by Dr. James R. Woodruff

Corn/Soybeans Respond to Starter

Studies show that starters produce optimum responses in coastal plain soils with low Kk-holding capacity.

Summary: *Data from South Carolina studies show that positive corn and soybean yield responses were obtained from N, P, K, and B banded near the seed at planting in coastal plain soils with low K-holding capacity. Nutrient deficiency symptoms are commonly observed during early growth of corn or soybeans in the coarse-textured soils of the test sites. The most common nutrient deficiency symptoms observed has been interveinal chlorosis, which resembles Zn and Mg deficiencies. On occasion, yellowing and slow growth associated with N and S deficiencies have been observed.*

The advent of minimum and no-till, the increased occurrence of compacted soils with restricted rooting, earlier planting, and higher yield goals have promoted a renewed interest in starter fertilizer banded at planting.

Studies in coarse-textured soils of the coastal plains have shown crop yield increases with NP or NPK handed at planting in addition to broadcast P and K. Similar increases have been experienced with NP banded at planting, compared to NP broadcast before planting. Even though soil P was high in these corn studies, yield increases were attributed to P in the starter when N was not limiting. Past work on the relative effectiveness of granular versus fluid as a source for P has shown that fluids are generally equal to or, in sonic cases, even superior to granular.

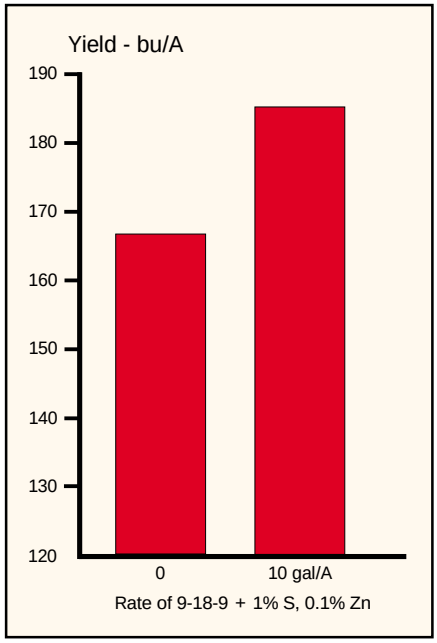

Figure 1. Corn response to 2 by 2 banded 9-18-9 fluid starter, plus broadcast and side-dressed N (@ 180 lbs/A), $P_2 0_5$ (@ 140 lbs/A), K_2O (@ 140 lbs/A) in Dothan loamy sand.

Maintenance and proper balance of sufficient amounts of available nutrients in the rooting zone are extremely difficult in the coarse-textured soils of the coastal plain. Leaching and limited rooting occur because of less than one percent organic matter in these loamy sands and thick surfaces that restrict vertical roofing. Phosphorus levels are high in the plow layer. High rates of ammonium N increase acidity and accelerate the movement of calcium, magnesium, potassium, sulfur, nitrogen, and boron from the plow layer into the subsoil.

Nutrient deficiency symptoms and slow growth are commonly observed during early growth of crops in these soils. Deficiencies are accentuated by cold-wet or cold-dry weather. We have observed that applying nutrients such as N, S, K, and Boron in the inter-row area does not increase leaf concentration of the nutrient elements as effectively as banding or sidedressing close to the plant row.

Selected field and greenhouse experiments conducted in South Carolina to examine yield response to various nutrients in starters follow below.

