it to remain strong over this long period? Members selected for the team have been chosen for unselfishness, cooperativeness, and interest in team research. Plant breeding has been maintained as one program to which everyone contributes and all receive credit. The assignment of a combination of plant breeding and research has allowed a large measure of individual expression in research. The scope of the project has been kept so broad that no one has felt restricted in opportunity. The every changing opportunities have provided continuous new stimuli to individual team members.

Summary

The greatest stimulus is success. This organization provided the opportunities for both team and personal successes. Finally, a team member must be rewarded in promotion, salary, and recognition in relation to overall contributions. Individual evaluation in each professional department has been highly beneficial. ■

Fifteen Steps for Intensive Management of Winter Wheat

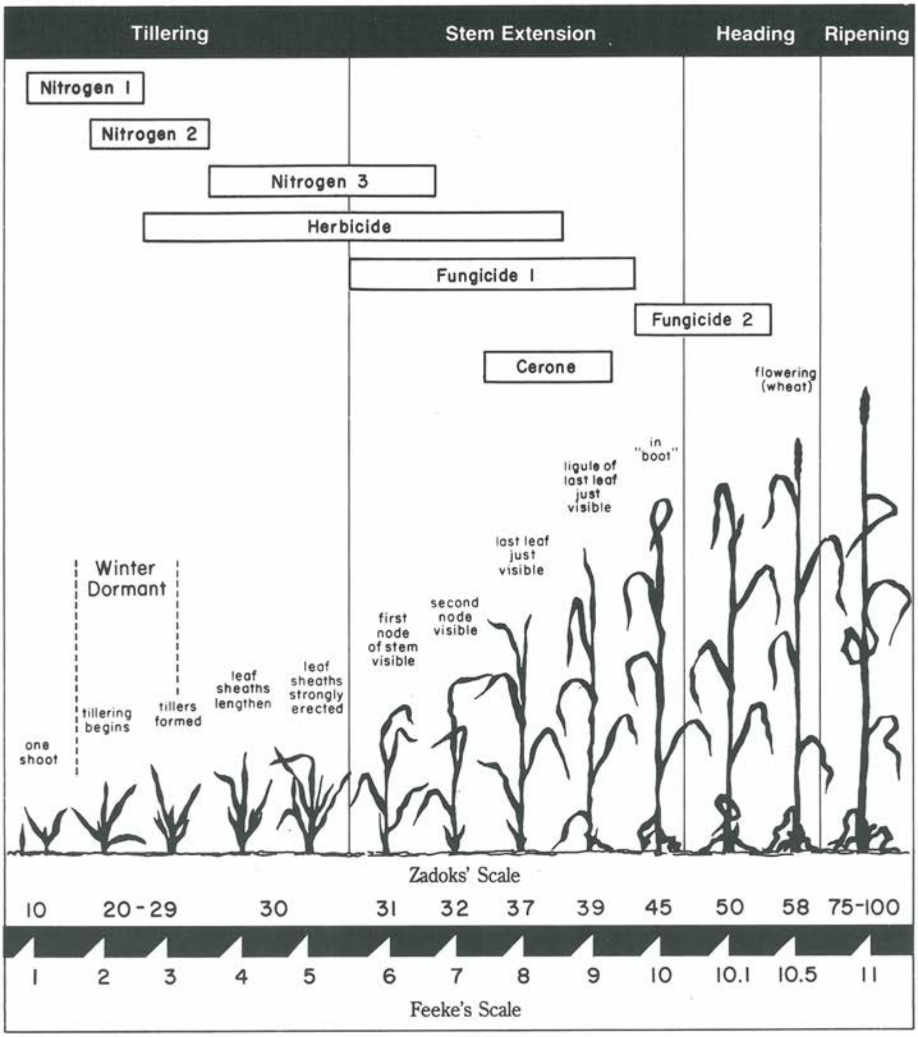
1. Test soil to determine fertility of field.
2. Control perennial weeds such as quackgrass.
3. Use good tillage practices.
4. Fertilize to a yield goal of 100 to 150 bu/A.
   a) Nitrogen – 25 lb/A in fall.
   b) Phosphorus and potassium – fertilize to high levels in fall prior to planting.
5. Select a variety with the highest yield for your area, as well as good winterhardiness.
6. Plant at optimum date for your area considering location and likelihood of aphid infestation.
7. Plant in 4- to 7-inch row spacings, incorporating tramlines for subsequent management practices.
8. Seed 30 to 40 seeds/ft^2; use certified seed.
9. Check stand density in the spring as soon as winter survival can be rated.
   a) If stand is adequate (> 18 plants/ft of row), apply 25 lb of nitrogen just prior to or at tillering time (GS*20).
   b) If stand is poor (< 18 plants/ft of row), apply up to 50 lb of nitrogen to promote tillering.
10. Use proper weed control measures if weeds are anticipated to be a problem.
11. Apply an additional 50 to 75 lb nitrogen at GS 30 for grain filling.
12. Apply Cerone plant growth regulator (0.25 lb/A) at GS 37 to control lodging.
13. Apply fungicides as needed for disease control during the growing season.
14. Harvest on time at optimum grain moisture.
15. Provide for adequate, safe storage space.

