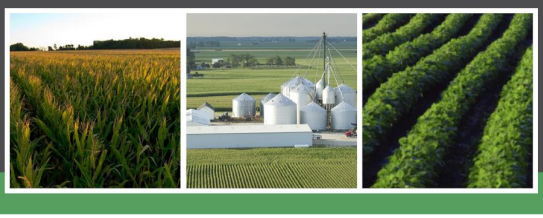

PRO HARVEST SEEDS

Agronomic Spotlight

Nitrogen Availability this Spring

- Spring nitrogen availability is affected by many factors such as the type of fertilizer and specific nutrient compound applied, use of stabilizers, soil type, and weather conditions.
- Understanding how N loss can occur through leaching, denitrification, and volatilization can help better manage N use efficiency.
- Determining the amount of nitrogen available for plant uptake this spring and identifying further management steps needed this season is critical to help maximize crop yield potential.

Sources of Nitrogen

Nitrogen (N) can be supplied for plant growth in several ways. Atmospheric N is a major component of the N cycle. Legumes such as soybean and alfalfa can use this type of N via N fixation. Decomposing plant material from these legume crops will release N into the soil. Small amounts of atmospheric N are also added to the soil through precipitation.

Soil organic matter is composed mainly of humus and is an important source of N for plant growth. Organic N is converted to nitrate and ammonium and made available to crops through a process called mineralization. Decomposition of humus occurs at a slow rate and can release about 20 lb N per acre per year for each percent of organic matter in the soil.[1] Additional sources of N include organic wastes such as manure, crop residues from non-leguminous plants, and commercial N fertilizers.

Nitrogen Fertilizers and Risk of Loss

Nitrogen fertilizers contain N in one or more forms: ammonia (NH_3), ammonium (NH_4), nitrate (NO_3), or urea ($CO(NH_2)_2$) (Table 1). Ammonia is a gas, which becomes liquid under pressure. When anhydrous ammonia is applied, the ammonia is converted to ammonium in the soil. Ammonium binds to clay and organic matter in the soil, preventing it from leaching. Soil microorganisms convert ammonium to nitrate - the main form of N taken up by plants. Conditions favorable to this process of nitrification are a soil pH of 7, soil moisture at 50% of holding capacity, and a soil temperature of 80°F.[2] Nitrate can be subject to leaching. Excessive rainfall can leach nitrate out of the root zone making it unavailable for plant use.

When soils are waterlogged, soil organisms take oxygen from nitrates. This process, called denitrification, converts NO_3 to N_2O and N_2, which are gaseous forms of N that ultimately can escape into air. This type of N loss occurs most often in fine-textured soils subjected to prolonged anaerobic conditions. Urea is converted to ammonia 2 to 4 days after application when soil moisture and temperature are favorable. Lower temperatures will slow the process. Urea is first converted to ammonia, then to ammonium, and finally to nitrate. Volatilization can occur when urea is applied to the soil surface and is more likely to occur with high soil temperatures, low soil moisture and soil pH greater than 7.[2] No matter what form of N fertilizer is used, most of the N will be converted to nitrate in the soil.[3]

Nitrogen Stabilizers

Nitrogen additives can be used to delay N transformations and prolong N availability. If N stabilizers are used with N fertilizer applications, the amount of N loss may be reduced, even if weather conditions are not ideal. There are two categories of N stabilizers generally used: nitrification inhibitors and urease inhibitors. Nitrification inhibitors N-Serve® and Instinct® (nitrapyrin) inhibit soil bacteria responsible for denitrification, slowing the conversion of ammonium to nitrate. N-Serve is primarily used with anhydrous ammonia and labeled for immediate incorporation or injection. Instinct is an encapsulated formulation of nitrapyrin that can be applied to fertilizer left on the surface for up to 10 days. Urease inhibitor Agrotain® (NBPT) is intended for broadcast, surface-applied urea and UAN (urea ammonium nitrate) fertilizers. Agrotain inhibits soil urease conversion of urea to ammonia to allow more time for rainfall to incorporate urea-based fertilizers. Agrotain® Plus is an additive for UAN solutions that combines the urease inhibitor to reduce volatilization loss with dicyandiamide to hinder nitrification.

