

FLUID DIGEST®

Research Update from the Fluid Fertilizer Foundation

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In drought or normal rainfall on winter wheat

Banding APP below seed produces best yields

Such were the findings of Havlin and Lamond of Kansas State University in 1989-90 studies where banding APP two inches below the seed produced best yields in both years of drought (1989) and near normal rainfall (1990) when compared to other placement methods.

Figure 1 shows how banding APP below the seed produced yields superior to those produced by other placement methods in a year of extreme drought and low yields

broadcast treatments by as much as 22 bu/A (Figure 2). Surface banding was also more effective with favorable moisture, nearly equaling banding below the seed but only at the highest fertilization rate.

In the check, where no phosphorus was applied, the nitrogen alone was ineffective, yielding only 26.2 bu/A.

The banded-with-seed treatments (*, **) gave indications that some residual phosphorus was available to

would increase the net return by \$94.20/A, compared with \$67.20/A for the surface band and \$38.70/A for broadcast. At 45-lb/A rates of application, net produced would be \$103.85/A for below-the-seed placement, \$99.85/A for surface band and \$65.85/A for broadcast. That's a top advantage of \$55.50/A at the lower rate and \$38/A at the higher rate for "doing it right." Note also that at the 45-lb/A rate, surface banding and below-the-seed placements showed

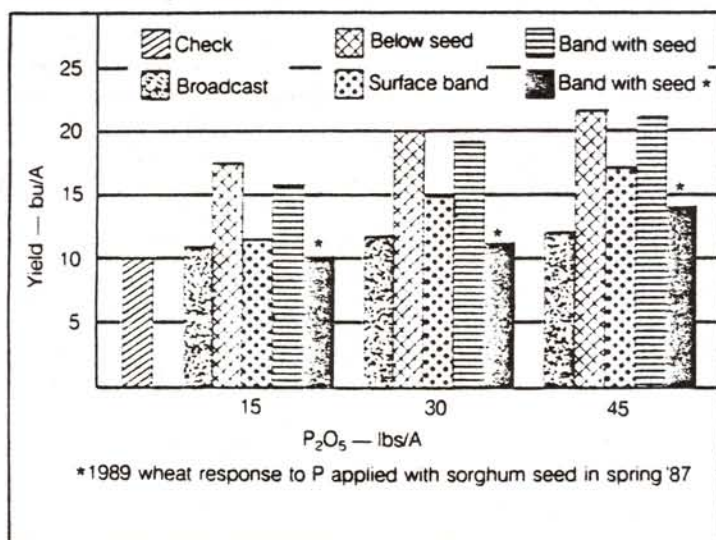


Figure 1. Response of winter wheat to P rate and placement in a year of severe drought, Butler County, Kansas 1989 (Havlin and Lamond, Kansas State University).

(1989). Banding two inches below the seed outyielded broadcasting by as much as 10 bu/A. Note that broadcast P produced little response change even up through the 45-lb/A rate. In this very dry situation, subsurface bands were more effective than surface-banded phosphates. Yields were doubled and economic losses were minimized. In the residual treatment (*), where phosphorus was applied with sorghum seed in the spring of 1987, there was a small but significant response from the 45 lbs of P₂O₅ applied per acre.

Banding near the seed also produced superior yields under near normal rainfall (1990), outyielding

the 1990 crop, but not enough to optimize yield on this low-phosphorus site.

Based on 22-cent/lb P₂O₅, each 15-lb increment would cost \$3.30 (1.32 bu of \$2.50/bu wheat buys 15 lbs of phosphate). With \$2.50/bu wheat, the first 15-lb rate placed below the seed

only a \$4/A differential.

Soil at experimental site was Woodson silt loam with a pH of 5.6 and a P level of 3 ppm (Bray P₁), 0 to 6 inches. Source of phosphorus in all of the experiments was 10-34-0 and N source was UAN, broadcast after planting at the N rate of 80 lbs/A.

