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# Starters Perform More Consistently Than Seed-Placed Fertilizers

Illinois researchers compare 2 x 2 starter with seed-placed fertilizer treatments in no-till corn field studies.

***Summary:*** *When early-season soil test levels of P and K were adequate, 2 x 2 starter containing N + P increased yields by 14 bu/A at two northern locations, regardless of previous crop. The same combination of N + P increased yields by 9 bu/A at one of two southern locations in 1993. Banding N + P consistently increased V6 plant weights of late-planted corn at all locations. Plant growth and yield were more consistently increased when starter fertilizer was side-banded instead of seed-placed. However; yield benefits from some seed-placed fertilizer treatments were observed at the same locations showing responses to 2 x 2 placement. Better yield responses occurred when N was injected and 2 x 2 starter containing N + P was used.*

No-till corn acreage has steadily increased in Illinois. No-till corn producers there have three options for applying the majority of their N: 1) preplant inject, 2) surface apply urea-based compounds, and 3) inject N at sidedress. Problems unique to no-till are nutrient stratification, increased surface residue, and cool wet soils that may influence nutrient availability.

Experiments described here, begun in 1993 at four locations, will show evaluations of corn response to: 1) 2 x 2 starter applications with factorial combinations of N, P, and K, and 2) seed-placed fertilizers with various N, P, and K rates. Experimental locations and soils were varied to gain a better understanding of how environment might influence those treatments.

### Combinations pack punch

In 1993, plant weight at V6 was consistently increased by 2 x 2 treatments of 25-0-0, 25-30-0, and 25-30-20. At Ashton, a northern continuous corn location with soil testing high in P and K, starter with N + P (25-30-0 or 25-30-20) increased yields by 15 to 20 bu/A (Table 1). In Oblong, these starter combinations increased yields by 9 bu/A. The Oblong location yielded about 60 bu/A above the average for that soil type, so it is likely that N became yield limiting, and the N in the starter provided the extra boost.

In 1994, plants at Oblong showed a strong response to starter K fertilizer because the soil K test was low and no additional K was broadcast. Plant weight and yields were similar to those in 1993 in that 25-30-0 performed similarly to 25-30-20 when soil K was adequate. Yields at both Gridley (corn after soybean) and Ashton (corn after corn) were increased by 14 bu/A with 25-30-0 or 25-30-20 starter (Table 2).

Gridley and Ashton are in the northern half of the state and have heavier, colder, wetter soils, which should increase the likelihood of a benefit from starter.

### Seed-placed less consistent

In 1993, seed-placed fertilizer rates of 10-10-0 and 10-10-10 in the NPK factorial portion of the experiment provided V6 plant weight and grain yield results similar to the 10-10-10 and 25-30-20 banded treatments (2 x 2). At Ashton, treatments receiving at least 10 lbs/A of N + $K_20$ yielded better than check and performed similarly to the 2 x 2 banded starter. As with the 2 x 2 study, no yield differences were observed at Pana or Oblong, and Gridley was damaged by herbicide. There was no significant stand reduction by any of the seed-placed treatments, even at rates of 20 lbs N + $K_2O$.

In 1994, Ashton was cold and dry (Figure 1), which slowed germination and increased the amount of time the seed was in contact with the fertilizer.

Table 1. Effect of 2 x 2 banded starter on grain yield, 1993.

| Starter | | | Location | | | |
|---|---|---|---|---|---|---|
| N | $P_2O_5$ | $K_2O$ | Ashton | Gridley | Pana | Oblong |
| lbs/A | | | - - - - - - - - bu/A - - - - - - - - | | | |
| 0 | 0 | 0 | 122 | *** | 171 | 187 |
| 25 | 0 | 0 | 131 | | 175 | 194 |
| 0 | 30 | 0 | 126 | | 175 | 183 |
| 25 | 30 | 0 | 142 | | 185 | 196 |
| 0 | 0 | 20 | 128 | | 171 | 184 |
| 25 | - | 20 | 136 | | 175 | 193 |
| 0 | 30 | 20 | 126 | | 170 | 187 |
| 35 | 30 | 20 | 138 | | 178 | 196 |

***Damaged by herbicide at V7 growth stage.

Gridley was also cold and dry. Stand counts at all locations at the V3 stage did not reveal any consistent significant population differences between treatments. At Pana and Oblong, plant populations were reduced by seed-placed urea products.

