Understanding and Using Nitrogen[1]

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With the exception of two products, melamine urea and oximide, nitrogen sources for turfgrass fertilization have remained rather constant over a number of years. Nitrogen sources are classified as (organics), (synthetic organics), or (inorganic). Organic or synthetic organics contain carbon as part of their molecular structure while organics do not. Inorganic forms of nitrogen are soluble and so is the synthetic organic, urea. True organic forms of nitrogen (derived from plants and animals) are not soluble until the source material is complete broken down by soil microorganisms and proteins and other N-containing compounds are converted to plant useable nitrogen - NO3-(nitrate ion) or NH4+ (ammonium ion). This is a slower process.

Chemists have learned that reacting soluble urea with formaldehyde, isobutraldehyde, and other materials can alter the structure of urea so that it is no longer soluble and nitrogen is released over a long period of time. Hence, we have slowly soluble nitrogen. Urea formaldehyde (Nitroform methylene urea, Formolene, etc.), oxamide, melamine urea, and IBDU are all slowly soluble forms of N. Methylene urea is the fastest acting form of these slowly soluble sources due to shorter "molecular chains." Materials such as sulfur coated urea (urea prills coated with molten sulfur) and Osmocote (urea prills coated with a plastic-like material) are slow release since urea inside the "shell' becomes liquid when water is applied and is slowly released through microscopic pores or cracks in the shell.

WHAT HAPPENS TO THESE PRODUCTS AFTER APPLICATION?

There are many myths and false claims made about slowly soluble and slow release products and with the foregoing description, let's briefly examine the factors that influence release of plant available N.

Water: All nitrogen-containing compounds require water "the universal solvent" to dissolve and carry the nitrogen to a position for plant uptake. This reaction is hydrolysis. If the nitrogen is not in solution, a plant cannot absorb it.

Favorable Soil Temperatures: All organic or synthetic organic forms of N require soil temperatures over 50°F for optimum N release (may be as high as 70°F). Soil microorganisms that decompose organic matter and nitrifying bacteria are sluggish or relatively inactive at low temperatures. These soil microorganisms supply an important (enzyme) - (urease) which is essential for breaking the complex molecule urea into simpler N compounds. Nitrifying bacteria do the rest, taking simple N compounds through a series of reactions to NH+ and NO3-. The NH+ is not stable in the soil and is rapidly coverted to NO3- when all conditions are optimum (water, temperature and bacteria). At low soil temperatures the NH+ may remain in this form and does not leach readily if the soil has any cation exchange capacity (organic matter or clay) but can be utilized by grasses in this form. The NO3- is not bound or attached to clay or organic matter and is readily utilized or leached.

Soil microorganisms: Soil microorganisms must be present in large numbers to provide the functions discussed above. Sands devoid of organic matter or recently fumigated soils may be devoid or have low populations of microrganisms and explains why ammonium nitrate or ammonium sulfate provide faster plant response.

Leaching Responses

For simplicity I shall categorize the most commonly used N compounds into fast, intermediate and slow leach rates.

[Fast]: (Solubles)
Ammonium nitrate 33.3%
Calcium nitrate 14%
Sodium nitrate
Potassium nitrate
Urea 46%
Ammonium sulfate 21%

[Intermediate]
Methylene urea - variable N
IBDU 31%
Sulfur-coated urea 32-36% (depending on sulfur shell thickness)

[Slow]
Urea formaldehyde 38%
Natural organics including sewage sludges - variable N

SOME KNOWN FACTS ABOUT NITROGEN SOURCES

To help guide you in making judgments in the use of nitrogen and in purchasing, I have listed some facts you may find useful.

1. Urea is the least expensive form of nitrogen, followed by ammonium nitrate and ammonium sulfate.
2. Organic nitrogen is usually the most expensive followed by urea formaldehyde (including methylene urea), IBDU, melamine urea and sulfurcoated urea.
3. IBDU and SCU - slowly soluble and slow release, respectively, become soluble in the presence of water at temperatures above freezing, BUT DO REQUIRE HIGHER TEMPERATURE for the conversion of urea to NH4 or NO3. They are both ureas.
4. All forms of urea, ammonium nitrate and sulfate will lower soil pH. Calcium nitrate will raise soil pH.
5. Leaching losses are higher from urea, ammonium nitrate and sulfate, calcium nitrate, potassium nitrate and sodium nitrate than from UF, IBDU, SCU, melamine urea and natural organics.
6. Plant tissue burning is greater from solubles than slowly soluble and slow release due to higher salt indices, and should be applied in smaller amounts more frequently.
7. Plant nitrogen availability during the first 10 days is greater for solubles than slowly soluble or slow release. SCU and methylene urea releases faster than IBDU and UF.
8. IBDU releases N over a slightly longer period of time than SCU, but not as long as UF.
9. Ammonium sulfate reduces incidence of Fusarium patch and takeall patch (Oophiobolus) more than urea sources.

In conclusion, the purpose of this paper is to show comparative differences among various N sources and their modes of action. Some sources are more expensive than others considering purchase price per pound of N but may not cost significantly more when you consider labor costs of application, leaching losses and mistakes made by inexperienced operators. These are some of the facts and individuals must make their own judgments based upon their relative positions and budgets. Also remember that blends are often good compromises.