Dr. Donald J Eckert

Nitrogen Management Key In Conservation Tilliage Crop Production

Ohio studies show that method and timing of N placement have an effect on N-use efficiency.

Summary: Where growers practice conservation tillage, minimizing contact between urea-containing materials and urease-rich crop residues is critical in mitigating nitrogen losses and maintaining crop yields. Studies of different UAN placement and timing methods have shown that the least desirable method of placement for optimizing nitrogen-use efficiency is broadcasting. More desirable placement methods are injection, banding, and split applications. Some starter nitrogen is also recommended in any system where nitrogen is to be applied in a band away from the seedling. Generally, when proper nitrogen management practices are used, conservation tillage and conventional tillage systems require about the same quantity of nitrogen to produce a crop.

Efficient nitrogen (N) management in conservation tillage corn production (particularly no-till) has been of concern to producers since the early 1970s. It was then researchers first demonstrated that different N management programs could have more effect on crop yield in conservation tillage than in conventional tillage situations. While such research has identified several potential problems that should be addressed when managing N under conservation tillage conditions, it also has provided many solutions to these problems.

Dealers, consultants, and producers have a number of options available to them for managing N efficiently when residue cover is present in fields. We'll review some of the problems and their solutions.

Immobilization. Where there's a crop residue cover and N is placed on the soil surface, the N usually comes into much more intimate contact with the decomposing organic material than if both materials had been mixed into and diluted by the soil. More fertilizer-N may be consumed by microorganisms as they decompose residue under such conditions. This N immobilization may reduce the availability of N to the crop for some period of time, particularly early in the season.

Delayed availability. Usually, immobilized N is released back into plant-available forms later in the season, but this delayed availability may reduce yields, particularly if the quantity of available N is already marginal. In fact, research often has shown that inadequate N rates have reduced corn yield more under no-till than conventional tillage conditions. Such yield depressions usually disappear when optimum rates are

used, and these optimum rates are not necessarily higher for conservation tillage. Ensuring adequate applications of N, therefore, is a major step toward achieving optimum N-use efficiency in conservation tillage.

Volatilization. Conditions for N loss are ideal when broadcasting fertilizer onto moist, warm surfaces with heavy residue cover. Crop residues contain high concentrations of an enzyme called urease, which converts urea to ammonia and carbon dioxide. This reaction is essential for efficient use of urea-N by plants. Normally, it causes no problem when it occurs underground, because the ammonia dissolves in soil water and quickly attaches to the soil's cation exchange complex. When urea-containing fertilizers are applied to the soil surface, however, the ammonia generated from urea usually evaporates into the atmosphere, resulting in loss of N fertilizer. Yields may be reduced severely as a result.

