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Starter Fertilizers Optimize Corn/Wheat Responses To N and P

Reduces need for preplant applications of N, as well as P for soils testing medium to high in P.

Summary: *Starter fertilizers with N:P ratios of 1:1 or 2:1 provide the opportunity to optimize early-season corn nitrogen (N) and phosphorus (P) needs and reduce the need of preplant broadcast applications of N, as well as P for soils testing medium to high in plant-available P. Nitrogen alone can be used in the starter band on soils testing high to excessively high in plant-available P. Research in Kansas has shown grain yield and nutrient use benefits to applying N and P below the surface residues for no-till winter wheat production systems. Our research with starter fertilizer placements for no-till winter wheat has shown increased fall tiller growth, indicating efficient use of nutrients but no grain yield responses. In the case of corn, our research has shown that starter fertilizers should contain up to 50 lbs/A of N applied in a 2 x 2 band, as well as needed P as shown by soil testing*

Early-season nutrient availability is influenced by fertilizer placement. Germination and emergence of the corn seeding usually occurs in six to ten days with reasonable temperatures and moisture. The corn seedling can be expected to develop two fully-expanded leaves and a primary root system that obtains needed nutrients from the soil within seven days after emergence. The supply of nutrients in the seed will be exhausted by this time (seven days after emergence). The corn plant roots generally do not reach the middle of the rows until the corn plant has eight fully emerged leaves, which is about the time the corn is knee-high. Therefore, during approximately the first six weeks after planting, nutrients that are banded close to the corn row are more likely to be available for corn plant uptake than if the same amount of nutrients was broadcast over the entire soil surface.

Corn

Early-season N. We conducted nine field experiments to determine the optimum starter/band N rate in conjunction with the optimum sidedress N rate. Our research used blends of UAN solution as the N source and 10-34-0 as the P source. We varied N rates from 10 to 70 lbs/A placed in a 2 x 2 band. Soil test P levels in these studies were all high and the banded P_2O_5 rate of 34 lbs/A would be expected to provide for any P fertilizer needs. In addition, we conducted starter band P_2O_5 application rate studies of 0, 20, 40, and 60 lbs/A at each site to measure corn responses to varying P application rates.

An example of enhanced N availability from starter/band placement is shown in Figure 1. The percent N in whole corn plant tissue samples collected six weeks after planting (knee-high) was approximately the same with either an N starter/band application of 30 lbs/A or a surface broadcast of 60 lbs/A plus 10 lbs/A in a starter/band. The starter/band N was more efficient than the broadcast treatments in supplying N to the young corn plants.

The response observed in Figure 1 is reasonable in that the broadcast N was subject to losses and immobilization as well as much of the applied N not being near the corn seedling's small root system. The banded N minimized losses and immobilization while maximizing positional availability to the small seedling root system.

Data in Table 1 show that optimum starter/band (2 x 2) N rates ranged from 27 to 70 lbs/A for the nine experimental sites, all of which were no-till planted into wheat double-crop soybean residue. Optimum sidedress N rates ranged from 0 to 125 lbs/A as yield potential varied due to varying weather conditions for these mid-Atlantic Coastal Plain region sites. Detailed statistical analysis of the starter/band placement data demonstrated that essentially all the yield advantage for the higher starter/band N treatments could be obtained with a 50 lbs/A starter/band. The 50 lbs/A N starter/band also reduces the potential for salt injury compared to a 60 or 70 lbs/A band and provides room in the starter fertilizer for the addition of potassium (K) or other nutrients. The most important aspect of these data is that higher rates of starter/band N are the most efficient

way to apply early-season N.

Early-season P. Our data showed no grain yield responses on soils testing high to very high in plant-available P and that one grain yield response of 12 bu/A was obtained on a medium testing soil. Research on poorly drained, cooler soils in continuous no-till has shown that corn yield can be improved most consistently by placing a small amount (10gal/A of starter fertilizer (10-15-0) over the seed zone. More consistent corn yield increases were obtained in conjunction with the use of row cleaners and injecting additional N below the surface residues.

Wheat

Banded P. For no-till winter wheat, supplying fertilizer nutrients in proximity to the seed at planting and below the surface residue may increase fall tiller and root system development and lead to higher yields. Other studies have shown seed-banded P on acid soils with high soil test P levels increased total season wheat forage yield. In our work, placing P in-furrow at planting increased tillering, early growth, and P uptake in another study. Wheat grain yield responses have been shown to be related to increased N and P uptake where N and P fertilizers were placed below previous crop residues for wheat planted no-till into corn or soybean residues. In a Virginia study with N and P application methods for winter wheat, early-season growth responses were found for banded-at-seeding applications of N and P, but no grain yield responses were observed.