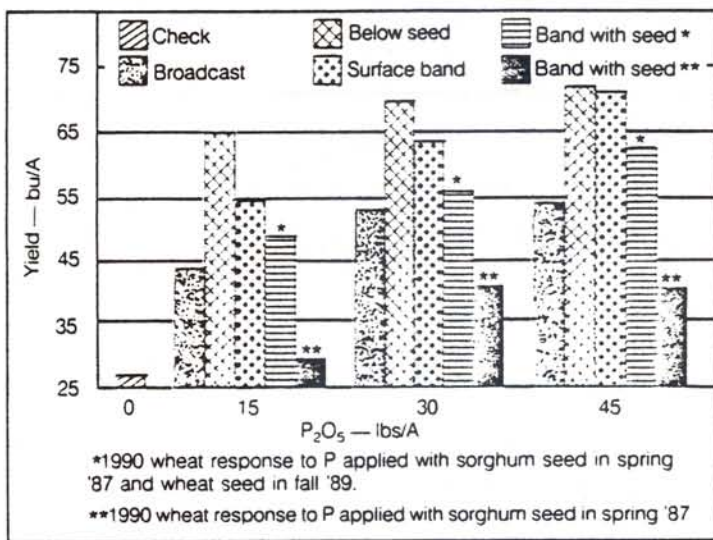


Figure 2. Response of P rate and placement in a year of near normal rainfall, Butler County, Kansas, 1990 (Havlin and Lamond, Kansas State University).

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Foundation News from your Research Director, Bob Munson



It's great to be on board and have the opportunity of working with the NFSA and the FFF team. The system of dealer and industry support and interaction of researchers on projects, which offer direction and generate answers to questions, are fantastic. Needless to say, things have been busy. Since arriving on June 1st, I've attended a Round-Up, board meetings and visited research plots throughout the United States.

We are working together to speed the "technology transfer" process. This should speed adoption of new "best management practices" to aid in market development, farmers' profits, agricultural competitiveness and environmental protection. We will be giving things an economic twist to drive home points. We are striving to create "win-win" situations for dealers, farmers and the industry.

Remember: to succeed, *serve* and be profitable!

Bob Munson, PhD.

Vice President Research, Education and Market Development

Alfalfa responds best to banded APP in Oklahoma studies

As can be seen in Figures 3 and 4, banded APP clearly outdistanced all other fertilizer forms and methods of placement in producing alfalfa yield gains over check. The research was conducted by Stein and Westerman of Oklahoma State University on a low-phosphorus, Meno fine-sandy loam soil in southwestern Oklahoma.

The two-year field experiment was initiated in the fall of 1980 with the seeding of alfalfa. Phosphorus was then applied at varying rates of 0, 40, 60, or 80 lbs/A of P_2O_5 in February of 1981. Subsurface bands were spaced 12 inches apart and placed 3 to 4 inches deep. As can be seen in Figure 3, yield increases over check, averaged over varying application rates, ranged from 7 tons/A for banded APP to 3 tons/A for broadcast TSP.

The phosphorus application was repeated in February of 1982. Yield increases over check, averaged again over varying application rates, were equally impressive — ranging from 7 tons/A for banded APP to 6 tons/A for banded TSP (Figure 4).

Economic benefit from the '82

maximum average gain over check would have been \$630/A, less cost of inputs applied at varying rates for each year and assuming alfalfa at \$90/ton.

Among the general conclusions reached by the researchers conducting the study were: "The combination of low soil P and young stand age provided for marked response to the phosphorus applications. The observation of an apparent superiority of subsurface applied APP on newly established alfalfa when the soil P index is low seems to be worthy of further investigation."

