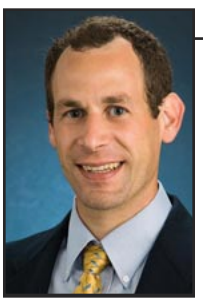
Nitrogen Management This Fall



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We are experiencing a very early harvest in Illinois. That reality combined with fields that were chopped, plowed under, or harvested for biomass earlier in the summer because they did not produce grain is resulting in many fields cleared and ready for fall operations. Decisions about applying nitrogen this fall rank high in producers' priorities because the application can affect profitability and the environment. As I do every year, I'd like to review important guidelines developed through years of research and experience. I acknowledge that any given recommended management practice may not work very well every year, usually because of environmental conditions beyond our control, but I also emphasize that following these guidelines will ensure the greatest chance to both protect your N investment and enhance environmental protection.

Nitrogen sources. For fall application, the only recommended N sources are anhydrous ammonia (NH3) and ammonium sulfate ([NH4]2SO4). Ammonia transforms quickly to ammonium (NH4+), and N in ammonium sulfate is already in the ammonium form. Ammonium is adsorbed onto the exchange sites in soil particles and organic matter and thus is protected from leaching. On the other hand, N sources containing nitrate (NO3-) should not be used in the fall because nitrate does not become adsorbed onto exchange sites in the soil and can easily be leached or denitrified long before corn plants are ready to use it. Common fertilizers that contain nitrate include ammonium nitrate (NH4NO3) and urea ammonium nitrate (UAN).

Another common N source is urea (CO[NH2]2). Urea converts to NH3 and then to NH4+ within a few days of application. However, research has demonstrated that this fertilizer should not be used in the fall because it has a greater risk of loss compared with anhydrous ammonia before rapid nutrient uptake by the crop the following spring. The same can be said of polymer-coated ureas. While the polymer coating protects urea for a while, often urea starts to diffuse out of the granule too early, and the loss potential is higher than for anhydrous ammonia. This is especially true when the application is done too early in the fall or in cases where inappropriate handling of the fertilizer damaged the coating, allowing for quicker dissolution of the urea granule.

One of the benefits of anhydrous ammonia is that it kills nitrifying bacteria (which are responsible for the transformation of ammonium to nitrate) at the point of application. In addition, as ammonia reacts with water to form ammonium, the reaction creates an alkaline (high pH) environment within the ammonia retention zone. This high pH also inhibits activity of nitrifying bacteria for a while. However, these effects are temporary.

To lengthen the period of bacterial inhibition, it is a good idea to include a nitrification inhibitor with the application of anhydrous ammonia. Many years of research have indicated that nitrification inhibitors, such as dicyandiamide (DCD) and N-serve, can protect fall N against loss and increase the amount of N present in the ammonium form the following spring. Just like with most practices, the use of a nitrification inhibitor might not pay every year. For example, if the following spring is dry and cool, the inhibitor might not be as beneficial to enhancng ammonium recovery. However, the practice will overall ensure the greatest chance to protect your N investment and at the same time enhance environmental protection.

Ammonium sulfate is an excellent source for no-till fields where broadcast applications are preferred. It is always best to apply it before soils freeze so the fertilizer can be dissolved and be incorporated into the soil by rain. In fields with minimal slope (less than 5 percent) and where the potential for runoff is very low, it is feasible to apply ammonium sulfate on frozen ground because there is no concern of volatilization loss. An important point to keep in mind is that ammonium sulfate is more acidifying than other N sources, so be sure to monitor soil pH. As a general rule, 5 pounds of lime is needed to neutralize 1 pound of N from ammonium sulfate, compared with 2 pounds of lime per pound of N from anhydrous ammonia.

Lastly, organic fertilizers derived from animals (manure, poultry litter, etc.) are good fertilizer sources that can be used in the fall. These products supply N as well as phosphorus, potassium, and other crop nutrients. Often these organic fertilizers represent a less expensive source of nutrients than inorganic fertilizers.

Timing N applications. In years like this, when harvest is done so early, it is critical to keep in mind that soil temperature can impact to a large extent the efficiency of fall N applications and the effectiveness of nitrification inhibitors. Nitrifying bacteria are active till soils freeze (32°F), but their activity is greatly reduced once soil temperature goes below 50°F. For this reason, it is recommended that the start of fall N applications be directed by soil temperature and not by calendar date, harvest date, or any other consideration. The temperature guideline applies equally for anhydrous ammonia, ammonium sulfate, and manure/organic fertilizers that can be used in the fall. Because the efficiency of nitrification inhibitors also decreases with warm temperatures, higher temperatures result in faster breakdown of the molecule responsible for inhibition of nitrifying bacteria. The cooler the temperature, the greater the efficiency of the inhibitor and the greater the chance that ammonium does not convert to nitrate.

