

Turfgrass Nitrogen Sources

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(Editor's Note: The following article was downloaded and adapted from PENpages Internet file at Penn State University — College of Agricultural Sciences. Those of you who can access this database would find many useful turf and horticultural articles available. Thanks go to Bob Mugaas at the Minnesota Extension Service for collecting this information. Because of the length of this article, Hole Notes is presenting it in two parts. This is the second half of the article.)

IBDU: IBDU is made by reacting isobutyraldehyde and urea. It contains 31% N, with 90% of the total N being water insoluble in the coarse (0.7 to 2.5 mm) product and 85% being water insoluble in the fine (0.5 to 1.0 mm) product. Release is slow due to low solubility, but once in solution, IBDU is hydrolyzed and releases available nitrogen. Particle size has a large effect on release of N, with smaller particles releasing more quickly. Release also increases with increased soil water content. Release is also affected to some extent by temperature and pH. Hydrolysis is faster under acidic conditions. The rate of release also increases with temperature, but low temperature does not affect IBDU as much as it does those sources dependent on microbial activity for release.

We have observed a 3 to 4 week delay before obtaining response from IBDU applications on Kentucky bluegrass, but not after applications to an aerated and topdressed green. Probably the close contact with wet soil and more liberal irrigation practices enhanced release on the putting green. If the delay in response is considered objectionable, a soluble N source can be used to supplement the IBDU. We have observed early spring greening with IBDU, and N recovery from IBDU exceeded that from ureaform during the initial years of use. We have obtained a quicker response and greater N recovery from fine than coarse IBDU, which has a greater residual effect.

Sulfur-coated urea: Sulfur-coated urea (SCU) is made by spraying preheated urea prills or granules with molten sulfur. A sealant, such as wax, a mixture of oil and polyethylene, or a polymer, is usually applied to seal pores and imperfections in the sulfur coating. Nitrogen content is usually in the range of 32 to 39% and is dependent on coating thickness (weight). Increasing the thickness decreases the nitrogen content. Smaller particles of urea have a greater surface area than larger particles; thus more sulfur is needed to obtain a given coating thickness on finer particles. This increased sulfur requirement decreases the percent nitrogen in the final product. Nitrogen is released from

SCU by degradation of the coating and/or diffusion of soluble nitrogen through pores in the coating. Release rate increases as coating thickness decreases and as temperature increases. The formation of ferrous sulfide on SCI under water-logged conditions slows release of N. As with the plastic coated materials, breakage of the coating increases release. The 7-day dissolution rate in water (laboratory determination) is commonly used to characterize different formulations of SCU. Most commercial products for turf have dissolution rates within the range of 25 to 35%. These values can be used to roughly estimate the amount of N that will be readily available. The remainder will have some degree of slow release. A much wider range of dissolution rates has been used in experimental SCU. We found a product with an 11% dissolution rate to be somewhat slow for three years under our conditions, but it was quite satisfactory in tests conducted in the warmer climate of Alabama. Another experimental SCU had a dissolution rate of 83% and gave results similar to those obtained from soluble sources. Although this material was a SCU, it could hardly be called slow-release. It would, however, offer less potential for fertilizer burn than straight urea.

Particles within an SCU product are not identical. If they were, one might expect all of them to release N at the same time. Quickest release occurs from imperfectly coated particles; particles in which sealant has covered imperfections release N at an intermediate rate, and the greatest delay in release occurs with thicker coated and more perfectly coated particles having no imperfections. The second class of particles is not present in SCU products manufactured without a sealant. Once release begins from a given particle, it is quite rapid. Thus, the slow-release property of SCU comes from the variability in coatings among the individual particles.

SCU has given good response from two applications per year on Kentucky bluegrass turf, and N recovery has equaled that of soluble N sources. Combinations of SCI and soluble N sources did not give improvement over the performance of SCU alone. The SREF SCU product of Scotts had a higher dissolution rate (65%) than most SCU that we have evaluated. Greater initial response and less residual occurred with this product. Scotts has recently replaced SREF with polymer coated SCU products (POLY-S), which have much better slow-release characteristics than the SREF SCU. Some of the finer SCU materials are suggested for use on putting greens. Breakage could be a problem under these conditions. As much as 20% of applied SCU

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was picked up at a mowing height of 3/16 inch in a study conducted in England. Mowing without grass catchers would prevent such removal, but breakage could still occur. High rates should be avoided where breakage due to mowing or traffic could occur. The Lesco Elite SCU is finer than the product tested in England, and pick up with it should be minimal.

