Starter Fertilizer Application Method and Composition in Reduced-Tillage Corn Production

By W.B. Gordon

Field studies were conducted at the North Central Kansas Experiment Field to evaluate four methods of starter fertilizer application (in-furrow, 2x2, 2x0, and placed in an 8-in. wide band centered on the row). Starter fertilizer consisted of 5, 15, 30, 45, or 60 lb N/A with 15 lb P_2O_5 and 5 lb K_2O/A. A no starter check was also included. Starter placed in the seed furrow reduced plant populations and yield. Dribble (2x0) application of starter in a narrow surface band was approximately equal to 2x2 applied starter. Increasing the amount of N in the starter up to 30 lb/A consistently increased P uptake and yield. The use of a dicarboxylic copolymer product in starters was also evaluated and found to be beneficial in increasing P fertilizer performance and corn yield.

Conservation tillage production systems are being used by an increasing number of producers in the central Great Plains because of several inherent advantages. These include reduction of soil erosion losses, increases in soil water-use efficiency, and improved soil quality. However, the large amount of surface residue present in reduced-tillage systems can reduce seed zone temperatures, which may inhibit root growth and reduce nutrient uptake.

Starter fertilizer applications have proven effective in enhancing nutrient uptake, even on soils that are not low in available nutrients. Many producers favor placing fertilizer with seed (in-furrow) or surface starter applications because of the low initial cost of planter-mounted equipment and prob-lems associated with knife and coulter systems in high-residue environments. It has long been recognized that crop injury can occur when excessive amounts of fertilizer containing N and/or K are placed in contact with the seed. However, surface application of starter fertilizer is an option that has not been exten-sively investigated and compared to sub-surface applications. Additionally, a new class of long-chain, high cation exchange capacity polymers that apparently has the ability to enhance fertilizer P performance has recently become available. This product is marketed under the name AVAIL®[1]. The objective of this research was to determine corn response to different liquid starter fertilizer combinations using four application methods, and to evaluate the use of AVAIL® in starters.

Table 1. Starter fertilizer placement and composition effects on plant population, 3-year average.

Starter, lb/A N-P_2O_5-K_2O	In-furrow	2x2	2x0	Row band
	plants/A			
5-15-5	25,202	31,266	31,170	31,266
15-15-5	23,142	30,729	31,655	31,552
30-15-5	23,307	31,266	30,492	30,589
45-15-5	21,329	30,976	30,392	30,492
60-15-5	20,371	30,687	30,613	30,298
Average	22,670	30,985	30,864	30,839

Table 2. Starter fertilizer placement and composition effects on corn grain yield, 3-year average.

Starter, lb/A N-P_2O_5-K_2O	In-furrow	2x2	2x0	Row band
	plants/A			
5-15-5	172	194	190	179
15-15-5	177	197	198	180
30-15-5	174	216	212	192
45-15-5	171	215	213	195
60-15-5	163	214	213	201
Average	171	207	205	189

Irrigated, reduced-tillage experiments were conducted at the North Central Kansas Experiment Field on a Crete silt loam soil (fine, smectitic, mesic Pachic Argiustoll). Soil test P values were in the upper-part of the medium range and soil test K was in the high range. Soil organic matter was 2.5% and pH was 7.0.

The study consisted of four methods of starter fertilizer application: in-furrow with the seed; 2 in. to the side and 2 in. below the seed at planting (2x2); dribbled in a narrow band on the soil surface 2 in. to the side of the row at planting (2x0); and placed on the soil surface in an 8 in. band centered on the row. Starter fertilizer consisted of combinations that included either 5, 15, 30, 45, or 60 lb N/A with 15 lb P_2O_5/A and 5 lb K_2O/A. Nitrogen as 28% UAN was balanced so that all plots received 220 lb N/A regardless of starter treatment. Starter fertilizer combinations were made using liquid 10-34-0, 28% UAN, and KCl (muriate of potash). Additional studies compared starter fertilizer with and without the AVAIL® additive.

When starter fertilizer containing 5 lb N and 5 lb K_2O/A was applied in-furrow with the seed, plant population was re-duced by over 6,000 plants/A (**Table 1**). As N rate increased, plant population continued to decrease. When averaged over starter fertilizer rate, corn yield was 36 bu/A lower when starter fertilizer was applied in-furrow with the seed than when ap-plied 2x2 (**Table 2**).

Dribble application of starter fertilizer in the 2x0 con-figuration was statistically equal to starter that was placed in the traditional 2x2 band. A surface band is much easier and less costly for producers to apply than the 2x2 band. The 8-in. band over the row treatment resulted in yields that were greater than the in-furrow treatment, but less than the 2x2 or 2x0 treatments. The wide fertilizer band was just too diffuse to provide the full benefit of a starter fertilizer application. Regardless of whether the starter

[1] The mention of a product does not imply endorsement by Kansas State University or by this publication.