*GS is abbreviation for Growth Stage (Zadoks Scale). See following page.

Source: *Intensive Wheat Management,* University of Wisconsin-Extension.

Winter Wheat Growth Stage Scale

Wheat growth stages according to Zadoks' decimal code and Feeke's scale. Intensive management inputs are indicated by ▭



Intensive management inputs indicated on this chart are described in "Fifteen Steps for Intensive Management of Winter Wheat," preceding page.

Source: *Intensive Wheat Management*, University of Wisconsin-Extension.

Important Changes in Staff Assignments for Potash & Phosphate Institute (PPI)

SEVERAL SIGNIFICANT ADJUSTMENTS in staff responsibilities have been announced by Dr. R.E. Wagner, President of the Potash & Phosphate Institute (PPI) and the Foundation for Agronomic Research (FAR). These changes were effective July 1, 1986.

Dr. Bob C. Darst, formerly Southwest U.S. Director, has been promoted to Vice President of PPI and Vice President and Director of FAR. He will have a dual responsibility as head of Communications for PPI while also directing Foundation activities and building support for FAR. Dr. Darst has moved from Stillwater, Oklahoma, to Atlanta, Georgia, and will be located in the PPI/FAR headquarters offices.

Dr. Charles P. Ellington has retired from the position of Vice President and Coordinator of Research for PPI and Director of FAR. He joined the Institute staff in 1977 and was previously Director of Extension, University of Georgia.

Dr. David W. Dibb, PPI Vice President for Domestic Programs, now also has responsibility as Coordinator of Research for PPI and FAR. Dr. Dibb is located in West Lafayette, Indiana. **Dr. Albert E. Ludwick,** Western U.S. Director, succeeded Dr. Dibb as PPI Latin America Coordinator in January 1986 and continues with the dual responsibilities.

Dr. Noble R. Usherwood, PPI Vice President for Member Services, will now also serve as Southeast U.S. Director to coordinate the Institute's programs in the states of Florida, Georgia, and South Carolina.

Dr. James D. Beaton, formerly Northwestern U.S. and Western Canada Director, has been promoted to Vice President of the Potash & Phosphate Institute of Canada (PPIC). Dr. Beaton is moving from Cochrane, Alberta, to new PPIC offices in Saskatoon, Saskatchewan. While his new responsibilities are primarily with international programs, Dr. Beaton will retain responsibility as Western Canada Director.

"The net results of these changes will be to direct more efforts to international programs, while streamlining operations to accommodate budget guidelines," Dr. Wagner explained. "Other PPI staff members will be taking on added responsibilities for PPI programs in states affected by these staff moves. For example, Dr. Ludwick will serve Washington and Idaho; Dr. Larry Murphy will add Oklahoma and Montana; and Dr. Bob Thompson will cover Arkansas."

PPI and FAR will also reduce emphasis on research funding and place higher priority on **implementation** of information already established from maximum yield research. Agriculture can benefit from the **low unit cost** advantage generated by maximum economic yield systems, Dr. Wagner concluded. ■

Dr. Darst

Dr. Ellington

Dr. Dibb

Dr. Usherwood

Dr. Beaton

Dr. Ludwick

Five Top Graduate Students Receive PPI Fellowship Awards

THE POTASH & PHOSPHATE INSTITUTE (PPI) has selected five outstanding graduate students as 1986 winners of the PPI Fellowship Award. Grants of $2,000 each are presented to the students, all of whom are candidates for either the Master of Science (M.S.) or the Doctor of Philosophy (Ph.D.) degree in soil fertility and related sciences.

