

EVALUATION OF BANDED FERTILIZER FOR SOYBEAN PRODUCTION

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Response of the soybean crop to phosphate and potash fertilizer when soil test levels indicate the need for additional P and/or K is well documented. The value of the additional bushels exceeds the cost of the fertilizer.

In general, phosphate and potash fertilizer, when needed, can either be broadcast and incorporated before planting or applied in a band at the time of planting. The banded application is frequently preferred for a variety of reasons. This is especially true when the soybean crop is grown in one of a variety of conservation tillage production systems.

There are several options for the placement of the fertilizer band. With modern planters, use of starter attachments is no longer a viable option for many producers. In addition, use of air seeders is becoming more popular where this planting equipment can be used for planting of both wheat and soybeans. Various attachments allow for several options in fertilizer placement.

Past research had compared the more traditional "starter" placement with broadcast applications of the immobile nutrients. An evaluation of alternative banded applications was needed. Therefore, the studies described and summarized in the following paragraphs were designed to evaluate various options for banded application of immobile nutrients for soybean production.

Experimental Procedures

Seed Placement Study

This study was conducted for 2 years at the Southern and Southwest Research and Outreach Centers located at Waseca and Lamberton respectively. The study was conducted at a different site each year. The soybean crop followed corn at both locations each year. Sites selected had high soil test values for both P and K as measured by standard soil test procedures.

Two factors (fertilizer source, rate of application) were combined in a complete factorial with 4 replications. Three fluid materials (10-34-0, 4-10-10, 7-21-7) were each applied at rates of 0.1 gal. and 0.2 gal. per 1000 ft. row. An appropriate control (no fertilizer applied) was also included in the study. The fertilizer was delivered through a double disk opener of a Tye Drill to be placed in direct contact with the seed. Row spacing was 8 inches. The treatments were arranged in a randomized complete block design.

Seeding rate in both years was adjusted to approximately 180,000 seeds per acre. Varieties chosen were adapted to the location. Preemergence herbicides were used for weed control. Soybeans were planted in late May of each year.

Soybean emergence was measured approximately 4 weeks after planting by counting the number of soybean plants in 2, 5 ft. sections of row in each plot. Soybeans were harvested in mid-October and yields were corrected to 13.5% moisture.

Air Seeder Study

This study was conducted in the fields of cooperating soybean growers in Grant and Sibley Counties. Grant County is located in West-Central Minnesota. The soil at this site was calcareous and poorly drained with a high percentage of clay. Tile drainage was not used at this site.

Sibley County is located in Central Minnesota. The calcareous soil was classified as being somewhat poorly drained. Tile drainage was used. Relevant soil test values are summarized in Table 1.

An air seeder was used to plant soybeans following corn at each site. This study was limited to the evaluation of the placement of phosphate fertilizer (0-46-0).

Two factors (placement, rate of P_2O_5) were combined in a complete factorial design with 4 replications. For Grant County, a single control was used and P_2O_5 rates were 35 and 70 lb. P_2O_5 per acre. A control was used for each placement at the Sibley County site. The rates of applied phosphate were also changed to 20, 40, 60, and 80 lb. P_2O_5 per acre.

A brief description of the various placements of phosphate follows.

broadcast: Phosphate fertilizer was broadcast and incorporated before planting. Incorporation was achieved with a field cultivator following a primary tillage utilizing a chisel plow.

seed mixed with fertilizer: For this placement, a shoe was attached to the air seeder that provided for a mixture of fertilizer and soybean seed. This mixture was placed in a band that was approximately 3 to 4 inches wide, 1 inch below the soil surface.

banded beside seed: An attachment was placed on the air seeder that placed the phosphate fertilizer to the side of and below the seed at planting. Both seed and fertilizer were applied in individual bands that were separated by approximately one inch of soil.

banded between two rows: In this banded placement, a band of fertilizer is placed between 2 narrow rows of soybeans by changing shoes on the air seeder. The soybean rows were 4 inches apart. Seeding rate was the same as used in other placements. The soybeans, however, were divided between 2 narrow rows.

The soybean varieties used were adapted to each site. A preemergence herbicide was used for weed control. Planted population was approximately 180,000 at both sites.

