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Corn Yield Responses to Starters Vary with Climatic Conditions

Nitrapyrin additions to fluid starters have significant effect on early growth in 1996 trials conducted by Illinois researchers.

Summary: Two sites were used for our study At Dixon Springs, corn grain yield increased significantly with fluid starters compared to control. At Belleville, no yield differences were observed with the use of starters. Apparently, late planting, nearly ideal summer growing conditions, and high soil P and K levels at this site precluded any responses. At both locations, N-Serve addition in the fluid starters had no influence on yield. However, its inclusion in starters did result in significant early growth increases at Belleville. Starters also had a significant effect on early corn growth at both locations, with N and P combinations working best at Dixon Springs, while N-only in the starter worked best at Belleville. The plant and yield responses observed in 1996 generally followed a similar pattern to those found in 1994 and 1995 at the two sites.

Starters have a well established history of enhancing early nutrient uptake, growth, and yield of corn. In trial after trial, scientists have reported consistent responses in a wide range of soils using conservation practices, and in cool/wet soils—even under high-testing soil environments. Providing nitrification inhibitors has been shown to improve N use. Similarly, applications of chloride have enhanced grain yield.

To further explore the effects of starters on corn yields, we initiated a three-year study in 1994 to:

• evaluate the influence on corn nutrient uptake and yield of phosphorus, potassium, and chloride, under a fixed ammonium-N component included with a starter

• determine the effect of nitrapyrin inclusion (to retain a high level of ammonium-N in starters) on nutrient uptake and yield in corn. Following is a report on the final 1996 phase of our three-year study.

Climate impacts response

Early-season wetness delayed corn planting until May 24 at Dixon Springs and May 31 at Belleville. Poor emergence and bird damage necessitated replanting at Belleville on June 24. Even after the second planting, the stand of corn on no-till plots was unsatisfactory for making meaningful research comparisons. Therefore, only results from the chisel-tilled plots at Belleville are presented. On average, the region experienced a cooler than normal summer, which reduced the severity of moisture stress when it occurred.

Yield. At Dixon Springs, corn grain yield was significantly affected by starter treatment but not by *N-Serve* inclusion with starters or tillage treatment employed (Figure 1). Not only did nitrogen addition to starters

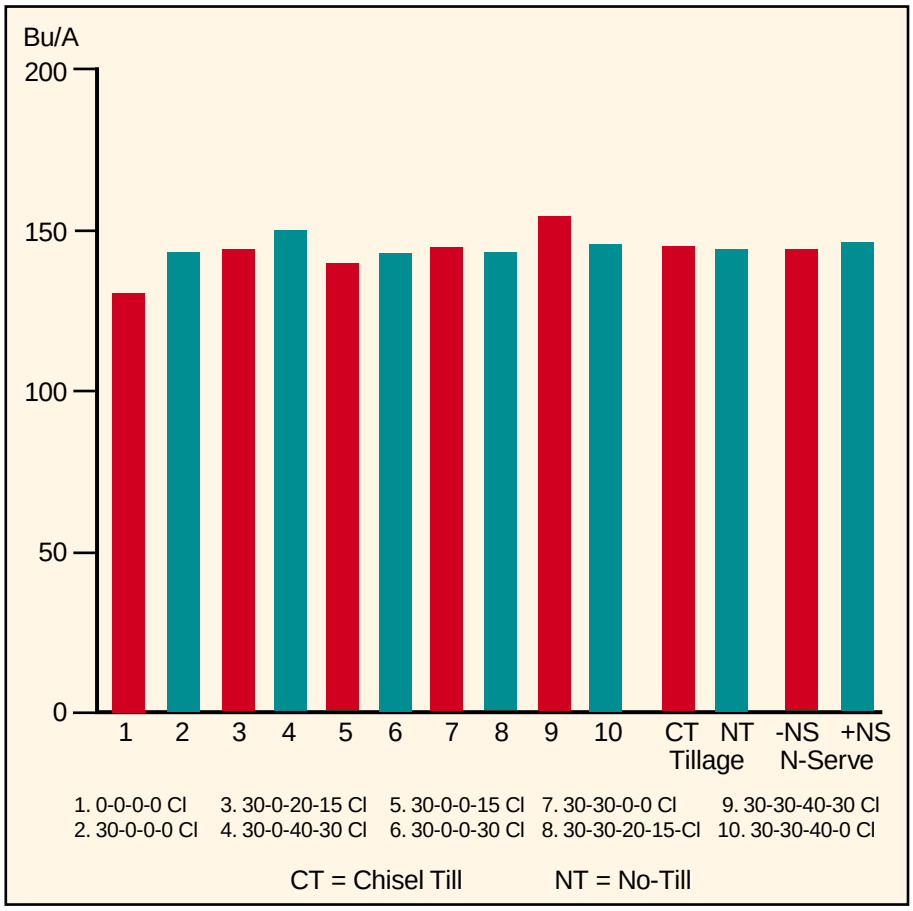

Figure 1. Corn yield as affected by starter fertilizers, tillage and nutrification inhibitor, Varsa and Ebelhar, Dixon Springs Agricultural Center, 1996.

