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Tools to More Efficiently Manage In-Season Corn Nitrogen Needs

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Nearly 80% of the atmosphere is composed of nitrogen gas. Plants can only utilize this nitrogen after being taken from the air and made into an available form. Nitrogen can be made available through man-made reactions (specifically the Haber-Bosch process) that result in chemical fertilizers such as urea or UAN, or nitrogen can be made available through complex biological methods (soil bacteria and legumes). Nitrogen is also abundant in the soil, and in our area makes up approximately 0.14% or 2700 lbs of N per acre. Approximately 98% of this is in the organic form, and is in a very stable form making it virtually unavailable for plant uptake. The remaining 2% (about 54 lbs per acre) is in the mineral form, as either ammonium or nitrate. Only when the organic form is converted to the mineral form can it become available.

The process of transforming the various forms of nitrogen is called the nitrogen cycle. Mineralization, nitrification, de-nitrification and immobilization are all terms that describe various steps in these processes. The problem for “nitrogen managers” is that these processes are happening all the time and thus predicting the nitrogen needs of our crop plants are not simple. Further complicating matters is that these processes will change from year to year depending on temperature and precipitation. Any attempt to predict an economically optimum application rate of nitrogen for a given year is extremely difficult.

Nitrogen fertilization decisions for a corn crop need to be made throughout the entire growing season, not just at or before planting. Generally, the closer we can link our nitrogen applications to the timing of the crop demands the more efficient feeders we will become. You would never consider feeding a growing dairy heifer the entire quantity of the feed she will need at the beginning of her life. Not only will she be unable to consume the feed before it spoils, she will eventually deplete the feed she can reach before she is mature. The challenge comes in determining when and how much nitrogen we should apply to meet the needs of the crop and, if all else is sufficient, ensure us adequate yield.

Fortunately there are several tools available that can be used very accurately to help us make these decisions. The first is the pre-sidedress soil nitrate test (PSNT). This test is designed to determine the level of nitrate-N available in the soil prior to side-dressing. Optimum time to side-dress corn has been shown to be between the six- and eight-leaf stages. Research in Virginia and elsewhere have indicated that when the soil nitrate-N level is above 26 ppm, there is little chance of an economic response to adding additional N to the field.

PSNT procedure:

1. Test is well suited to fields that have received manure applications. If only chemical fertilizer has or will be applied, use standard nitrogen recommendations.
2. Take soil sample at least a week before planned side-dressing. The optimum time to side-dress corn is between the V6 and V8 growth stages.
3. Sample fields by taking 10 to 20 cores, to a 12-inch depth if possible. Avoid sampling in areas of starter band application.
4. Combine, crumble and dry the cores as quickly as possible, or freeze immediately after sampling.
5. Send the sample to a reputable soil-testing lab for soil nitrate-N analysis or use a reliable field testing kit to determine the nitrate-N level in the sample.
6. Calculate the N recommendation with the following calculation.

Line A) Soil nitrate-N_____ppm. (Note: If this is above 26 ppm the N recommendation is 0 lbs.)
Line B) Expected yield_____(bu / acre)
Line C) Manure since last harvest:_____(0.75 if none was applied; 3.5 if any was applied)
Line D) Previous crop:_____(0 if corn; 1.0 if soybean; 3.5 if forage legume; 0 if other) *Line E)* Manure history in the last 3 years:___(0 if none was applied; 1.75 if any was applied)
Line F) Sum of lines C, D and E = _____
Nitrogen recommendation = (Line B) – (Line F * Line A) =_____lb / acre

Another available tool to help determine how much if any side-dress N is required is the chlorophyll meter. The chlorophyll meter (CM) is a portable handheld device that instantly measures the level or greenness (or chlorophyll content) of a plant in the field. Nitrogen is closely associated with leaf chlorophyll, and thus CM readings of corn provide an instant reading of the N status in the plant. Advantages of this method include the speed and efficiency of collecting the samples and the accuracy (if performed correctly) of the recommendations. Disadvantages are primarily the cost of the meter, which may exceed $1200.00.

There are two methods for accurately using a chlorophyll meter in corn. The preferred method is to establish a high-N reference plot or strip that has been adequately fertilized with N early in the season. Leaf chlorophyll will vary between hybrids, and thus a different reference plot should be made for each hybrid used. Meter readings are taken from this reference strip and the corn to be tested, and a relative reading is determined. Recommendations are then made based on this reading. The second method does not require a high-N reference strip, but is limited to fields that have a recent history of manure. Detailed operating instructions come with the chlorophyll meter, and calculations for either method are available from your extension office.

The final tool available to us is the end of season corn stalk nitrate test. This test was developed at Iowa State University and allows growers to conduct a “post-mortem”

evaluation of the efficiency of the nitrogen program for the previous growing season. This is a “post-mortem” test because stalk nitrate samples are measured after the grain has reached physiological maturity, and thus this test is not useful to guide side-dress decision making. However, this test provides good insight into N management options for the following years. Corn stalks that are deficient in N will move stored N from the lower portions of the stalk and leaves to the developing grain, resulting in lower stalk N concentrations at the end of the growing season. Plants that take up excessive amounts of soil nitrogen will store up excess N in the lower stalk sections. We can use this test to identify fields where soil nitrogen uptake was excessive and we saw no yield benefit of the excess nitrogen. For example, if we unnecessarily applied side-dress N to a field that had adequate levels of N available this test would indicate that we might want to consider modifying our N management approach the following year. To perform this test, follow the procedure below:

1. Collect stalk samples after about 80% of the kernels have reached black layer
2. Collect stalks from about 15 plants in the sample field
3. On each plant, cut an 8” segment of stalk beginning at 6 inches above the ground. Remove any leaves and leaf sheaths from the stalk sample.
4. Avoid sampling diseased, stunted or damaged stalks
5. Package sample in paper bags and ship to a reputable lab for analysis.