

Urease Inhibitors

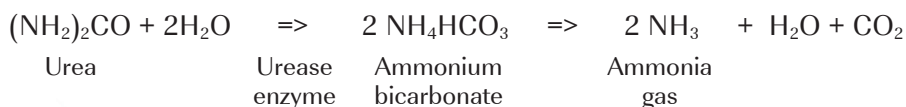
Some compounds added to urea or urea-containing fertilizers can reduce the rate of the first "hydrolysis" step, and slow the rate of ammonia production. Under certain conditions, this can help reduce ammonia loss to the atmosphere.

Urease Enzymes and Nitrogen Loss from Urea

Urea is the most widely used form of N fertilizer, and can be formulated as dry granules, prills, or as a fluid alone or mixed with ammonium nitrate (UAN). Urea is also present in animal manures. All these forms of urea have the disadvantage of undergoing considerable losses as ammonia gas if not incorporated into soil soon after application.

Once dissolved in water, urea is converted to ammonium bicarbonate within a few days following application by the naturally occurring enzyme, urease. Urease is produced by many soil microorganisms and plants, and is present in nearly all soils.

When urea is hydrolyzed by urease, much of the resulting ammonium is held on soil cation exchange sites. During the conversion, the pH temporarily rises and ammonia gas is produced. The loss of ammonia, termed volatilization, can be from nil to over 50%.



The factors conducive to N loss as ammonia from urea are: surface application, less than 10 mm (0.4 in.) of rainfall and/or irrigation in the first few days after application, presence of crop residues, open crop canopies, high temperatures, high soil pH and low cation exchange capacity soils. Moving the applied urea below the soil surface with tillage or through rainfall and irrigation also effectively minimizes ammonia loss from urea.



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Reducing Urease Activity

Urease inhibitors are used to temporarily reduce the activity of the enzyme and slow the rate at which urea is hydrolyzed. There are many compounds that can inhibit urease, but only a few that are non-toxic, effective at low concentrations, chemically stable and able to be mixed with or coated onto urea-containing fertilizers.

The most widely used urease inhibitor is N-(n-Butyl) triphosphoric triamide (NBPT), which converts to active NBPT (N-(n-Butyl) phosphoric triamide). Other widely studied urease inhibitors include phenylphosphorodiamidate (PPD/PPDA) and hydroquinone. Ammonium thiosulfate and some metals can also inhibit urea hydrolysis. There are many other organic compounds, especially structural analogues of urea, capable of inhibiting urease.

Management Practices

Urease inhibitors are potentially useful tools for controlling or reducing gaseous losses of ammonia following fertilization with urea. They can restrict urea hydrolysis for up to 7 to 14 days, after which rain, irrigation, or soil mixing would be required to further restrict ammonia losses.

Because the magnitude of ammonia loss varies with soil type, climate and crop cover, the reduction due to the use of a urease inhibitor can also be variable. Research suggests NBPT-treated urea use can reduce ammonia loss by 50% to 90% when compared to untreated urea.

The potential boost in crop yield from the preserved N will depend on the nutrient demand of the crop, the indigenous soil N supply, and other management practices.

Urease inhibitors provide farmers with an additional tool to keep applied N in the root zone, which can have agronomic and environmental benefits.

