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## KEEPING A LID ON NITROGEN LOSSES

**As fertilizer economics and supply change over the years, so do the most commonly used sources of nutrients.** Farmers have changed from using guano, to ammonium sulfate, to anhydrous ammonia, and now to urea as the most common source of N fertilizer used in the world.

**Each source of nutrient has unique properties that must be managed in order to get full benefit for the crop.** Urea itself is commonly found in nature and can also be manufactured under controlled conditions using natural products. Considerable research and experience have shown that when urea and urea-containing fluids are managed properly, they are excellent nutrient sources.

**Urea has the advantage of having a very high N content (46% N), making it much easier to transport and handle than many other sources.** Urea is converted by naturally-occurring soil enzymes to ammonium within a few weeks after being added to soil. When urea changes to ammonium, it becomes susceptible to loss as ammonia gas. There are many soil and environmental factors that determine how much is lost. A few of the most important are reviewed here.

- **Placement: If urea is placed or incorporated at least one inch beneath the soil surface, ammonia losses are virtually eliminated.** Similarly, if one-half inch (or more) rainfall or irrigation occurs very shortly after surface application, the urea will move deep enough into the soil to virtually eliminate ammonia loss. The ammonium that is released from the urea will be retained on the soil particles to be used by plants, instead of being lost to the air.
- **Soil pH: When urea begins the change to ammonium, the soil around the granule or droplet becomes more alkaline.** This natural process makes ammonium more susceptible to the loss of ammonia gas to the air. As the ammonium later becomes converted to nitrate by soil microorganisms, the soil pH will drop again. Ammonia loss from soils receiving surface applications of urea becomes a greater concern as the soil pH increases above 7.
- **Crop Residue: The presence of crop residues on the soil surface can increase ammonia loss from surface applications of urea in two ways.** The enzyme that converts urea to ammonium is very abundant in crop residues and high organic matter soils. Additionally, when surface residue is present, the urea may remain trapped on the residue and not interact with the soil.
- **Soil Properties: Soils with a higher cation exchange capacity retain more of the ammonium released from urea than soils with a lower cation exchange capacity.** Similarly, soils that can resist a rapid change in pH usually have less ammonia loss from surface urea applications. This generally translates to higher ammonia loss from coarse-textured soils than from more clayey soils.
- **Coatings and Additives: Various coatings have been developed to control the solubility of urea and improve crop nutrient recovery.** A coating of S or a polymer can be used to protect the urea from soil reactions and prolong its persistence. The rate of N release from the coated urea should be closely matched to the nutrient demand of each particular crop. Chemical compounds are also available for dry or liquid urea to inhibit the enzymes responsible for the conversion to ammonium. This inhibition typically lasts for 2 to 8 weeks, during which time rainfall or irrigation should move the urea into the soil, protecting it from volatile losses.

**Several soil and climate factors need to be considered when using surface-applied urea.** In general, incorporate the urea into the soil whenever possible using equipment, rainfall, or irrigation. When this is not possible, consider using a coated fertilizer or an additive to keep the ammonia from being lost to the air.

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For more information, contact Dr. Robert Mikkelsen, Western North America Director, IPNI, 4125 Sattui Court, Merced, CA 95348. Phone: (209) 725-0382. E-mail: [rmikkelsen@ipni.net](mailto:rmikkelsen@ipni.net).

Abbreviations in this article: N = nitrogen; S = sulfur.

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