

by Dr. Larry G. Bundy

Do Starters Work Better in Reduced-Till Systems?

Research suggests that beneficial responses to starter may be more frequent, and the size of the response greater in high residue systems, specially in no-till.

Summary: In general, use of starter fertilizers for corn is more important in high residue reduced-till systems than in conventional-till because consistent responses to starter in no-till systems have been found even at high phosphorus (P) and potassium (K) soil test levels. K in starter appears to be particularly important in optimizing yield in some reduced-till systems. Use of starters in reduced-till may help overcome detrimental effects of slow early growth, soil compaction, and nutrient stratification. Starters often stimulate early plant growth and development, and may lower grain moisture at harvest.

Use of starter fertilizer is a well-established and often profitable practice in corn production. Current production trends toward more extensive use of no-till or high-residue tillage systems have stimulated a renewed interest in the importance of starters in reduced-till. Where soil test levels are in the responsive range, starters usually increase yields because plants respond to nutrients in the starter. This response is likely regardless of other management practices. At high soil fertility levels, the response to starter, when it occurs, is probably due to a placement effect that enhances early-season plant growth or helps overcome limitations to nutrient uptake imposed by the management system.

ment system.

Although relatively few studies have examined starter response in a range of tillage systems, data available suggest that response to starters may be more frequent and the size of the response greater in high-residue systems, especially in no-till. This conclusion is supported by numerous reports of response to starters in no-till or reduced-till systems (Table 1). Potential reasons for these responses to starter include 1) lower soil temperatures and early-season plant growth rates, 2) increased stratification of soil nutrients, 3) increased soil compaction, and 4) higher soil moisture content in systems with little or no tillage as compared with conventional-till.

COMPOSITION EFFECTS

Several studies have attributed corn yield response to N in starter applications while other work indicates that P and/or K in starters is needed to produce or maximize response. The geographic location of the research and the associated climate differences appear to influence the findings relative to starter composition effects. Experiments showing response to only starter N generally are located in southern or central USA corn producing areas while results showing response to P and/or K in starters are from central or northern production regions.

RATES AND PLACEMENT

Producers frequently question whether the full benefit of starters can

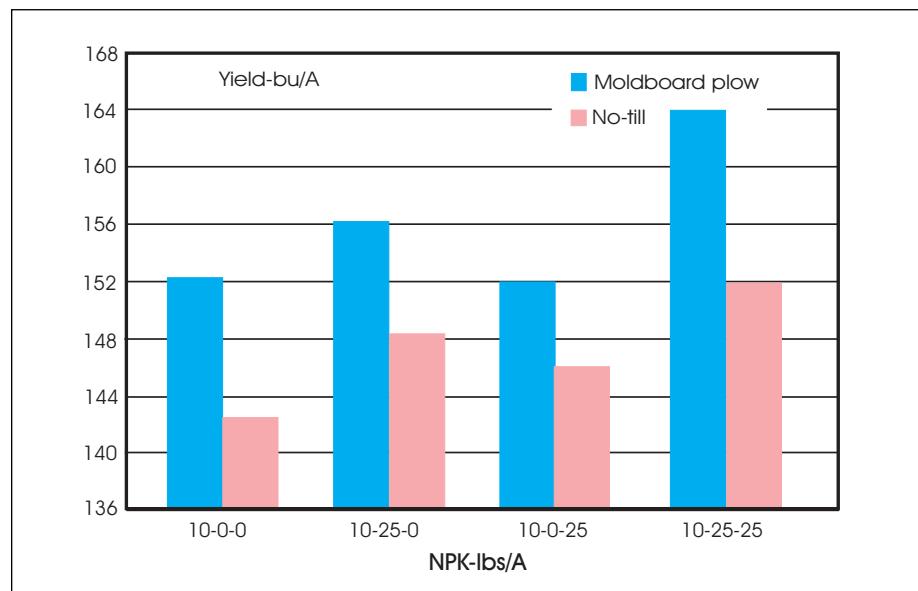


Figure 1. Effect of tillage and starter NPK composition on corn yield, Bundy and Widen, 1992.

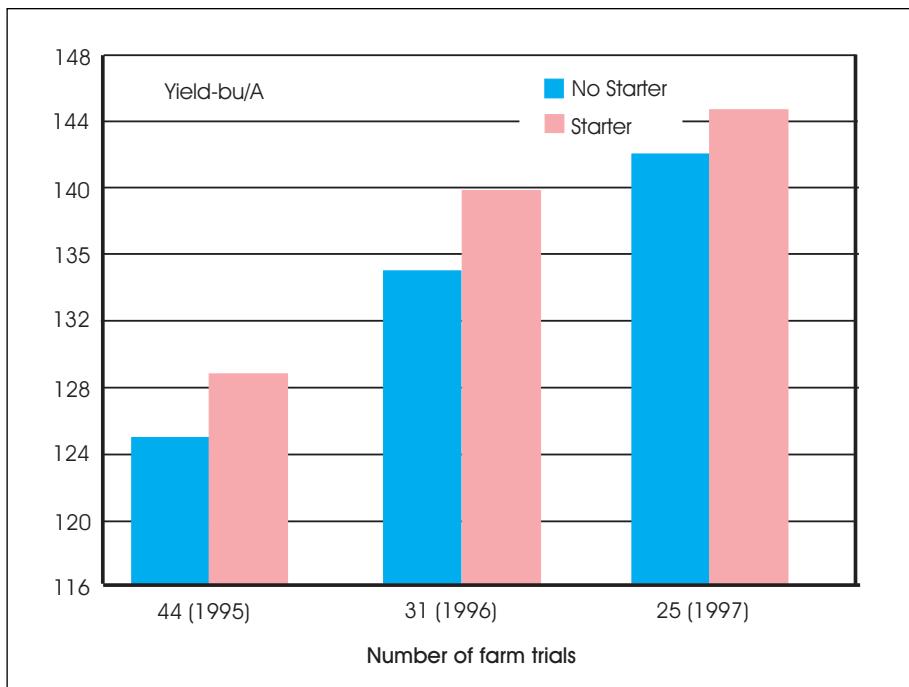


Figure 2. Effect of starter on average corn grain yield from 100 on-farm trials in soils testing excessively high in P and K, 1995-1997.