The 1986 recipients were chosen from nearly 50 applicants. The winners are:

- Colleen M. Hudak, Ohio State University, Columbus, Ohio;
- Gregory W. McCarty, Iowa State University, Ames, Iowa;
- Gregory Wayne Roth, Pennsylvania State University, University Park, Pennsylvania;
- Maria Christine Sadusky, University of Delaware, Wilmington, Delaware;
- Calvin L. Trostle, Texas A&M University, College Station, Texas.

"We are truly pleased to recognize and honor these young scientists. The enthusiasm and excellence with which they pursue their work are a real inspiration," noted Dr. R.E. Wagner, President of the Potash & Phosphate Institute (PPI) and of the Foundation for Agronomic Research (FAR). "We hope the Fellowships will encourage these and other young people to continue their quest in higher education."

Scholastic record, excellence in original research, and leadership are some of the major qualifications evaluated for the PPI Fellowship Awards.

Colleen M. Hudak is working toward the M.S. degree in the soil fertility curriculum at Ohio State University. Her thesis project involves evaluation of potassium (K) rate, surface strip placement, and tillage systems for soybeans. The goal of this study is improving potassium fertilizer efficiency. Miss Hudak graduated with high honors from Kent State University and worked as a teacher before beginning graduate work at Ohio State. She is a graduate of Conotton Valley High School in Carroll County, Ohio.

Gregory W. McCarty is pursuing the Ph.D. degree in soil microbiology and biochemistry at Iowa State University, where he previously received B.S. and M.S. degrees. His Ph.D. research program involves the evaluation of acetylenic compounds for inhibition of nitrification in soil and studies of the effects of these compounds on other nitrogen transformations in soil. He is also assessing the potential value of a variety of non-acetylenic compounds as fertilizer amendments for inhibition of nitrification in soil. For the future, he hopes to help develop new technologies which will increase the efficiency of fertilizer N uptake by crops and reduce environmental problems associated with N fertilizer use. Mr. McCarty is a native of Sanborn, Iowa.


Colleen Hudak


Maria Sadusky


Gregory McCarty


Calvin L. Trostle


Gregory W. Roth

Gregory Wayne Roth is a candidate for the Ph.D. degree, in soil fertility and crop management, at Pennsylvania State University. He earned his B.S. at Penn State, and his M.S. at Virginia Polytechnic Institute and State University. Mr. Roth's Ph.D. project involves evaluation of plant tissue test procedures for estimating fertilizer N requirements of winter wheat in Pennsylvania. Previous studies have indicated that accurate prediction of N requirements for winter wheat is essential for consistently high yields in an integrated crop management (ICM) program.

Maria Christine Sadusky is advancing toward her M.S. degree in soil chemistry at the University of Delaware, where she earned the B.S. degree. Miss Sadusky has investigated the kinetics of potassium (K) release from three major soil types of Delaware, and from the sand fractions of these soils. Her research efforts originated from observance of poor crop response to applied K on many Atlantic Coastal Plain soils. Greenhouse studies with corn will seek to determine if the sand fraction of these soils could supply K to plants under enhanced conditions.

Calvin L. Trostle is seeking the M.S. degree in soil chemistry and fertility at Texas A&M University. He received his B.S. from Kansas State University and is from Le Roy, Kansas. Mr. Trostle's thesis project is on the study of cyclotriphosphate and cyclotetraphosphate as a potential source of fertilizer phosphorus. Other workers have shown that simple cyclophosphates are not sorbed on soils, thus the phosphorus may be more available for plant nutrition. Four Texas soils (selected for a range in texture, calcium and magnesium, and pH) will be used in studying possible sorption, stability and rate of hydrolysis.

The winners were chosen by a committee of five members: two from the PPI staff and three from the PPI Advisory Council. Dr. J. Fielding Reed, President (Retired) of PPI, serves as Chairman of the Selection Committee.

"Each year, we're proud of the group chosen to receive Fellowships. We've seen recipients from previous years develop into respected leaders as researchers, teachers, industry representatives, or in other areas of work," Dr. Reed commented. ■

Workshop on Implementing MEY Systems Set for November 12-13 in St. Louis

THE POTASH & PHOSPHATE INSTITUTE (PPI) and the Foundation for Agronomic Research (FAR) will sponsor a national workshop November 12-13 to provide "hands-on" training in the implementation of intensive crop management systems. As a follow-up to a similar workshop held in 1985, this program will review key management decisions facing farmers and their advisers.

Small workgroups will analyze real farm situations, using technical information and computer software to develop detailed management strategies for maximizing profits. Emphasis will be on the selection of realistic yield goals and the allocation of available resources to achieve those goals.

