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Injection is Most Efficient Method of UAN Placement

Comparison trials show effects of timing, application methods, and nitrification inhibitors on no-till corn yeilds.

Summary: *For no-till corn in the eastern Corn Belt, the most efficient time to apply N for uptake is to apply the majority of N at planting or after planting. Early preplant applications of N lead to a high level of N loss in the humid climate of this region.*

The most efficient method of N placement is injection below the surface. Placing N below the surface minimizes fertilizer residue contact and avoids immobilization and volatilization losses.

Split applications, where a portion of N is broadcast and a portion injected later in the growing season, may be an attractive alternative to growers who want to use UAN as a carrier for herbicides, or do not have access to starter equipment, yet still hope to maintain high levels of N-use efficiency and corn yields.

Applications of a portion of N as starter appeared to be beneficial in N management systems where N was injected into the soil at or near planting. However, in systems where a sizable amount of N was broadcast prior to emergence of the crop, starter nitrogen responses were minimal.
No significant response to the use of DCD or ATS was observed in this study. However, consistent trends to higher N uptake and yield with the use of DCD were observed, suggesting that additional work on this product may be warranted.

The project reported here provides a comprehensive evaluation of early preplant UAN applications in no-till corn production systems. It discusses timing and placement of applications, the use of nitrification inhibitors, and the use of starter fertilizers. This project was designed to compare interactions among these components, as well as their interaction with different residues and environments. Objectives of the project were:

- Compare efficiency of early preplant UAN applications with at-planting, and delayed (V6 growth stage)
- Determine effect of DCD, and DCD + ATS, at enhancing the effectiveness of surface-applied UAN as compared to delayed application or subsurface applications of the fertilizer
- Compare the effectiveness of split applications of UAN
- Determine the effect of starter fertilizer (N only) on corn growth when used in combination with a number of N application systems.

Timing/placement

Timing and placement of UAN had a definite effect on all measures taken. Several key observations can be made. Broadcast preplant and at-planting treatments, and injection at planting time produced the best early-season growth. Nitrogen applications delayed until the 6-leaf stage reduced early-season growth and N uptake. However, while broadcast applications gave greatest early-season growth, delaying N applications until the V-6 stage resulted in the highest N uptake and yields (Figure 1). Note also that injecting UAN below the residue at planting produced a yield significantly higher than when broadcasting UAN on top of the residue at planting. These results are consistent with a number of previous studies conducted in Indiana and other states.

Early preplant N application resulted in significantly lower total N uptake and yield, as compared to all other application times or