Plastic-coated fertilizer: Grace-Sierra Horticultural Products Company uses the Osmocote process to produce plastic-coated fertilizers. In this process, plastic coatings (also called resin or polymeric coatings) are applied to soluble sources of N, P and K. Plastic-coated urea made by this process contains 39 or 40% N, with the 39% product being slower release due to a thicker coating. For release to occur, water passes through the coating and dissolves the fertilizer salt. This causes pressure that swells the capsule, and the dissolved salts diffuse out through enlarged pores in the coating. Different coating thicknesses are used to obtain different release patterns. The thicker the coating, the slower the release. Release increases with increased temperature. If coatings are ruptured or cracked by mechanical damage or due to prolonged, excessive drying, release rate increases. The release rate is not significantly influenced by soil moisture levels (from wilting point to field capacity), volume of water applied, soil pH or microbial activity. The high cost of these products has been a dominant factor in delaying their acceptance for turf fertilization. They are often used on greenhouse and nursery plants.

Pursell Industries' reaction layer coated urea (RLCU) is a plastic-coated material made by sequentially applying liquid monomers to urea granules. The monomers react to form a polyurethane coating and also chemically bond to the urea surface. Depending on the coating thickness, RLCU has N contents of 41 to 44%. The N release rate from RLCU is increased with increasing temperature and with decreasing coating thickness. As soil moisture content increases, N release increases only slightly. Other nutrient sources are also coated with this process. Products manufactured using this process are marketed under the name of POLYON fertilizers.

Another plastic-coated urea is Estech's Escote, which has a coating of plastic containing talc. Release rate is controlled by the amount of talc added. Escote products are used for ornamental fertilization, and some have been used experimentally on turfgrass.

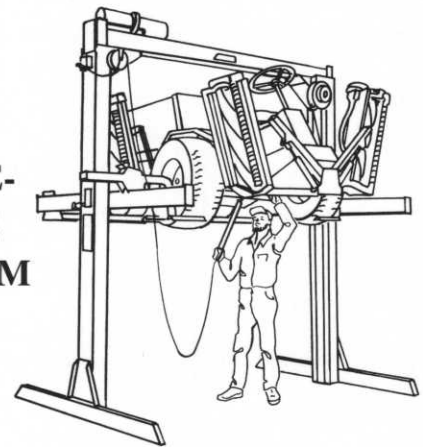
A number of experimental plastic-coated ureas and sulfur-coated ureas have been evaluated for turfgrass fertilization. Some of these products do not provide a slow-release of N, but they do offer some safety from the standpoint of fertilizer burn. Thus, not all coated fertilizer can be considered slow-release.

Oxamide: Oxamide is a N source that has been known for over sixty years. High production costs have kept it from

being produced commercially. A renewed interest in this material as a slow-release N source has resulted in recent studies on turfgrass. Oxamide contains 31.8% N, and the chemical formula is $NH_2-CO-CO-NH_2$. Release of N is by hydrolysis reactions and more rapid release is favored by finer particle size and warm temperatures. Our results with this material have shown a similarity in response following application (especially with larger granule sizes) and adequate release in cold weather to promote good green color. Fine oxamide (less than 0.25 mm) has given quicker response than granular oxamide (1-3 mm), but release from the fine material was slower than with soluble sources.

Melamine: Another older slow-release source that has gained some attention in recent years is melamine. Melamine (2, 4, 6 triamino- 1, 3, 5 - triazine) is a long lasting, insoluble N source containing 66% N. Melamine and urea have been combined to produce N fertilizers known as "Super 60" nitrogen fertilizers. Three formulations are currently available and are made by utilizing various ratios of melamine and urea. Ratios of 1:3, 1:1, and 3:1 yield 50-0-0, 55-0-0, and 60-0-0, respectively. The lowest N content (50%) reflects the highest amount of urea used, and this product will give the greatest initial response. The initial response with each is due to the urea component. Melamine begins to release N after a delay of several months. The "Super 60" fertilizers can be applied dry as granules or in water. In fluid applications, the urea dissolves and the melamine is a suspended solid.

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