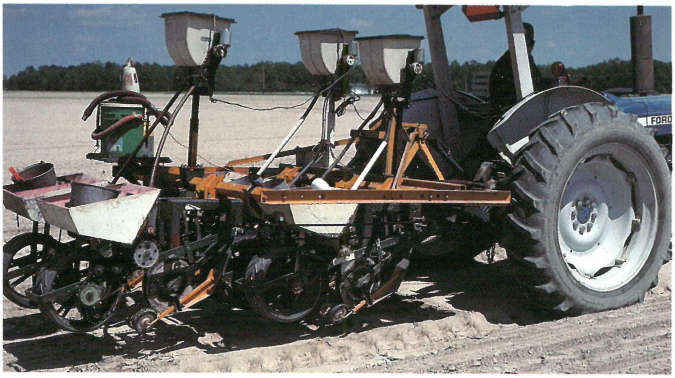
BETTER CROPS

WITH PLANT FOOD

Summer 1990



Inside this issue:

- Surface Banding Fertilizer for Winter Wheat
- Foliar-Feeding of Potassium Nitrate in Cotton
- Improved Management for Peanuts
- Potassium for Ridge-till Corn

. . . and much more.

BETTER CROPS With Plant Food

Editor: Donald L. Armstrong
Editorial Assistant: Kathy Hefner
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Contents

Our Cover: A sampling of scenes from articles in this issue.

Surface Banding of Fertilizer Gives High Winter Wheat Yields—But Caution Required

By N.R. Kitchen and D.G. Westfall

Colorado researchers have demonstrated that band application of nitrogen (N) and phosphorus (P) for wheat over the row at seeding can be an effective means of fertilizer placement.

THE ABILITY of wheat to take up fertilizer nutrients is greatly affected by fertilizer placement. Proper placement of relatively immobile nutrients, like P, is particularly crucial for maximum availability. Subsurface banding of fertilizer close to or with the seed is recognized as an application method that maximizes fertilizer nutrient recovery. Typically, plant roots will proliferate in the fertilized soil, facilitating uptake of fertilizer nutrients throughout the growing season. However, subsurface banding requires either specially designed drill shoes to allow fertilizer placement below the seed, or another application device. Research at Colorado State University has identified an efficient fertilizer placement method that allows easy, inexpensive adaption to existing drills.

Field experiments with dryland winter wheat in eastern Colorado compared three methods of fluid N and P fertilizer placement: (1) preplant broadcast without incorporation, (2) banding the fertilizer one inch below the seed, and (3) dribbling the fertilizer over the seed row behind the press-wheel. Planting was with a hoe-drill. This was a key in interpreting the results.

Wheat Yields

The results show that highest wheat yields occurred when both N fertilizer (**Table 1**) and P fertilizer (**Table 2**) were banded rather than broadcast. Wheat yields were similar when fertilizer was either surface banded or subsurface banded. **(continued on next page)**

Table 1. Surface or subsurface banding of N fertilizer gave the greatest improvement in winter wheat yields.

Fertilizer Placement	N rate (with 30 lb P_2O_5/A)	Yield
	--- lb/A ---	--- bu/A ---
Control, no N or P	—	47
Surface broadcast	30	54
	60	57
Subsurface banded	30	59
	60	61
Surface banded	30	59
	60	62

Ward, CSU

Table 2. Surface or subsurface banding of P fertilizer was the most effective for improving winter wheat yields.

Fertilizer Placement	P_2O_5 rate (with 60 lb N/A)	Yield
	--- lb/A ---	--- bu/A ---
Control, no N or P	—	47
Surface broadcast	0	54
	30	57
Subsurface banded	0	57
	30	61
Surface banded	0	55
	30	62

Ward, CSU

N.R. Kitchen is a former soil science graduate student and Dr. D.G. Westfall is a Professor of Agronomy at Colorado State University.

ADAPTING drill equipment for surface banding of N and P fertilizer over the top of the seed row is not difficult. Simply add a tube to apply the fertilizer behind the press wheel.

How Does Surface Banding Work?

How can a wheat plant absorb fertilizer nutrients applied in a surface band? Nitrogen is mobile in soils and can move into the rooting zone with rain or irrigation. On the other hand, fertilizer P is immobile. Examination of the furrows during wheat growth indicated that wind and rain had moved soil off the ridges between the rows into the furrow slot (**Figure 1**). That soil movement buried the surface applied fertilizer band. Crown roots growing near the soil surface could then intercept the immobile P for plant growth. Use of a hoe-type drill is essential for surface banding immobile nutrients because of the need for soil movement into the furrow.

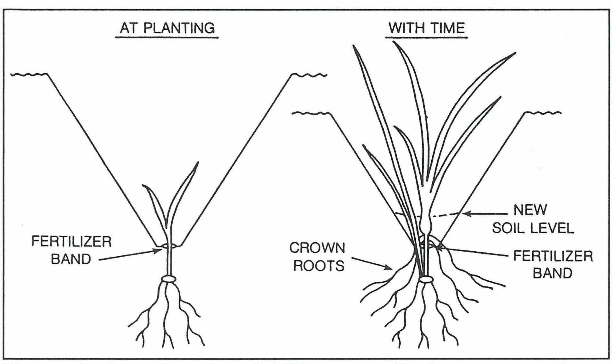


Figure 1. A surface band will eventually become a subsurface band as soil moves down into the furrow.

But What If . . . ?

If rain or sprinkler irrigation followed planting, soluble N in urea-ammonium nitrate solutions (UAN) could move from the surface band downward around the seed (**Figure 2**). That could spell trouble since urea (in the UAN) near or in direct seed contact can inhibit germination and emergence, particularly on high pH soils.

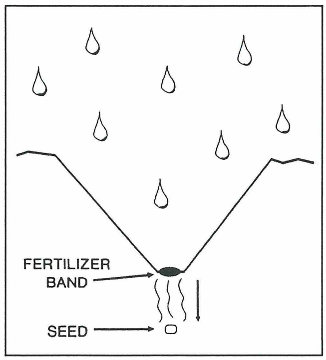


Figure 2. Soluble fertilizer nutrients could move with rain or irrigation water from the surface band to the seed zone.

A growth chamber study was conducted to determine the maximum rates of solution N that could be used with the surface band placement method. Emergence of wheat based on 12-inch row spacing, and corn based on 30-inch row spacing, was reduced with increasing N rate (**Table 3**).

As the row spacing increases, the actual amount of fertilizer being dribbled over the seed row increases, too. Corn in this study actually had higher N concentra-

Table 3. Wheat and corn emergence were reduced with high rates of surface banded N fertilizer.

Soil Clay Content	N	Seed Emergence	
		Wheat	Corn
--- % ---	lb/A	----- % -----	
10	40	98	91
10	80	97	37
10	120	62	1
30	40	97	96
30	80	95	93
30	120	84	68

12-inch row spacing for wheat and 30-inch row spacing for corn.

tions in seed contact. Seedling emergence was inhibited more in soils with low clay content. The data were used to predict maximum amounts of N fertilizer that should be dribbled over the seed row without reducing emergence (**Table 4**).