significantly increase grain yield over control, but potassium inclusion (especially at the 40-lb/A rate of K_2O was important as well. Highest yields observed were with 30-0-40-30 (N-P-K-Cl) at 150 bu/A and 30-30-40-30 at 153 bu/A as shown in Figure 1. Apparently the K added in the starters supplemented the somewhat lower than optimum soil test K levels in the plot area. Even though phosphorus soil test levels were also only in the medium range, the addition of P in the starters had no effect on grain yield. Similarly, the $CaCl_2$ treatments had no significant effect on yield. Late summer dryness seriously stressed the crop at this location.

At Belleville, there were no significant effects of starters or *N-Serve* on grain yield of corn (Figure 2). Apparently the late planting and the nearly ideal summer growing conditions (versus dry conditions at Dixon Springs) precluded any responses from the starters or *N-Serve* addition to the starters. The control plot yield (Figure 2) was even higher than the average yield for all the starter treatments, although the difference was not significant.

Early growth. At Dixon Springs, adding N had only very little impact on 6-leaf-stage growth of corn. But applying N plus P in the starter increased dry weight of harvested tissue by 24 percent. The addition of K to starter had no additional effect on early growth of corn. Neither the addition of *N-Serve* nor chloride had any effect on the weight of ten harvested plants. However, chloride addition to starter (as 0-0-62 or $CaCl_2$ produced a moisture content in immature corn about 0.5 percent greater than for the control or other starter treatments not containing chloride. Overall, growth was much better on the no-till than the chisel-tilled plots.

At Belleville, the application of a starter that contained only N resulted in the largest dry matter increase at 6-leaf-stage growth of corn. Application of P or K with starter resulted in no additional growth of corn compared to N-only. Contrasted to Dixon Springs (where a starter response to P was observed), soil tests at Belleville were considerably higher in P and K, which may have accounted for the lack of a P or K starter response at that location. Application of N and K, but without P in the starter, actually decreased plant weight compared to the N-only treatment. N-Serve inclusion with starters at Belleville resulted in 15 percent dry matter increase. Unlike Dixon Springs, chloride addition had no effect on moisture composition of plant tissue.

Nutrient composition. At Dixon Springs, all macro and secondary nutrients were affected by starter composition, except for sulfur. Nitrogen in the tissue was highest for N plus Cl (from $CaCl_2$) treatments. All starters contained 30 lbs/A of N, which resulted in significantly higher N in the tissue compared to control. Nitrogen uptake was enhanced the least when K source in starter was KNO_3. *N-Serve* inclusion with the starters significantly increased N in the tissue by about 0.1 percent. Phosphorus in immature corn tissue was significantly increased by its inclusion in starter, but increased P composition was greatest when the starter also included $ potassium. High K levels in soil solution are known to decrease Ca and Mg uptake. Addition of Ca in starter tended to result in the highest Ca and Mg levels in the tissue. Tillage tended to have a minimal impact on nutrient composition differences.

At Belleville, nutrient composition of 6-leaf-stage corn plants was significantly affected by the starter components, but to a lesser degree than at Dixon Springs. Nitrogen composition of the tissue was unaffected by starter composition, but was increased by *N-Serve*. Both phosphorus and potassium composition were increased in the tissue by their addition to the starter. Potassium in the tissue was increased to the greater degree when K application rate was highest. This effect occurred even though the soil test K level was considered adequate for ideal crop growth. *N-Serve* enhanced P