Attendees are expected from all major farmer support groups: industry agronomists, fertilizer dealers, consultants, farm managers, seed company agronomists, extension specialists, and lenders.

The workshop will be held November 12-13, 1986, at Henry VIII Inn & Lodge, St. Louis, MO. A registration fee will be charged for workshop printed materials and meals. The software used in the workshop will be available for purchase at the end of the workshop for those who want to use it with their clientele.

The workshop is open to anyone who is involved in educational programs for dealers and/or farmers in the development of crop management plans. For more information, please contact: Dr. Harold F. Reetz, Jr.; Potash & Phosphate Institute; R.R. #2, Box 13, Monticello, IL 61856; Phone (217) 762-2074. ■

Soil Acidity and Aluminum Toxicity: An Important Factor in Winter Wheat Yields

By Larry Unruh and David Whitney

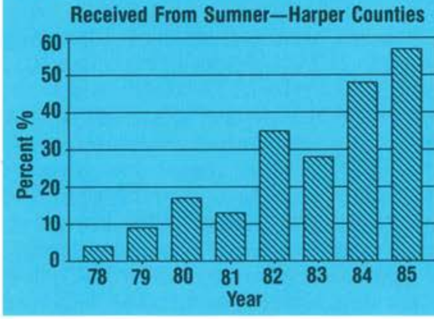
Soil acidity has become a major problem in some wheat production areas. Some varieties are more sensitive and may suffer from aluminum toxicity. Growers should monitor soil pH as part of total management.

IN SOUTH CENTRAL KANSAS, where four out of the top five wheat producing counties are located, occasional very low soil pH (less than 5.0) has been reported since 1978. Soils in the area are relatively young geologically and liming has not been a common practice. Low pH fields have been identified by variable wheat growth with the low pH areas showing the poorest growth. Growers describe these areas as "droughty", a symptom of aluminum (Al) toxicity.

Affected plants tend to be prostrate and show signs of both N and P deficiency **(Figure 1).** Aluminum toxicity results from the decomposition of clays in the soil.

In the past four years, an alarming number of low pH samples has been analyzed from south central Kansas by the Kansas State University Soil Testing Laboratory **(Figure 2).** Increased numbers of low pH samples have been due in part to farmers' awareness of the problem and soil sampling for the first time in several years due to poor yields. Adding more fertilizer or changing varieties had not corrected the problem. Low pH samples usually have high nitrate levels and high soil test phosphorus (Bray & Kurtz P_1) indicating high rates of fertilizer applications and/or poor yields. Soil acidification has been accelerated by the use of ammoniacal nitrogen.

Figure 2. Percent of soil samples below pH 5.6 from two south central Kansas counties.



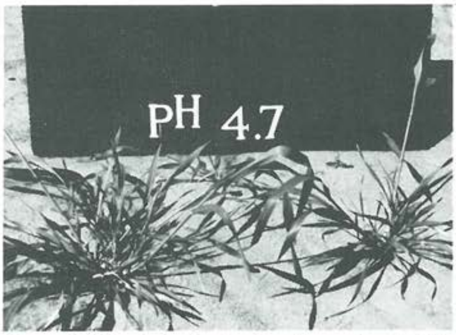


Figure 1. Wheat plants showing signs of soil acidity and aluminum toxicity. Plants tend to be prostrate, do not tiller well and may show chlorosis similar to N deficiency, purpling of lower leaves and stems suggesting P deficiency.

As ammonium nitrogen is converted to nitrate by soil bacteria, hydrogen ions (acidity) are produced. Urea, ammonium nitrate, anhydrous ammonia and nitrogen solution all have the same net effects on soil acidity per pound of applied N.

Several lime rate experiments were established in the fall of 1982 on sandy soils in Reno and Stafford counties. Data in **Table 1** show substantial yield increases from lime application at two of five locations. The five locations had similar soil pH but varied in KCl-extractable aluminum (Al). The Hildebrand location with greater than 40 ppm Al did not respond

Mr. Unruh is Research Assistant and Dr. Whitney is Professor of Agronomy, Kansas State University, Manhattan, Kansas 66506.

Table 1. Effect of lime on wheat yields in south central Kansas.

Lime Rate	Location: Hurst-S	Hurst-N	Hildebrand	Miller	St. John
ECC lb/A	bu/A				
0	30	24	27	43	48
2000	48	42	28	43	51
Variety	Newton	Newton	Buckskin	Newton	Newton
Initial pH	5.1	4.9	5.1	5.2	5.1
KCl Extractable Al, ppm	44	66	53	19	14
O.M.%	0.9	0.7	0.8	1.2	0.5
Texture	LS	LS	LS	LS	S
Visual Response	Yes	Yes	Yes	No	Yes

to lime, was grazed, and a different wheat variety was planted. This observation and other field observations raised the question of differing Al tolerance in winter wheat varieties.