Stand counts were taken approximately 4 weeks after planting. Counts were taken from 2, 5 foot sections of row in each plot. Soybean yields were measured in early October and corrected for 13.5% moisture.

Results and Discussion

Seed Placement Study

The effect of fluid fertilizer grade and rate of application is summarized for the Southern and Southwest Research and Outreach Center in Figures 1 and 2 respectively. The values shown are expressed as % of the control where no fertilizer was applied.

Except for the use of 7-21-7 at a rate of 0.2 gallons / 1,000 ft. row, neither the fertilizer grade nor the rate applied had an effect on emergence at the Waseca site (Figure 1). When compared to the control where no fertilizer was used, emergence was greater when phosphate fertilizers were applied in contact with the seed. Enhanced crop emergence is frequently identified as one of the major benefits of using a banded fertilizer.

The negative effect of 7-21-7 on emergence at the Lamberton site is shown in Figure 2. Reduction in emergence at this site was greater than the reduction measured at the Waseca site. This observation is attributed to differences in soil moisture with soil moisture at planting usually less at the Lamberton site. At Lamberton, emergence of soybeans was nearly equal to the control for all treatments with the exception of 7-21-7 applied at a rate of 0.2 gallons per 1,000 ft. of row. The use of fertilizer in contact with the seed did not improve emergence.

In both years of the study, placement of all fertilizer grades in contact with the soybean seed had no effect on yield at both sites. The yields from the Lamberton site are summarized in Table 2. Even though there was a substantial reduction in emergence when 7-21-7 was applied at a rate of 0.2 gal./1,000 ft. row, this reduction was not reflected in reduced yield. There is general recognition that the soybean plant can compensate for reduced stand by increased branching with the added branches producing more pods. This ability to compensate explains the absence of a reduction in yield.

The emergence information gathered in this study shows that soybeans can tolerate fluid fertilizer in contact with the seed at planting if the fertilizer is applied at relatively low rates. As evidenced by the damage associated with the use of 7-21-7, this is a management practice associated with some risk.

Although reduced emergence was not associated with reduced production in this study, yield reductions can be the end result of reduced emergence. Because of the risk involved, the use of fertilizer in contact with the seed at planting is not a recommended practice at this time.

Air Seeder Study

Air seeding equipment provides the soybean grower the opportunity to plant soybeans and apply fertilizer in one field operation. This equipment can be fitted with various attachments to place the fertilizer in a variety of positions with respect to the seed. This study was conducted to evaluate the effect of those placement options.

One attachment provides for the mixing of fertilizer with the seed and both are placed in a band approximately 3 to 4 inches wide at a depth of 1 inch. This attachment was also used to plant the control and broadcast-treatments. Therefore, emergence as affected by placement of fertilizer placed with the seed can be compared to the control. At the Grant County site, emergence resulting from this placement was reduced by both rates of applied phosphate (Table 3).

Other attachments were used to place fertilizer in a band beside the seed or in a band between two narrow rows. A control (no applied phosphate) was not included with these placements in Grant County. Depth control was a problem and probably explains the difference in emergence that was measured for these two placements (Table 4). However, emergence was not reduced as the rate of phosphate was increased from 35 to 70 lb. per acre. Both attachments provided for soil between seed and fertilizer probably eliminating damage to emergence.

Application of phosphate fertilizer did not increase soybean yield at the Grant County site (Table 5). A soil test value of 8.5 ppm when P is extracted by the Olsen procedure is considered to be marginal by University of Minnesota standards. A response to applied phosphate may or may not be measured. In this study at this site, there was no measured response.

The measured reduction in emergence was associated with reduced yield. With a marginal soil test for P, a stand reduction of approximately 20% produced a reduction in yield of about 4.5 bu. per acre.

The effect of phosphate placement on soybean emergence at the Sibley County site is summarized in Table 6. Since a control was included with use of each attachment, emergence from applied phosphate can be reported as % of the control (Table 6). The placement where the banded phosphate is positioned between two narrow rows was not used at this site.

In agreement with the results from Grant County, phosphate mixed with seed decreased emergence when the rate exceeded 20 lb. P_2O_5 per acre. With the other placements, emergence varied in the range of 90 to 110% of the control.