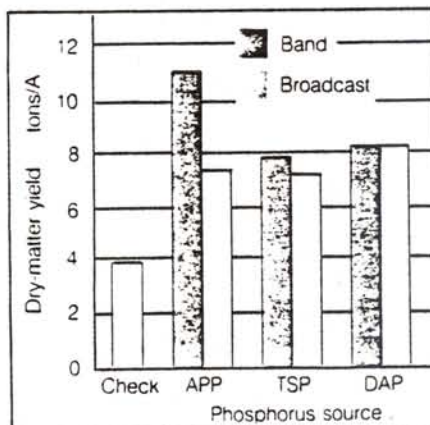


Figure 3. Effect of P source and application method averaged over application rates on dry-matter yield of established alfalfa, 1981 (Stein and Westerman, Oklahoma State University).

BMP is the law in Nebraska

A fact of life the ag community has lived with since 1986 when the Nebraska Legislature moved away from voluntary observance of best management practices (BMP) and defined it into law. Although the statute allows for mandated use of BMPs through regulation, triggering of this regulation is generally permissive and requires action by local governing bodies. Major thrusts continue to be education and demonstrations through voluntary adoption of BMPs.

Determinations of groundwater violations are made in Nebraska's 23 natural resource districts (NRD) by locally elected officials. An NRD is authorized by Nebraska law to require through regulation the use of BMPs to reduce, stop or prevent groundwater contamination. If groundwater contamination is present and a board votes "yes" on remedial action, steps may be taken that could lead to BMP regulations. The process is subject to public hearings and final adoption by the elected members of the NRD board.

A second alternative is for an NRD to request the Nebraska Department of Environmental Control (NDEC) to study the problem. If a problem is determined, the NDEC will establish a special groundwater protection area to be administered by the NRD. One such protection area now being established prohibits N application in the fall and winter.

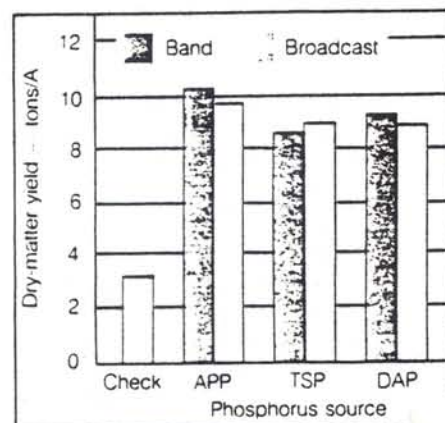


Figure 4. Effect of P source and application method averaged over application rates on dry-matter yield of established alfalfa, 1982 (Stein and Westerman, Oklahoma State University).

For improved efficiency

Soil test before applying P to soybeans

Figure 5 shows how yield response to P can vary dramatically if soil test P is not accounted for prior to fertilization. The data were taken from eight experiments conducted from 1987 through 1989 by Sander, Ferguson, Shapiro and Essman of the University of Nebraska.

Evaluations were made of knife, starter and broadcast methods of phosphate application in combination with five rates: 0, 18, 37, 55 and 75 lbs/A of P_2O_5 . Soil test P (Bray P_1) ranged from 4.2 to 16 ppm.

Soils were divided into those ranging from 4.2 to 6.5 ppm and 6.5 to 10 ppm. When the soil test was less

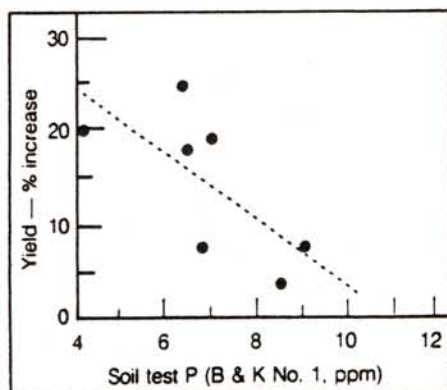


Figure 5. Percent soybean grain yield increase to applied P as related to soil test P levels. Mean of seven soils, 1987-89 (Sander, Ferguson, Shapiro and Essman, University of Nebraska).

