

NITROGEN facts

Arne van Amerongen sheds some light on nitrogen and the release characteristics of its various sources.

Nitrogen is a vital constituent of the chlorophyll molecule, amino acids, proteins, nucleic acids, enzymes and vitamins. Nitrogen has been shown to affect turfgrasses in several ways including colour, density, shoot growth, root growth, susceptibility to diseases and environmental stress, composition of the turfgrass swards, and recuperative ability.

Many different sources of nitrogen are used currently in the turfgrass industry. The nitrogen sources vary considerably in their release characteristics, and these factors should be considered when fertiliser programmes are developed. The following survey describing each form of nitrogen-source will be a benefit to all turfgrass managers dealing with fertiliser programmes.

There are several ways in which nitrogen sources may be classified; however, the most widely accepted means is to classify nitrogen-sources as quickly available or slowly available fertilisers.

1. Quickly available nitrogen-sources

Quickly available nitrogen sources are often called quick release, water soluble, or farm grade fertilisers, and contain nitrogen in the NO_3 or NH_4 form. Nitrate-nitrogen is immediately available for plant uptake, but is also easily leached from the soil. Ammonium nitrogen is less prone to leaching but more prone to volatilisation. Nitrification of NH_4 to NO_3 is fairly rapid in most soil conditions, therefore the nitrogen from NH_4 fertilisers is also quickly used by turfgrass plants.

1a. Inorganic Salts

Inorganic salts commonly used for turfgrass fertilisation include $(\text{NH}_4)_2\text{SO}_4$, NH_4NO_3 , and several ammonium phosphates. These sources are water soluble and may be applied in dry form or liquid delivery systems. They are commonly used in turfgrass fertiliser formulations rather than alone. Application of inorganic salts to turfgrasses produced a rapid initial flush of growth of short duration. Inorganic salts have relatively high salt indexes, therefore the protection for foliar burning exists with these sources.

1b. Urea

Urea is produced by combining atmospheric nitrogen with methane to produce ammonia gas and CO_2 . The ammonia is then reacted with the CO_2 under high temperature and pressure to form urea, which contains 45-46% nitrogen. Urea has been evaluated on both warm and cool season turfgrasses. Characteristics of urea include a quick initial release rate of short duration. Urea nitrogen is prone to leaching and volatilisation losses. A urea based fertiliser programme must be based on several light applications through the growing season.

1c. Urea formaldehyde products

Urea formaldehyde (urea form, UF) is a generic name for several methylene urea polymers that are the condensation product of urea with formaldehyde. The initial reaction product of urea and formaldehyde is methyloleurea. Methyloleurea is a water-soluble form of chemically combined formaldehyde which in many respects is similar to formaldehyde; that is, it is a strong bactericide. Methyloleureas have been commercially available for turfgrass fertilisation as products containing about 50% of the nitrogen from methyloleurea and the rest from urea. Methyloleureas have produced turfgrass responses similar to other water-soluble sources; that is a rapid initial response of short duration.

2. Slowly available nitrogen-sources

Slowly available nitrogen-sources can also be called slow release, controlled release, or water insoluble fertilisers. Slowly available n sources include those that contain nitrogen either in an insoluble form or as a water-soluble source encapsulated in an impermeable coating. Release of nitrogen from slowly available sources may involve biological or physical processes. General characteristics of slowly available nitrogen sources include low water solubility, lower salt index, and slow initial turfgrass response of longer duration than quick release sources.

Slowly available nitrogen sources can be classified further as natural organics, synthetic organics, and coated materials.

2a. Natural organics

Prior to 1950 natural organics were the only slow release nitrogen sources available to turfgrass managers. Examples of natural organic nitrogen-sources include bone meal, dried blood and other waste products

of the food industries, activated sewage sludge, soy bean meal, and sottom seed meal. The n in natural organics is tied up in complex organic compounds that must be broken down by soil organisms before the nitrogen can become available to the turfgrass plants. Therefore environmental factors that influence microorganism activity such as soil pH, temperature, and moisture will govern nitrogen release from these materials.

2b. Synthetic organics

The synthetic organic class of slowly available n sources includes urea formaldehyde reaction products and IBDU. IBDU isobutylidene diurea is a synthetic organic slow release fertiliser, introduced in the mid 1960s from Japan. Isobutylidene diurea is the condensation product of the reaction of urea with isobutyraldehyde.

It is a white crystalline material that is marketed in two particle sizes: coarse, (0.7 -2.5mm) and fine (0.5-1.0mm). IBDU contains 31% n, of which 90% of the total n is water insoluble in the coarse material and 85% of the total nitrogen is water-insoluble in the fine material.

Nitrogen release from IBDU is influenced by temperature, moisture, particle size and soil pH.

2c. Oxamide

Oxamide is a synthetic organic nitrogen source still in the experimental stage of development. High production costs have hindered its commercial production, but a review of research results indicated that it has potential for use as an nitrogen source for turfgrass. A diamide of oxalic acid oxamide is white, non hygroscopic powder with a nitrogen content of 31.8% and very low water solubility. The release of nitrogen is the result of hydrolysis of oxamide in the presence of the enzyme amidase.

2d. Coated materials

Coated nitrogen sources are made by coating urea or soluble semi permeable coating. The coatings prevent the wetting of the soluble nitrogen sources so that the release of the nitrogen from the final product is delayed. The release of nitrogen may depend on the degradation of the coating, or controlled by the physical make up of the coating. The two most common forms of coated fertilisers include SCU and Resin coated urea (RCU). Sulphur coated urea is made by spraying atomised molten sulphur

on preheated urea granules or prills. The sulphur coating provides an insoluble barrier that prevents the immediate dissolution of urea. As the sulphur solidifies on the urea, however, pinholes, cracks and other defects occur in the coating. Usually the sulphur coating is then sealed with a thin coating of wax of a combination of polyethylene and heavy weight oil. A conditioner (diatomaceous earth) is added to the decrease stickiness and to make the product hydrophilic. The final product contains 32-38% n, 13-22% S, 2-3% sealant, and about 2% conditioner. The sealant and conditioner are absent from SCU. The slow release of nitrogen from SCU results from differences in the time periods required for individual granules to begin releasing urea through their pores.

2e. Resin-coated ureas (RCU)

Resin-coated ureas (RCU) are a class of nitrogen sources that include two product: Agriform and Escote. Agriform fertilisers are resin-coated fertiliser manufactured by Osmocote primarily for the nursery and greenhouse industries. Agriform fertilisers available for the turfgrass market have been evaluated for fertilisation of creeping bent grass turf.

2f. Escote RCU

Escote RCUs are made by spraying a thin plastic coating onto a urea prill. Talcum is added to the process to alter the physical characteristics of the coating. More specifically, the amount of talc added during production will influence the pore size and number on the coating. Therefore, RCUs of well defined and reproducible release rates may be made. The final product contains 41% nitrogen. The exact mechanism of release is not documented, but it has been suggested that the release of nitrogen is the result of a "controlled" osmosis of water into the pellet. The fertiliser pellet will swell until the internal pressure either causes the pellet to crack open, release the urea, or forces the urea solution back out through the pores.

References: Allen, S.E., and D.A. Mayas. 1971. *Sulphur-coated fertilisers for controlled release: Agronomic evaluation.* J. Agric. Food. Chem. 19:809-812.
Hummel, n.W., Jr., and D.V. Waddington. 1981. *Evaluation of slow-release nitrogen sources.* Soil Sci. Soc. Am. J. 45:966-970.