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What Is Optimum Placement of NPKS Starters for Corn on High-Testing Soils?

Historically, starter fertilizers have not commonly been recommended for corn production on high or very high P-testing soils due to poor yield responses, even though early growth responses may be seen. However, renewed interest in starter (band-placed) fertilizer has increased as corn yields continue to increase, tillage intensity tends to decrease, and corn planting becomes earlier. With this renewed interest, questions have been raised regarding the inclusion of potassium (K) and sulfur (S) in the fluid starter in optimum positions 2 inches from the seed or as bands dribbled on the soil surface. Thus, the objectives of this research were:

- Determine effect of various combinations and rates of NPKS as fluid starters for improving corn production and profitability on high P- and K-testing soils
- Evaluate starter placement positions for NPKS fluid fertilizers for corn grown on high P- and K-testing soils
- Provide management guidelines on fluid starter fertilizer rates and placements for corn grown on high P- and K-testing soils with reduced tillage.

Concentration

Concentrations of NPKS in the whole small plant at the V7 stage were inconsistently affected by the NPKS treatments. This was particularly true for N where statistically significant differences were found, but there was no clear effect of rate or placement, and no interaction between rate and placement. Whole plant P and K concentrations were not affected by the starter P and K treatments. Whole plant S concentration was increased by the 2x0 and 2x2 treatments that received S. Concentrations of NPKS were similar between the 2x0 and 2X2 placement positions.

Minnesota researchers seek answers as they conduct corn studies at research center in Waseca, Minnesota.

SUMMARY

Corn plant populations were not affected by any of the starter treatments except the 6+20+6+4 in-furrow, popup treatment, which reduced the population by 30 percent. Concentrations of NPK at the V7 growth stage generally were not affected by the starter treatments. Uptake of NPKS at the V7 stage was affected by the starter treatments due to large effects of the treatments on dry matter production. Dry matter was increased over the control by all starter treatments. With the exception of the 21-bu/A decrease in corn grain yield with the 6+20+6+4 popup treatment, grain yield and moisture content were not affected by the starter treatments. In summary, profitability was not improved this year on this very high P-testing soil by any of the starter NPKS rates or placement positions despite very significant and profitable responses on the same soil the preceding year.

Dry matter

Dry matter accumulation at V7 was greatly affected by the starter P treatments on this very high P-testing soil (Table 1). Dry matter was increased over the control by all starter treatments. Largest plants were obtained with the 6+20+6+4 and 6+20+0+0 popup treatments. Dry matter accumulation was similar for the 2x0 and 2x2 placement positions.

Uptake

These early growth differences resulted in highly significant differences in NPKS uptake among treatments. In general, greatest NPKS uptake occurred with the popup treatments and the 20+20+10+10 (2x2) treatment. Placement position (2x0 vs. 2x2) had no effect on NPKS uptake. Both were effective.

Grain yield

Grain yield was not increased on this very high P-testing soil over the no-starter control by any of the starter treatments (Table 2). However, the 6+20+6+4 treatment

applied in the furrow with the seed reduced yield by 21 bu/A compared to the no-starter control. This yield reduction was associated with a 30 percent reduction in plant population apparently due to K and S (6 and 4 lbs/A, respectively) placed on the seed. Potassium and S rates and placement position (2x0 and 2x2) did not affect grain yield. These results contrasted with the preceding year's data where the same in-furrow application increased yields 17 bu/A and S application produced an additional 12 bu/A.

Table 1. Dry matter yield of corn plant as influenced by rate, placement, and source of fluid starter, Waseca, 2005.