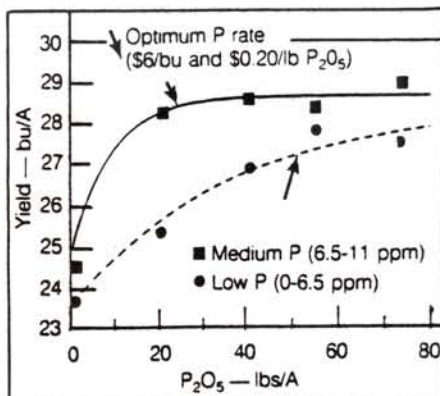


Figure 6. Effect of applied P on soybean grain yield, showing optimum rate to apply on soils testing low and medium in available P (B & K No. 1), 1987-89 (Sander, Ferguson, Shapiro and Essman, University of Nebraska).

than 6.5 ppm, soybean yields increased 15 to 25% (Figure 5). When it fell between 6.5 and 11 ppm, yield increase was 0 to 15%. Note that above 11 ppm, no yield response occurred.

Optimum rate for applying P (soybeans @ \$6/bu and P_2O_5 @ \$0.20/lb) also differed according to how soils tested (Figure 6). On low-testing soils (0 to 6.5 ppm), optimum rate was 51 lbs/A of P_2O_5 . On soils testing 6.5 to 11 ppm, optimum rate was 23 lbs/A of P_2O_5 .

Although yield again varied according to how soils tested, note in

Figure 7 that knifing P produced higher yields than either broadcast or row, especially on the soils testing low. The researchers speculated that "knifing P may provide better root access for the tap rooted soybean."

The researchers concluded that it appears P fertilization will increase soybean yields, provided that P tests below 10 ppm (as recommended by the University of Nebraska Soil Testing Service). "Knifing in a 15-inch spacing appears to be a superior method of application with row application somewhat better than broadcast."

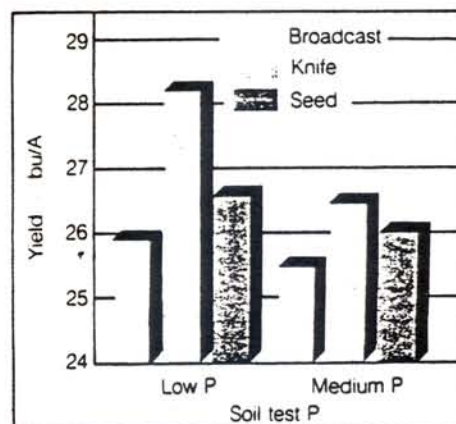


Figure 7. Effect of method of P application on soybean grain yield as influenced by low and medium soil P availability. Mean of seven soils in eastern NE, 1987-89 (Sander, Ferguson, Shapiro and Essman, University of Nebraska).

Profitmaker P ideal for winter wheat

So say researchers in a winter wheat study conducted from 1979 through 1982. Sander and Penas of the University of Nebraska found that winter wheat responded more to P than other grain crops.

Table 1 shows yield responses to different methods of P (23 lbs/A of P_2O_5) placement. Differentials in yield responses ranged from 3 to 22 bu/A among the varying methods of placement, with a mean yield advantage of 10.2 bu/A. Even with \$2.50/bu wheat, that gives an average advantage of \$25.50/A to the better method.

When P soil tests were in the 4 to 6 ppm range, responses to best placement ranged from 9 to 29 bu/A, averaging 18.2 bu/A or a net return of

Table 1											
Effect of different methods of phosphorus placement on yield of winter wheat over ten locations, 1979-82 (Sander and Penas, University of Nebraska).											
Placement *	1979		1980		1981		1982		Mean		
	bu/A										
N alone	34	33	39	21	55	30	35	49	8	14	32
Knife	42	35	48	50	60	42	45	55	16	24	42
Broadcast	33	32	39	28	53	31	47	54	9	15	34
Seed	40	35	42	46	61	35	58	63	15	26	42
Bray No. 1 P ppm	13	11	5	6	8	9	4	5	—	—	

* All treatments: 70-80 lbs/A of N; 23 lbs/A of P_2O_5 .

over \$40/A with \$2.50 wheat and \$0.22/lb phosphate. Apparently, the broadcast phosphate was just positionally unavailable.

