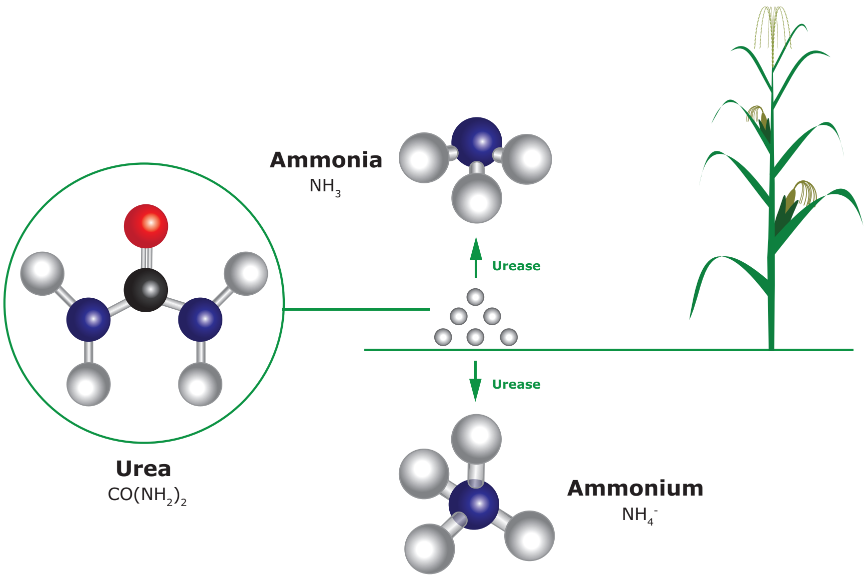
Nitrogen Stabilizers

General Information

When applying urea– and ammonium–based nitrogen to the surface and subsurface of soils, research has shown that up to 40% of nitrogen can be lost to volatilization, and nitrification. In the case of urea ($CO(NH_2)_2$), *urease* enzymes persist at and near the surface of the soil and break down urea into ammonia and carbon dioxide, resulting in an average of a 16% loss of nitrogen. In the case of ammonium, bacteria convert it into nitrite (NO_2^-), and then nitrate (NO_3^-) whereby the nitrogen could either leach from the soil, or go through the process of denitrification where it converts to nitrous oxide (N_2O) and is released into the atmosphere. Research has shown that by using nitrogen stabilizers like NanoChem's Sun 27 and N Savr 30, that farmers can increase the stability of their nitrogen, and increase their yields on average by 5–10%.

Volatility

Ever since the Haber–Bosch process made the conversion of nitrogen gas (N_2) into ammonia (NH_3) scientifically and economically possible, farmers have increased their consumption of urea dramatically. Urea is manufactured in this process by reacting carbon dioxide with the anhydrous ammonia that's produced in the first step of the Haber–Bosch process. It is 46% nitrogen by weight, and is available in a variety of prill sizes and liquid concentrations—making it an economical and flexible nitrogen product for farmers across the world. Very few plants have the ability to take up nitrogen in the form of urea through the roots, which explains why nature has a mechanism to convert the urea into ammonia and ammonium. The nickel–based enzyme *urease* is prevalent on the soil surface, and rapidly converts urea into ammonia and carbon dioxide (CO_2). In more acidic soils, with a higher concentration of hydrogen (H^+) ions, ammonia has a better chance of converting to ammonium (NH_4^+)—although there's still quite a bit of ammonia lost to the atmosphere if the urea is on the surface. In soils where the pH is 7.0 or greater, a much greater amount of ammonia is not converted to ammonium, and is lost. On average, 16% of the urea applied is lost to this volatilization. In hot and humid conditions, up to 40% of the nitrogen can be lost.