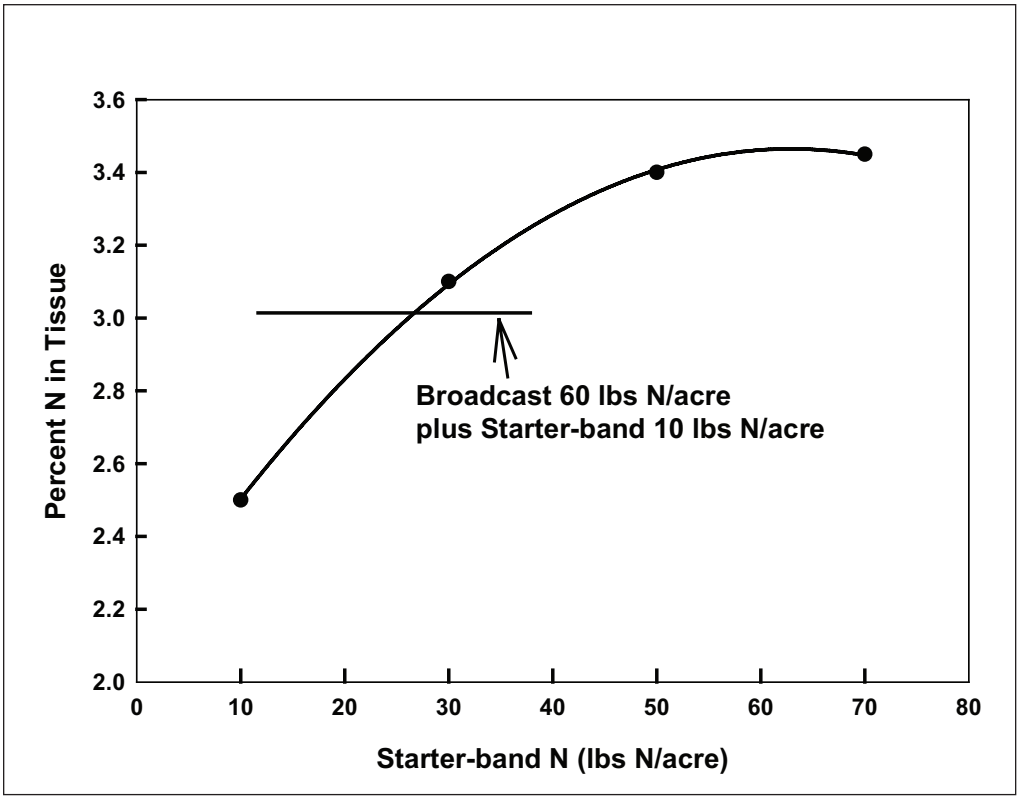

Figure 1. Percent N in whole corn plant (12-15 in. height) related to starter-band and broadcast N applications on a Slagle silt loam soil (Alley et al., 2007).

Soil Series	Optimum starter-band N Rate*	Optimum Sidedress N Rate*	Yield**
	Lbs N/acre	Lbs N/acre	Bu/acre
Pamunkey sil	66	0	89
Slagle sil	70	93	168
Pamunkey fsl	70	80	154
Slagle Sl	49	125	128
Turbeville	27	107	111
Cullen l	44	58	126
Eubanks sil	70	0	122
Ross l	40	93	105
Pamunkey sil	70	93	148

*Optimum starter band and sidedress N rates were the combination of starter-band and sidedress rates that resulted in the highest yield for the site. Starter-band N rates were 10, 30, 50 and 70 lbs/A. These were applied in combination with sidedress N rates of 0, 60, 120, and 180 lbs /A.
**Multiple regression analyses were used to determine the combination of starter-band and sidedress N that produced the highest yield at each site.

Table 1. Starter band and sidedress N rates for achieving highest yields in 9 no-till corn field experiments in the Virginia Coastal Plain.

N:P ratios for corn

Data from our Virginia trials clearly indicate that relatively high rates of N are needed in banded starter fertilizers, and that P applications can be determined by soil testing. Our recommendations for corn are to apply N at 50 lbs/A in a 2 x 2 starter band in conjunction with needed P_2O_5 in the starter band when P needs are low to moderate (i.e., 0 to 50 lbs P_2O_5/A). This rate of P covers the vast majority of soils used for corn production in the mid-Atlantic region. In most cases, either a 1:1 N:P ratio starter fertilizer such as 15-15-0 material can be used, or on high-available P soils, starter fertilizers with ratios of 2:1 N:P, such as a 20-10-0, can be used to maximize corn response to N, assure adequate early-season P, and optimize both N and P efficiency. For very high levels of soil-test-available P, starter applications (2 x 2) of N only, using either UAN or urea, provide the benefits of increased early-season N availability and early-season vigor. In no-till systems, data from regions with cooler dry season temperatures indicate that starters may be needed in small amounts to enhance early-season growth and maintain consistently high yields, even on high P-testing soils.

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