

STARTER FERTILIZATION SOMETIMES BOOSTS CORN YIELD

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With lower grain prices and perhaps lower than normal pre-plant phosphorus (P) and potassium (K) fertilizer application, farmers and crop consultants are asking questions about starter fertilizer for corn this spring. The placement of small amounts of plant nutrients in bands offset to the side and below the seed row or in the seed furrow increases the concentration of nutrients where seedling roots grow. Common starter fertilizers have nitrogen (N), P, and K, and a few times other nutrients. Research in Iowa and the north central region has shown that early plant growth increases from starter fertilizer are common and can be large in corn but are uncommon and small in soybean. The early growth responses usually are more frequent in low-testing soils or when conditions are colder than usual. 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 with earlier than recommended planting dates and with reduced tillage that has high residue cover because the residue keeps soils cooler and wetter for a longer time compared with soils with little cover.

Phosphorus diffuses through soil less easily than K, and much less than mineral N forms (especially nitrate), and the P concentration in the soil solution at a particular time can be low. Also, P is very critical for plants during very early growth to help with cell division, and an early P deficiency seldom can be fully corrected after emergence. Therefore, it is not surprising that early-season corn growth responses to starter mixtures often is explained by P, sometimes even in soils with optimum soil-test P levels. Starter K seldom increases corn early growth, except with less than optimum soil-test K. Corn responses to starter N occur less often than for P, and happen mainly when the primary N rate is not applied pre-plant in spring, with no-tillage, and in continuous corn.

The effects of starter fertilizer on corn grain yield are not nearly as consistent as effects on early growth. When the recommended pre-plant P rate is broadcast, yield responses to starter may occur only with cool and wet soils and with reduced tillage because high residue cover keeps soils cooler and wetter in spring. However, a yield response to starter P is not observed when the two-year P rate for the corn-soybean rotation is broadcast before corn. A response to starter N is unlikely in corn after soybean when the primary N rate is applied pre-plant in spring and when N solutions are used as herbicide carriers. Wisconsin research showed that starter P application was likely to increase yield and reduce grain moisture with very late planting dates and full-season hybrids. Iowa results were not so consistent, probably because the research did not include many years with late planting dates and many Wisconsin research sites were further north. Therefore, ISU Extension publication PM 1688 suggests starter applications for corn under conditions of limited soil drainage, cool soil, crop residues on the soil surface, or late planting dates with full season hybrids ([A General Guide for Crop Nutrient and Limestone Recommendations in Iowa](#)). Recently begun research by ISU Professor Dr. John Sawyer is addressing the question of starter N fertilization for corn planted on a cereal rye cover crop.

What about the Starter Application Method?

Both in-furrow application and side-placed planter attachments can be used to apply granulated or fluid starter fertilizers for corn, but in-furrow rates of N and K must be low to avoid seedling damage from high fertilizer concentrations. Some farmers wonder about applying fluid starter fertilizer behind the planter press wheel. Limited research in the north-central region suggests this can be an acceptable application method but is not widely recommended because many questions remain, such as efficiency of nutrient uptake due to limited P and K movement into the soil. Surface banded N to the side of the seeding row can be more effective because of nitrate movement into soil with rainfall. Efficiency as a starter would be low if there is no rain until a couple of weeks after plant emergence, and if a urea-containing source is used due to potential loss through ammonia volatilization. Soybean seldom responds to starter fertilizer and seedlings are very sensitive to high nutrient concentrations; thus starter application in furrow or behind the planter wheel is not recommended for soybean.

The traditional rule of thumb is to avoid applying to the corn seed furrow more than 10 lb of N plus K₂O/acre, mainly with fertilizers that have products containing ammonium, potash (potassium chloride, KCl), potassium nitrate, or sulfur except gypsum or elemental sulfur). South Dakota State University scientists developed a tool that helps make decisions for in-furrow starter application ([Seed-placed Fertilizer Decision Aid](#)). In spite of studies over the years and this tool, no research can fully answer the question of how "safe" higher in-furrow starter rates can be because of several unpredictable factors. Definitely, higher in-furrow rates are not recommended when the planting season is dry.

So in When Is A Corn Grain Yield Response To Starter Fertilizer Likely?

1. Earlier than normal planting dates (from N and P)
2. No-till with high residue cover or earlier than normal planting date (from N and P)
3. Late planting dates (mainly from P)
4. Continuous corn, especially in no-till (from P and K)
5. With lower than recommended P and K broadcast application rates
6. Without primary N rate application before planting (from N)

Additional Online Information

Bergmann, N., A.P. Mallarino, and D.E. Kaiser. 2008. Starter potassium for corn: why and when? <http://extension.agron.iastate.edu/nce/ncepdfs/2008/nc08-bergmann-pg-51.pdf>

Kaiser, D.E., A.P. Mallarino, and M. Bermudez. 2003. In-furrow starter and broadcast phosphorus and potassium fertilization for corn. http://www.agronext.iastate.edu/soilfertility/info/NC-Ext-Ind_2003_Starter_Publ.pdf

Mallarino, A.P. 2009. Phosphorus and potassium placement methods for corn and soybean: An Iowa perspective. http://www.agronext.iastate.edu/soilfertility/info/Mallarino_PK-Place_WCM-2009.pdf