Determining N Availability

Because so many factors affect N loss and the amount of N in soils, it can be difficult to accurately estimate the amount of N available to plants. Soil testing to determine the level of nitrate and ammonium forms of N can help estimate the amount of N loss due to rainfall or flooding. Soil cores should be collected to a depth of at least one foot. In sandy soils prone to leaching, sampling at a greater depth may help to identify plant-available N deeper in the soil profile.[4] If fertilizer was broadcast in the fall or early spring, collect 20 to 30 cores per sample. If previously applied fertilizer was banded, samples should contain 15 to 20 soil cores. Samples should be collected perpendicular to the direction that fertilizer was applied. Each sample should represent no more than 10 acres.[5] Samples should be dried or refrigerated as soon as possible to stop soil microbial activity from changing N levels. Results indicating substantial levels of soil ammonium are more likely if anhydrous ammonia was recently applied, nitrogen stabilizers were used, or soil pH is 5.5 or less. In such cases, low levels of soil nitrate may mean that little conversion of ammonium to nitrate occurred rather than loss of nitrate from the soil due to leaching or denitrification.

Nitrogen Availability this Spring

Table 1. Common Nitrogen Fertilizer Options

Fertilizer Type	% Nitrogen	Risk of N loss and other considerations	Suggested use*
Ammonium nitrate	33-34	Half ammonium N and half nitrate N; not recommended for soils subject to leaching or denitrification; can be surface applied where volatilization of urea is a concern	Side-dressing corn
Ammonium sulfate	21	Little risk of loss to surface volatilization on most soils; requires 2-3 times more lime to neutralize acidity compared to other N fertilizers	Spring preplant Side-dressing corn Fall application
Anhydrous ammonia	82	Converts to nitrate N slowly, so less risk of loss due to leaching or denitrification; must be injected into soil, therefore little loss to surface volatilization; can be hazardous to handle	Side-dressing corn Fall application
Urea	45-46	Converts to nitrate N relatively quickly; denitrification on wet/compacted soils can be serious; leaching can be a problem; surface volatilization can occur when temperatures are above 50° F, therefore needs to be incorporated	Spring preplant Side-dressing corn Fall application
UAN	28-32	Usually consists of urea + ammonium nitrate; each component has the same loss mechanisms as mentioned above	Spring preplant Side-dressing corn

*Source: Mengel, D. Types and uses of nitrogen fertilizers for crop production. AY-204. Purdue University Cooperative Extension.

The preplant soil nitrate test (PPNT) and the pre-sidedress soil nitrate test (PSNT) can be used to determine nitrate concentrations in soils. This makes it possible to predict the amount of N that will be available to plants during the growing season through mineralization. Most N is released from the soil in the spring when temperatures increase. The rate of N release from soils is influenced by soil temperature, moisture, and aeration. Sampling for the PSNT should be done when corn is 6 to 12 inches tall or in late May to early June. Soil cores should be taken at a depth of one foot with one sample containing 15 to 20 cores. Samples should come from field areas that are similar and no more than 10 to 20 acres in size.[6] Fields that are likely to have high nitrate concentrations (manured, previous year in alfalfa, fine-textured, fall-tilled, south-facing slopes) should be sampled. Although some differences exist in University recommendations for interpreting PSNT results, a general rule of thumb is that if soil test results are over 23 to 25 ppm, additional nitrogen is probably not needed.[6]

Summary

A study from the University of Wisconsin found that "regardless of the rate or source, the fate of fall– and spring-applied N is mostly impacted by weather conditions in early spring."[4] Careful soil sampling and testing this spring can help determine if additional N is needed to help maximize crop yield potential.

Sources

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