Profit from phosphate use could be essentially doubled by either knifing in or applying it with the seed, when compared to broadcast. Knifed-in treatment was usually equal to or better than seed-placed phosphate.

DIRECT-DIAL HELP!

If you desire detailed information on studies reported in this issue.

314/256-4900

In good P management Planting date another key

As Table 2 shows, P performance is influenced not only by method of placement and rate of application but by planting date as well. The results are from a 1988 southeast Nebraska study by Sander of the University of Nebraska.

On the phosphate control (check) plots, delaying planting decreased yield by 22.5 bu/A at one site and 6.9 bu/A at a second. Soil test P levels were low at the two locations.

Knifed-in phosphate for the September 22 planting date (near optimum for the area) produced a net return of \$5.79 to \$14.79/A at the 18-lb/A P_2O_5 rate.

Wheat studies Placement less of a factor in high-P soils

Table 2						
Effect of planting date, phosphate rates and method of application on yields of winter wheat in southeast Nebraska, 1988 (Sander, University of Nebraska).						
Planting date Days after 9/15	P_2O_5 rate lbs/A	Knife	Location			Seed
			88-7	Seed bu/A	Knife	88-6
7 (9/22/87)	0		57.3			56.7
7	18	61.2		57.2	64.2	56.2
7	36	56.2		63.2	68.3	56.2
7	54	67.2		58.2	56.2	66.2
20 (10/6/87)	0		48.2			54.4
20	18	54.2		56.2	58.2	58.2
20	36	55.2		61.2	54.2	69.3
20	54	58.2		62.2	60.2	67.2
33 (10/19/87)	0		34.9			49.8
33	18	43.2		58.2	44.4	62.2
33	36	55.2		55.2	59.2	62.2
33	54	46.2		59.2	52.2	63.2

Seed-placed phosphate was more effective than knifed-in on the October 19 date than on the October 6 date. At both sites and for both dates, the 36-lb/A rate produced yield increases

an average of 20+ bu/A, with profits increasing an average of \$42+/A. Seed-placed P was also very effective at the 18-lb/A rate on the October 19 date.

Differences between placement methods were not considered significant in a two-year maximum yield wheat research program run by Alley, Brann and Hammonds of Virginia Polytechnic Institute.

Evaluated was P placement on a State sandy loam soil with a P soil test of 24.5 ppm. APP was the source of the P and was applied at the rate of 80 lbs/A of P_2O_5 , also supplying 24 lbs/A of N.

Timely planting on October 18 increased yield by 22 bu/A on control plots and 30.5 bu/A when averaged over the phosphate treatments (Table 3). Note there was response to P from the October planting but none from the crop planted in December. Extremely cold temperatures in late December were believed to have masked treatment effects.

Although placement was not considered significant in these experiments, the P treatments, when averaged across methods of placement, did increase net return by \$7.40/A over check.

Table 3

Winter wheat (Feland) yields as influenced by phosphate placement and planting date on a State sandy loam soil, Mt. Holly, VA. 1983-84 (Alley, Brann and Hammonds, VPI).

Planting Date	No N No P	Phosphorus placement					Planting date means
		Broadcast	Strip	Inject	In-row	N*	
					bu/A		
Oct. 18	77	90	83	86	93	78	85
Dec. 1	55	58	54	59	59	53	56
Placement means	66	74	68	72	76	66	

LSD .05: Planting date means, 1; placement means, 5; between placement methods within the same planting date, 9.

* N applied as 30% UAN broadcasted at rate of 24 lbs/A of N.



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