Seed-placed fertilizer did not increase plant weight as much as 2 x 2 starter did. Grain yield was improved at Ashton and Oblong by N + $K_20$ rates of 15 to 20 lbs/A. Much of the yield response was due to the presence of K (Table 3).

In 1995, by the V2 stage, there were few differences in emergence, except in treatments with urea and high-salt fertilizers. After late planting, little or no rainfall occurred for about eight days, and temperatures were quite warm. Lack of rain to help dilute seed-zone salts was probably responsible for the slower emergence in 1995.

• Although several fertilizer rates clearly delayed emergence in 1995, V6 plant weights were similar to or higher than those of the check treatment. Fertilizer banded 2 x 2 improved plant weights more than did seed-placed fertilizer. Surface applications provided plant weights similar to seed-placed rates, but significantly less than those with 2 x 2 starter.

**Methodology**

*Test sites*. Four locations varying in climate, soil type, crop rotation, and soil test values were used for the experiments conducted from 1993 to 1995. While cooperating farmers were the same each year, the field or area within the field was different each year.

*Treatments*. In experiment 1, within each of three main plots, eight starter treatments (2 x 2) were applied as factorial combinations of N, P. and K. See Table 1 for a complete list of starter treatments. Corn was planted with a two-row planter at rates near 35,000 seeds/A. Planting dates ranged from early May to mid-June. In experiment 2, seed-placed, surface-dribbled starter, and 2 x 2 banded fertilizer treatments were studied. Twelve treatments compared factorial combinations of N, P, and K.

*Stand counts* were taken for experiment 2 during the period from emergence to V3. About one month after planting, uniform stands of 26,000 plants/A were established by hand thinning both experiments.

*Sampling*. Above-ground whole plant samples were taken at the V6 growth stage. Plant weight and tissue N, P. and K were measured. Ear leaf samples were collected at silking for N, P, and K analysis.

*Yield* was determined by hand harvesting at maturity. Grain yields were corrected to 15.5 percent moisture.

*Anomalies*. Because the Gridley plots were injured by a herbicide application at the V7 stage in 1993, grain yields were not reported. The Pana location had swales and received excessive rainfall in 1994 and 1995, thus causing stunted plants and highly variable results.

**2 x 2 vs seed-placed**

*Starter* fertilizers offer the potential to increase nutrient availability on cool, wet, no-till soils, particularly where P and K have become stratified. Several studies have demonstrated that 2 x 2 banding is a safe, effective way to supply starter fertilizer. In Indiana, Mengel reported an average yield increase of 10 bu/A at ten of eleven sites. All sites in this 1990 study were high in fertility, where starter wouldn't have been recommended for conventional tillage. In a Wisconsin 1994 study, Shulte and Bundy saw responses to starter in high-testing soils that were cold at planting. Fixen and

Table 2. Effect of 2 x 2 banded starter on grain yield, 1994.

| Starter | | | Location | | | |
|---|---|---|---|---|---|---|
| N | $P_2O_5$ | $K_2O$ | Ashton | Gridley | Pana | Oblong |
| lbs/A | | | - - - - - - - - bu/A - - - - - - - - | | | |
| 0 | 0 | 0 | 177 | 128 | 136 | 136 |
| 25 | 0 | 0 | 189 | 139 | 152 | 129 |
| 0 | 30 | 0 | 185 | 132 | 134 | 130 |
| 25 | 30 | 0 | 191 | 142 | 151 | 136 |
| 0 | 0 | 20 | 178 | 146 | 132 | 150 |
| 25 | 0 | 20 | 189 | 146 | 137 | 141 |
| 0 | 30 | 20 | 181 | 138 | 143 | 136 |
| 25 | 30 | 20 | 189 | 146 | 141 | 150 |

Table 3. Effect of seed-placed fertilizer on corn grain yield, 1994.