Summary

Surface banding of fluid N and P fertilizers increased wheat grain yields similar to subsurface banding. The advantage of surface banding is the ease and low cost of converting drills to accommodate this method of placement. But the effectiveness of surface banding P fertilizer depends on soil moving from ridges between rows into the furrow. Soil movement converts the surface band to a subsurface band and allows for wheat roots to absorb the fertilizer nutrients. However, there are rate limits to application of N fertilizer in this manner. Fertilizer N rates higher than those outlined in **Table 4** can result in crop germination injury and loss of yield. Soils low in clay or organic matter should receive relatively lower rates of surface banded N. ■

Table 4. Maximum recommended rates of solution N fertilizer application when surface banding over the seed row.

Row Spacing	Soil Clay Contents (%)		
	10	20	30
	-------- lb N/A --------		
12-inch (wheat)	70	75	75
30-inch (corn)	20	25	50

HIGH APPLICATION rates of N as UAN in surface bands over the row caused severe germination damage in wheat and corn. Wider rows make the problem worse for a given rate of N. Higher soil clay contents allow higher rates of N.

Potassium Deficiency in Corn—A Common Ridge-till Problem

By George W. Rehm and Paul E. Fixen

Potassium (K) deficiency, even at high soil test levels, is a documented problem in ridge-till systems in the northern Corn Belt. Fall banding of K into the ridge appears to be a very profitable solution to the problem.

A SUSTAINABLE AGRICULTURE will require production management to protect the soil resource from degradation by erosion. Conservation tillage systems such as ridge-till are proven means of controlling erosion and maximizing water use efficiency. Use of ridge-till in the northern Corn Belt has been increasing. However, in recent years K deficiency symptoms have been reported in many ridge-till corn fields even at high soil test levels.

Potassium Deficiency

For more than a decade, we have recognized the increased importance of adequate K fertility under reduced tillage. What makes our recent observations different is that K deficiency is being documented in soils testing relatively high in K. The data in **Table 1** are recent examples of studies where corn grown in reduced tillage systems has had relatively low K levels in ear leaf samples taken at silking.

A study was conducted in 1989 in southwestern Minnesota in a ridge-till field that had a history of K problems. Results after just one year indicate that knifing fertilizer into the ridge may be a successful means of correcting the K deficiencies. Good corn response was measured to potassium chloride (0-0-60) knifed in the fall in the center of the ridge at a depth of 3 to 3.5 inches following soybeans (**Table 2, Figure 1**). The data in **Table 2** show that K deficiency was retarding growth in the check plots early in the season (4 to 5 leaf stage) and that K concentrations remained low throughout the year. The photos show the striking visual symptoms that occurred in these plants.

Hybrid Differences

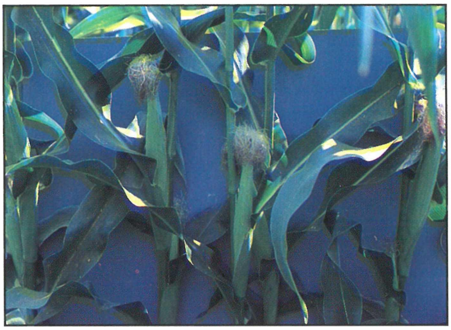
Grain yields of all three hybrids (Pioneer 3737, 3732, and 3902) evaluated in the experiment were increased by K fertilization, with responses varying from 8

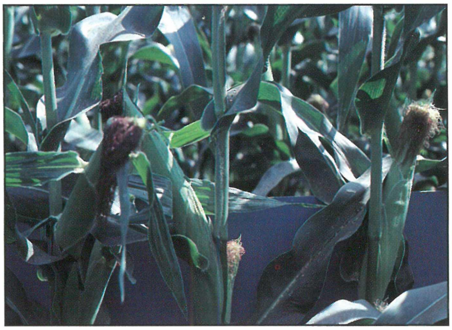
Table 1. Reduced tillage has frequently decreased corn ear leaf K content at silking in the northern Corn Belt.

Tillage system	Waseca, MN[1] 1984-85 Avg. Soil Test K= 190	434 lb/A	Brookings, SD 1984-85 Avg. Soil Test K= 500 lb/A	Stearns Co.,[2] MN, 1987 Soil Test K= 222 lb/A	Lamberton,[2] MN, 1988 Soil Test K= 207 lb/A
			K (%)		
Plow			1.91	1.90	2.05[3]
Chisel	0.95	1.85		1.15	1.74[4]
Ridge	0.85	1.83		1.08	1.65
No-till			1.64	0.98	1.60

[1]Averaged across placement, 2 rates of K applied, and starter fertilizer use.
[2]Moncrief, U. of MN, drought at Lamberton in 1988.
[3]Corn/soybean rotation with corn stalks plowed and soybean stubble chiseled.
[4]Corn/soybean rotation with corn stalks chiseled and soybean stubble no-tilled.

Dr. Rehm is with the Soil Science Department, University of Minnesota. Dr. Fixen is Northcentral Director, Potash & Phosphate Institute (PPI).





IN THIS STUDY, K fertilization advanced crop development and increased yield. Corn shown at left received no K, corn at right had 80 lb/A K_2O knifed in plot.

to 21 bu/A (**Figure 1**). Potassium application in this study was very profitable. A $5.00 investment in 40 lb K_2O/A increased yields 11 bu/A and crop value $28.00/A (assuming $2.50/bu, averaging across hybrids, and excluding application cost). A rate of 40 lb/A was adequate for top yields on two of the hybrids, while the third hybrid appeared to show some response to the second 40 lb/A rate. Differences among hybrids in their sensitivity to K deficiency under reduced tillage have also been observed in South Dakota, at a soil test level of 300 lb/A.

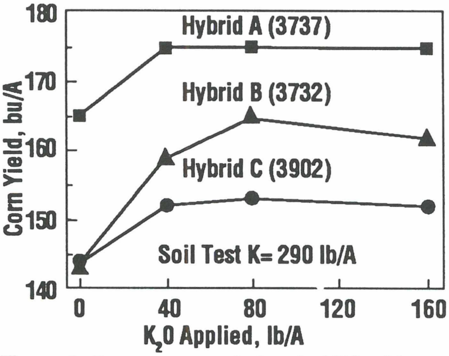


Figure 1. Corn response to banded K in ridge-till.

This study and others like it indicate that fall banding of K may be an effective means of correcting K deficiencies. Application in the fall has the added advantage of allowing the ridge disturbance from the knife to heal by planting time. Other trials have indicated that the rate of K normally used in starter fertilizer programs, 100 lb/A of 7-21-7 for example, may not be adequate to correct the K deficiency.

Table 2. Banded K increased corn early growth and K concentration.

K_2O applied	Early growth June 7	Early growth June 21	K concentration June 7	K concentration June 21	K concentration Silking
lb/A	grams/plant		%	%	%
0	0.68	4.8	0.9	1.1	1.0
40	0.94	6.9	2.2	1.5	1.2
80	1.02	7.3	2.6	1.8	1.4
160	1.09	7.7	3.1	2.1	1.5

Whole plants sampled on June 7,21; ear leaf at silking.
Average of three hybrids and four replications.

The soil test level at which adequate K is provided to the corn crop without banding K is not well defined, nor is the rate of broadcast K needed to eliminate the deficiency. The complex interactions with weather factors and soil type that cause the severity of the deficiency to vary among years, hybrids, and locations are not well understood.

Why the Problem?