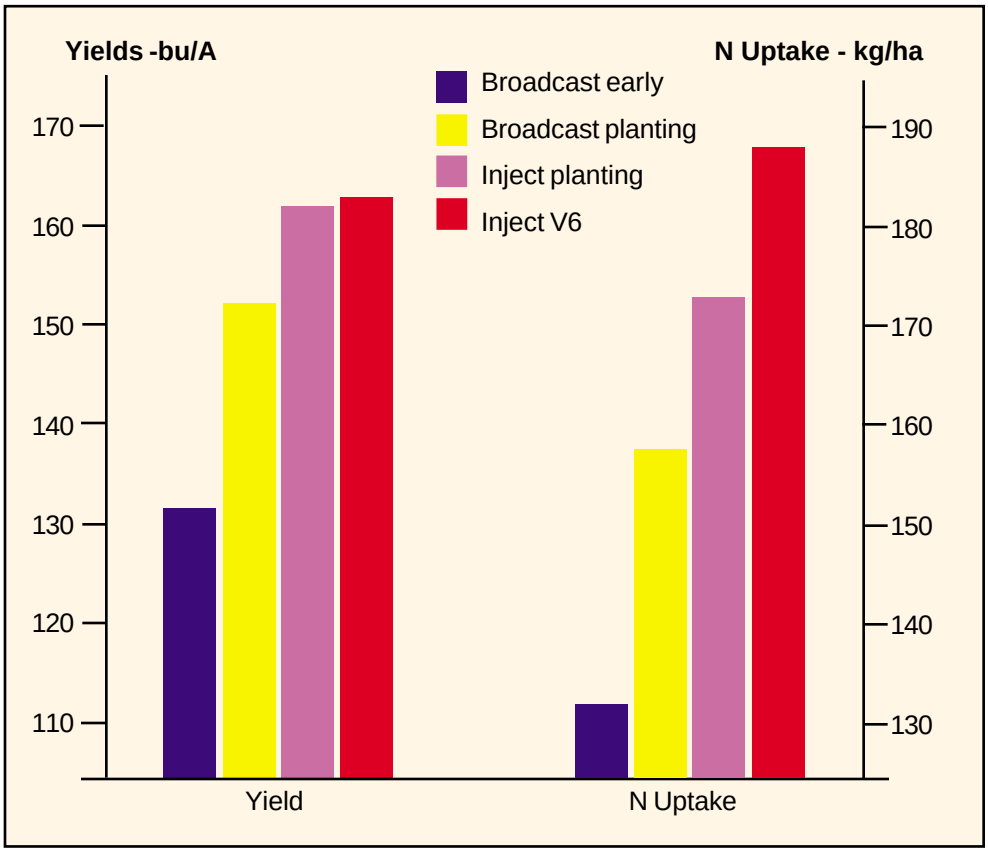

Figure 1. Effects of timing and placement of UAN on N uptake and yield of no-till corn.

methods. Applying N six to eight weeks prior to the initiation of the corn crop's grand vegetative growth stage makes N vulnerable to loss for a long period. In the humid climate of the eastern Corn Belt, it is likely that denitrification losses would be high most years.

DCD/ATS

Neither dicyandiamide (DCD), a nitrification inhibitor, nor ammonium thiosulfate (ATS), a reported urease inhibitor, had any statistically significant effect on corn growth or grain yield in these studies, though there was a clear trend for enhancement of yield from the use of DCD (Figure 2), suggesting that additional work may be warranted. There were no indications that ATS had any beneficial effects on corn in these studies.

Split vs. single

A clear trend towards improved N-use efficiency, as measured by greater N uptake and higher yields, has been noted as a portion of the N is applied subsurface or later during the growing season. Growers willing to use multiple applications can provide excellent fertilizer-use efficiency by broadcasting half of their N early preplant as a carrier for herbicides, and injecting the balance at V-6 (Figure 3).

Starters

Starter N and its effect on yield was analyzed separately from the total data set because data was available for only one test site in 1993 and both in 1994.

Starter N significantly enhanced early-season growth as measured by height at V-6. While there were no significant effects of starter on nitrogen nutrition of the crop, starter did significantly increase yield. This supports earlier findings from Indiana and Alabama.

Interaction between starter use and N timing and placement is shown in Figure 4. Note that when starter was used with injected preplant treatments, a large and highly significant yield response was found.

Sidedress-injected N applications with starter enhanced early growth but not yield. This was probably due to extremely dry conditions after planting at both locations both years. Applying N late put N in dry soil with limited root activity and opened soil for further drying.

No significant response to starter fertilizer, either in early growth or yield, was observed when starter was used in combination with an early-season broadcast application of N. This supports the findings of many farmers who have reported no starter response in no-till corn when they used UAN as a carrier for their preemerge herbicide applications. The trend toward higher yields with starter when UAN was applied in an early preplant broadcast application is probably due to enhanced N-use efficiency from the later application, and lower loss of N from the starter.

Fine-tuning for no-till

Weed and feed. No-till growers have a number of options for applying N. These include different fertilizer materials, and timing or methods of application. Many producers spray UAN directly on the soil surface as a preferred method of applying both nitrogen and herbicides. This method is popular because it accomplishes two tasks--weed control and nitrogen application--in one field operation, lowering machinery, labor, and fuel costs. The early application of herbicide prior to germination and emergence of many annual weeds also reduces the need for a contact or burndown herbicide, saving considerable money. However, little research has been done to date on the effectiveness of early-season applications of N. Past research and observations of farmer's fields suggest that

