

Starter Fertilizer for Corn: A Potentially Useful Practice with a Cold Spring and High Fertilizer Prices

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The weather forecast for the rest of April suggests likely well below average temperatures that may result in corn planting on soils colder than optimum which require careful consideration ([see recent ICM News article](#)). Also, fertilizer prices continue to be much higher than normal. Starter fertilization can be useful to complement primary preplant fertilization for corn, but not always. The placement of small amounts of nutrients in the seed furrow or in a band to the side and below the row increases the concentration of nutrients where seedling roots grow. Common starter fertilizers have nitrogen (N), phosphorus (P), and potassium (K) and sometimes other nutrients.

Phosphorus and sometimes nitrogen are the key starter nutrients for corn

Early corn growth responses to starter N and P fertilizers are more common than for other nutrients. With cold soil, root growth is slowed, the capacity to absorb nutrients is reduced, and the diffusion of nutrients through soil towards the root surface also is slowed. These effects are more likely to happen in soils with moderately poor to poor drainage and with no-till with thick cornstalks cover because these conditions keep soils cooler and wetter for a longer time compared with other soils. Starter may also help with later than normal planting dates even if soils are warm to speed-up growth mainly in northern Iowa and fields farther north.

Starter P can have a large effect on growth because it helps with cell division in young plants, reaches the root surface by diffusion from a small volume of soil surrounding the roots, and the diffusion is slowed down in cold soils. In corn, early growth response to starter N occurs less often than for P and is observed mainly when the primary N rate is not applied pre-plant in spring, with no-tillage, and in continuous corn. Recent research with starter N applied beside and below the corn seeds after a cereal rye cover crop has shown inconsistent differences compared with no use of a cover crop. Starter responses with strip tillage done in the fall are much less common. Potassium is much less critical for early growth compared with N and P and starter K seldom increases corn early growth except for low-testing soils without preplant K application. Therefore, it is not surprising that early-season corn growth responses to starter mixtures often is explained by N or P.

What about potential yield response to starter application?

Research in Iowa and the northcentral region has shown that effects of starter fertilizer on corn grain yield aren't nearly as common as effects on early growth (Figure 1). This is because growth conditions after planting may speed-up plant growth and development with time to avert yield loss. Yield responses to starter P are seldom observed when the recommended pre-plant P rate is broadcast in the spring and when the 2-year P rate for the corn-soybean rotation is

broadcast before corn in the fall or spring. A response to starter N is unlikely when the primary N rate is applied pre-plant in spring and when N solutions are used as herbicide carriers.

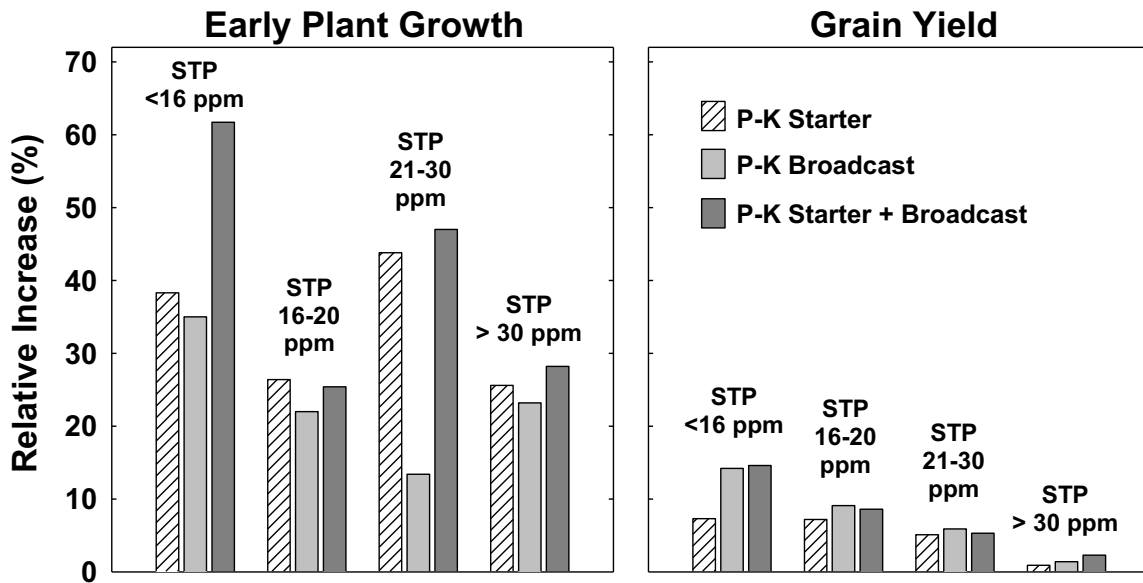


Figure 1. Corn early growth and yield responses to starter P-K fertilizer (5 to 25 lb P₂O₅ and K₂O/acre) and broadcast fertilizer (100 to 160 lb P₂O₅/acre and 100 to 180 K₂O/acre) across 31 Iowa trials in fields managed with no-till or chisel-plow/disk tillage (Mallarino, 2009).