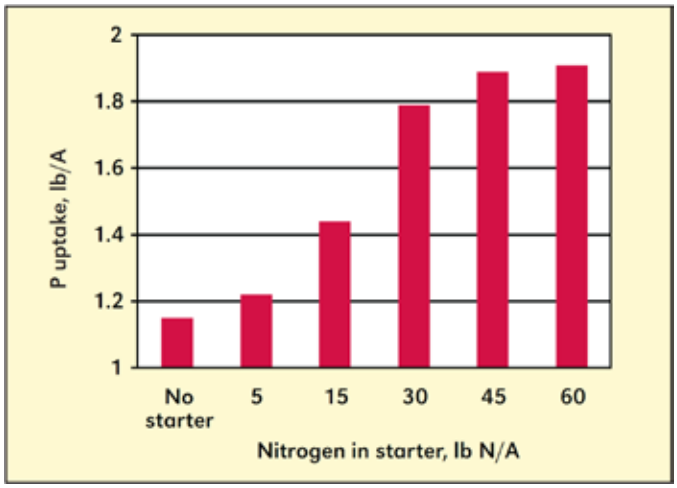

Figure 1. Average starter N-rate effects on 6-leaf stage whole plant P uptake (P and K rate constant at 15 lb P_2O_5 and 5 lb K_2O/A), 3-year average.

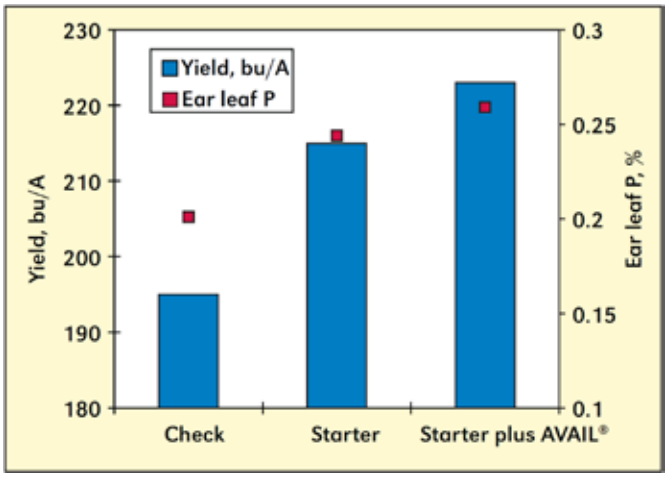

Figure 2. Starter and starter plus AVAIL® effects on corn grain yield and ear leaf P concentration, 3-year average.

fertilizer was placed 2x2 or 2x0 , yields increased with increasing starter N rate up to the 30 lb N/A rate. Plant P content also increased with increasing N up to the 30 lb N/A rate (**Figure 1**).

The results of this research have shown that the addition of AVAIL® can improve P fertilizer performance. This work compared a no-starter check to fluid starter containing both N and P with and without AVAIL®. Use of starter increased corn grain yield by 19 bu/A over the no starter check (**Figure 2**). The addition of the polymer AVAIL® to the starter fertil-izer further increased yield by an additional 9 bu/A. Corn ear leaf concentrations at silking were greater in plots receiving the starter plus polymer than in plots receiving no starter or starter alone. This indicates that the use of AVAIL® can result in an increase in P uptake by plants and ultimately in higher grain yield.

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Improving Soil Fertility and Wheat Crop Management Through the Long-term Study of Cereal Crop Rotations

By Brian Arnall and Fernando García

Long-term fertility trials are established and used across the globe. Unfortunately, for many reasons long-term trials are regularly discontinued. These trials are a wealth of data and information laden with golden nuggets of new and amaz-ing insight. In this article, such nuggets gleaned from long-term wheat trials in Canada, United States, and Argentina are presented.

Nothern Great Plains

The Swift Current "Old Crop" rotation is located in south-east Saskatchewan and was established in 1967. Swift Current is located in the driest portion of the Canadian Prairies and is known for its long-cold winters and short grow-ing seasons (Pelton et al. 1967). This report will focus on four of the original 12 treatments implemented in 1967: fallow-wheat-wheat with N and P fertilizer (FNP); fallow-wheat-wheat with P fertilizer only (FP); continuous wheat with N and P fertilizer (CNP), and continuous wheat with P fertilizer only (CP). On average, all cropped treatments designated to receive P received 9 to 10 kg P/ha/yr. The data, f gures, and results are derived from Selles et al. (2011).

To evaluate trends over time, the data set was evaluated as three periods identif ed by water def cit estimations of 1967 to 1979; 1980 to 1993; and 1994 to 2005. The response in Olsen P (0 to 15 cm) soil test values were signif cantly affected by treatments among the three periods. During the f rst 12 years, there were no differences among the four treatments. During the second period; treatments began to separate, due to the higher frequency of cropping and therefore fertilization, and as a result the Olsen P of the CW rotations became signif cantly higher than the FWW. In the third period, FNP had signif cantly lower Olsen P than the other treatments. Phosphorus balance, calculated as fertilizer added – grain P removal, of the CW rota-tion was signif cantly higher than the FWW. During this time period, FWW received 43 kg P/ha less than the CW treatments. In the second period, P balance of the FWW was signif cantly lower than the f rst period and again signif cantly lower than the CW treatments. By the third period, the P balance of the FP and CNP was similar and the CP signif cantly higher than other treatments. The P balance of the FNP became negative; however, the Olsen P level was still signif cantly higher than at establishment.

The temporal trend in Olsen P levels was also assessed (**Figure 1**). All treatments showed linear positive trends that persisted for the f rst 20 years of the experiment. The P only treatments, CP and FP, maintained the