The specific reason for the K availability problem in ridge-till is not known, but one can speculate about potential causes. Some soils can become compacted under

(continued on page 9)

Foliar-Feeding of Potassium Nitrate in Cotton

By D.M. Oosterhuis, S.D. Wullschleger, R.L. Maples and W.N. Miley

Field research was conducted to evaluate the benefits of foliar-applied potassium nitrate (KNO_3) on cotton yield and fiber quality. Supplemental KNO_3 increased petiole K concentration. Yield improvements were observed for plants fertilized with both soil- and foliar-applied K, or foliar-applied KNO_3 alone. Fiber length uniformity and strength also increased with foliar applications of KNO_3.

PROPER PLANT NUTRITION for optimal crop productivity in cotton requires that mineral deficiencies be avoided. However, the introduction of fast-fruiting varieties and the increased use of nitrogen (N) in crop management have led to widespread K deficiencies.

These deficiencies can be corrected through soil applications, or possibly by mid-season foliar applications of KNO_3. Foliar sprays would have the advantage of allowing producers to add K, when tissue analysis indicated a pending shortage, and thereby prevent yield losses. Our studies were designed to evaluate the effectiveness of foliar-applied KNO_3 on cotton yield and fiber quality.

Research Methods

A field trial was conducted at the Agricultural Experiment Station, University of Arkansas (Fayetteville) on a Captina silt loam. Treatments consisted of: (1) a check with no added soil or foliar K; (2) soil-applied muriate of potash (KCl) preplant; (3) foliar-applied KNO_3 at 2, 4, 6, and 8 weeks after first flower; and (4) preplant soil-applied KCl and foliar-applied KNO_3 at 2, 4, 6, and 8 weeks after first flower. The soil rate was 36 lb K_2O/A and the foliar rate was 10 lb/A KNO_3 (in 10 gal.) using a knapsack sprayer.

Other fertilizer included 36 lb N/A and 66 lb P_2O_5/A incorporated before planting. Initial soil analysis showed 358 lb K/A (high). A randomized split-plot design with five replications was used.

Research Results

Petiole analysis of upper-canopy leaves indicated that the combined application of soil KCl and foliar KNO_3 significantly enhanced plant K concentration. No consistent differences in N, phosphorus (P), and sulphur (S) nutrition were noted.

The application of foliar KNO_3 alone, or in combination with soil KCl, had a beneficial effect on both boll dry weight and final seedcotton yield **(Table 1).** The greatest influence on average boll weight was obtained from the combined soil and foliar K treatment, followed by foliar KNO_3, and then finally by soil-applied KCl alone. Seedcotton production was also significantly increased 7 percent following the combined application of soil and foliar K.

Table 1. The influence of soil- and foliar-applied K on boll weight and seedcotton yield.

Treatment	Average Boll Weight	Seedcotton Yield
	--- g ---	--- lb/A ---
Control	3.51 b[1]	1,545 c
Soil KCl	3.52 b	1,580 bc
Foliar KNO_3	3.73 ab	1,609 ab
Soil + foliar K	3.87 a	1,655 a

[1] Values within a column followed by the same letter are not significantly different ($P = 0.05$).

The authors are cotton scientists at the University of Arkansas.

MID- TO LATE-SEASON deficiency of K in cotton reduces yield and lint quality. Leaves exhibiting K deficiency turn yellowish-green to gold and the leaf edges subsequently turn brown and necrotic. Foliar application of KNO_3 may alleviate these symptoms.

Soil- and foliar-applied K had a significant influence on fiber quality **(Table 2)**. Both fiber length uniformity and strength were increased in K-treated plants, whereas micronaire and length were unaffected. Application of KNO_3 either as foliar treatments, or in combination with supplemental soil KCl, improved length uniformity and strength. Surprisingly, soil application of KCl alone did not enhance any of the fiber quality components.

Table 2. The influence of soil- and foliar-applied K on cotton fiber quality, as measured by high volume instrumentation (HVI).

Treatment	Length Uniformity Index	Strength
	------ % ------	--- g/tex ---
Control	85.4 b[1]	24.4 b
Soil KCl	85.8 b	24.2 b
Foliar KNO_3	87.1 a	26.6 a
Soil + foliar K	86.0 ab	25.1 ab

[1]Values within a column followed by the same letter are not significantly different ($P=0.05$).

In related field tests, visible symptoms of foliar burn were not observed following the application of up to 20 lb/A KNO_3.

These preliminary data suggest that K, when applied either to the soil or as a foliar spray, can have a significant effect on cotton yield and fiber quality. This research will be continued for a second year to evaluate the beneficial aspects of KNO_3 as a management tool for cotton producers. ■

Ridge-till . . . from page 7

reduced tillage. More compaction could reduce root density in the soil by decreasing root elongation rates, and locally elevated bulk density could slow K diffusion. Similar patterns between years in preferential root growth along paths of least resistance could decrease the effective K concentration near individual roots. Subtle changes in root hair density, induced by ridge-till, could be involved as could moisture or temperature effects.

In Summary

Ridge-till can be a very successful cropping system, but corn will not reach full yield potential or input efficiency unless adequate K is present. Though the specific cause of K deficiency in ridge-till is not known, the problem has been observed and verified many times. It is critical that farmers be aware of the potential problem and its solutions to prevent abandonment of a cropping system that has many advantages. ■

Alfalfa Response to Potash and Phosphate on Irrigated Western Soils

By Terry A. Tindall and Larry Bond

Balanced phosphorus (P) and potassium (K) nutrition is important for producing high-yield, profitable alfalfa. This article reports on a three-year study of irrigated alfalfa.

GROWERS of irrigated alfalfa hay in the western U.S. can produce some of the finest quality hay anywhere. This is related to favorable climate and the ability of the grower to schedule irrigations in relation to the crop's needs rather than relying only on precipitation. However, many growers could improve production through better nutrient management, especially P and K fertilization.

Alfalfa Demand for P and K

It is estimated that a healthy alfalfa crop will remove the equivalent of about 15 lb P_2O_5 per ton. This must be replaced through natural chemical/weathering processes or by fertilization. If not, each subsequent crop will be drawing from a smaller reservoir of available P until it is depleted and yields suffer. This is exactly what has happened in the West. Consequently, alfalfa and other crops have responded to P fertilizer for many years.

The same situation is true for potash. However, the available K reservoir has been much larger, and even though alfalfa removes the equivalent of about 60 lb K_2O per ton (480 lb in an 8-ton season), widespread deficiencies in the West have been acknowledged only in recent years. Western growers, therefore, do not have the same "tradition" of K fertilization as they do for P.

K Deficiency in Utah

In Utah, recommendations for K fertilization of alfalfa in the past have been rare. But things have changed. Responses to K fertilization have become more frequent. Responses are generally associated with those areas where the irrigation water is of high quality (low salts, including K), soils are coarse to medium in texture, and alfalfa has been grown for several years.

Potassium deficiency symptoms on alfalfa leaflets show up as white fawn-like spots on the outer fringe (see photo). In our research plots involving both P and K, we have seen K deficiency symptoms

POTASSIUM DEFICIENCY symptoms on alfalfa leaflets appear as fawn-like spots on the outer fringe.

Dr. Tindall is Extension Soils Specialist, University of Idaho (previously with Utah State University); Dr. Bond is Agricultural Economist, Utah State University, Logan.

Table 1. Alfalfa response to P and K fertilization.