Soybean yields from the Sibley County site are provided in Table 7. The reduction in emergence was reflected in a reduction in yield. A reduction of approximately 30% in emergence was associated with a yield reduction of 6 bu. per acre.

Except for the applied rate of 80 lb. P_2O_5 per acre, yields resulting from a broadcast application were slightly higher than yields resulting from a comparable rate applied to the side of and below the seed at planting (the traditional starter placement). This observation agrees with results of other studies that were designed to compare broadcast and starter applications of phosphate fertilizer for soybean production.

The yields from the Sibley County site also show that soybean yields were not increased by the rate of applied phosphate. As was the case at the Grant County site, the soil test P measured by the Olsen procedure was marginal. With yields in the range of 30 to 35 bu. per acre, added phosphate was not needed for optimum production at this soil test level.

Summary

Past research has shown that corn can tolerate reasonable rates of fertilizer applied in contact with the seed (pop-up) if urea is not used as the source of N. Less was known about the tolerance of the soybean crop to fertilizer placed in contact with the seed.

In addition, the use of air seeding equipment offers various options for placement of fertilizer in a band in the vicinity of the seed. There was a need to evaluate these placement options for soybean production.

Two studies were conducted to answer questions about banded placement of fertilizer for soybean production. Emergence was reduced when 7-21-7 at a rate of 0.2 gal. per 1,000 ft. row was placed in contact with the seed while 10-34-0, and 4-10-10 had no negative effect at the same rate. The reduced emergence did not result in lower yields because soybeans can compensate somewhat for reduced stand.

Using an air seeder, the application of 0-46-0 reduced emergence when it was applied in a mixed band with soybeans. This reduction in emergence produced a reduction in yield. Emergence was not affected when soil was placed between seed and fertilizer.

The results of the two studies showed that there is a risk when fertilizer, either liquid or dry, is placed in contact with the seeds. Soils were wet at the sites where these studies were conducted. Increased damage might be expected when soils are drier at planting.

Table 1. Relevant soil test properties at the experimental sites used for the air-seeding study.

Property	<u>Location</u>	
	Grant County	Sibley County
pH	7.9	7.9
potassium, ppm	209	166
phosphorus (Olsen), ppm	8.5	9.0
phosphorus (Bray), ppm	9.3	5.7

Table 2. Soybean yield at the Southwest Research and Outreach Center (Lamberton) as affected by the application of 3 fluid fertilizers in contact with the seed at planting.

Fertilizer Grade	Rate Applied (gal./1,000 ft. row)		
	0	0.1	0.2
	-----bu./acre-----		
none	50.3	—	—
10-34-0	—	51.2	50.3
4-10-10	—	52.3	51.8
7-21-7	—	49.4	50.7

Soil Moisture (0 to 3 in.) = 24.9%

Table 3. Soybean emergence as affected by broadcast application and mixing of phosphate fertilizer with the seed when soybeans were seeded with an air seeder. Grant County.

Placement	P ₂ O ₅ Applied (lb./acre)	
	35	70
	-----% of control-----	
broadcast	97.2	96.9
seed mixed with fertilizer	78.1	77.8

P₂O₅ Source = 0-46-0

Table 4. Soybean emergence as affected by phosphate fertilizer applied in a band near the seed. Grant County.

Placement	P ₂ O ₅ Applied (lb./acre)	
	35	70
	-----plants / acre-----	
banded beside seed	172,880	176,960
banded between two rows	157,450	156,090

P₂O₅ Source = 0-46-0

Table 5. Soybean yield as affected by placement of phosphate fertilizer. Grant County.

Placement	<u>P₂O₅ Applied (lb./acre)</u>		
	0	35	70
	-----bu / acre-----		
control	43.9	–	–
broadcast	–	42.0	42.2
seed mixed with fertilizer	–	39.3	39.3
banded beside seed	–	37.2	41.5
banded between two rows	–	41.2	41.0

Table 6. Soybean emergence as affected by rate and placement of phosphate fertilizer when the soybeans were seeded with an air seeder. Sibley County.

