Nitrogen Fertilizer Recommendations

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Nitrogen fertilizer recommendations are created by a simple four-step process of determining 1) yield goals, 2) crop requirements, 3) nitrogen gains and 4) nitrogen losses.

Establishing Yield Goals

The most important part of making a nitrogen fertilizer recommendation is establishing a realistic yield expectation. Accomplish this by averaging the yields from the previous five years and increasing that number by five to ten percent. Once this yield goal is established the amount of nitrogen fertilizer required to reach that goal can be determined.

Estimating Crop Requirements

To determine initial nitrogen guidelines, yield goals must be multiplied by a crop-removal rate. A crop-removal rate is the amount of nitrogen taken up by the crop during one growing season. Each crop type has a different factor used for calculating nitrogen needs. The crop-removal rate for corn is 1.2 pounds per bushel harvested; wheat has a rate of 2.6, and milo has a rate of 1.3 pounds per bushel. Thus, for a yield goal of 200 bushels of corn per acre, the nitrogen requirement will be 200 x 1.2 for an initial guideline of 240 pounds of nitrogen per acre.

Estimating Nitrogen Gains

Nitrogen gains will reduce your nitrogen fertilizer application rate. The key soil process that contributes to increased nitrogen availability is mineralization. Mineralization is the decomposition of soil organic matter and plant residues with subsequent release of nitrogen. In general, ten to 30 pounds of nitrogen will be released for every 1 percent of organic matter in the soil. This factor ranges from ten to 30 because soil microbial activity is dependent on soil temperature, moisture, aeration, fertility, and carbon content. A safe estimate is ten pounds for each percent of soil organic matter, although you could increase the factor for particularly warm, wet soil.

Credits are also allowed for the past legume crop because of the breakdown of legume residue in the year following harvest. Soybean and other grain legume credits are the equivalent of one pound of nitrogen per bushel of the harvested legume crop, with a cap of 40 pounds per acre. Clover and mixed legume hay is credited at ten pounds of nitrogen per ton of hay, up to 40 pounds per acre. Alfalfa hay is credited at ten pounds of nitrogen per ton of hay up to 60 pounds of nitrogen per acre.

Estimating Nitrogen Losses

It is important to keep in mind the factors governing nitrogen losses. If they are ignored, an early season nitrogen deficiency could appear. Unlike mineralization and legume credits, it is much more difficult to determine nitrogen losses in the soil. Current research is working toward creating some guidelines for nitrogen losses. In the meantime, growers should consider the following factors.

Volatilization –If urea fertilizer is applied to the surface of a soil with a high pH and is not incorporated into the soil, the nitrogen loss could be as high as 50 percent. This occurs from the conversion of urea to ammonia, which is lost from the soil as a gas.

Immobilization – Microbiological decomposition of plant residues can temporarily immobilize nitrogen if the residue is high in carbon. A field with 70 percent corn residue cover and surface-applied nitrogen could suffer a short-term loss of up to 30 pounds of nitrogen. In this scenario the pre-plant nitrogen application rate could be increased by 30 pounds or the immobilization could be avoided by applying in the nitrogen fertilizer below the soil surface.

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Leaching – Nitrogen in the nitrate form is subject to leaching losses, particularly on sandy or coarse textured soils. An indirect measure of soil texture is the Cation Exchange Capacity (CEC). A soil with a CEC below 15.0 would indicate a course-textured soil. Applying an ammonium fertilizer with a stabilizer or splitting the fertilizer applications into a pre-plant and side dress application would be beneficial in reducing this loss.

It is also possible to test the nitrate in the soil and allow a credit for the available nitrogen at a rate of two lbs. N for each one ppm nitrate-N measured. If a soil's leaching potential is high, then any nitrate residual measured after the previous crop may have leached below the rooting zone in which case the nitrate credit may need to be reduced or eliminated.

Denitrification – In ponded or waterlogged soils, the process of denitrification converts soil nitrate to gaseous nitrogen that escapes to the atmosphere. Denitrification should not be a problem on most coarse textured soils where drainage is adequate. On soils that are subject to seasonal flooding, as well as fine-textured soils, the potential for denitrification from localized spots is significant. Splitting applications and measuring spring nitrate levels to adjust fertilizer rates can be a successful management strategy.

Example Nitrogen Recommendations

Once a guideline is established from the yield goal, then adjustments to this number are made by taking into account how nitrogen gains and losses will affect the nitrogen available to the crop during the growing season. These factors will have an impact on how much nitrogen should be applied. The following example demonstrates how to take gains and losses into account.

Field Data

Intended Crop: corn – 200 bushels/acre
Previous Crop: soybeans – 60 bushels/acre
Soil test info: 3 percent organic matter
15 ppm of nitrate, (equal to 30 lbs. N per acre)
10.5 cation exchange capacity (CEC)
7.5 soil pH

Crop residue is 70 percent cover and urea nitrogen fertilizer will be surface applied.

Calculation

Crop total N requirement: 200 x 1.20 = 240 lbs. N/acre

Nitrogen Credits

+ 30 lbs. (residual nitrate credit)
+ 30 lbs. (OM mineralization credit)
+ 40 lbs. (legume residue, max of 40 pounds)
100 lbs.

Total needed: 240 lbs. – 100 lbs. = 140 lbs. nitrogen

Two adjustments to the application rate could be made to allow for the leaching losses in this coarse textured soil and/or volatilization losses from surface applying urea on a high pH soil.

The residual nitrate credit could be reduced to zero, and an additional 30 pounds of N could be added to compensate for the volatilization losses from the urea fertilizer. The recommendation could therefore range from 140 lbs. to 200 lbs. N per acre.

Summary

When making a recommendation for nitrogen fertilizer application, it is important to consider all factors within the nitrogen cycle. If the factors governing nitrogen losses are underestimated, a nitrogen deficiency may occur. If the gains are not credited appropriately, too much nitrogen can be applied.

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