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Searching For More Effective Corn Starters In Conservation-Till

A combination of laboratory/greenhouse and field experiments offers useful information to dealers, producers, and agronomists.

Summary: *Starter fertilizer formulation and placement studies in 2002 were: 1) effect on corn growth and grain yield, 2) changes in P bio-availability in the soil, and 3) differences in hybrid response. Formulation and placement generally had no effect on corn emergence in 2002, with a mean of 86 percent and values ranging from 78 to 90 percent. The exception was 21 gal/A of 7-21-7, applied as a 4-inch surface band over the row, which decreased emergence. In 2002, no one N:P_2O_5 ratio or starter placement consistently outperformed all others; however, the highest yields were produced with starters containing more N relative to P_2O_5. Measurements of P availability within the profile were inconsistent. Highest concentration of bio-available P 43 days after application occurred more than four inches below the surface for 15-30-10 (2x0), while application of 60-30-10 (2x0) had little measurable effect. At 68 days after application, changes in P bio-availability probably reflected differences in root proliferation, rather than the effect of a starter fertilizer application. Finally, preliminary results of a pot experiment suggest that two non-transgenic corn varieties took better advantage of early growing conditions in Clarion silt loam soil than did transgenic isolines.*

Starter fertilizer has been a key management tool for corn production in the Midwest for many years. During spring planting, low soil temperatures and high soil water content can inhibit corn root growth. Experience and research have shown that starter applications can alleviate nutrient stress, frequently producing a yield response—particularly in conservation-till systems.

Recent studies suggest that both N and P are responsible for early growth responses and grain yield increases, with specific N:P ratios more effective. Research also has shown that N and P stimulate root growth and enhance uptake. Placing N and P together enhances P uptake. In general, starter effectiveness depends on how well it increases the soil's supply of N and available P and how well corn seedlings respond to this increase.

Hybrid selection bears on starter effectiveness. Earlier studies in Florida and Kansas reported that 46 to 60 percent of hybrids tested showed a positive response to starters. However, little research has specifically addressed hybrid-starter interactions of transgenic and non-transgenic hybrids.

To investigate the interactions of soil supply characteristics and hybrid selection outlined above, laboratory/greenhouse and field experiments were conducted. Objectives of this research were to evaluate the effectiveness of 7-21-7 fluid starters in combination with UAN as a corn starter, determine the effect of N:P_2O_5 ratio on soil supply of P, and determine if P response is hybrid dependent.

Starter effects

Plant nutrition. Starters generally had no effect on plant emergence in 2002, with a mean of 86 percent and values ranging from 78 to 90 percent. The exception was 21 gal/A of 7-21-7, applied as a 4-inch surface band over the row, which decreased emergence.

At mid-silk, both the N and P contents of ear leaves (Table 1) were in the sufficiency ranges of 2.7 to 4 percent for N and 0.25 to 0.50 percent for P, although some values were on the low end of the range. However, K content of the tissue was below the sufficiency range of 1.7 to 3 percent. Given that precipitation once again fell below normal during this part of the 2002 growing season, the soil supply of K via diffusion may have been limited. Although soil strength measurements were not made, it also is possible that soil compaction affected K uptake by the root systems. The very high level (200 ppm) of exchangeable K in the soil certainly did not limit K availability.

Yield. In 2002, starters produced variable yield effects (Table 2). When 21 gal/A of 7-21-7 was surface-banded over the row, yield decreased. This

reflects the poor emergence observed at the beginning of the season and suggests that high rates of high-salt-index starters should not be applied over the row. Highest yield (191 bu/A) was obtained with a 60-30-10 starter application dribbled over the row. It is interesting to note that the higher yields were produced with starters containing more N relative to P_2O_5. Given the lack of precipitation, however, the overriding yield-limiting factor in 2002 was lack of soil water.

As in previous years, more P_2O_5 was removed with the grain than was applied with the starter. Soil tests suggested that initial P was adequate for a majority of these plots, so additional P would likely not have been recommended. However, continuing Kansas studies have consistently reported responses to starter N and P on high-P testing soils under reduced-till conditions.