Starter rates applied in the seed furrow can't be too high because salt effects can damage seedlings. The traditional rule of thumb for in-furrow starter application is to apply less than 10 to 12 lb of N plus K₂O/acre, mainly with fertilizers containing ammonium, potash (KCl), or potassium nitrate. In furrow starter of urea, ammonium sulfate, and either ammonium or potassium thiosulfate is not recommended in the northcentral region. Rates that could be applied safely do not help much with early growth or grain yield. South Dakota State University scientists developed a tool that helps make decisions for in-furrow starter application ([Seed-placed Fertilizer Decision Aid](#)). Despite many studies over the years and the development of this tool, no research can fully answer the question of how "safe" higher in-furrow starter rates can be because of many unpredictable factors.

What about starter P and K in high-testing soils?

Corn yield responses to P and K are unlikely in high-testing soils, but many farmers still apply removal-based rates as an "insurance" practice. This doesn't make economic sense with currently very high fertilizer prices, however, as research shared in an [ICM News article](#) from last fall indicated. With corn planting on exceptionally cold soils that test in the High soil-test P interpretation category in P, starter fertilizer may help but this is unlikely in soils testing Very High ([see PM 1688 for soil test categories](#)). Starter P-K also is a more profitable practice than applying removal-based rates to high-testing soils. As Figure 2 shows, infrequent responses to N-P-K starter in high-testing soils are mostly due to N in conditions mentioned above.

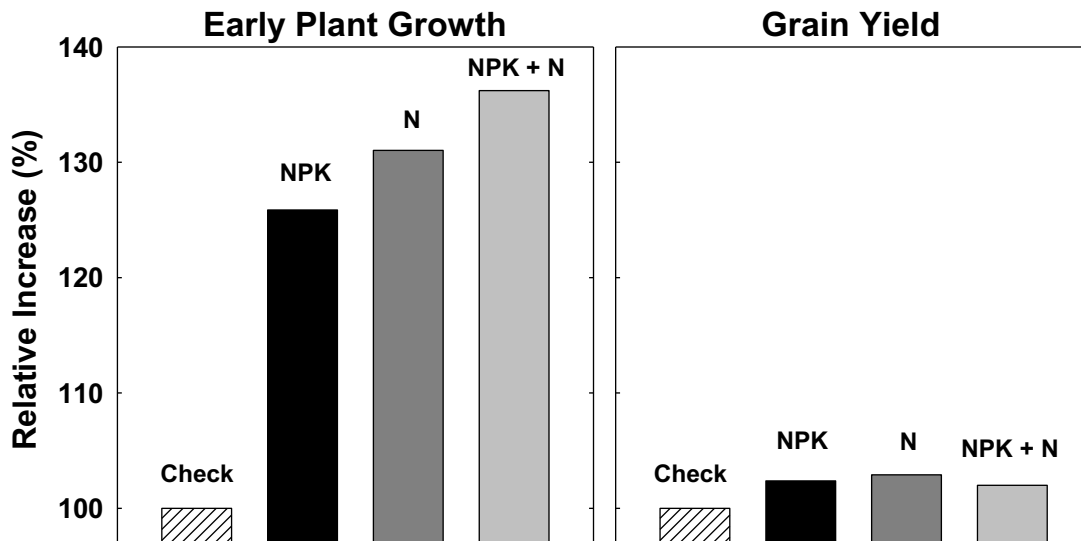


Figure 2. No-till corn early growth and yield responses to liquid starter N-P-K (5-10, 15-25, and 0-7 lb N, P₂O₅, and K₂O/acre), starter N (UAN to supply 23-30 lb N/acre), and starter mixed with UAN to supply a total of 23 to 30 lb N/acre across eight Iowa fields with P and K testing high or very high (Mallarino, 2009).

In summary, conditions where cost-effective starter use for corn is fertilizer likely are

1. With lower than recommended N, P, or K broadcast application rates
2. Without spring preplant N application, mainly for corn after corn
3. Planting on cooler than normal soils
4. No-till with high residue cover, especially in con after corn
5. Northern Iowa soils with moderate to poor drainage, which are often colder than other soils
6. Late planting dates, mainly in northern Iowa
7. Used in high-testing soils **instead of** applying removal-based P and K rates