Pre-plant vs. In-season Corn Nitrogen Strategies

Late nitrogen applications may not correspond to positive yield gains.

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Increased weather variability, fluctuating commodity prices, new application technologies, and concerns over water quality all continue to emphasize improving upon current corn nitrogen (N) management strategies. Nitrogen losses tend to be greatest during wet, warm weather conditions or when soil nitrate is present without an actively growing crop. To reduce this risk of N loss and increase N efficiency, N placement and timing are often used to better synchronize N availability in the soil with corn N uptake. However, yield potential is determined early in the growing season (e.g., V6) which emphasizes the importance of meeting early corn N demands. The Corn Marketing Program of Michigan recently helped support a three-year study investigating corn grain yield response to several N management programs involving multiple placements and timings applied at a consistent N rate.

Three N management strategies were utilized including:

- Broadcast pre-plant incorporated (PPI) N with 100% urea, 25/75 mix of urea and polymer-coated urea, and poultry litter applied at 1 T A^{-1} plus sidedress (SD) N at V10;
- Starter N applied in-furrow (7 lbs. N A^{-1}) with sidedress N at V4, V10, or a 50/50 split at V4 and V10;
- Starter N sub-surface banded as 2x2 (40 lbs. N A^{-1}) with sidedress N at V4, V10, or a 50/50 split at V4 and V10;

Sidedress N applications are often dependent upon seasonal weather patterns. When spring rainfall was at or below normal, in-furrow applications with no SD until V10 reduced grain yield up to 22 bu A^{-1} as compared to a V4 SD timing. Grain yield reductions by delaying SD from V4 to V10 indicated that the in-furrow strategy was not able to maintain grain yield potential from planting until V10 with below normal rainfall.

Similar yield trends, although not statistically different, were observed with 2x2 N strategies where up to an 11 bu A^{-1} yield reduction occurred when SD was delayed until V10. In dry years, similar grain yields were often achieved using in-furrow or 2x2 strategies but both increased grain yield $\geq$ 9 bu A^{-1} compared to the PPI strategies.

In wet growing seasons, yield potential was maintained but not statistically different by delaying SD until V10 using either the in-furrow or 2x2 strategy. Poultry litter and a V10 SD provided a slowly available N source and increased grain yield 17 – 27 bu A^{-1} as compared to in-furrow or 2x2 with a V4 SD when moisture was above normal.

Many growers still prefer a single PPI N application in the spring as compared to a split-N system. In 5 of 6 site years a 7-30 bu A^{-1} yield increase occurred with a split-N strategy as compared to a single PPI application of urea, but results were only statistically significant in 3 of 6 site years in which a 16 – 30 bu A^{-1} yield increase was observed. Yield increases utilizing split-N strategies further illustrate the risk of N loss or difficulty in N uptake associated with PPI N applications when rainfall is either excessive or too little, respectively. In the current study, there was little benefit observed across all site years to polymer-coated urea.

One implication from this study was the importance of N management strategy (i.e., PPI, in-furrow, or 2x2) to sufficiently supply N until SD application timing. Corn yield expression is influenced early in the growing season and the success of the in-season N application may be influenced by the pre- or at-plant N strategy. With the exception of a single site year (i.e., poultry litter with V10 SD in wet soil conditions), no significant positive yield responses were observed when delaying SD until V10 during the three year study. While split-N applications generally increased yield, more risk was involved with the in-furrow strategy due to the reduced N rate at planting and concern for seedling injury. The 2x2 N strategy appeared to offer a more consistent yield response across site years. Growers missing the V4 application window may ultimately still utilize the late season V10 SD timing as a rescue application as corn yields greater than 187 bu A^{-1} were achieved.

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