MEASURING THE NITROGEN STATUS (PART 3)

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Tools are available that can aid decisions about applying supplemental nitrogen (N) when there have been losses of applied fertilizer or manure N. These can provide more site-specific information than estimating losses and can also provide N rate application guidance.

Late spring soil nitrate test

Details about this test can be found in ISU publication PM 1714, *Nitrogen Fertilizer Recommendations for Corn in Iowa*, available for download through the ISU Extension online store at www.extension.iastate.edu/store/. Soil samples are collected when corn is 6 to 12 inches tall, often in late May to early June. This year the corn growth is behind, and with the wet soils some fields will be sampled later than normal. Late sampling may complicate test interpretation. Soil conditions should allow the collection of good samples from the entire one-foot depth and with no excess water “leaking” from the sample bag. With the current wet conditions, this will be difficult. A large number of cores are needed, especially in fields with band-injected N. Test interpretations are adjusted when spring rainfall is well above normal. In fields where less than full rates of N were applied preplant, lower the critical concentration from 25 ppm to 20–22 ppm when rainfall from April 1 to time of sampling is more than 20 percent above normal. With full rates of N applied preplant (fall or early spring) or with manured soils, the suggested critical concentration is 15 ppm if May rainfall exceeds 5 inches. In these fields, if tests are between 16 and 20 ppm, consider a small N application. In situations where manure or full rates of N were applied, a suggestion is to limit additional N application to 60–90 lb N per acre, even if the test result is 10 ppm or less.

Corn plant N status

A method to determine the N status of corn plants is explained in ISU publication PM 2026, *Sensing Nitrogen Stress in Corn*, available through the ISU Extension online store at www.extension.iastate.edu/store/. The corn plant expresses N stress through reduced leaf greenness, which can be seen as you look at corn plants and measured with sensors such as a chlorophyll meter, active canopy sensors, or remote images. Measurements need to be compared with adequately fertilized (non-N limiting) reference areas in order to reduce bias due to different growing conditions, soils, hybrids, or factors affecting corn plant color other than N deficiency (like plant yellowing in response to wet soils or sulfur deficiency).

Figure of N-deficient corn and well-fertilized, non-N limiting strips (photo by John Lundvall).

If you are concerned about N losses, then apply two or three supplemental N strips (a rate that is non-N limiting) across fields or in targeted field areas and watch the corn. These will be the reference areas that are compared with the rest of the field. When corn gets some size to it, around the V8–V10 growth stages, and you see differences in the color between the strips and the rest of the field, then additional N should be applied to the field or field areas showing deficiency. These applications should be made as quickly as possible in order for the corn to have best chance to respond to the supplemental N.

A method to quantify N deficiency stress and amount of N to apply is to monitor the crop with a chlorophyll meter, other sensing instrument, or aerial image. Relative chlorophyll meter values (readings from the field area of interest divided by readings from the reference area) give an indication of the severity of deficiency; that is, the lower the relative value the greater the N deficiency and the larger the N application rate needed.

Chlorophyll readings can aid in confirming suspected N-loss situations and need for supplemental N. This is especially helpful when corn has recovered from wet conditions, resumed good growth, and is putting pressure on the available N supply in the soil. The later into the growing season these readings are taken, the more they can indicate deficiencies and the better they relate to total crop N fertilization need. Small plants usually do not reflect potential N shortages because the amount of N taken up is small. Therefore, corn plant sensing is more reliable with larger plants. Measurements from approximately V10 to VT stages should provide similar results. The table below gives suggested N rates to apply at various relative chlorophyll meter values. Readings are taken from the uppermost leaf with the collar visible until the VT stage (tassel emergence), and then from the ear leaf. Average 15–30 representative readings per field location or reference strip location.

Relative Minolta SPAD 502® chlorophyll meter value and N rate to apply.

Relative SPAD Value*	N Rate to Apply**
	lb N/acre
< 0.88	100
0.88 – 0.92	80
0.92 – 0.95	60
0.95 – 0.97	30
> 0.97	0

* Relative values calculated by dividing readings from the area of interest by readings from the well-fertilized reference strip. Readings taken from approximately the V10 to VT corn growth stage.
** Suggested supplemental N rates limited to a maximum of 100 lb N per acre.

An advantage of plant N stress sensing or visual observation, and comparison with reference areas, is the ability to monitor the crop multiple times as the season progresses to see if the N supply is adequate, remains adequate, or N stress develops. Wet soils will cause corn to have poor coloration and rooting, and can also limit yield potential. Therefore, it is important to allow plants to recover fully from wet conditions before assessing the N status. Another advantage to plant N stress sensing is that plants integrate N supply across a period of time. Since mineralization of N from soil organic matter is an important source of N for crop growth, waiting to determine the N status allows the plant to respond to N accumulated in the soil from mineralization. Warm, moist soils with high organic matter levels can have considerable mineralization (even when flooded), and this source of N can help offset N losses. Plant sensing and comparison to reference areas is a way to determine this contribution, as well as nitrate located deeper in the soil profile.