Treatment[1]		Year			3-Year	Yield
P_2O_5	K_2O	1986	1987	1988	Total	Increase
----- lb/A -----		------------- Yield, tons/A (15% moisture) ----------------				%
Control		5.61	5.50	4.28	15.4	—
0	240	5.98	6.79	5.83	18.6	20.9
0	480	6.24	6.29	5.01	17.5	14.0
1,375	0	7.12	6.68	5.70	19.5	26.7
230	240	6.76	7.07	6.26	20.1	30.5
460	480	7.08	7.31	6.57	21.0	36.2

[1]Applied in the fall of 1985; no other applications.

most commonly where P has not also been limiting. The deficiencies appear more frequently during the second and third cuttings. Some alfalfa varieties exhibit the symptoms more clearly than others.

Research Results

A recently completed three-year study in central Utah illustrates the profit potential when P and K fertilizers are properly incorporated into an irrigated alfalfa production program. This particular study was conducted on a three-cut alfalfa system grown at an elevation of 5,300 feet. All fertilizer was incorporated preplant in the fall of 1985; no additional fertilizer was applied for any succeeding season. Available soil P and K index values were 10 (low) and 240 (medium) lb/A, respectively. Ten commonly grown varieties were evaluated in relation to different P and K rates for yield and quality. Only the fertilizer treatments will be discussed in detail in this article.

All fertilizer treatments produced a positive economic return, except the high P-only treatment which was intended to evaluate residual P availability over a long period of time. Yields for the three years were increased by an average of 36 percent over the control (no fertilizer) for the highest application rate of P and K in combination (**Table 1**). Net profits from fertilizer were highest where P and K were applied in combination (**Table 2**).

In increasing order of magnitude, yields and economic returns were increased by variety selection, P alone or K alone, and PK combinations, respectively. There appeared to be less difference among varieties as fertility (P and K) increased.

Recommendations for P and K

Information from this study has already been adapted by the cooperating farmer who now sets the standard for alfalfa production in the area. He has selected a variety with higher yield potential and is fertilizing with a combination of P and K.

Based on this and previous studies in Utah, both P and K should be broadcast and incorporated preplant for best results. For P, where soil test levels are similar to this study, a minimum of 200 lb P_2O_5/A should be incorporated. For K, a minimum of 200 lb/A K_2O should be used. On low to medium testing soils, 400 lb/A K_2O should be applied. Soil test levels should be checked at the end of two years. It is essential that sufficient quantities of both P and K be applied when needed to obtain maximum efficiency and the best quality hay. ■

Table 2. Economic return to P and K fertilization (3-year total).

Treatment P_2O_5	K_2O	Fertilizer cost	Net return	Return over control
---- lb/A ----		---------------------- Dollars/A ----------------------		
Control		0	1,386	—
0	240	37.90	1,636	250
0	480	73.90	1,501	115
1,375	0	455.65	1,299	-87
230	240	113.80	1,695	309
460	480	225.70	1,664	278

Fertilizer cost: P_2O_5 = \$0.33/lb, K_2O = \$0.15/lb, application = \$1.90/A.
Hay Price = \$90.00/ton

Five Graduate Students Receive "J. Fielding Reed PPI Fellowships"

FIVE OUTSTANDING graduate students have been announced as 1990 winners of the "J. Fielding Reed PPI Fellowships" by the Potash & Phosphate Institute (PPI). Grants of $2,000 each are presented to the individuals. All are candidates for either the Master of Science (M.S.) or the Doctor of Philosophy (Ph.D.) degree in soil fertility and related sciences.

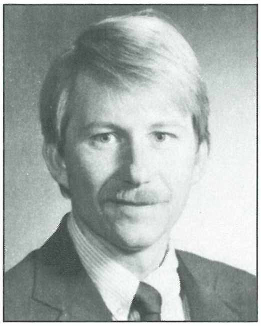
The 1990 recipients were chosen from more than 40 applicants who sought the Fellowships. The five are:

- **David C. Ditsch, Virginia Polytechnic Institute and State University,** Blacksburg;
- **Kathrin Grahammer, Texas A&M University,** College Station;
- **Jan K.D. Jarman, University of Wisconsin-Madison;**
- **Ramona Mohr, University of Manitoba,** Winnipeg;
- **Pengchu Zhang, University of Delaware,** Newark.

Funding for the Fellowships is provided through support by potash and phosphate producers who are member companies of PPI.

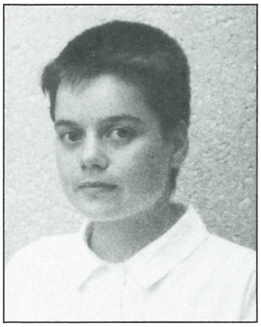
"Each year, we have the privilege of presenting this recognition. All of the applicants for the Fellowships have excellent credentials," noted Dr. David W. Dibb, President, PPI. "These individuals and their educational institutions can take pride in the level of achievement represented."

Scholastic record, excellence in original research, and leadership are among the important criteria evaluated for the Fellowships. Following is a brief summary of information for each of the winners:



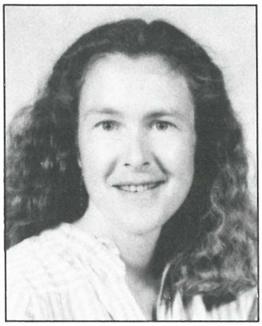
David C. Ditsch

David C. Ditsch is a native of Louisville, Kentucky, and received his B.S. and M.S. degrees in Agronomy from the University of Kentucky. He worked as a student trainee and soil conservationist for the U.S. Soil Conservation Service as a student, then served four years as Extension Agronomy Specialist at Princeton, Kentucky. He is currently pursuing his Ph.D. degree at Virginia Polytechnic Institute and State University. He is using labeled nitrogen (^{15}N) to document the movement and recovery of N applied to a corn-rye rotation. His research should add much-needed information to the N use efficiency/environmental impact knowledge base. Mr. Ditsch plans a career in research and Extension in the area of efficient plant nutrient utilization.



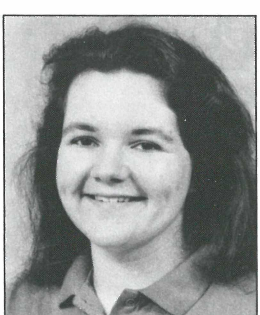
Kathrin Grahammer

Kathrin Grahammer was born in Bludenz, Austria, and holds degrees from the University of Vienna and the University of Nebraska-Lincoln. She is currently working toward her Ph.D. degree at Texas A&M University. She graduated with distinction from the University of Vienna and has compiled an outstanding academic record as a graduate student at both the University of Nebraska and Texas A&M University. Her doctoral research deals with organic matter dynamics in the tropics. She is assessing the influence of organic matter additions on water and fertilizer use efficiency by millet and cowpea on sandy lateritic soils of West Africa. After graduation she plans to continue research on the fertility of tropical soils.



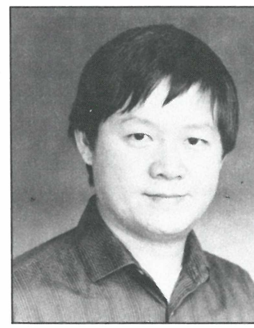
Jan K.D. Jarman

Jan K.D. Jarman is a native of Arizona, born in Phoenix. She received her B.S. degree in Meat and Animal Science at the University of Wisconsin-Madison and is in the first year of her M.S. program in soil fertility, also at the University of Wisconsin. Her research deals with the determination of nitrogen (N) credits for corn following alfalfa, as determined by stand density and previous hay-year management of the alfalfa. The ultimate goal is to provide data that will allow for more accurate assessments of N credits than are currently available. Her professional objective is to help Wisconsin farmers make more efficient use of agricultural research data by working in the areas of research, Extension and consultation.



