SeedSCOOP

PREPLANT NITROGEN OPTIMIZATION FOR CORN

Key Points

- There are advantages and disadvantages for each method of preplant nitrogen (N) fertilization. Fertilization method and application timing should be evaluated to minimize N loss along with fertilizer cost while meeting crop needs.
- Each N fertilizer has a potential for loss and understanding these loss mechanisms can help make a knowledgeable choice for each unique situation.
- Denitrification, leaching, and volatilization are three processes that can lead to N loss associated with a preplant application.

Potential Nitrogen Loss

Denitrification

Denitrification is the process by which soil bacteria that thrive in water saturated (anaerobic) soils convert nitrate-N into gaseous forms of N. Volatilization of the N gas can result in as much as 5% nitrate-N loss per day. Losses will be higher under warmer soil temperatures.

Leaching

Leaching occur when nitrate-N moves downward in the soil profile, out of the root zone, with excessive rainwater or irrigation. Fertilizers that contain urea ammonium nitrate (UAN) are highly susceptible to leaching, especially when applied to course textured soils.

Volatilization

Volatilization can occur with urea-based fertilizers when surface-applied and not incorporated. Urease enzymes in the soil and plant residue convert urea to free ammonia gas. On warm sunny days, with moist soil surface conditions, up to 15 to 20% urea-based N can volatilize within a week of application.

Products that can be used to inhibit or delay N losses include nitrification inhibitors, urease inhibitors and polymer coated urea.

Nitrogen Application Timing

Timing of N application can be influenced by factors such as weather and workload. Applying N as close to the rapid plant uptake growth stage, between the V12 and V18 growth stages, as possible can help reduce potential N loss.

Figure 1. Anhydrous ammonia applications in the spring.

Fall applications have the greatest risk of N loss. If applying N in the fall is preferred, anhydrous ammonia is recommended because it has the lowest loss risk of any N fertilizer. Anhydrous ammonia should be applied with a nitrification inhibitor when soil temperature is less than 50°F. A nitrification inhibitor works by slowing down the conversion of ammonium to nitrate in the soil, reducing the potential risk of N loss.

Spring pre-plant applications are preferable due to the lower potential for N loss and improved timing relative to rapid plant uptake. However, spring can also be a time of large potential N loss due to wet soils. If N is applied more than two weeks prior to planting, anhydrous ammonia is recommended to

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help reduce the risk of loss. Nitrogen loss potential due to leaching is highest when applied to sandy or coarse textured soils.

Strip till preplant fertilizer applications can apply both a N source and a second fertilizer, or combination of fertilizers, six to eight inches deep. This can be done in the fall or in the spring prior to planting. This one trip tillage operation tills a narrow strip to prepare a seed bed while positioning preplant fertilizer several inches below the seed slice, where the seed will be place at planting. Placing a band of fertilizer into the future root zone increases plant utilization, especially if the soil has very low nutrient availability.

Caution *- Avoid placing high rates of N or potassium fertilizer in direct contact with seed to prevent potential seedling injury from fertilizer burn.*

There is always a risk that soil conditions or workload will prevent the preplant application of N fertilizer. These conditions may result in pushing the application of N into the at planting or in-season sidedress window. Any N source can be susceptible to denitrification if the soil is saturated after the application and the N has been converted to nitrate N by soil organisms.

Table 1. Nitrogen (N) source and application.

N-Source Analysis	Common Name	N Form	Time of application	Strength of product	Primary method of N loss	Use with N stabilizer/ Inhibitor
82-0-0	Anhydrous Ammonia	Gas/liquid	Fall, Pre-plant, Sidedress	Nitrogen Dense	Volatilization	Yes
46-0-0	Urea	Dry Pellet	Pre-Plant, Band	Good Storage and Handling	Volatilization/ Leaching	Yes
28/32-0-0	Urea Ammonium Nitrate (UAN)	Liquid	Preplant, Sidedress	Relatively easy to handle and apply	Volatilization/ Leaching	Yes

Nitrogen Sources and Application

Ammonium and nitrate are the two forms of N used by plants. Other forms of N must be converted by soil organisms to one of these forms. The N source should be considered when determining application method. Anhydrous is the densest nitrogen source. All other nitrogen fertilizer sources are made from anhydrous ammonia. These additional manufacturing processes reduce the concentration and typically increase the cost per unit of N. While these lower N fertilizers generally have a higher price per pound of N, this can be affected by seasonal supply and demand. All N sources are generally easier to store and apply, as well as safer to handle than anhydrous ammonia.

Determining the Nitrogen Application Rate

The rate of N applied is an important variable because of economic and environmental issues.

Before determining the amount of N to apply the producer must:

- Estimate the amount of N in the soil that will be available for corn crop use.
- Determine the total N needed for the expected crop yield. As yield goals increase, the amount of N required will also increase.

Determining the proper N rate can be difficult due to temperature and precipitation affecting the release

Figure 2. Growing corn crop that is nitrogen deficient.

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of N (mineralization) from the soil over time and the potential loss of N after an application.

Crop need and corresponding N applications must be calculated every year and for every field. A common calculation to determine the total N needed for an acre of corn can be determined by multiplying the yield goal for the projected crop year by a factor of 1.0 to 1.2 pounds of N per bushel per acre. Applying N based upon yield goals and soil test levels has been a common method used in western corn growing areas to recommend the amount of N to apply. Several universities in the Corn Belt recommend using a "maximum return to N" (MRTN) formula to determine N fertilizer rate. Calculations are made for a single N cost and corn price combination; different price combinations can be placed on the same graph to compare additional N cost and corn price combinations. Different states and different crop rotations are used to formulate different MRTN graphs for those situations. For more information, see the Corn Nitrogen Rate Calculator from Iowa State University at http://cnrc.agron.iastate.edu/.

Microbial activity releases more N under good corn growing conditions. Using variable rate technology to apply more N in fields or areas of fields, where there is greater potential for response, can increase yield potential. Consider all N sources when deciding on which application options to use. Take into consideration a previous legume crop and manure application, where applicable, to calculate the amount of N supplied from those sources and credit it accordingly, to reduce the amount of nitrogen fertilizer needed.

Sources

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Web sources verified 1/21/21.

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