Blackville

Plants not receiving complete starter fertilizer were yellow and stunted, even

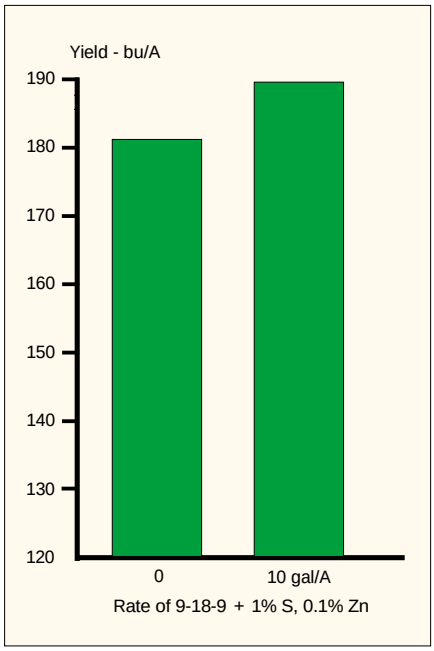

Figure 2. Corn response to 2 by 2 banded 9-18-9 fluid starter, plus broadcast and side-dressed N (@ 380 lbs/A), P_2O_5 (@ 40 lbs/A), K_2O (@ 340lbs/A), and B (@ 2 lbs/A) in Dothan loamy sand.

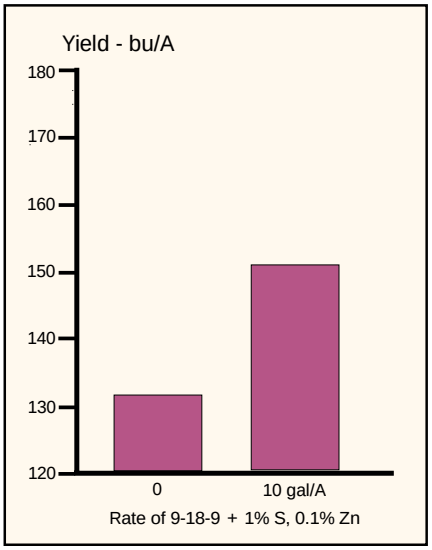

Figure 3. Corn response to 2 by 2 banded 9-18-9 fluid starter, plus broadcast and side-dressed N (@ 180 lbs/A), P_20_5 (@ 140 lbs/A), K_2O (@ 140 lbs/A) in Dothan loamy sand.

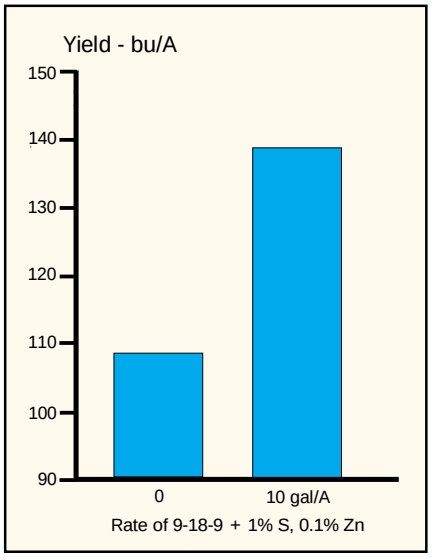

Figure 4. Corn response to 2 by 2 banded 9-18-9 fluid starter, plus broadcast and side-dressed N (@ 380 lbs/A), P_20_5 (@ 40 lbs/A), K_2O (@ 340 lbs/A) and B (@ 2 lbs/A in Dothan loamy sand.

though all plots had received 400 lbs/A 10- 10-10 broadcast before planting. Fluid starter (10 gal/A 9-18-9) significantly increased grain yield where 180 lbs/A of N were added (Figure 1), but not where 380 lbs/A of N were added (Figure 2). Leaf N at the 4-leaf stage was deficient where starter was not added and remained deficient in the ear leaf for the 180-lb/A split (pre-plant and sidedress) application of N.

In another study, complete fluid starters significantly increased grain yield at both the 1 80- and 380-lb/A rates of N when compared to those plots receiving only banded N (10 lbs/A) and S (1.4 lbs/A) at planting (Figures 3 and 4). Without starter, all plants showed some signs of yellowing and stunting. There were some signs of P deficiency.

Florence

In field studies, boron (@ 0.58 lbs/A) in combination with an N, K_2O fluid starter banded 2 by 2 at planting under maximum yield conditions increased yields as shown in Figure 5. Addition of boron to a complete NPK starter also increased yield (Figure 6). A larger amount of B (2 lbs/A) applied as sidedress was equally effective (Figure 6). The addition of 30 lbs/A of K_2O in an NP starter also increased corn yield (Figure 7).

