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# Use of Urea for Crop Production in Kentucky

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## USE OF UREA FOR CROP PRODUCTION IN KENTUCKY

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Current trends indicate that urea will become the major source of solid and liquid N fertilizer in the future. Although urea has several advantages over other N fertilizers, especially in manufacturing, transporting, and marketing, there are some potential agronomic problems that farmers should keep in mind when using urea.

### Urea as a Fertilizer

Urea is a white, crystalline, prilled or granulated material containing about 45% N, the highest of all solid N fertilizers. It has excellent handling qualities and dissolves readily in water, making it a good source of N for direct application, for blended solid fertilizers, or for liquid fertilizers. The use of urea fertilizer has increased rapidly in recent years. In Kentucky, the use of solid urea fertilizer increased from about 1,450 tons in 1965 to almost 60,000 tons in 1982, while N solution fertilizers, most of which contain urea, increased from about 19,000 to 66,000 tons.

Although urea is highly soluble in water, it must undergo a process called hydrolysis before the N is available to plants. The hydrolysis process occurs as follows:

$$(NH_2)_2CO \text{ (urea)} + 2H_2O \longrightarrow (NH_4)_2CO_3 \text{ (ammonium carbonate)}$$

Urea hydrolysis is greatly accelerated by the presence of urease, an enzyme that is abundant in soil,on plant leaves, and on crop residues. Thus, under favorable temperature and moisture conditions, urea usually hydrolyzes rapidly whether in the soil, on the soil surface, or on the surface of live or dead plants. The hydrolysis is essentially complete in 4 to 7 days.

### Ammonia Volatilization during Hydrolysis

The greatest potential agronomic problem with urea fertilizer arises during hydrolysis. Some of the ammonium carbonate breaks down to ammonia, carbon dioxide and water, and some of the ammonia may be lost by volatilization into the atmosphere. If urea is applied on the surface and is not tilled or washed into the soil within a few hours, there is potential for a large amount of N to be lost, depending on the conditions that

exist as the urea hydrolyzes. High soil and air temperatures, high soil pH (greater than 6.5), dry weather, and moist soil drying rapidly are among the most important factors that increase ammonia volatilization. Research results in Kentucky suggests that the single most important factor determining the amount of N loss is whether or not rain washes the urea into the soil within about 3 days following a surface application.

## How to Control Volatilization Loss

If urea is tilled or washed into the soil, little or no loss from volatilization of ammonia occurs. Since the soil is not tilled when fertilizing pastures, hay crops, or no-tillage row crops and rainfall is difficult to predict, there is a risk that some N will be lost when urea is used for these crops. Certain things can be done to minimize that risk. For pastures and hay crops, timing the application is probably the most effective control. Results of research at Princeton, Ky. showed that when urea was broadcast topdress on a fescue sward in early May or before, apparently there was little or no loss of N. When applied after early May, the efficiency of urea was significantly inferior to ammonium nitrate, a source from which volatilization loss is not likely to occur. Other studies in Kentucky showed that urea was as effective as ammonium nitrate when applied as a topdress on wheat and barley in March.

Some application methods have been shown to increase the efficiency of urea fertilizers for no-tillage crops. These include band application of solid urea or N solution below the soil surface by knifing or chiseling and band application of N solution through dribble tubes instead of spraying it uniformly over the surface.

## Summary

Urea is an excellent solid or liquid fertilizer material when tilled or washed into the soil; but, when surface-applied, there is a potential for a substantial amount of the N to be lost by ammonia volatilization under certain weather, soil, and application conditions. For surface application of N solution, the risk of volatilization loss can be minimized by applying in bands rather than broadcasting. Urea applied on the surface early in the spring (mid-May or before) has proven to be as effective as ammonium nitrate in fertilizing pastures, forage crops, and small grain crops.

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