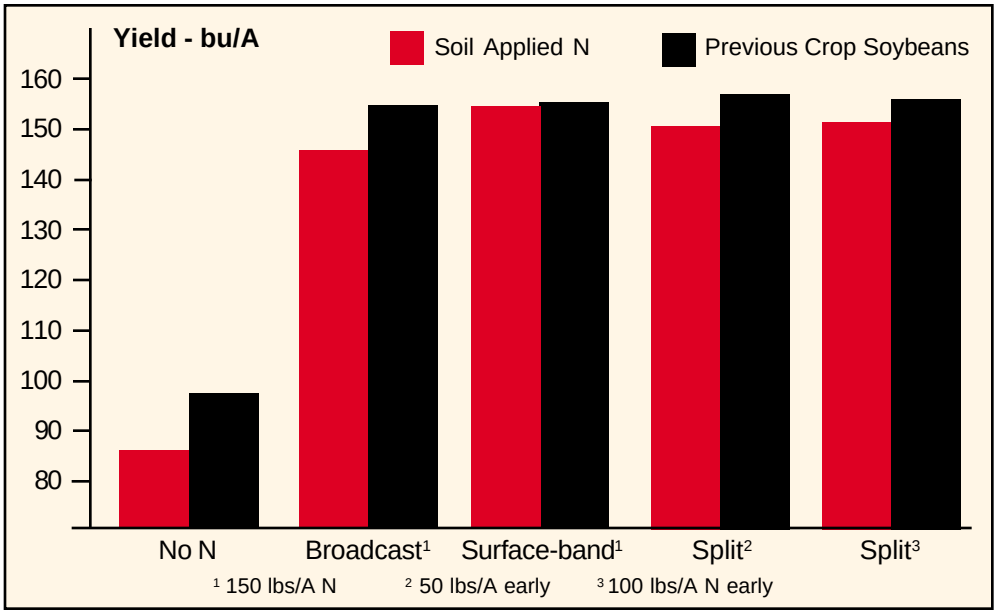

Figure 1. Effects of different UAN management systems on corn yield following corn and soybeans over two years, Eckert, Wooster and Springfeild, Ohio.

Placement is key

N losses can be reduced and yields maintained by adopting practices that minimize contact between urea-containing materials and urease-rich crop residues. Since placement is crucial, we'll review the pros and cons of various placement systems.

Broadcasting. Broadcasting granular urea or urea-containing materials is not advisable, unless it will be incorporated very shortly after application. Broadcast applications of UAN should be limited from a fourth to a third of the crop's total N requirement, and should be confined to "weed and feed" or at-plant application programs only. Broadcasting all N as UAN in heavy residue, such as corn stalks, may reduce yields almost as much as broadcasting urea does. In lighter residue situations, such as soybean stubble, its effect on yield reductions may be mitigated (Figure 1). However, despite this tendency, losses are possible. Therefore, UAN placement programs other than broadcasting are usually more desirable or consistent. In the Wooster and Springfield studies cited in Figure 1, N rates were 150 lbs/A.

Injection. Injecting UAN several inches below the soil surface prevents urea-loss and mobilization problems because it is placed below the residue. The result will be improved yields.

Banding UAN on the soil surface reduces contact between the fertilizer and residue, reducing potential for yield reductions as shown in Figure 1.

Split applications. Here the bulk of N is applied after crop emergence as a surface-banded or injected sidedress. This method has also proven more effective than broadcast, especially in corn following corn (Figure 1). N in these treatments was broadcast at planting and surface-banded at sidedressing. In experiments at Wooster and Hoytville, similar responses were shown between at-planting and split applications (Figure 2). Split applications also have the advantage of allowing producers to evaluate the condition of the crop before applying the majority of N, permitting increased rates of application under ideal conditions and reduced rates under poor ones.

Starters. In any system where N is to be applied in a band away from the seedlings (i.e., in row middles or as a sidedress), some starter N should be applied to ensure that young plants do not become N deficient before roots grow into the main concentration of N. Such at-planting applied N can be placed in the row with the planter or included as UAN in a "weed-and-feed"

