Saskatchewan
Soil Conservation
Association

Soil Facts

# Nitrogen Management Options in Direct Seeding

Nitrogen (N) fertilizer is probably the most common fertilizer used in world food production. There are many different nitrogen fertilizers, many different application methods as well as fertilizer additives and coatings. The goal of nitrogen management is to increase the Fertilizer Use Efficiency (FUE) by reducing losses of available N from volatilization of ammonia, denitrification, leaching and immobilization. From a greenhouse gas perspective, nitrogen lost as nitrous oxide ($N_2O$) is of particular concern since it is a powerful greenhouse gas; 310 times more potent than $CO_2$.


*Anhydrous Ammonia is one of the most common nitrogen fertilizer sources.*

Anhydrous Ammonia ($NH_3$, AA) is a fertilizer commonly used as a nitrogen source in crop production. It contains the highest percentage of any fertilizer manufactured at 82% N by weight. AA is a gas at atmospheric pressure and is stored as a liquid under pressure. Application requires high-pressure tanks and elaborate metering systems designed for high-pressure liquids. AA can be applied to the soil using coulters, knives, or sweeps. Because AA is a gas at atmospheric pressure, care needs to be taken to decrease the amount of $NH_3$ lost during application. Factors that affect loss of AA are the physical condition of the soil, soil moisture, soil texture, and depth of placement. These properties affect the "sealing ability" of the soil behind the knife or coulter. If the soil is cloddy, excessively dry, or coarse textured, the furrow may not close properly and losses occur. Usually coarse textured soil and/or dry soil require a deeper placement to minimize losses. Row spacing also influences loss of AA. Generally, the greater the row spacing the greater the losses because the concentration in each row increases and more AA needs to be "packed" into each furrow. As a rule of thumb, if vapor cannot be seen behind the opener and the odor is not unbearable, the losses are minimal. Care needs to be taken when applying AA at the same time as seeding. Separation between AA and seed is crucial to avoid seed and seedling damage and it is necessary to have both vertical and horizontal separation. This should be checked carefully and continually to account for changes in soil conditions and opener wear as they affect separation. Horizontal separation is more important than vertical. Seed openers should be inspected for excessive wear that may influence separation. An indicator test kit can be used to check the separation and ensure there will be no seedling damage.

Ammonium nitrate ($NH_4NO_3$) is a fertilizer N source that when sold as a solid (prill) contains 32-33.5% nitrogen. This product is easy to handle but when exposed to humidity and/or water, will cake together like many other granular fertilizers. Ammonium nitrate is commonly used for broadcast applications because losses from ammonia volatilization are potentially lower than some other forms of nitrogen. Ammonium Nitrate is explosive when in contact with oxidizable carbonaceous material such as oils. Granular ammonium nitrate should not be mixed with granular urea as this mixture readily absorbs water and cakes.

Ammonium sulfate [$(NH_4)_2SO_4$] is a fertilizer that is an effective source of both sulfur and nitrogen. Ammonium Sulfate is available as a dry granular prill or crystal. Sulfur is an important nutrient to crops and Ammonium Sulfate contains sulfur in the form that is readily available to plants. It is less susceptible to loss through volatilization than Urea

since all of the N is already in the ammonium form.

Urea ($CO(NH_2)_2$ is made by reacting ammonia with carbon dioxide at high pressure. Urea is the most highly concentrated solid Nitrogen form at 46% N. When added to the soil, the urease enzyme acts on urea to hydrolyze it first to Ammonium Carbonate which is unstable and breaks down further to Ammonia and Carbon Dioxide in the soil. The Ammonia is then converted to ammonium in the presence of soil water and is then adsorbed by the colloidal fraction of the soil if the fertilizer is placed under the surface of the soil. The hydrolysis of Urea by the enzyme urease is quite rapid in most soils and is accelerated by high temperatures and moisture. Urea that is broadcast on the surface is easily lost due to the rapid hydrolysis and production of ammonia. On the surface, the ammonia gas produced can readily escape (volatilize) to the atmosphere. If application is followed by immediate heavy rainfall or irrigation, the urea will infiltrate into the soil and losses will be minimized. Fertilizer left on the soil surface can be hydrolyzed and because it is not surrounded by soil colloids, the N is lost. There are a couple of ways to minimize losses of Urea. One is to place the fertilizer into the soil, preferably in bands, and the other is to use urease inhibitors or polymer coatings. A urease inhibitor will keep the fertilizer in the urea form and consequently reduce losses because the fertilizer will stay in a stable form for a longer period of time. The commercial product, Agrotain, is available and provides as much as 14 days protection from volatilization. The 14-day protection period gives time for rainfall to dissolve the Urea and move it into the soil where it is not as susceptible to loss.

Urea Ammonium Nitrate (UAN) is a common solution nitrogen fertilizer product. UAN contains 25% nitrate, 25% ammonium, and 50% urea dissolved in water to produce a liquid formulation with 28 % N by weight. The versatility and ease of handling makes this product popular. Side banding liquid fertilizer for one pass seeding systems is easily accomplished by squirting the liquid to the side of the seed row. UAN is easily blended with other sources of liquid P, K, and S. UAN is useful for post emergent dribble banding or coulter injection. UAN is susceptible to losses if surface placed. The urea portion of UAN similar to granular urea. Agrotain can also be used with UAN by adding it to the solution. It has the same effect on urea in UAN as in granular Urea.

There are many different options for N fertilization. Although all sources have potential benefits and drawbacks, proper use and application methods play a large part in increasing (FUE). Fertilizer type, application method and also timing play a role in maintaining high FUE. Applying fertilizer when the crop needs it is the best plan of attack. Many producers apply fertilizer in the fall because the benefits include potentially lower fertilizer prices and the spreading of the workload. A drawback to fall application is the potential for denitrification in waterlogged flats on spring flood plains or additional leaching losses. In general, fertilizer N forms should be applied in late fall when the soil has stopped conversion of ammonium to the easily lost nitrate form. Fall application of nitrate forms should be avoided. Spring application as in a one pass seeding system, works well as the fertilizer is delivered when the plant starts growing and requires the nutrients. Split application by means of coulter, broadcast, or dribbling is becoming a common practice. Some producers apply urea in early winter after snowfall on forage and winter seeded crops. The broadcasting of urea should be undertaken only if there is no more than four inches of fresh fluffy snow and a period of mild weather follows the snow and broadcast application. When these conditions are met, urea pellets can dissolve and melt through the snow to the surface of the soil. The urea should then infiltrate into the soil with spring melt. If these conditions do not exist potential for loss through volatilization and runoff is high. This practice should only be attempted on a small percentage of acres to obtain experience and to analyze results. While split application allows the delivery of fertilizer to meet crop demands; it also allows flexibility in decision making later in the growing season. The key to selecting nitrogen fertilizer is to look at how each will work in a given operation.

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