Soil Bio-available P. Movement of bio-available P into the soil profile was evaluated at 43 and 68 days after dribble application of starter during the 2002 growing season. Studies in 2001 had shown P movement up to 4 inches in high N starter bands, but measurements in 2002 were inconsistent. Some movement into the soil profile was evident 43 days after application in 2002 (Figure 1). Highest bio-available P concentration at 43 days after application occurred more than four inches below the surface for a 15-30-10 (2x0) starter. Given that samples were collected well after emergence, these increased P levels would benefit the plant when root length density reached a maximum at tasseling. In contrast to 2001 results, application of 60-30-10 (2x0) had little measurable effect on bio-available P concentrations 43 days after application. Because the data in Figure 1 represent only two replications, P movement may have occurred, but was not measured.

At 68 days after application of 15-30-10 (2x0), highest bio-available P concentration was measured less than two inches below the surface (Figure 2). For 60-30-10, highest P concentration occurred more than three inches below the surface.

Unfortunately, these measurements may be an artifact of P in the corn root system rather than the soil. At this stage, root proliferation in the surface soil was extensive. Although measurements were made no closer than 12 inches from a plant, roots could not be avoided.

When bio-available P profiles for 15-30-10 and 60-30-10 are compared (Figures 1 and 2), the effect on P

Table 1 Effect of starter composition and placement on ear leaf NPK content at mid-silk in 2002. Values are means of four replications.

Treatment	Nutrient		
	N	P	K
	—————%—————		
Check	2.91	0.32	1.39
5 gal/A 10-34-0 in-furrow	2.87	0.29	1.28
8.7 gal/A 7-21-7 in-furrow	2.81	0.29	1.27
12 gal/A 10-34-0 surf. band	2.82	0.30	1.28
21 gal/A 7-21-7 surf. band	2.82	0.28	1.25
15-30-10 dribbled over row	2.97	0.30	1.29
30-30-10 dribbled over row	2.91	0.29	1.29
45-30-10 dribbled over row	2.93	0.29	1.27
60-30-10 dribbled over row	2.91	0.29	1.28
15-30-10, 2x0	2.84	0.28	1.29
30-30-10, 2x0	2.72	0.28	1.29
45-30-10, 2x0	2.75	0.27	1.24
60-30-10, 2x0	2.74	0.28	1.22

Table 2. Effect of starter composition and placement on corn yield and grain moisture at harvest in 2002. Values are means of four replications.

Treatment	Yield*	Grain moisture	P removal
	bu/A	%	lbs P_2O_5/A
Check	180	16.4	63
5 gal/A 10-34-0 in-furrow	181	16.4	63
8.7 gal/A 7-21-7 in-furrow	177	16.3	62
12 gal/A 10-34-0 surf. band	180	16.4	63
21 gal/A 7-21-7 surf. band	169	16.5	59
15-30-10 dribbled over row	181	16.4	63
30-30-10 dribbled over row	177	16.3	62
45-30-10 dribbled over row	181	16.8	63
60-30-10 dribbled over row	191	16.4	67
15-30-10, 2x2	183	16.5	64
30-30-10, 2x2	181	16.6	63
45-30-10, 2x2	185	16.5	65
60-30-10, 2x2	174	16.5	61

*Yields adjusted to 15.5% moisture.

movement when increasing N relative to P_2O_5 is unclear. To characterize this effect, more intensive sampling is needed.

Hybrid response. Although soil and plant data are still being analyzed, preliminary results suggest that two non-transgenic corn varieties took better advantage of growing conditions in Clarion silt loam soil than did two transgenic varieties. Dry matter accumulation 13 days after seedlings were planted was greater for both non-transgenic isolines, regardless of the $N:P_2O_5$ ratio of the starter.

At this point, it is difficult to draw any conclusions because information is not yet available on root growth, plant uptake of N, P and other nutrients, and changes in soil nutrient supply. It may be that the non-transgenic isolines produce more above-ground biomass early or that transgenic isolines require higher nutrient levels, greater light intensity, or some other input to produce similar levels of plant dry matter after emergence. Moreover, these differences may disappear later in the season under field conditions. The results of this preliminary study under controlled conditions set the stage for further field trials.

