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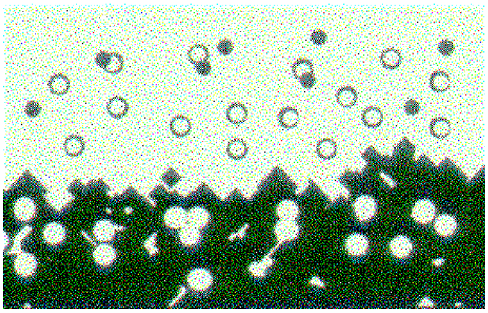

Urea: A Low Cost Nitrogen Fertilizer with Special Management Requirements

Fertilizer Fact Sheet

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Urea (46-0-0) usually has the lowest cost per pound of nitrogen compared to other single-element nitrogen fertilizers. However, urea undergoes unique chemical transformations when field applied and severe losses in efficiency may result if special management practices are not followed. The purpose of this fact sheet is to briefly describe urea transformations and to suggest how urea-N may be conserved with proper management in the field.

Urea Composition and Transformation in the Field

In common with most commercial nitrogen fertilizers, urea is manufactured from anhydrous ammonia (NH_3). The high analysis of urea—46% N—is the main reason for the low cost of this form of nitrogen fertilizer. Freight costs and storage and handling are all lower than with lower analysis fertilizers such as ammonium nitrate (34-0-0) or ammonium sulfate (21-0-0).

When field applied, urea changes to ammonium bicarbonate. This is a natural process resulting from the activity of the enzyme urease. Chemically the reaction is:

$$(NH_2)CO + 2H_2O \xrightarrow{\text{urease}} NH_4HCO_3 + OH^-$$

This chemical reaction takes place after the urea is dissolved in water and will be complete within about 48 hours under field conditions. The water solution in which the reaction takes place has an alkaline pH, to as high as 8.5, and the ammonium (NH_4^+) tends to convert to ammonia gas (NH_3). This gas will volatilize to the air if not protected. Urea placed on the soil surface or plant foliage may loose from 50% to 90% of its N as ammonia if not protected within a few hours of application.

Conserving Urea-N

If the urea-to-NH_4^+ reaction takes place in the soil the nitrogen will be captured as exchangeable ammonium on the soil exchange complex and little if any loss of ammonia gas to the air will occur. **Therefore, the key to conserving urea fertilizer nitrogen is to put the urea into the soil and not merely on the soil.**

Soil incorporation of urea can be done several ways. Since urea is completely water soluble, when applied to the soil surface it can be moved down with irrigation water or rainfall, if one or the other occurs immediately after fertilization. Also, urea can be broadcast and plowed down immediately. And urea can be injected or banded into the soil.

Soil banding or injection is usually not feasible with an established crop such as pasture. Under these conditions the nitrogen fertilizer of choice would be either ammonium nitrate, ammonium sulfate, or one of the ammoniated phosphates (for example 11-52-0).

Urea is applied alone or in combination with other fertilizers. It is available in solid prills and in water solution. The latter includes a 50-50 mix of urea and ammonium nitrate, which is sold under various trade names and is guaranteed at 32% nitrogen (32-0-0). The urea-to-NH_4^+ transformation will take place regardless of whether another nitrogen form or other fertilizer element is present in the fertilizer.

Summary

Urea is a low cost nitrogen fertilizer form. This is because of its high nitrogen composition and consequent low transport and storage costs. Urea may be the fertilizer of choice when only nitrogen is needed in a soil fertility program.

Urea converts to ammonium bicarbonate within about 48 hours after field application. Nitrogen in this form will tend to volatilize to the air as ammonia gas. This lost fertilizer investment risk can be minimized or eliminated by assuring that the urea gets into the soil and does not merely remain on the surface of the soil or crop foliage. This can be accomplished by irrigating in the urea; by plowdown soon after surface broadcast application; or by banding or injecting the urea directly into the soil.

For further information see Chapter 8 “Fertilizer Composition and Reactions in Soils,” Utah Fertilizer Guide, AG 431.

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