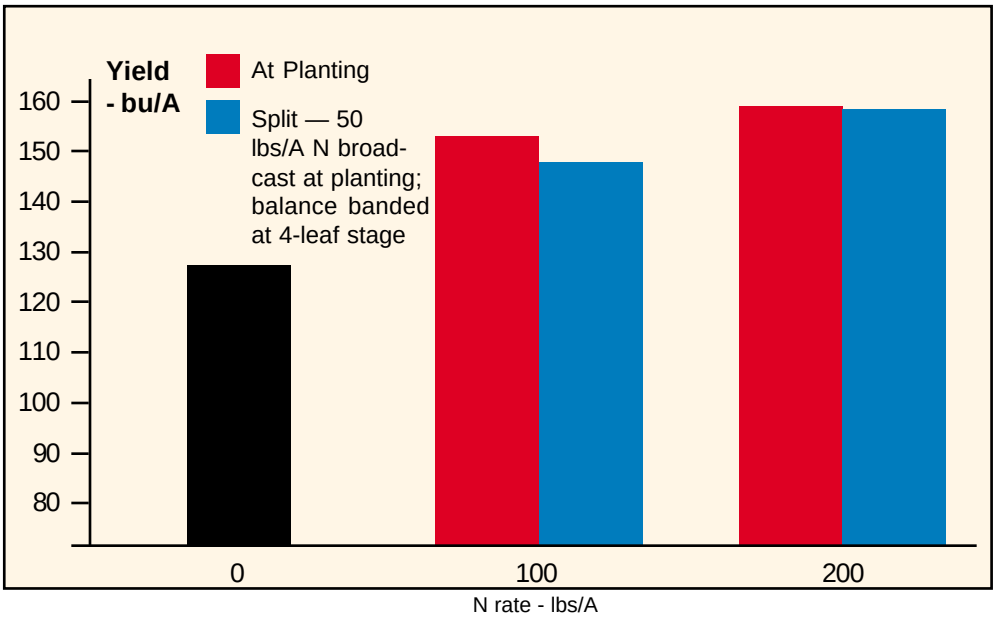

Figure 2. Corn yield as affected by N rate and timing of UAN application over three years, Eckert, Wooster and Hoytville, Ohio.

program.

Generally, 20 to 30 lbs/A of N in the row or 50 to 60 lbs/A of N broadcast is sufficient if the rest of the N is to be surface banded or injected at planting. There is little justification for using more N in the starter with such programs (Figure 3). Such rates are also usually appropriate in split application programs when the sidedress will be made at the 4-leaf growth stage or earlier. If later sidedressing is anticipated, increasing the amount of N applied near planting time may increase yield.

Optimum rate

If proper management practices are used, the quantity of N needed by corn grown under conservation tillage is usually no different from the rate needed by corn grown under conventional tillage in the same field. Optimum rate will be influenced more by soil type, previous crop, and yield potential than by tillage system. Producers should follow local recommendations in selecting rates and then apply those rates properly. If such steps are taken, corn yields will not be limited because of less than adequate N management.

Dr. Eckert is professor in the School of Natural Resources at Ohio State University.
❑

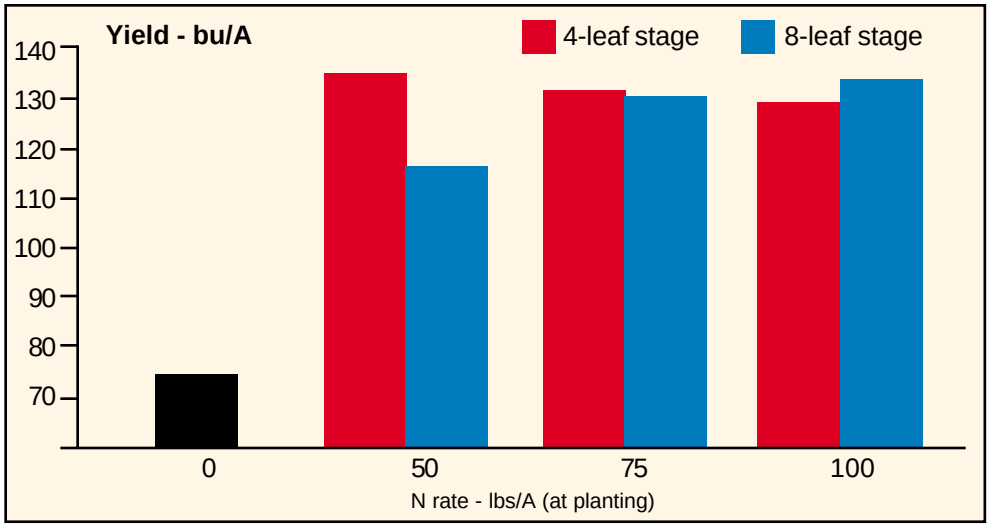

Figure 3. Effect of quantity of N applied at planting and time of sidedressing (150 lbs/A total) on corn yield in split application programs, Eckert, Springfield, Ohio.