Ramona Mohr

Ramona Mohr was born in Gunton, Manitoba. She received her B.S.A. degree with distinction from the University of Manitoba, Winnipeg, in 1989 and is completing her first year of the M.Sc. degree program in Soil Science at the same university. Ms. Mohr compiled an outstanding record as an undergraduate and was awarded the "University of Manitoba Gold Medal in Agriculture" in her year of graduation. The award is given to the top ranked student of all graduates for a particular year. Her research project deals with chloride fertilizer requirements of wheat and barley crops in Manitoba. She hopes to pursue a career in government or industry as an agronomic advisor to the agricultural community.



Pengchu Zhang

Pengchu Zhang was born in Chengdu, People's Republic of China and is currently pursuing his Ph.D. degree at the University of Delaware. He attended the Southwestern University of Agriculture, Chongqing, China, and received his M.S. degree at the University of California, Riverside. He has achieved exceptional academic success in China and the U.S. A former professor describes him as, "... among the best students I have encountered in 30-odd years of teaching." His doctoral research is concerned with the kinetics of anion adsorption/desorption on goethite, an important soil mineral. His career goal is to conduct research in soil chemistry and teach at the university level or at a public or private research institute.

The Fellowship winners are selected by a committee of individuals from PPI staff and the PPI Advisory Council. The Fellowships are named in honor of Dr. J. Fielding Reed, retired President of the Institute, who now lives in Athens, Georgia.

Dr. W.R. Thompson, Jr., PPI Midsouth Director, served as chairman of the selection committee for the 1990 Fellowships. "The knowledge, dedication and high ideals of the 1990 applicants were quite evident. It is reassuring to note the achievement and goals of these young people, not only in academic work but also in other aspects of their lives," he stated. ■

In Virginia

Research Indicates Better Returns with Improved Management Practices for Peanuts

By R.W. Mozingo, F.S. Wright and N.L. Powell

Management practices for commercial peanut production must be improved to obtain the maximum return per unit of input. Current research indicates seed spacing and planting configuration may offer some alternative to conventional planting practices. Research yields have been consistently double, or more, those obtained with current management practices. A demonstration program with field-size plots is beginning in 1990 to determine if these improved practices can be transferred to farmer practice.

SEED COST is a major cash input in peanut production. Growers in Virginia plant approximately 110 lb of seed per acre at a cost of $80 to $85. Reducing seed requirements, without reducing yields or changing the planting configuration, and increasing yields offer improved management practices which may increase the dollar return per acre.

Diamond Shaped Plantings

A three-year study was conducted at the Tidewater Agricultural Experiment Station in Suffolk, Virginia, using three seed spacings and six cultivars. The seed were spaced in a 6x6, 12x12, and 18x18-inch diamond shaped configuration. Cultivars included Florigiant, NC 7, VA 81B, NC 9, NC-V 11 and the experimental line VNC 851.

To accurately space the seed, an experimental tractor-mounted plot planter was constructed. The planter consisted of drop tubes and predrilled holes in sheets of plywood. After positioning the planter on a 60-inch wide reshaped bed, the seed were hand placed in the drop tubes and deposited in the soil by a hydraulically operated opening at the bottom of the drop tubes. See photos, next page.

Measurements of plant height and yield determinations were made on each replicated plot. Plant height increased as the seed spacing decreased. Plants spaced 6x6-inches apart were 29.2 percent taller than the 12x12-inch spaced plants and 72.2 percent taller than plants spaced 18x18-inches apart. Yields for the 6x6-inch spacing were 8.3 percent higher than for the 12x12-inch spacing and 22.6 percent higher than yields for 18x18-inch spacing. The yields and seed requirements per acre are shown in **Table 1.** The yields obtained in research (4,800 to 5,900 lb/A) are well above the yields obtained by farmers. The Virginia state average for these years ranged from 2,600 to 2,900 lb/A.

Table 1. Peanut yield and seed requirements at three diamond shaped seed spacings.

Seed Spacing (inches)	Yield[1]	Seed Requirement
	---------- lb/A	----------
6x6	5,967	238
12x12	5,510	65
18x18	4,864	32

[1]Three-year average of six cultivars.

Additional Management Practice Changes

Using data obtained in the tests discussed above, a second phase of changes

R.W. Mozingo and N.L. Powell are Associate Professors of Crop and Soil Environmental Sciences, and F.S. Wright is USDA-ARS Scientist and Adjunct Professor of Agricultural Engineering located at the VPI & SU, Tidewater Agricultural Experiment Station, Suffolk, VA 23437.

EXPERIMENTAL plot planter used to obtain diamond-shaped planting configurations.

DIAMOND shaped plantings showing 6 x 6, 12 x 12, and 18 x 18-inch spacings.

in management practices was initiated in 1988. The three highest yielding cultivars (NC 7, VA 81B, and NC-V 11) were planted in two 3-row patterns on a 72-inch wide seedbed. The intrarow seed spacings were 6 and 9 inches. Planter plates and planters were arranged so a diamond shaped seed pattern was obtained.

Fertilization treatments were the conventional (indirect) fertilization program. Nitrogen (N), phosphorus (P) and potassium (K) fertilizer was applied on the rotational crop the previous year. A treatment with additional P-K fertilizer (indirect-plus) was applied in the spring just ahead of moldboard plowing. Irrigation water was applied on all plots to assure soil moisture would not be a limiting growth factor. See photos, next page.

These management practices were evaluated to observe the influence of fertilization methods when optimum growing conditions were available. The two-year averages of this study indicate that the 9-inch spacing produced a higher yield than the 6-inch spacing. One year the indirect fertilization yielded the highest, the next year the indirect-plus was best. See **Table 2.** Further research is needed to determine the best fertilization method.

On-Farm Demos Planned

Using the data collected from the two studies discussed above, experiments have been designed for 1990 as replicated on-farm demonstrations. This will provide data applicable to the farm situation.

(continued on next page)

Table 2. Intrarow seed spacing and fertilization effects on peanut yield (lb/A).

Intrarow Seed spacing (inches)	1988	1989	Mean
6	4,762	3,483	4,122
9	4,838	3,755	4,296
Fertilization			
Indirect	4,781	3,745	4,263
Indirect-Plus	4,819	3,499	4,159

Average of three cultivars.

Three locations with irrigation capabilities have been selected in the Virginia peanut production area. Indirect and indirect-plus fertilization treatments will be evaluated at each farm location.

The 9-inch intrarow seed spacing with triple rows in a diamond shaped pattern will be used along with the conventional 3-inch intrarow seed spacing in a single row pattern. These two seed spacings and row configurations have the same seed requirements. The VA 81B cultivar will be planted on the Billy Bain Farm in Dinwiddie County, NC 7 on the Richard Simms Farm in Southampton County, and NC-V 11 on the Samuel Cox Farm in Surry County.

These three test locations will provide on-farm experience on how changes in management practices for peanuts in Virginia can maximize net return. ■

PLANTERS modified to plant two 3-row patterns on a 72-inch wide seedbed.

PEANUTS planted with the modified planters.