A study was established in 1983 (soil pH 4.7, KCl-Al 65 ppm) to determine if wheat varieties varied in tolerance to exchangeable Al and if such a tolerance would affect the response to agricultural lime. Four rates of lime – 0, 1.12, 2.25, 4.50 tons effective calcium carbonate (ECC) per acre – were applied in early September. The 4.5 T/A ECC rate was recommended to bring the top 6-⅔ inches of soil to pH 6.8 using the SMP buffer method. The lime was incorporated with a field cultivator before wheat planting in mid-November. Planting was delayed because of wet weather.

Soil samples (0-3 inch and 3-6 inch depth) in April 1984 showed no pH change for the 3-6 inch layer for the limed plots due to shallow lime incorporation. The field was plowed after the 1984 harvest for better lime incorporation **(Table 2).** Planting in 1984 was delayed by wet weather and yields were subsequently reduced.

Table 2. Liming and soil depth effect on pH (Cowley County, KS).

Soil Depth, inches	Lime Rate (Tons ECC/A): 0	4.5: 4/84*	4.5: 4/85**
0-3	4.7	6.8	5.0
3-6	4.7	4.7	5.8
6-9	5.0	5.0	5.4
9-12	5.7	5.8	5.7

* 8 months after lime application
**Moldboard plowed

Grain yield responses in both 1984 and 1985 showed a definite variety-by-lime rate interaction **(Figure 3).** Some of the most popular varieties in Kansas (Newton, Vona and Tam 105) seemed to be extremely sensitive to Al, while Hawk and

Figure 3. Wheat varietal responses to recommended rates of lime in Kansas.

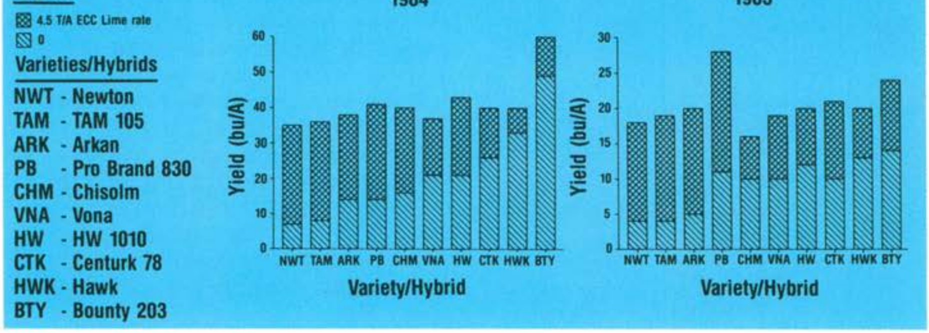


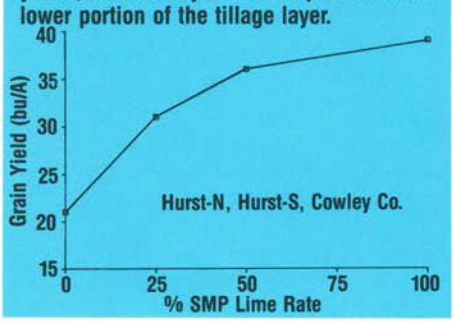
Figure 4. Varying effects of soil acidity and aluminum on two wheat varieties/hybrids. Note the difference in susceptibility between Vona (21 bu/A) and Bounty 203 (49 bu/A) in the left photo. With liming, Bounty 203 looked healthier and yielded 60 bu/A compared to 37 bu/A for Vona.

Bounty 203 showed much greater tolerance **(Figure 4).** The data clearly show that all varieties and hybrids responded to lime application.

The lime response curve in **Figure 5** was obtained when grain yield was plotted against lime for three responsive sites. It was somewhat surprising that the 25% lime rate was not equal to the recommended rate because unlimed soils (pH 5.3) with no KCl-extractable Al have not typically shown a response to lime. A possible explanation might be that yield limiting exchangeable Al was not totally eliminated because discing 6 inches deep incorporated lime to a depth of only 3 inches.

