

## Special Field Crop CAT Alert edition: Another look at fertilizers



Articles compiled by the [MSU Extension Field Crops Area of Expertise Team](http://www.ipm.msu.edu/fertilizer2009.htm) and Natalie Rector, issue coordinator. Visit <http://www.ipm.msu.edu/fertilizer2009.htm> to read the issue online.

### Managing nitrogen fertilizer for greatest efficiency

Hopefully you have experienced a year when corn yields exceeded the nitrogen applied. Soil N can provide as much as half of the total N available to the crop. (Camberato et al., 2008.) Rain and sunlight are often the two most sought after resources for high yields, and when these two resources are abundant and timely, plants seem to find the additional nutrients to exceed yield expectations.

However, excess rain has an impact on potential N losses; on sandy soils downward leaching can occur while prolonged standing water on heavy soils can cause denitrification (losing N up into the air). These excessive rains often come early in the season, after N fertilizers have been applied, but prior to maximum uptake by plants.

#### Timing of N application and N source

The rule of thumb is still true: uptake of fertilizer N is most efficient when applied as close as possible to the time of a corn plant needing it. Some forms of N are more suitable for application at planting while others are better suited for sidedress applications. Even when your situation does not allow for the greatest timeliness, there are factors to consider to decrease N losses and increase N uptake by corn.

#### Urea (46% N)

When urea dissolves, it is converted by the enzyme urease to ammonium and bicarbonate, creating an alkaline environment where ammonium is converted to ammonia (NH<sub>3</sub>). This production of NH<sub>3</sub> occurs naturally in soil and on plant material. For surface applied urea fertilizer, the goal is to decrease the amount of ammonia going up into the air and being lost (a process called hydrolysis). Warm temperatures and moisture accelerate this process.

Several research studies have found the following about broadcast urea at various temperatures:

- At 35°F 50 percent can hydrolyze within 4 days and by 10 days, 100 percent hydrolysis.
- At 50°F, half of the urea can hydrolyze in 2 days and 80 percent within 4 days.
- At 79°F, 90 percent can hydrolyze within 2 days.

**When immediately incorporated into the soil, these losses can be reduced to virtually zero.** (Bundy, et al., 2001)

Light rainfall can cause urea to move into the soil protecting it from ammonium-N losses. As little as 0.1 inch of rain can minimize ammonium-N losses and 0.2-0.5 inches within 24 hours after urea application usually prevent volatilization. (Bundy, 2001). Rainfall or irrigation moves the dissolved urea into the soil where ammonium will be held on the exchange sites of clay and organic matter.

Urea-N can be converted to nitrate-N ( $\text{NO}_3\text{-N}$ ) in less than two weeks in late spring. At this point, the  $\text{NO}_3\text{-N}$  is susceptible to leaching if excessive rain occurs, especially on sandy soil.

A soil pH of 7 and higher can also accelerate loss of ammonium-N into the air when urea is surface applied. Do not surface apply urea if lime has also been surface applied within the last three months as this can increase  $\text{NH}_3$  volatilization losses. Incorporation of lime and/or urea will reduce these potential N losses, especially on high pH soils.

In summary, the worst case scenario for urea losses into the air is a surface application with no incorporation onto a high-residue field, when it is warm and sunny, and the soil pH is greater than 7.

Another potential high loss scenario would be applying urea early, even when incorporated, on sandy soils followed by excessive rains before peak crop demand. In this case urea is applied too early and has time to convert to nitrate-N.

### **Anhydrous ammonia (82% N)**

Generally, anhydrous ammonia ( $\text{NH}_3$ ) is the cheapest source of N per pound of N and must be knifed into the soil. Wet soils may hinder the soil sealing behind the knife injection slot, resulting in N losses. Deeper injection (6 inches) is best on both dry and damp soils to prevent losses.

Anhydrous quickly converts to ammonium-N which is held tightly to the soil, eliminating leaching or volatilizing. However,  $\text{NH}_4\text{-N}$  then converts to nitrate-N which can be leached. This conversion happens faster in warm temperatures. Fall applications of N are not recommended, but if they must be, it should be as anhydrous and applied after the soil temperatures are below  $50^\circ\text{F}$  and predicted to stay cool. Under spring conditions, the conversion generally happens in a week to 10 days when soil temperatures are above  $50^\circ\text{F}$ . This is why pre-plant applications are not as efficient as at-planting, which aren't as efficient as sidedressing. Ammonia's effects on soil microbes within the application band acts as its own nitrification inhibitor for at least a week. Periodic winter thaws and abundant soil moisture make anhydrous applications susceptible to overwinter N losses. As a result, fall anhydrous ammonia applications are not recommended in Michigan.

### **UAN solutions (28%-32% N)**

Urea and 28% UAN will cost less per ton of material, but more per pound of N. The higher cost may be partially offset by lower application costs. As a mixture of ammonium nitrate and urea, UAN already has a portion of its N in the nitrate-N form, which could leach if applied early, on sandy soils and if heavy rains occur. The urea portion requires banding, injecting or incorporating to keep from losing N into the air and makes UAN a good N source for sidedressing. Again, all the conditions discussed for urea would apply to these liquid solutions.

The form of N, timing, application method, and resulting weather conditions all play a role in achieving maximum N value. Often producers have few options to change the type of fertilizer product they use, but there are adjustments that can be made to timing and the application method. Utilize these products to bring the greatest value to your 2009 season.

For more information on fertilizer sources and management, visit [www.fieldcrop.msu.edu](http://www.fieldcrop.msu.edu)

## Sources

Bundy, L. 2001. Managing Urea-Containing Fertilizers. Area Fertilizer Dealer Meetings. University of Wisconsin-Madison.

Camberato, J., R.I. Nielsen, D. Emmert, B. Joern. 2008. Nitrogen Management Update for Indiana. Corny News Network, Purdue.