Clemson

In field experiments on a Cecil sandy loam at the Simpson Experiment Station, 6 gal/A of 3-18-18 fluid starter were banded 2 by 2 at planting of soybeans to compare yield response with plots where larger amounts of dry fertilizer were broadcast before planting. In what was a dry year, soybean yields were increased *equally* by 13 lbs/A of liquid P_2O_5 banded versus 50 lbs/A of dry P_2O_5 broadcast and disked before planting.

However, soybeans did not respond as well to starters in the following year when there was more rainfall. With ample soil moisture throughout the growing season, soybeans obtained sufficient P from the soil as evidenced by leaf P concentration.

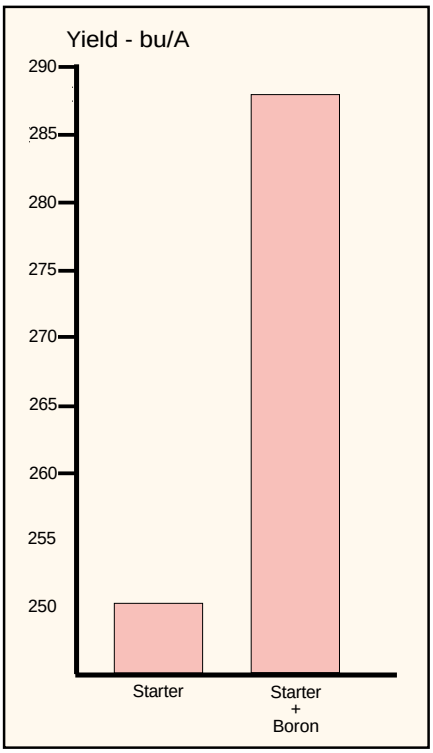

Figure 5. Corn response to 2 by 2 banded N (@ 30 lbs/A), K_2O (@ 30 lbs/A), fluid starter without and with addition of 0.58 lbs/A of B.

Greenhouse experiment

Because of questions concerning the effect of K_2O in starter and the effect of granular versus fluid fertilizers for starters, a growth chamber (greenhouse) experiment was designed and established at our Clemson site to measure yield response of corn seedlings. A liquid 9-18-9 starter was compared with a granular 9-18-9 starter to study the effects of these two sources on P and K uptake. Both starters were placed in sand and soil rooting media.

Overall corn growth response to 9-18-9 granular and liquid starters was similar.

Phosphorus uptake efficiency was greater under an adequate K regime (soil with adequate K or 9-18-9 starter added) than under an inadequate K regime (sand without adequate K or with a 10-34-0 fertilizer added). For this reason, the use of a complete NPK starter is recommended as desirable on