Economics of Dryland Grass Fertilization

By Paul McCaughey, Elwin Smith and Hugo Gross

The economic optimum nitrogen (N) supply for dryland grass hay production, on two soil types, can be predicted accurately by a model which includes N fertilizer price, hay value and expected precipitation. This information may be used in conjunction with soil nitrate-N values to estimate the most profitable N fertilizer application rate.

IN WESTERN CANADA, N is generally considered to be the first limiting nutrient for grass hay production. Research at many locations in western Canada and the western United States has shown that N fertilization can increase both the yield and protein content of grasses. In spite of overwhelming research evidence, many farmers are reluctant to fertilize grass stands. This may be because factors such as variable precipitation and soil type make the crop response to N fertilizer difficult to predict.

In Manitoba, current N recommendations for established grass stands range from 89 to 107 lb/A. However, no data are available which indicate how the economic optimum N supply might be affected by variables such as grass species, soil type, precipitation, N fertilizer price and standing hay value. Thus, the present recommendations are applicable in a very broad sense. If producers had more information regarding the effects of variable precipitation and soil type on the yield response of hay to applied N, perhaps they would be willing to increase N application in management of grass stands.

Based on five years of yield data, an economic model has been developed to predict economic optimum N application rate over a range of N prices, hay values, soil types and precipitation conditions. In this model the N supply is defined as soil nitrate-N plus applied fertilizer N. The value of standing hay as opposed to baled hay is used in the model because harvesting costs per ton vary with yield. The value of standing hay may be determined by subtracting the total handling costs associated with cutting, baling and hauling hay from the baled hay price.

Nitrogen Required for Maximum Yields

Nitrogen is required to maximize the yields of smooth bromegrass, crested wheatgrass, intermediate wheatgrass and Russian wild ryegrass grown on sandy loam and clay loam soils (**Table 1**). Research indicates that both precipitation and soil type have large effects on dry-matter yields and on the quantity of N needed to produce them.

Under average spring precipitation conditions at Brandon (total April-June precipitation = 6.6 in.), N rate needed to produce maximum yield ranges from 185 to 250 lb/A on sandy loam soil and from 279 to 464 lb/A on clay loam soil. Usually, clay loam soils are potentially more productive than sandy loam soils and require larger amounts of N fertilizer to maximize yields. This is because of a greater water holding capacity and better supplies of other nutrients. The precipitation adjustment factors in **Table 1** should be added to the value shown under wet (average plus 2.1 in.) spring conditions and subtracted under dry (average minus 2.1 in.) conditions.

(continued on next page)

Dr. W.P. McCaughey is a Forage Agronomist at the Agriculture Canada Research Station, Brandon, Manitoba. Dr. E.G. Smith is an Agricultural Economist with the Production Economics Branch of Alberta Agriculture, Edmonton, Alberta, Mr. A.T.H. Gross (deceased) was a Forage Agronomist at the Agriculture Canada Research Station, Brandon, Manitoba.

Grass Fertilization . . .
from page 17

Economic optimum N application rates will always be less than those needed to produce maximum yields. In this study, commonly used methods of economic analysis were used to determine the economic N application rate for the four grass species listed above. This economic model predicts the economic optimum N supply for each grass species under a range of N prices and standing hay values for each combination of soil type and precipitation level. The economic optimum N supply under each of these conditions is indicated in **Figure 1.**

Table 1. Total spring precipitation and soil type affect forage productivity and total N supply necessary to produce maximum yields.

Species	N supply for maximum yield lb/A	Maximum yield tons/A
Sandy loam		
Smooth bromegrass	185 ± 59[a]	1.9 ± 0.9[a]
Crested wheatgrass	250 ± 80	1.7 ± 0.8
Intermediate wheatgrass	237 ± 76	1.7 ± 0.7
Russian wild ryegrass	204 ± 74	0.9 ± 0.6
Clay loam		
Smooth bromegrass	323 ± 104	4.1 ± 1.3
Crested wheatgrass	464 ± 148	4.2 ± 1.3
Intermediate wheatgrass	313 ± 100	4.0 ± 0.9
Russian wild ryegrass	278 ± 68	3.3 ± 0.9

[a] Precipitation adjustment factors. With average April, May and June precipitation (6.6 in.), these values would be ignored; in a moist spring (average plus 2.1 in.), they would be added; and in a dry spring (average minus 2.1 in.), they would be subtracted.

Under current economic conditions (fertilizer N:standing hay price ratio = 10) and average precipitation values, the economic optimum N rate would range from 45 to 116 lb N/A and 156 to 201 lb N/A on sandy loam and clay loam soils, respectively. When spring precipitation is greater than average (6.6 in. plus 2.1 in.), the economic optimum N supply increases by 59 to 80 lb N/A and 68 to 146 lb N/A on each soil type, respectively. When spring moisture is less than normal (6.6 in. minus 2.1 in.) economic optimum N needs are reduced by the same quantities. Specific N needs depend on grass species. The values generated by this model should be used in conjunction with residual soil nitrate tests to determine the most profitable rate of N fertilizer application.

Smooth Bromegrass Example

Smooth bromegrass on a sandy loam soil (**Figure 2**) has been used as an example of how to interpret the information in **Figure 1.**

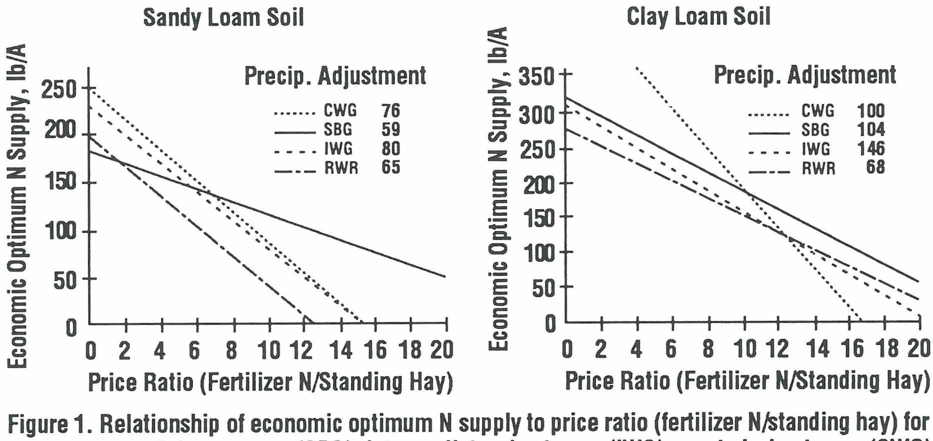


Figure 1. Relationship of economic optimum N supply to price ratio (fertilizer N/standing hay) for smooth bromegrass (SBG), intermediate wheatgrass (IWG), crested wheatgrass (CWG) and Russian wild ryegrass (RWR) on two soil types.

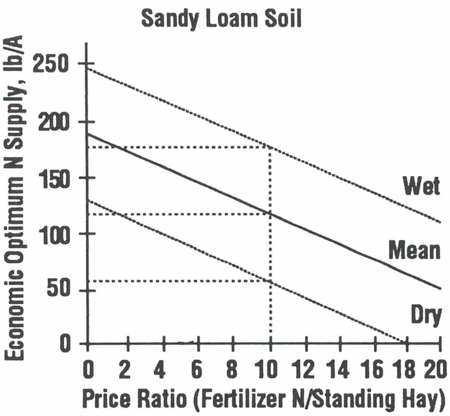


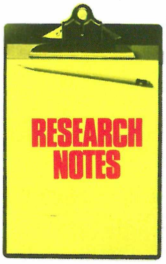
Figure 2. Effects of moisture conditions on economic optimum N supply for smooth bromegrass on sandy-loam soil.

