Nutrient Source SPECIFICS

Urea-Ammonium Nitrate

No. 7

Liquid fertilizer solutions or fluid fertilizers are popular in many areas because they are safe to handle, convenient to mix with other nutrients and chemicals, and are easily applied. A solution of urea [$CO(NH_2)_2$] and ammonium nitrate [NH_4NO_3] containing between 28 and 32% N is the most popular N fluid fertilizer.

Production

Liquid urea-ammonium nitrate (UAN) fertilizer is relatively simple to produce. A heated solution containing dissolved urea is mixed with a heated solution of ammonium nitrate to make a clear liquid fertilizer. Half of the total N comes from the urea solution and half from the ammonium nitrate solution. UAN is made in batches in some facilities or in a continual process in others. No emissions or waste products occur during mixing.

Since UAN is a concentrated N solution, its solubility increases as the temperature rises. To prevent the N components from precipitating as crystals, UAN solutions are made more dilute in regions with cold winter temperatures. Therefore, the N concentration in commercial UAN fertilizers will vary from 28% N to 32% N depending on geography. A corrosion inhibitor is usually added to the final solution to protect the steel in storage tanks.

Chemical Properties

Properties:	28% N	30% N	32% N
Composition (% by weight)			
Ammonium Nitrate	40	42	44
Urea	30	33	35
Water	30	25	20
Salt-out temperature (°C) (Crystal precipitation temperature)	-18	-10	-2
Solution pH	- - - -	approximately 7	- - - -

Agricultural Use

Solutions of UAN are widely used as a source of N for plant nutrition. The NO_3^- portion (25% of the total N) is immediately available for plant uptake. The NH_4^+ fraction (25% of the total N) can also be assimilated directly by most plants, but is rapidly oxidized by soil bacteria to form NO_3^-. The remaining urea portion (50% of the total N) is hydrolyzed by soil enzymes to form NH_4^+, which is subsequently transformed to NO_3^- in most soil conditions.

Solutions of UAN are extremely versatile as a source of plant nutrition. Due to its chemical properties, UAN is compatible with many other nutrients and agricultural chemicals, and is frequently mixed with solutions containing P, K, and other essential plant nutrients. Fluid fertilizers can be blended to precisely meet the specific needs of a soil or crop.

UAN solutions are commonly injected into the soil beneath the surface, sprayed onto the soil surface, dribbled as a band onto the surface, added to irrigation water, or sprayed onto plant leaves as a source of foliar nutrition. However, UAN may damage foliage if sprayed directly on some plants, so dilution with water may be needed.

Management Practices

UAN makes an excellent source of N nutrition for plants. However, since half of the total N is present as urea, extra management may be required to avoid volatile losses. When UAN remains on the surface of the soil for extended periods (a few days), soil enzymes will convert the urea to NH_4^+, a portion of which can be lost as ammonia gas. Therefore, UAN should not remain on the soil surface for more than a few days in order to avoid significant loss. Inhibitors that slow these N transformations are sometimes added. When UAN is first applied to soil, the urea and the NO_3^- molecules will move freely with water in the soil. The NH_4^+ will be retained in the soil where it first contacts cation exchange sites on clay or organic matter. Within 2 to 10 days, most of the urea will be converted to NH_4^+ and no longer be mobile. The originally added NH_4^+ plus the NH_4^+ coming from urea will eventually be converted to NO_3^- by soil microorganisms. ■

Abbreviations and notes: N = nitrogen; NH_4^+ = ammonium; NO_3^- = nitrate; P = phosphorus; K = potassium.

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