A laboratory staining technique developed by Polle, Konzak and Kittrick (Crop Sci. 18:823-827) was used to substantiate field results on variety/hybrid susceptibility to aluminum. Atlas 66, an Al tolerant soft red winter wheat variety, was included as a reference. A tremendous range of Al tolerance was noted and the majority of the varieties grown in the Southern Great Plains seem to be extremely sensitive to Al. Aluminum tolerance in some of the varieties/hybrids may have resulted from the use of genetic material from acid soil regions to obtain a desired trait such as protein content and/or the use of high rates of ammoniacal nitrogen fertilizer in the breeding program. Aluminum tolerant varieties are absent from breeding populations selected on non-acid soils.

Figure 5. Wheat yield versus lime rate. Even though partial lime applications improved yields, toxic Al may have been present in the lower portion of the tillage layer.



Conclusion

In summary, soil acidity has become a major wheat production problem in south central Kansas and north Oklahoma due to continued use of high rates of nitrogen without routine soil testing. Most wheat varieties grown in the region are very sensitive to exchangeable aluminum resulting from soil acidity. Even the more tolerant varieties have responded to lime applications on very acid soils. However, tremendous yield differences can occur between aluminum sensitive and tolerant varieties at soil pH near 5.0.

Even with lime costs ranging up to \$30/ton of ECC (due to lack of quarries in the area) returns can be as high as \$2 for each dollar invested. Partial rates of application have significantly improved yields and can help spread production costs. Liming costs should be amortized over several years because of the residual effect. ■

THE PROBLEM: Weak and thinning alfalfa stands.

Plant Problem Insights

for Maximum Economic Yields (MEY)

ALFALFA STANDS which start to thin, show reduced vigor, and are slow to regrow after clipping can cut farmers' profits in many ways:

- **Lower dry-matter yields**
- **Less TDN (total digestible nutrient) production**
- **Higher bills for purchased feed**
- **More frequent costs to establish stands**

Thick, vigorous alfalfa stands are essential to obtain high yields of alfalfa that are of high quality. Numerous research results have shown that potash (K_2O) is the most important nutrient in maintaining productive alfalfa stands.

The photo shows how an alfalfa stand deprived of adequate potash becomes thin. Alfalfa plants under low-K conditions lose vigor and are unable to compete with weeds, grasses and the frequent clipping schedules used by MEY producers. The results are that many plants die and the stand remaining is weak and unprofitable.

An adequate potassium fertilization program helps alfalfa build food storage levels in the roots and then helps translocate these reserves when the plant needs them for regrowth. Ample food reserves are essential for faster regrowth after harvest and aid in more frequent cutting schedules—a high yield management tool. Adequate food reserves in the roots are also an important factor in protecting the plant against winterkill during dormancy.

As you plan your alfalfa fertilizer program be sure that potash is not a limiting factor. A good rule of thumb is to use 60 lb of K_2O for every ton of alfalfa hay you expect to harvest. The rewards are a stronger, more vigorous, and longer-lived stand with high yield and good quality potential.

Other conditions sometimes contribute to thin alfalfa stands, such as: low pH, low phosphorus levels, poor variety selection, insects, diseases, and improper cutting schedules. ■

*This message is available on a 3½ x 7½-inch information card. Other topics also currently available in the "Plant Problem Insights" series are: **Poor Early Corn Growth, Poor Early Wheat Growth, Lodged Corn, and Soybean Cyst Nematode.** For more information, contact: Potash & Phosphate Institute (PPI), 2801 Buford Hwy., NE, Atlanta, GA 30329 (404) 634-4274.*

Concentrate on the Positive Ones

Optimism creates hope
If optimism goes, hope goes

IN THE SUBURBS we are surrounded by an affluency that is unequaled in the history of this nation. Inflation is down and the stock market is up.

Not so on the farm. The economy is in a shambles. How can the agriculture industries sell their products, so vital to all life, under such conditions? Certainly not by succumbing to the negative.

Fortunately, many farmers follow good management practices, produce high yields, and **decrease their cost of production per unit.** There are many others who can be **shown** how to improve their management practices and cut costs per unit. Concentrate on these.

The first law in selling is to drop a prospect fast if he shows a strong hostility to your product. Don't waste time on him. Devote your energies to those that can be sold.

One summer I sold tractors. I knew what our tractor could do for the farmer. A prospect greeted me, "You couldn't sell me one of those tractors if they were two-bits apiece." I smiled, moved on, and sold a tractor to a positive prospect.

Progressive, open-minded farmers are a pleasure to work with.

You know the values of your product in good management practices. Go out and sell these to the positive prospects. ■

— J. Fielding Reed

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