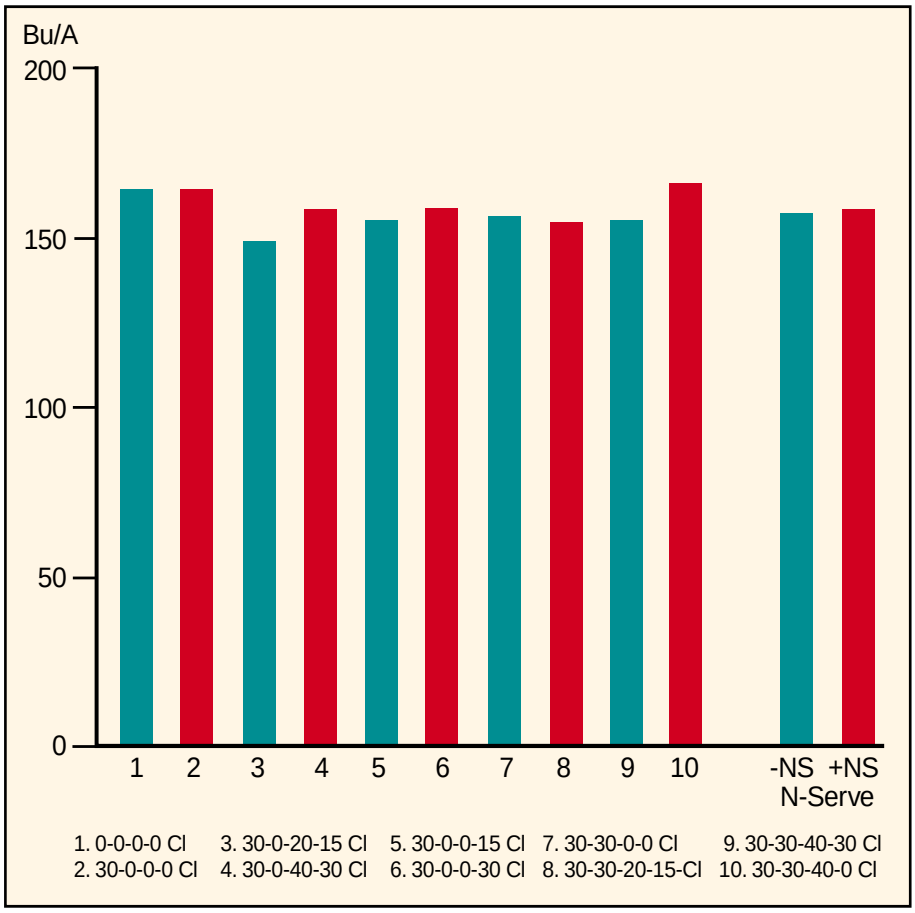

Figure 2. Corn yield as affected by starter fertilizers and nitrification inhibitor at the Belleville Research Center, Varsa and Ebelhar, 1996.

composition of the tissue but had no effect on K composition. The highest rate of K application in starters also had the greatest depressing effect on Mg in the tissue, similar to that observed at Dixon Springs.

At Dixon Springs, the lowest ear leaf K was found in the treatment receiving N plus P but no K (30-30-0-0). In all treatments, ear leaf K composition was well above the critical levels of 1.75 percent needed for optimum corn production. Ear leaf Ca and Mg were highest in the 30-30-0-0 treatment where the lowest K composition was observed. This response was probably a result of the antagonism of higher levels of K in the soil solution reducing the uptake of Ca and Mg.

Procedure

Fertilizers. Starter treatments included a fixed application of N (30 lbs/A) with variable amounts of phosphorus, potassium, and chloride added as companion nutrients. Source for the nitrogen component in the starter was 28-0-0. For phosphorus (and part of the N) it was 10-34-0. For potassium it was 0-0-62. For chloride it was either 0-0-62, or it was added as calcium chloride. Each starter treatment was duplicated: one without N-Serve and the other with N-Serve added.

Application. Starters were applied in a band 2 inches to the side and 2 inches below the seed at planting (controls were included). At planting, 30 lbs/A of N (28-0-0) was sprayed as a "weed and feed" to the controls to balance the N applied in the starter treatments. An additional 150 lbs/A of N was applied as a knife-injected UAN at sidedressing to give a total of 180 lbs/A of N applied to the crop.

Tillage. Starter treatments were evaluated under both no-till and reduced (chisel) tillage systems at each location. At Belleville in 1996, however, treatment effects were evaluated using only chisel tillage because the final stand of corn under no-till was too uneven to be satisfactory for a valid yield comparison.

Plot design. A split plot design was used at both locations, with tillage as main plots and starter treatments (with and without *N-Serve*) as subplots. At Belleville, however, no main plot comparisons or interactions of tillage with fertilizers were possible. Four replications of all treatments were employed at each location.

Soil. Soil at the Dixon Springs Agricultural Center site of the University of Illinois is classified as a Fluvaquent (bottomland soil). Soil at the Belleville Research Center site of Southern Illinois University is classified as an Alfisol that has a moderately well developed soil profile (a weak claypan). Organic matter content in both soils ranges from 1.5 to 2.0 percent.

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