UREAFORM: FIRST SYNTHETIC SLOW RELEASE FERTILIZER

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Fertilizers based on the reaction of urea with formaldehyde have been known for a long time. Solutions containing urea and formaldehyde were marketed by the du Pont Company in 1939. The pioneering work on the solid condensate was done by Dr. K.G. Clark of the U.S. Department of Agriculture (USDA), as reported in publications beginning in 1946. He coined "ureaform" for this product, and this name seems to us to be far preferable to "urea-formaldehyde" to distinguish the odorless, stable fertilizer from the noxious urea-formaldehyde resins made with a large excess of formaldehyde. There is no free formaldehyde in ureaform (as exemplified by Nitroform slow release fertilizer), and it cannot liberate formaldehyde under use conditions.

Manufacture of solid ureaform was begun by the du Pont Co. and the Nitroform Corporation in the mid-1950's. Hercules purchased the Nitroform Corp. in 1960 and marketed Nitroform slow release fertilizer until early this year, when Boots Hercules Agrochemicals Company (formed jointly by Hercules Incorporated and the English firm Boots) took over marketing this product. Du Pont has discontinued manufacture, so Nitroform slow release fertilizer is the only solid ureaform manufactured in this country at present. O.M. Scott utilizes urea-formaldehyde solutions in the manufacture of mixed fertilizer, but these products are technically not ureaforms.

In addition to designating ureaform as the "oldest" synthetic source of slowly available nitrogen, we might add that it is also the longest lasting (in the agronomic sense).

Ureaforms and natural organics undergo decomposition by soil microorganisms to form ammonia (ammonification), which may be converted to nitrate (nitrification). Variables, such as temperature, soil pH, and aeration have a great effect on these reactions. The microbiological reactions are less sensitive to particle size and soil moisture. Generally, conditions that favor plant growth also favor microbiological reactions.

Quality factors

According to the "Specialty Fertilizer Labeling Format" proposed by the American Association of Fertilizer Control officals and widely adopted: "When a fertilizer infers or connotes that the nitrogen is slowly available through use of *organic, organic nitrogen, ureaform, longlasting,* or similar terms, the guaranteed analysis must indicate the percentage of water-insoluble nitrogen in the material."

Unfortunately, specification of minimum WIN and its source, which is all that is required by the labeling format, gives no indication of agronomic availability; a fertilizer can appear to be of high quality on the basis of its WIN but be of little value because of low availability. In the case of ureaforms, solubility determinations can be used to calculate the Activity Index (AI), which gives an indication of agronomic availability.

Ureaform Specifications

The specifications for commercial Nitroform ureaform fertilzer are:

Total nitrogen—38.0 percent (minimum)

WIN—27.0 percent (71 percent of 38 percent total nitrogen)

AI—40 (minimum) (percent WIN soluble in hot water)

The AI thus supplements the WIN determination by indicating the percentage of the WIN that is readily available (soluble in hot water). The AI does not give the complete picture: it gives no measure of the cold water-soluble fraction, and it does not indicate the availability of the fraction insoluble in hot water. Nevertheless, an AI of 40 in the normal WIN range will assure availability of a major portion of the ureaform.

The solubility approach is not directly useful for other types of slowly available fertilizers. For sulfur-coated urea, dissolution rate or coating thickness is needed to indicate availability. For IBDU, particle size and soil moisture content are needed. For natural organics, the permanganate value is of some use.

Rate of Release—Nitrification Studies

When a fertilizer containing organic nitrogen is incubated with soil, micro-organisms in the soil convert the nitrogen to ammonia. Under favorable conditions (near neutral pH, adequate aeration), the ammonia formed is quickly oxidized by soil bacteria to nitrate (nitrification). Measurement of the nitrate produced under carefully controlled conditions is thus a good laboratory indication of the rate of release of nitrogen from ureaforms and other organic nitrogen fertilizers.

We have found the nitrification method to offer a good qualitative basis for comparison of slowly available nitrogen fertilizers. Generalizing from a large number of laboratory experiments at 86° F (30° C), we arrive at the following projection of rate of nitrogen release from commercial Nitroform ureaform.

This pattern allows application of a relatively large amount of nitrogen in a single application, provides gradual release for up to 24 weeks, and leaves a portion for carry-over and utilization in the next growing season. To get an early response comparable to that from a soluble source, it is necessary to apply more ureaform nitrogen initially, or as is frequently done, to add a soluble source along with the ureaform.

Product Grades Available

Nitroform ureaform is available in both granular and powder forms. The granular form, Blue Chip nitrogen fertilizer, is designed for direct application in mechanical spreaders. It is also used in balanced fertilizer (N,P,K).

Powder Blue nitrogen fertilizer is the powder form. It is well suited for use in liquid-application equipment. One gallon of water will carry 1 pound of Powder Blue in a power sprayer. Screens should be removed from the spray system to avoid clogging, and a nozzle with a large orifice (9/64 inch or larger) should be used. Other fertilizer materials (P,K) normally applied in liquid form can be used along with Powder Blue as desired.

Another advantage of applying the powder form, in addition to its ready application in water suspension, is that it is somewhat more readily available than the granular form. Our nitrification data have indicated that the powder releases 1.3 to 1.65 times as fast as the granular.

Recommended amounts

On fairways, lawns and other similar turf areas, application of 10 to 15 pounds of Nitroform fertilizer per 1,000 square feet or 400 to 600 pounds per acre is recommended. Split applications are preferred with the heaviest application at the most important phase of the growth cycle. For cool-season grasses (bluegrass, fescue and bent) apply ⅔ in the fall and ⅓ in the spring. For warm-season grasses (bermuda, zoysia, centipede, and St. Augustine) apply ⅔ in the spring and ⅓ in the fall. For seedbed application, the year's supply is worked into the top 2 to 4 inches of soil.

On bentgrass greens, three applications of 7 to 10 pounds of Nitroform fertilizer per 1,000 square feet are recommended: the first in early spring, the second in early summer, and the third in early fall. A fourth application at half this rate may be needed in mid-summer until the residual nitrogen has built up. For seedbed application on average-size greens, use 25 pounds of Nitroform fertilizer worked into the top 3 inches of soil.

A striking feature of these recommendations is the relatively large amounts of nitrogen used in a single application. Thus 10 to 15 pounds of Nitroform fertilizer (3.8 to 5.7 pounds of actual nitrogen) is routinely put on turfgrass and other plants in a single application. Contrast these amounts with those of soluble fertilizer, where the rule of thumb is to use no more than 1 pound of nitrogen per 1,000 square feet in a single application and then to take the precaution of watering it in.

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