be attained with seed-placed applications or whether side placement with higher rates is needed. Results from field studies have been mixed. In one project (Schulte), starter response to side-placed (2 x 2) starters on high-testing soils was maximized via NPK applications of 10-20-20. In another (Wolkowski and Kelling), 2 x 2 starter placement gave a greater no-till corn yield increase than seed-placed treatments. However, Howard and Mullen found no difference in no-till corn response to 2 x 2 or seed-placed applications. Similarly, comparing surface band or dribble treatments with seed or side-placed produced mixed results. Surface band or dribble starter treatments were not as effective as seed or side-placed applications in Illinois, while, by contrast, band or surface dribble treatments in Kansas were similar in yield response to 2 x 2 starters.

KINSTARTERS

Several reports of response to starter or K additions using various placement methods indicate that some reduced-till systems may have higher than anticipated yields.

Planted needs for K. For example, K deficiencies in ridge-till corn at high soil test levels have been reported in Minnesota and these deficiencies were minimized with deep-banded K additions. Studies in Iowa report corn response to deep-banded K at some no-till sites with high soil K levels. In Wisconsin, corn response to starters on high-testing soils was shown to be more likely at soil test K levels below 140 ppm. Another Wisconsin study reports that conventional-till corn yield reductions due to imposed soil compaction could be partially offset by banded K additions, even at relatively high soil K levels.

Collectively, these observations suggest that inclusion of some K in 2 x 2 starters or deep-band applications will increase response to these treatments in some environments, and that this response may be more likely in reduced-till systems.

EARLY GROWTH/ GRAIN MOISTURE

Plant growth responses to starters in reduced-till systems are often observed

due to colder soils and slow plant growth rates early in the growing season, especially in northern climates. Many studies have reported accelerated plant growth rates where starters were used compared with no-starter controls. While starters accelerate early plant growth under these conditions, yield increases do not always occur. Another study (Bullock et al.) reported that starter on high-testing soils increased plant growth and development rates, but that this increase in early growth often did not result in a yield increase. Similarly, other researchers have concluded that early plant growth response to starters is not a good predictor of yield benefits from the starter treatments. In addition, several studies have reported lower grain moisture contents at harvest where starters were used. Lower grain moisture can translate into reduced grain drying costs and can be a factor contributing to profitability of starter use.

NO-TILL EXCELS

In a three-year study we conducted (Bundy and Widen), four planting dates were involved, ranging from late April to late May. Tillages were moldboard plow and no-till. Four starter treatments were applied using 2 x 2 placement. The experimental sites were located at Arlington, Wisconsin, on a Plano silt loam soil with P and K soil tests in the high to optimum range. The previous crop was corn.

Results showed that starter increased corn yield in 20 of 24 comparisons with positive responses ranging from 0.6 to 27 bu/A. Starter increased yield at all planting dates in moldboard plow tillage. The largest responses to starter were in no-till at the late planting date. Starter treatments usually increased plant height at the late planting date in no-till. Grain moisture at harvest was usually

reduced by starters, especially at the late planting dates in no-till.

Comparison of starter treatments indicated that yield benefits were maximized when starter contained N, P, and K (Figure 1). The same was true of grain moisture and plant height.

Economic analysis of starter response data—which included consideration of yield effects, drying costs differentials created by grain moisture effects, and the cost of fertilizer applications—indicated that the use of an NPK starter was profitable in 19 of 24 comparisons provided by these experiments.

Observations showing large responses to starter at late planting dates in no-till are consistent with results of Bullock et al. who reported that starters accelerated early plant growth and development as well as crop maturity at the end of the growing season. The beneficial effect of starter with the late no-till plantings was due to stimulation of early plant growth and development in an environment where late planting limited growth. The stimulation of early growth by the starter treatments allowed the crop to realize more of its yield potential by the end of the growing season.

HIGH-TESTING SOILS

To address questions about the need for starters on high or excessively high testing soils, corn yield response to starters was evaluated on 100 on-farm trials over three years. Most of the sites selected had P and K soil tests in the excessively high range, and response to NPK starters applied 2 x 2 was measured relative to a no-starter control. State-wide, starters increased yields by about 4 bu/A in each year (Figure 2). At individual sites, yield response to starters ranged from -10 to +42 bu/A with a positive economic response to starters at 40 percent of the sites. Results show that profitable responses to starter can occur on soils with excessively high soil test levels for P and K.

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Table 1. No-till corn yield response to starters in selected experiments, 1992-1999.

Location	Treatment	Yield increase
Missouri	NPK, 2 x 2	13 bu/A avg. (6 of 6 experiments)
Iowa	NPK, 2 x 2	4 to 18 bu/A (7 of 9 experiments)
Wisconsin	NPK, 2 x 2	15 bu/A avg. (8 of 12 experiments)
Illinois	NPK, 2 x 2	14 bu/A avg. (8 of 9 experiments)