At a fertilizer N to standing hay price ratio of 10:1 (N = 21¢/lb; standing hay, $42/ton), the economic optimum N supply to the plant would be 116 lb/A under average spring precipitation conditions (6.6 in.). If N prices drop or hay prices increase, the economic optimum N supply would increase. If N price increases or hay price decreases, the economic optimum N supply would decrease. It should be emphasized that the economic optimum N supply is extremely sensitive to the relative values of fertilizer and hay. Therefore, to use this model effectively, producers should determine the specific price ratio for their operation.

The precipitation adjustment value for smooth bromegrass was obtained from the inset in **Figure 1**, 59 lb N/A. The economic optimum N supply for a sandy loam soil would be 116 minus 59, or 57 lb N/A, under dry spring conditions; it would be 116 plus 9, or 175 lb N/A, under moist spring conditions. Subtract the quantity of nitrate-N indicated by soil test to determine the most profitable N application rate. The same procedure could be performed for each of the four grasses on each soil type. Even though April-June precipitation would have to be estimated for timely N applications, the information provided by this model should help hay producers to manage risk effectively and increase profitability.

Summary

The results of this analysis indicate that producers should consider using more N fertilizer in their management of dryland grass stands. However, the economic optimum quantity of N fertilizer to apply is sensitive to both soil type and spring precipitation. Economic models such as this one can assist in determining optimum N application rates for maximum economic yield (MEY) over a wide range of environmental and economic conditions. ■



Louisiana

SOY-DRIS: A Computer Software Program for Evaluating Nutrient Needs of Soybeans

SOY-DRIS uses nutrient analyses of the most fully expanded trifoliates in soybeans. It is capable of evaluating the status of phosphorus (P), potassium (K), calcium (Ca), manganese (Mn) and zinc (Zn). Studies in the Midwest and South have shown that SOY-DRIS is 95 percent accurate in predicting soybean needs of these five nutrients. Plant analyses are generally superior to soil analyses in predicting nutrient requirements because they are a direct measure of nutrient uptake by the crop.

Certain precautions must be taken in using SOY-DRIS. Only healthy, non-stressed plants should be analyzed. Also, it should be used in conjunction with soil testing since plant analyses only predict need. Soil tests determine fertilizer application rates on nutrient deficient soils.

SOY-DRIS is a user-friendly program which is adaptable to all IBM-compatible computers and is available for commercial application.■

Source: Dr. W.B. Hallmark, Iberia Research Station, P.O. Box 466, Jeanerette, LA 70544.

Colorado Research

Greater Crop Management Intensity Increases Soil Quality

By C. Wesley Wood, G.A. Peterson, and D.G. Westfall

Research in Colorado shows that greater cropping intensity (crops/unit time) under no-till increases surface soil organic matter quantity and nutrient supplying capability in degraded soils of the west central Great Plains. The research indicates that higher levels of management in conjunction with greater fertilizer inputs results in improved surface soil quality.

SOIL ORGANIC MATTER, with its associated biological, chemical, and physical properties, is an excellent measure of soil quality over the range of soil and climatic gradients in the Great Plains. Soil organic matter supplies nitrogen (N) to plants through microbiological transformations (mineralization) that require an energy source (mineralizable carbon (C)). Mineralizable C and N represent "active" fractions of soil organic matter that are important for supporting annual crop growth.

Quantity and activity of surface soil organic matter in the Great Plains is largely determined by factors such as climate, topography, soil texture, and native vegetation. Soil-crop management (fertilization, tillage, crop rotation, etc.) also has a direct bearing on surface soil organic matter quantity and activity, and thus soil quality, in the Great Plains.

Since the late 1800s, millions of acres of grasslands in the Great Plains have been plowed and planted to wheat. Long-term use of tillage and summer-fallow in these wheat cropping systems has resulted in losses of soil quality through increased decomposition of soil organic matter and erosion.

Table 1. Quantity of surface soil C and N as affected by cropping system (average of 3 sites).

Cropping system	1985 C	1989 C	1985 N	1989 N	1985 C:N	1989 C:N
	----------	lb/A	----------	----------	Ratio	
Wheat-fallow	5,300	5,100	520	510	10.2	10.0
Wheat-corn-millet-fallow	5,300	5,800	520	520	10.2	11.2
Significance Probability		0.005		0.918		0.164

Dr. Wood was formerly a Research Associate in the Department of Agronomy, Colorado State University,and is presently an Assistant Professor in the Department of Agronomy and Soils, Auburn University, AL 36849-5412. Drs. Peterson and Westfall are Professors in the Department of Agronomy, Colorado State University, Fort Collins, CO 80523.

Table 2. Cumulative grain and plant residue yield and N uptake as affected by cropping system (average of 3 sites).

Cropping system	Grain yield	Plant residue yield	Grain N uptake	Plant residue N uptake
	---------- tons/A ----------		---------- lb/A ----------	
Wheat-fallow	1.0	3.1	90	40
Wheat-corn-millet-fallow	2.1	4.0	120	40
Significance Probability	0.002	0.049	<0.001	N.S.

Yields and Management

Crop yields in the Great Plains have not paralleled losses in surface soil quality. Rather, wheat yields have steadily increased in the region since 1935. Increased yields have been due to factors such as fertilization (especially with N), improved varieties, pest control, and improved farm machinery that have compensated for losses of soil quality.

With these observations, two questions arise: (1) With improved management (less tillage, less summer-fallow, and greater fertilization), can soil quality on degraded soils in the Great Plains be enhanced?; and (2) If soil quality is improved on degraded soils, will grain production be enhanced?

Current Research

Long-term research directed at answering these questions is currently under way at three locations in eastern Colorado. This article summarizes results pertaining to the first question for the first four years of the long-term study. Answers to the second question will require many more years of study.

The study sites, located near Sterling, Stratton,and Walsh, CO, were converted to no-till management in 1985 after 50 or more years of tillage and alternate crop-fallow management. Wheat-fallow (WF) and wheat-corn-millet-fallow (WCMF) systems were compared with respect to their surface soil (0-2 in.) C and N quantity and activity during the 1989 fallow period. Soil organic matter activity was measured using incubation techniques under ideal laboratory conditions. Fertilizer applications for the cropping systems were based on soil test recommendations. The WCMF received approximately twice as much N, P, and zinc (Zn) as WF over the study period.

Soil organic C was greater under the WCMF system than the WF system after four years (**Table 1**). The difference was due to greater cumulative plant residue additions under WCMF than WF (**Table 2**). The WCMF system also had greater cumulative grain production than WF for the four-year study period (**Table 2**). Cumulative grain N

(continued on next page

Table 3. Quantity of active surface soil C and N as affected by cropping system (average of 3 sites).

Cropping system	Mineralizable C	C Turnover	Mineralizable N	N Turnover
	lb/A/day	%/day	lb/A/day	%/day
Wheat-fallow	50	0.11	3.4	0.07
Wheat-corn-millet-fallow	80	0.15	4.6	0.10
Significance Probability	0.022	0.020	0.022	0.098

Soil Quality . . . from page 21
uptake was greater in WCMF than WF, indicating that long-term protein output in the western Great Plains could be enhanced with higher levels of management and greater fertilizer input.