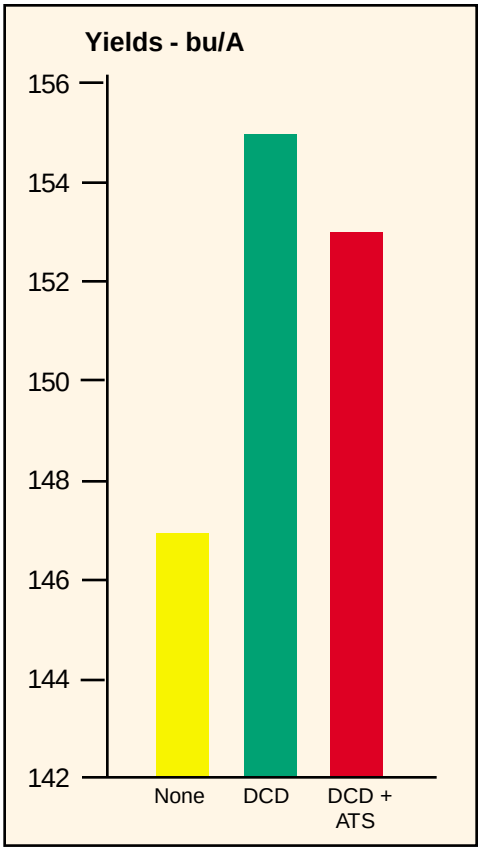

Figure 2. Effects of DCD and ATS on no-till corn yield.

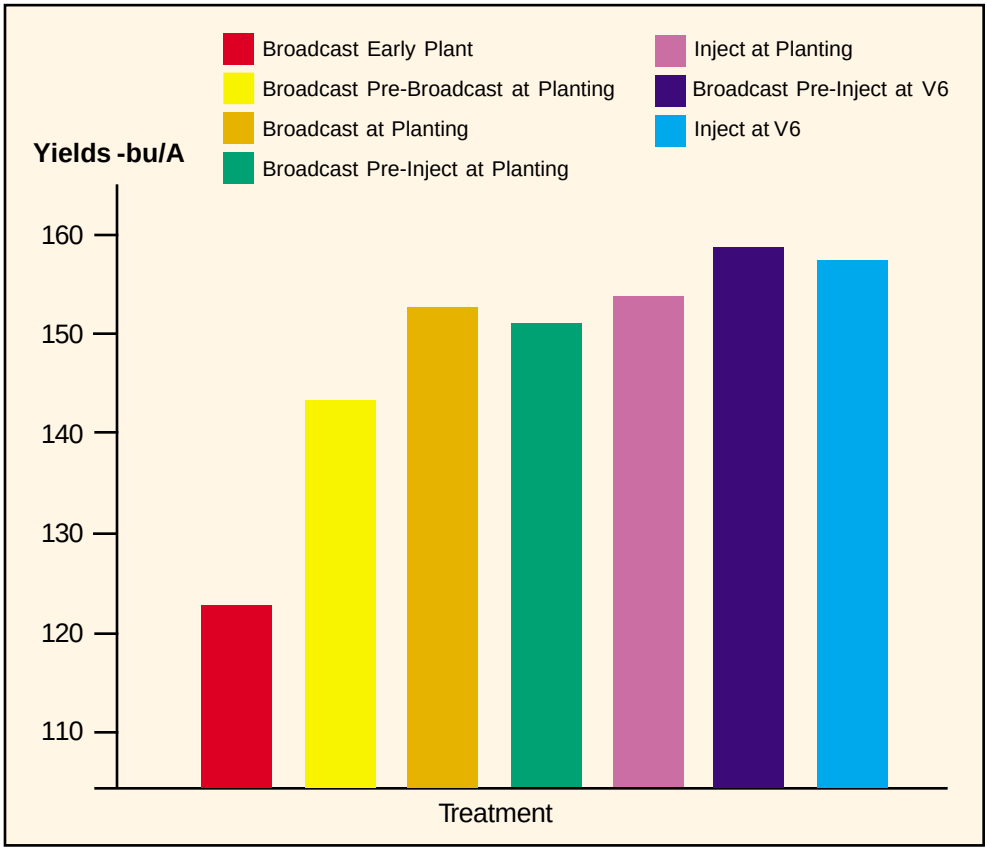

Figure 3. Comparison of split application to single application on no-till corn yield.