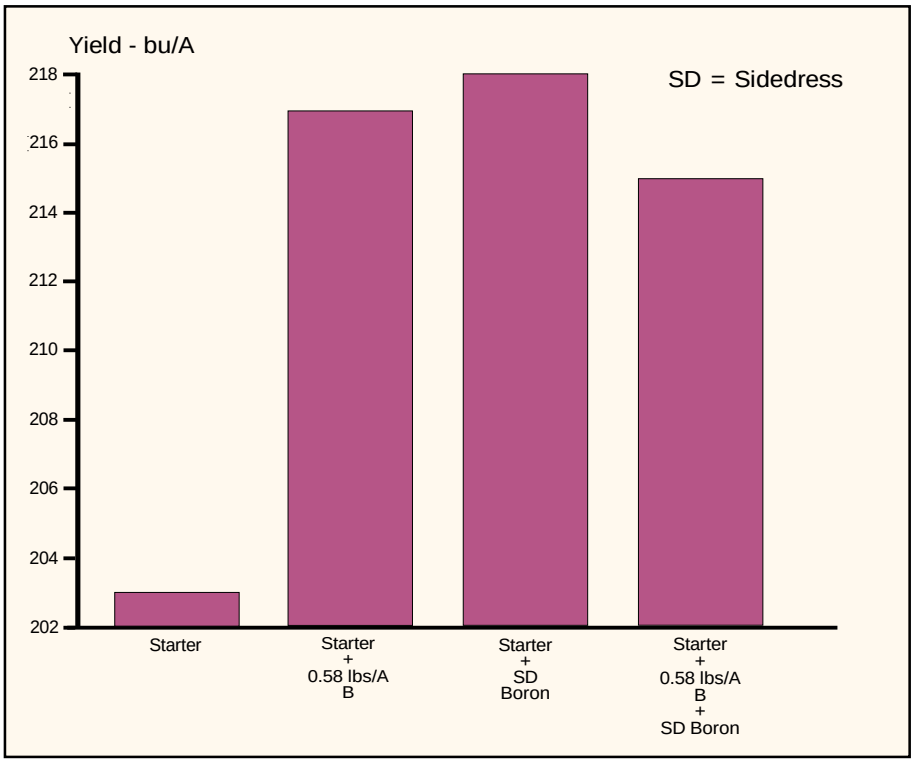

Figure 6. Corn response to 2 by 2 banded N (@ lbs/A), P_2O_5 (@ 30 lbs/A), and K_2O (@ 30 lbs/A) fluid starter without and with B, plus 2 lbs/A of B sidedressed.

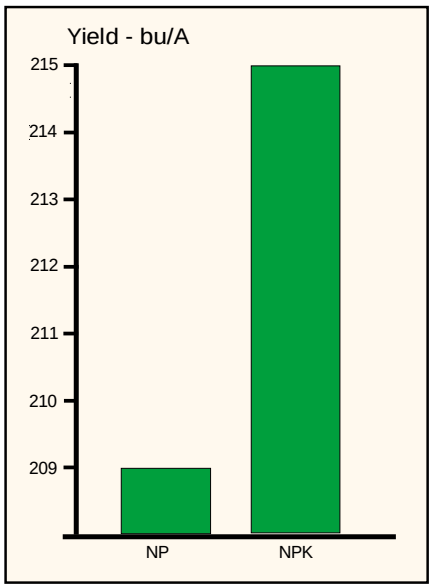

Figure 7. Corn response to banded N (@ 13 lbs/A),P_2O_5 K_2O (@ 13 lbs/A), and N (@ 20 lbs/A), P_2O_5 (@ 15 lbs/A), K_2O (@ 30 lbs/A) fluid starters.

low potassium soils.

Cause and Effect

Some conditions endemic to this region of the United States are worth citing when it comes to the use of starters.

NS deficiency. Sometimes we see general yellowing and slow growth associated with N and S deficiencies. Often the deficiencies are related to unfavorable weather, particularly cold-wet or cold-dry conditions. Plants usually grow out of this deficiency symptom (especially if subsoiling is employed under the row where subsoil clay is within reach of the subsoil shank) but not before yields are adversely affected.

Low testing soil. The plow layer in coastal plain soils normally tests low before spring fertilization in several nutrient elements, except P. The more mobile nutrients (N, S, B, and K) were moved out of the plow layer by leaching winter rains. The occurrence of nutrient deficiencies is inversely related to the depth required to penetrate to the subsoil clay.

Compaction. In addition to depth to clay, there is the problem of surface compaction and lack of seedling root proliferation toward inter-row areas. A compacted layer just below the plowed depth exists on most soil types in South Carolina. It retards root penetration into the subsoil. This is especially serious on soils having thick sandy surfaces. We have observed that applying nutrients such as nitrogen, sulfur, and boron in the inter-row is not as effective as banding materials near the seed or sidedressing close to the plant row.

Delayed responses to starter placement are related to time lapse before corn roots reach the subsoil clay and to a lack of penetration into the inter-row because of adverse soil physical characteristics and low moisture regime. South Carolina data show that handing N, P, K, and B near the seed at planting, and sidedressing S close to the plant row produce corn yield responses.

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