| Treatment | | | Location | | | |
|---|---|---|---|---|---|---|
| N | $P_2O_5$ | $K_2O$ | Ashton | Gridley | Pana | Oblong |
| lbs/A | | | - - - - - - - - bu/A - - - - - - - - | | | |
| 0 | 0 | 0 | 169 | 143 | 181 | 125 |
| 5 | 0 | 0 | 177 | 145 | 160 | 126 |
| 10 | 0 | 0 | 174 | 151 | 177 | 132 |
| 0 | 10 | 0 | 176 | 139 | 177 | 126 |
| 5 | 10 | 0 | 180 | 148 | 168 | 130 |
| 10 | 10 | 0 | 183 | 137 | 176 | 128 |
| 0 | 0 | 10 | 182 | 143 | 133 | 137 |
| 5 | 0 | 10 | 183 | 129 | 167 | 144 |
| 10 | 0 | 10 | 189 | 139 | 179 | 133 |
| 0 | 10 | 10 | 183 | 134 | 157 | 133 |
| 5 | 10 | 10 | 187 | 146 | 163 | 137 |
| 10 | 10 | 10 | 181 | 140 | 165 | 137 |

Lohry in 1993 and Randall and Hoeft in 1988 reviewed results from using starter in Midwestern corn experiments with both no-till and conventional tillage. They reported yield responses to starters in states surrounding Illinois, but found that responses to specific nutrients varied from state to state.

In warmer soils, however, responses to starters may not occur as consistently as in cool soil. In a southern Illinois 1990 experiment, Kapusta and Varsa did not find yield benefits from application of a portion of the fertilizer banded 2x2 when compared to all fertilizer being broadcast.

*Seed-placed*. Applying fertilizers in a 2 x 2 band requires equipping planters with an extra coulter and may slow planting speeds. These drawbacks, plus the availability of "low-salt" fertilizers, have resurfaced interest in seed-placed (pop-up) fertilizers for no-till. It is recommended that no more than 10 to 15 lbs/A of N + $K_20$ be applied with the seed because of the risk of salt injury. Mortvedt cites the desirable properties of seed-placed fertilizers as: high water solubility, low salt index, high analysis (especially P), and absence of NW liberating products. Baweja and Bates and Waters report that liquid fertilizers are less toxic to corn seedlings than dry fertilizers applied at rates providing the same total quantities of plant nutrients, because water contained in liquids dilutes the salts. However, the amount of water in these fertilizers is small compared to the amount in the soil, so these liquid sources probably also benefited from low salt contents.

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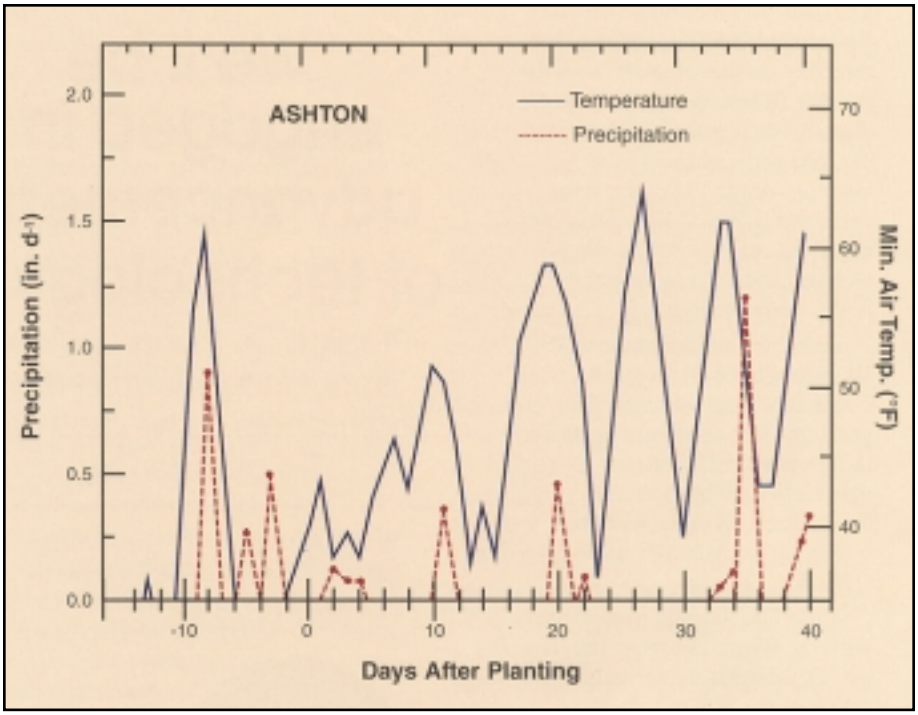


Figure 1. Daily precipitation and minimum temperature at Ashton.