While I realize that anxiety levels rise every year when soil temperatures are not getting down to 50°F and falling steadily, I would also like remind readers that in most years, the 50°F temperature allows for N applications before soils become too wet or frozen. There is no need to increase the risk of N loss by starting applications too early. Also, applying once temperatures are 50°F does not ensure no loss of N, but it does provide a better chance to protect your investment.

Air temperatures in Illinois can vary substantially in early fall. Even if they are getting to 50°F, historically the chance that temperatures will continue to decline without a significant bounce back up are very rare before the second week of October in northern Illinois and the third week in central Illinois. On average, soil temperatures reach 50°F and continue to decrease the first week of November in central and northern Illinois. Daily maximum 4-inch bare-soil temperatures for Illinois this week have been in the mid- to upper 60s.

Up-to-date soil temperatures can be accessed at www.isws.illinois.edu/warm/soiltemp.asp. However, these values should be used as a reference. Since soil temperatures can be influenced by multiple factors (including residue cover, soil color, and drainage), it is always best to monitor soil temperatures in individual fields prior to N application.

Where can fall N be considered? Because temperatures do not stay below 50°F long enough during the winter, fall N application should not be done south of a line roughly parallel to Illinois Route 16. In areas near this boundary, soil characteristics should be evaluated to determine whether fall application is appropriate. Soils with high potential for nitrate leaching in the fall or early spring (sandy soils or those with excessive drainage) should not receive fall N applications. Also, regardless of location in the state, soils with high potential for nitrate leaching or that are very poorly drained should not receive fall N applications.

Due to the length of time before use by the crop, application of manure and other organic N sources should be done as far as possible from environmentally sensitive areas, such as on steep slopes and near bodies of water. If the application cannot be accomplished in late fall, do not apply on frozen soils in the winter; it is better to wait until spring.

How to apply N. When applying anhydrous ammonia, make sure soil conditions are fit for the application. Soils that are too dry or too wet can result in ammonia losses to the atmosphere, as the application knife tracks may not seal properly. When soils are dry, increasing depth of application or reducing application rates typically can help minimize volatilization losses. In wet soil conditions there is little that can be done to minimize such losses. If you use manure, poultry litter, or other animal-derived fertilizer, incorporate it in the soil to avoid N volatilization.

How much N? To determine the economically optimal N rate at various corn and N prices, use the Corn Nitrogen Rate Calculator. While the calculator is designed to help you make the most profitable decision for N management, it does not account for carryover N that might have been unused by crops because of the dry conditions in many places this year. Also, if you applied manure or the soil has high potential for N mineralization (like in a field coming off of alfalfa), you need to adjust the values from the calculator to reflect what will be available next year.

Once you determine how much N you will need, remember that you need not make the entire application in the fall. If a fall application makes sense but you don't like taking big risks, consider applying some N in the fall and the rest in spring. Many fields will likely have high nitrate levels this fall because of the drought, and it is uncertain how much of that N will be present for the next crop. If a good portion is available, that should be all the plant needs to get started until sidedress time, which would reduce the need to supply additional N in the fall. If N is not present because of excessively wet conditions in the spring, chances are that a fall application of N could suffer similar losses.

Applying N in the spring, or splitting the application to supply N closer to when plants will need it, can increase use efficiency because there is less chance for leaching or denitrification. Research has also shown better efficiency of nitrification inhibitors when smaller N rates are used in the fall. So splitting the total application might result in benefits on several fronts.

An ongoing study over three years showed that fall applications reduced yield 17 percent relative to preplant applications done within three weeks of planting. The difference in yield, averaged across N rates, was 23 bushels per acre less with fall than with preplant applications. We are conducting the study this year, but I do not currently have yield information. I suspect, though, that differences might not be as large this year because there was very little N loss potential in the spring and because the drought was more limiting than any other factor.

Use caution. Be aware that anhydrous ammonia is under a lot of pressure inside the nurse tank, and when released it reacts quickly with water. If ammonia comes in contact with skin, eyes, or mucous membranes, it will cause dehydration and burns, so please use extreme caution when handling it. Δ

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