IPNI
Plant Nutrition TODAY
Better Crops, Better Environment...through Science

From Scientific Staff of the
International Plant Nutrition Institute (IPNI)
3500 Parkway Lane, Suite 550
Norcross, Georgia 30092-2844 USA
Phone: 770-447-0335 Fax: 770-448-0439
E-mail: info@ipni.net Website: www.ipni.net

Summer 2012, No. 2

THE FEATURES OF THREE COMMONLY AVAILABLE FORMS OF NITROGEN FERTILIZER

In the Northern Great Plains (NGP) there are often questions on whether a farmer should preferentially use one N fertilizer form over another. A common statement is that "A pound of N, is a pound of N." If applied appropriately, all N forms can perform equally well, but the important thing to consider is what does "applied appropriately" mean.

Anhydrous ammonia (NH_3 or 82-0-0). When pressurized liquid NH_3 is released to the atmosphere it becomes gaseous NH_3. At the soil surface, NH_3 is volatile and can travel short distances (1 mi or 1.6 km) before settling back on the land. NH_3 must be injected into the soil to be effective—usually at about a 4 inch (10 cm) depth. Denitrification and leaching losses from NH_3 applications are usually low unless NH_3 is applied very early during a warm, long fall. Most of the N will be converted to nitrate (NO_3^-) under such conditions and if waterlogged conditions are experienced the following spring, denitrification losses of NO_3^- may be a problem. If NH_3 is applied later in the fall, or early spring, when soil temperatures are below 50 °F (10 °C) denitrification losses are normally small in the NGP.

Urea ($CO(NH_2)_2$ or 46-0-0). Urea is hydrolyzed in the presence of the naturally occurring urease enzyme in soil, or crop residues, to release free NH_3. When left on the surface after broadcast applications there may be some NH_3 volatilization losses. The risk of volatilization is smaller under cool, late fall or early spring conditions, but it increases under warm conditions during the late spring or summer and can range between 30 to 50% unless rainfall or irrigation soon follows application. A half-inch (13 mm) rainfall is usually sufficient to dissolve and move the soluble urea into the soil before much hydrolysis occurs. Once in the soil, any free NH_3 resulting from hydrolysis becomes NH_4^+ and losses are minimized. Volatile losses are minimal if urea is incorporated or banded in the soil. As is the case for all NH_4^+-based fertilizers, the NH_4^+ is eventually converted to NO_3^- through nitrification. Urea is less subject to denitrification in the short-term, because the conversion to NO_3^- takes time and the product can be a reasonable choice for surface applications in late fall or early spring. Once temperatures warm up, N top-dressing may be less subject to losses if urea ammonium nitrate solution is used instead of urea.

Urea ammonium nitrate solution (UAN or 28-0-0). This liquid fertilizer is a mixture of dissolved ammonium nitrate and urea in an approximate 50:50 blend and has loss properties that are typically half like urea and half like ammonium nitrate. The urea portion can be subject to NH_3 volatilization losses, while the ammonium nitrate portion is not. The NO_3^- portion of the ammonium nitrate can be subject to denitrification losses if waterlogged conditions are experienced soon after application. Surface applications are generally recommended to be surface-dribble-banded because much of the fertilizer may adhere to the surface residue and not move readily into the soil beneath the residue (e.g. established forage crop or a no-till seeded crop) if sprayed evenly over the surface of the soil into a thatch cover. If banded into the soil it will perform well compared to banded urea or banded ammonia. This pre-dissolved liquid form of N has similar plant availability compared to NH_3 or urea. However, liquid fertilizer storage, distribution, metering and field application systems do have some convenience advantages. UAN is a popular N fertilizer in areas where retail fertilizer dealers sell the product, and transportation distances are shorter [e.g. 20 mi (30 km)]. If transportation distances are great, transportation costs for NH_3 and urea tend to be less per unit of N.

In most cases all three of the N fertilizers above can adequately fill the N requirements of a crop if applied in a way to minimize losses and maximize crop uptake. The fertilizer industry encourages farmers to follow the 4R Nutrient Stewardship approach by applying the Right Form of fertilizer, at the Right Rate, Right Time, and Right Place. Generally the cost per pound of N is least for ammonia, then (in order of increasing cost) urea and UAN. There are exceptions in different local markets where the comparative cost between these three N fertilizers can change in order. The common statement "A pound of N, is a pound of N" is valid as long as consideration of the movement and potential loss mechanisms are understood, and timing and placement of a specific N fertilizer is appropriate.

– TLJ –

For more information, contact Dr. Thomas L. Jensen, Northern Great Plains Director, IPNI, 102-411 Downey Road, Saskatoon, SK S7N 4L8. Phone: (306) 652-3535. E-mail: tjensen@ipni.net.

Abbreviations: N = nitrogen; NH_3 = ammonia; NH_4^+ = ammonium; NO_3^- = nitrate

Note: ***Plant Nutrition TODAY*** articles are available online at the IPNI website: www.ipni.net/pnt