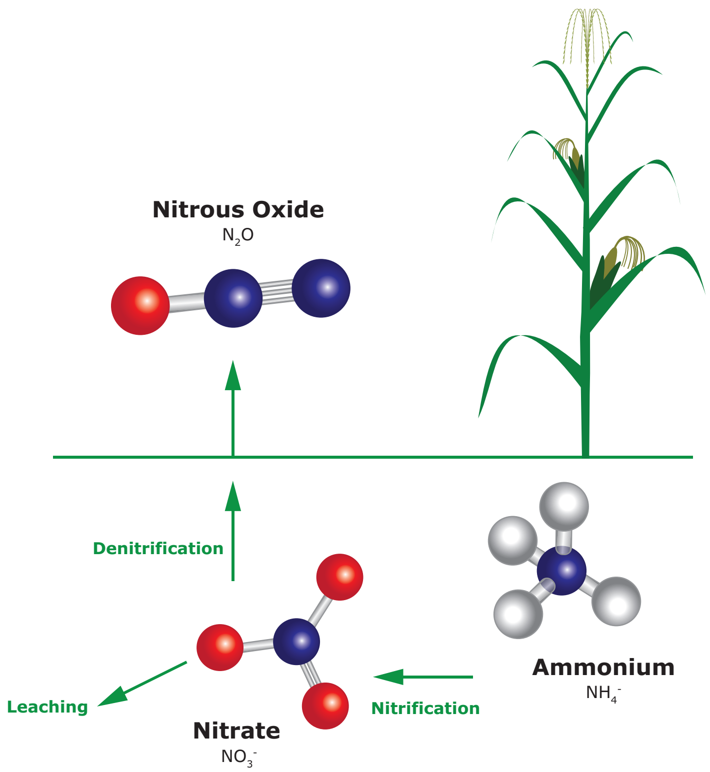
Urea that remains on the surface and subsurface is converted by the urease enzyme whereby nitrogen is lost to the atmosphere in the form of ammonia gas. When urea goes into solution through an irrigation or rain event, the urea moves deeper into the soil profile. When the urease converts the urea in the soil, ammonia diffuses much more slowly, and converts to ammonium.

When broadcasting urea onto the surface of the soil, or very close to the surface of the soil, guarding against this urea volatilization can bring significant yield improvements as more nitrogen remains in the soil. Using NanoChem's Sun 27 (26.7% N–(n–butyl) thiophosphoric triamide) (NBPT) by weight), the urea is protected against volatilization by temporarily reducing the effectiveness of the urease enzyme on the soil surface and subsurface. Because urea has a neutral charge, and because it is highly water soluble, it can dissolve, and diffuse deeper into the soil profile where it safely converts to ammonium. After this conversion, it is finally in the form and location where it can be taken up by the roots of the crop.

Nitrogen Stabilizers

Nitrification and Denitrification

While ammonium is readily taken up by plants, it is also easily converted by ammonia–oxidizing bacteria and archaea in the soil to nitrite (NO_2^-) and then to nitrate (NO_3^-). While nitrate is also a plant–available form of nitrogen, it has a negative charge. While the negatively–charged clay particles in the soil can readily adsorb positively–charged ammonium, it repels nitrate. This forces the nitrate deeper into the soil profile, away from the roots of plants, and eventually into the groundwater where it is leached away from crops. If nitrate isn't leached, it can also go through the process of denitrification, whereby it is converted to nitrous oxide (N_2O) and is lost to the atmosphere. Research has shown that up to 4–5% of nitrogen can be lost per day due to leaching and denitrification.



Through nitrification, ammonium is converted to nitrate, which can either be leached from the soil profile, or can go through the process of denitrification whereby nitrogen is lost to the atmosphere in the form of nitrous oxide.

When applying nitrogen in the form of ammonium—such as urea–ammonium nitrate (UAN), ammonium sulfate, and ammonium thiosulfate—using N Savr 30 (30.0% dicyandiamide (DCD) by weight) can reduce the conversion from ammonium to nitrate by inhibiting the ammonium monooxygenase enzyme, thereby temporarily reducing the effectiveness of the ammonia–oxidizing bacteria and archaea. Research has shown that the addition of DCD increased the soil ammonium by 25%, reducing the effects of leaching and denitrification, and increasing the nitrogen uptake in crops.

Sun 27 Product Information

Non–Plant Food Ingredients

N–(n–butyl)thiophosphoric triamide (NBPT)..26.7%
Inactive Ingredients.........................73.3%

Weight/gal: 9.38 lbs (4.26 kg)

General Use Guide

Urea: 1–3 quarts per ton
UAN: 1–2 quarts per ton

N–Savr 30 Product Information

Non–Plant Food Ingredients

Dicyandiamide (DCD).......................30.0%
Inactive Ingredients.........................70.0%

Weight/gal: 9.67 lbs (4.38 kg)

General Use Guide

UAN: 3–4 quarts per ton
Ammonium sulfate: 3–4 quarts per ton
Ammonium thiosulfate: 3–4 quarts per ton

Variables to Consider

Field Management

- Irrigation
- Till or non–till
- Field geometry
- Application method of fertilizers

Climate

- Precipitation
- Temperature

Soil Properties

- Moisture
- pH
- Texture
- Organic matter
- Mineral nitrogen

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