Cropping system had no effect on the quantity of surface soil organic N after four years of no-till management (**Table 1**). This was due to lack of difference between systems with respect to N content of plant residues added back to the soil and the low N content of those residues (**Table 2**). There was a trend for higher surface soil C:N ratios under WCMF than WF in 1989 (**Table 1**). This was due to the greater amount of soil organic C in that system, which was due to greater plant residue additions.

Cropping system had a significant impact on the potential for nutrient release after four years of no-till management. Carbon and N mineralization and turnover (the fraction of total C or N mineralized) in laboratory incubations were all greater under WCMF than WF (**Table 3**). Greater C mineralization and turnover under WCMF than WF indicate that a greater potential energy pool for microbial transformations that furnish crop plants with nutrients is promoted with higher levels of management and fertilizer inputs. Greater N mineralization and turnover under WCMF suggest that higher levels of management and fertilizer inputs increase the nutrient supplying capability of Great Plains soils. The N supplying capability of the soils under WCMF was increased above that under WF, even though no differences existed in the total organic N content of the soil (**Table 1**).

Summary

Soil quality, as indicated by differences in total C content, C:N ratios, mineralizable C and N, and C and N turnover was greatest under the more intensely managed WCMF system after only four years of no-till management. Colorado data indicate that active fractions of soil organic matter in degraded west central Great Plains soils are very sensitive to change in management, and are increased by higher levels of management in conjunction with greater fertilizer inputs.

The results show that a positive feedback mechanism is operating under the WCMF system. More intense management with greater fertilizer inputs allows greater grain and plant residue yields, which promote greater soil quality on degraded soils. More research is needed to determine if long-term enhancement of soil quality results in greater crop yields in these systems. ■

Correction for Spring 1990 Issue

THE Spring 1990 issue of *Better Crops With Plant Food* included an article titled "Varying Fertilizer Applications within a Field". **Figure 1** of the article appeared on page 13 and is also shown here.

Under the heading of Fertilizer Applied, the rates of 185-0-85 and 185-92-85 were switched in the original printing of the chart. The correct rates, as indicated by soil test phosphorus, are show in the chart below. ■

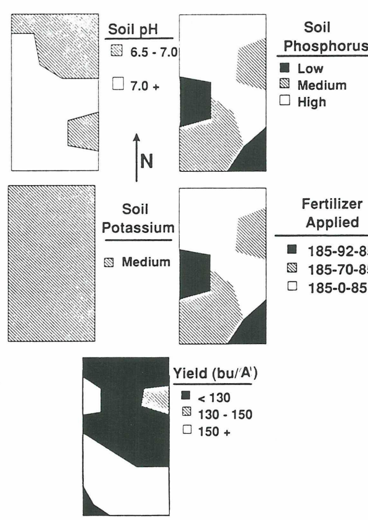
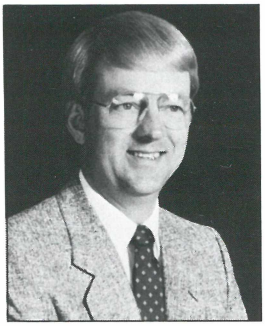


Figure 1. Southeast Missouri 80-acre corn field. Soil fertility determined from a 0 to 6 inch soil sample. Yields determined from hand harvested check strips.

Dr. J. Larry Sanders to Serve as PPI Director for Texas and New Mexico, Plus Great Plains

DR. J. LARRY SANDERS, Great Plains Director for the Potash & Phosphate Institute (PPI), has been given the expanded title of Great Plains/Southwest Director. The title change reflects Dr. Sanders' additional responsibilities in Texas and New Mexico. He will continue to maintain his office near Kansas City. The address is: P.O. Box 23529, Stanley, KS 66223; phone (913) 681-3998.

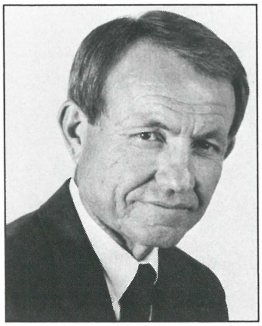
Dr. Sanders will now have responsibility for eight states: Kansas, Missouri, Nebraska, Oklahoma, Colorado, Wyoming, Texas and New Mexico. ■


Dr. J.L. Sanders

Dr. B.C. Darst Receives Medallion Award of American Forage and Grassland Council

THE American Forage and Grassland Council (AFGC) recently presented its highest award, The Medallion, to Dr. B.C. Darst, of Atlanta, GA. Dr. Darst is Vice President, Communications, of the Potash & Phosphate Institute (PPI) and President of the Foundation for Agronomic Research (FAR). Announcement of the selection came at the 1990 Forage and Grassland Council Conference in June in Blacksburg, VA.

Only one such award is presented annually. The recipient must have earned national recognition for work in research, teaching, extension, or industrial development. ■

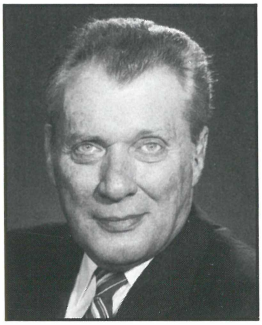

Dr. B.C. Darst

Dr. Kenneth M. Pretty, Former Leader in PPI International Programs, Dies Suddenly

DR. KENNETH M. PRETTY, age 62, passed away unexpectedly on June 23, 1990, in Toronto, Canada. He is survived by his mother, Drina (McAlpine) Pretty; a brother, Lyle Pretty; and a sister, Margaret Pretty Field.

At the time of his retirement in early 1989, Dr. Pretty was Senior Vice President for International Programs of the Potash & Phosphate Institute (PPI) and President of the Potash & Phosphate Institute of Canada (PPIC). He joined the staff of the Institute in 1959 as Canadian Director and later had responsibility for various international programs of agronomic research and education.

Dr. Pretty attended Ontario Agricultural College and received his M.Sc. and Ph.D. degrees in Soil Science at Michigan State University. He was a member of numerous professional and scientific societies. During much of his career Dr. Pretty was located in Ontario. He moved to Saskatchewan, Canada, in 1986 with the opening of the PPIC office there.


Dr. K.M. Pretty

Widely known for his efforts in international understanding of sound agronomic management, Dr. Pretty was a pioneer in establishing contacts in China and other parts of the world. He received many awards recognizing his international contributions. ■

Challenge

Life should be lived like a cavalry charge —
not like a nudist crossing a barbed wire fence.

Dixy Lee Ray, former governor of Washington and chairwoman, Atomic Energy Commission, called attention to a threat to our ecological balance that is often overlooked: FEAR! . . . fear of radiation exposure, of cancer-causing chemicals, of global warming. She says this fear "rests squarely on ignorance."

Dr. Ray urged the scientific community to recognize its responsibility in getting across to the public the truth about our health and environment — to distinguish between what is known by the scientific experts — and what the public believes because of the information it gets.

Some say such a task is fruitless, at a time when the self-appointed guardians of Mother Earth are riding high — and decisions and money expenditures are based on emotion and misleading statistics, rather than on scientific truths.

During the Alar scare, consumers called EPA and asked if it was safe to pour apple juice down the sink — would it pollute the groundwater?

We know the only answer to this vexing problem: "educate the public." But how? Can it be done? Scientists do not and cannot inform the public directly. The media inform the public. Our great challenge . . . to get the truth to the public . . . is one that will demand our best efforts.

— *J. Fielding Reed*

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