Placement	<u>P₂O₅ Applied (lb./acre)</u>			
	20	40	60	80
	-----% of control-----			
broadcast	92.2	108.3	94.7	99.4
banded beside seed	90.3	107.2	105.9	109.3
mixed with seed	96.1	64.5	71.0	62.5

P₂O₅ Source = 0-46-0**Table 7. Soybean yield as affected by rate and placement of phosphate fertilizer when soybeans were seeded with an air seeder. Sibley County.**

Placement	<u>P₂O₅ Applied (lb./acre)</u>				
	0	20	40	60	80
	-----bu. / acre-----				
broadcast	34.4	35.2	36.0	37.8	34.7
banded beside seed	33.9	33.5	34.3	31.9	34.4
mixed with seed	37.1	36.8	36.2	33.8	28.6

P₂O₅ Source = 0-46-0

Figure 1. Soybean emergence at the Southern Research and Outreach Center as affected by fertilizer grade and rate applied in contact with the seed (gallons per 1,000 ft. row).

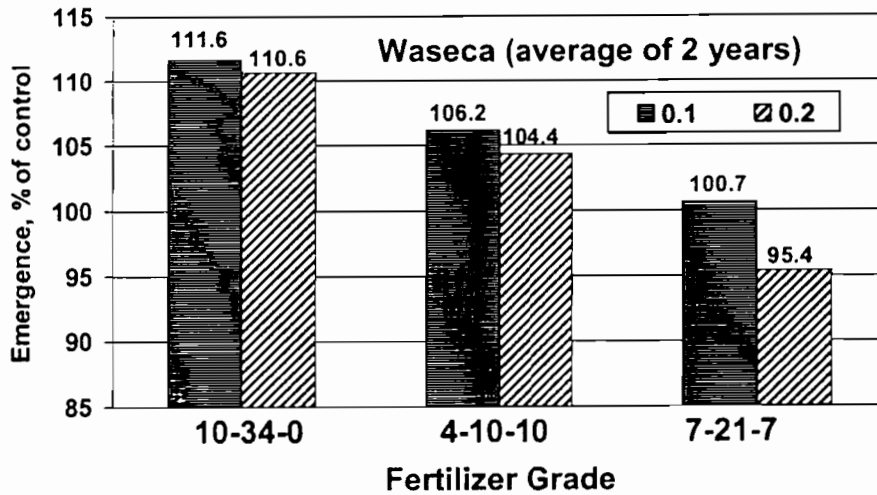
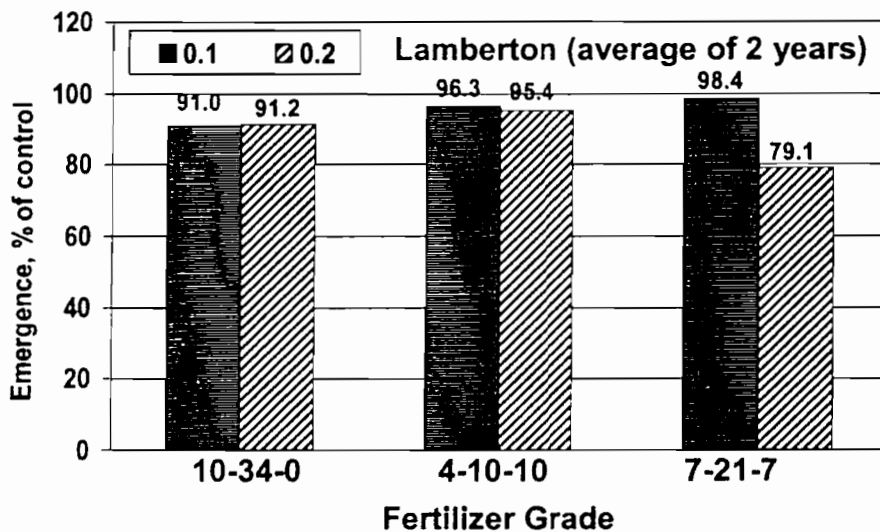


Figure 2. Soybean emergence at the Southwest Research and Outreach Center as affected by fertilizer grade and rate applied in contact with the seed (gallons per 1,000 ft. row).



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