Fluid starter treatments Rate lbs N+P_2O_5+K_2O+S/A	Placement	Sources	Yield lbs/A
0 + 0 + 0 + 0	None	None	392
6 + 20 + 0 + 0	Popup	APP	636
6 + 20 + 6 + 4	Popup	APP + KTS	690
20 + 20 + 6 + 4	2 x 0	APP + UAN + KTS	502
20 + 20 + 6 + 4	2 x 2	APP + UAN + KTS	494
20 + 20 + 0 + 4	2 x 0	APP + UAN + ATS	512
20 + 20 + 0 + 4	2 x 2	APP + UAN + ATS	524
20 + 20 + 6 + 0	2 x 0	UAN + 7-21-7	582
20 + 20 + 6 + 0	2 X 2	UAN + 7-21-7	526
20 + 20 + 10 + 10	2 x 0	APP + UAN + KTS + ATS	508
20 + 20 + 10 + 10	2 x 2	APP + UAN + KTS + ATS	592
20 + 40 + 10 + 10	2 x 0	APP + UAN + KTS + ATS	534
40 + 40 + 10 + 10	2 x 0	APP + UAN + KTS + ATS	480

Table 2. Corn grain yield as influenced by rate, placement, and source of fluid starter, Waseca, 2005.

Fluid starter treatments Rate lbs N + P_2O_5 + K_2O + S/A	Placement	Sources	Yield bu/A
0 + 0 + 0 + 0	None	None	166.5
6 + 20 + 0 + 0	Popup	APP	170.4
6 + 20 + 6 + 4	Popup	APP + KTS	145.1
20 + 20 + 6 + 4	2 x 0	APP + UAN + KTS	168.3
20 + 20 + 6 + 4	2 x 2	APP + UAN + KTS	162.0
20 + 20 + 0 + 4	2 x 0	APP + UAN + ATS	170.2
20 + 20 + 0 + 4	2 x 2	APP + UAN + ATS	170.7
20 + 20 + 6 + 0	2 x 0	UAN + 7-21-7	168.6
20 + 20 + 6 + 0	2 x 2	UAN + 7-21-7	164.5
20 + 20 + 10 + 10	2 x 0	APP + UAN + KTS + ATS	171.6
20 + 20 + 10 + 10	2 x 2	APP + UAN + KTS + ATS	166.3
20 + 40 + 10 + 10	2 x 0	APP + UAN + KTS + ATS	172.3
40 + 40 + 10 + 10	2 x 0	APP + UAN + KTS + ATS	159.1

Grain moisture

Grain moisture at harvest was not affected by any of the fluid starter NPKS rates or placement positions.

Plant population

Initial plant population was reduced 30 percent (to 22,600 plants/A) by the 6+20+6+4 popup treatment placed in the seed furrow on top of the seed. None of the other fluid starter treatments affected plant population, which averaged about 33,500 plants/A, indicating no phytotoxicity for the starter rates or placements. Why did the 6+20+6+4 popup treatment reduce plant stand in 2005 but not in 2004? Comparison of soil temperature (2-inch depth) and precipitation data for the two years at the time of planting and in the following 10 days revealed little difference in precipitation (1.5 inches in 2004 and 1.45 inches in 2005) but a large temperature difference. In 2004, soil temperature at the 2-inch depth was 56°F at planting and averaged 65°F in the next 10-day period. In 2005, soil temperature was 48°F at planting and averaged 59°F in the next 10 days. Moreover, the number of days between planting and emergence was 8 days in 2004 and 15 in 2005. The cool temperatures, which delayed emergence by a week, apparently weakened the germination viability, reducing stand significantly and yield response to starter.

Conclusions

• In this cool spring, when wet conditions prevailed after planting,

a significant plant growth response was observed for all fluid starter treatments on this very high P-testing soil. Largest growth increase was obtained with 6+20+0+0 and 6+20+6+4 popup treatments

• Plant population was reduced 30 percent by the 6+20+6+4 popup treatment. Plant population was not affected by the other popup or by other placement (2x0 or 2x2) methods

• Plant concentrations of NPK were not greatly different among any of the treatments at the V7 stage. Sulfur concentration was increased by the 2x0 and 2x2 treatments containing S. Uptake of NPKS was substantially increased by fluid starter due to the large effect on early growth

• Corn grain yields in 2005 were not increased over the control by any of the starter treatments but were significantly increased in 2004. A 21-bu/A yield reduction resulted from the 6+20+6+4 popup treatment that reduced plant stand by 30 percent. Grain yields were not different between surface dribble (2x0) and injected (2x2) placements in either 2004 or 2005

• Grain moisture at harvest was not significantly affected by any of the fluid starter treatments.

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