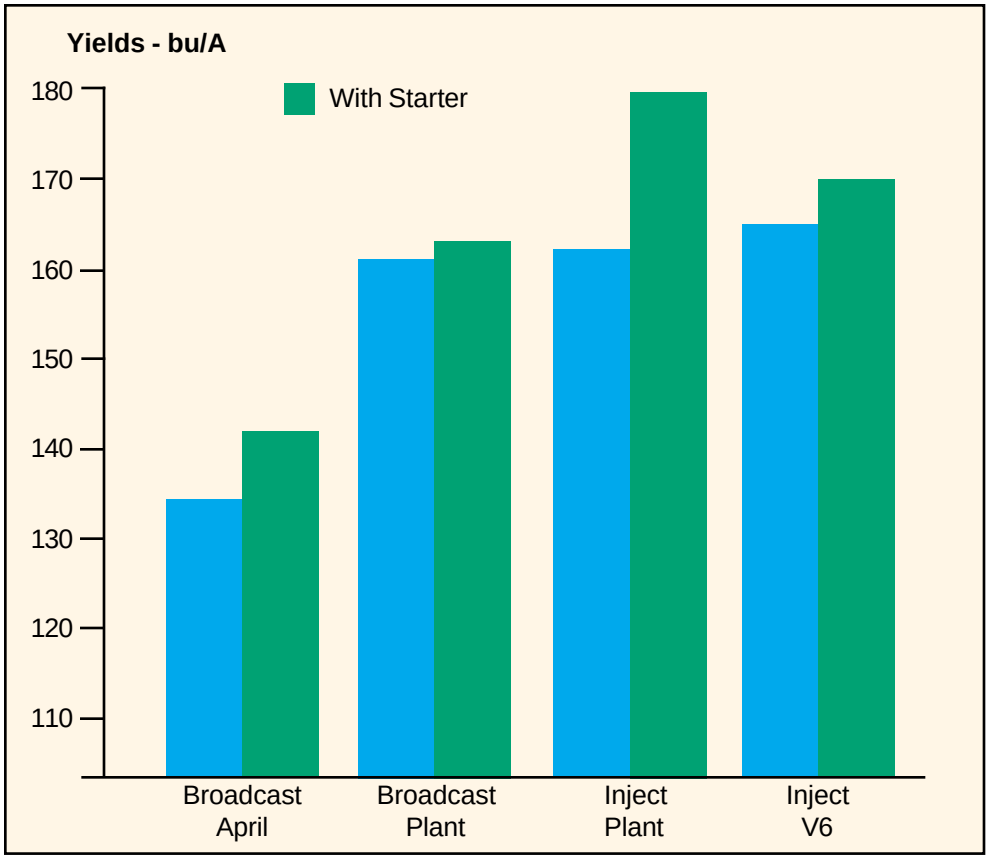

Figure 4. Interaction of starter fertilizer and N timing and placement on yield of no-till corn.

N applied with herbicides in early preplant applications is not efficiently used and a high percentage of N is lost through denitrification.

Broadcast vs. injection. Applying N on the surface of residue-covered soils can increase the risk of N loss. It has been well established that the efficiency of surface-applying N is generally lower and less predictable than injecting or incorporating N into the soil of no-till systems. Two mechanisms responsible for these reductions in efficacy of surface-applied N are: 1) immobilization of N in decomposing residue, and 2) ammonia volatilization from the hydrolysis of urea-based fertilizers.

Moisture retention. In no-till systems, the residue layer left on the soil surface enhances infiltration of precipitation and reduces evaporation of soil water. Thus, soil water content is generally higher than in conventionally-tilled soils, and soil temperatures are lower. Conditions in and directly under the residue cover also are conducive to microbial activity. Populations of soil organisms responsible for nitrification and denitrification are normally higher than those found in a clean-tilled soil. These conditions can lead to increased N losses from leaching and denitrification.

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