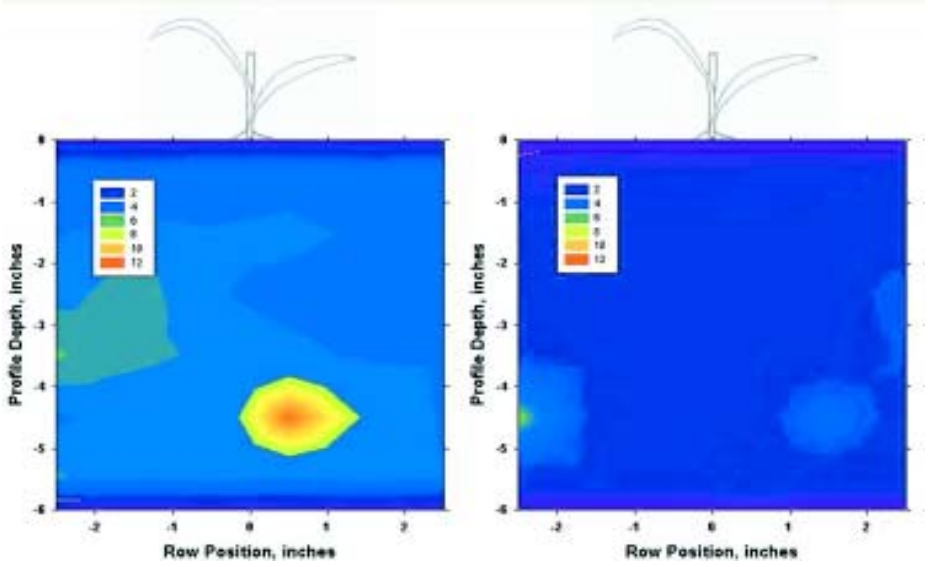

Figure 1. Profile distribution of bio-available P 43 days after dribble application of 15-30-10 (left) and 60-30-10 (right) two inches to side of corn row.

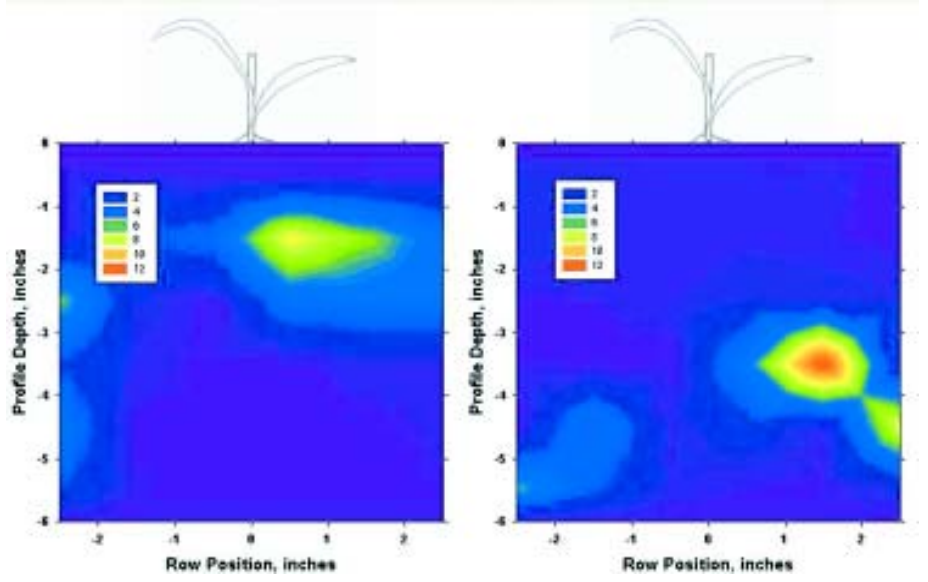

Figure 2. Profile distribution of bio-available P 68 days after dribble application of 15-30-10 (left) and 60-30-10 (right) two inches to side of corn row.

Specifics

Location. Field plots were established at the Iowa State University Agricultural Engineering

Research Farm west of Ames, Iowa.

Soil at this site is a Canisteo silty clay loam.

Plot size was 12.5 by 90 feet.

Experimental design was a randomized complete block with 13 treatments and 4 replications.

Fertilizer applied included: 6-20-0 (5 gal/A 10-34-0), 6-20-6 (8.7 gal/A 7-21-7), 14-48-0 (12 gal/A 10-34-0), 15-30-10, 30-30-10, 45-30-10, and 60-30-10. Accounting for N in the starters, a total of 150 lbs/A was applied to all plots.

Placement included in-furrow, surface band over row, and dribble band over row and two inches to the side of the row.

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