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Assessing nitrogen losses

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Abstract
Several methods can help estimate nitrogen (N) loss and supplement N need. They should be used as guides and for information regarding N application. Late spring soil nitrate test. Details about this test can be found in the Iowa State University publication PM 1714, Nitrogen Fertilizer Recommendations for Corn in Iowa. Soil condition should allow the collection ofgood samples from the entire one-foot depth.

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INTEGRATED CROP MANAGEMENT

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Late spring soil nitrate test. Details about this test can be found in the Iowa State University publication PM 1714, Nitrogen Fertilizer Recommendations for Corn in Iowa [1]. Soil condition should allow the collection ofgood samples from the entire one-foot depth. Test interpretations with spring rainfall were well above normal: (1) in fields where less than full rates of N were preplant applied, 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; (2) with full rates of N applied preplant (fall or early spring) as anhydrous ammonia, or 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, you might consider a small N application. In situations where manure or full rates of N were applied preplant, a suggestion would be to limit additional N application to 60-90 pounds N per acre, even if the test result is 10 ppm or less.

Studies evaluating the soil nitrate test indicate that when test results are above the 20-25 ppm critical level, no additional N is needed (in about three percent of the situations, when the test is high, there may be a small yield increase to added N). When concentrations are below the critical level, there is more uncertainty in results and on average, when errors occur, they are conservative - in about 25 percent of the situations, N may be suggested by the test but corn yield will not increase.

Corn Plant Sensing

The corn plant expresses N deficiency through reduced leaf greenness, which can be measured with sensors such as a chlorophyll meter. 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 other factors affecting leaf color other than N deficiency. Non-limiting N reference areas can be applied across fields or to specific field areas. Relative chlorophyll meter readings (values 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 greater the N needed (Figure 1 shows relative SPAD values versus N rate).

Chlorophyll readings can aid in confirming suspected N-loss situations and need for supplemental N. This is especially helpful when the corn has recovered from wet conditions, resumed growth, and takes up N, putting pressure on the available N supply. 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 need. Measurement from approximately V15 to R1 should provide similar results. Table 1 gives suggested N rates to apply at relative SPAD values. Readings are taken from the uppermost leaf with the collar visible until the R1 stage (silking), and then from the ear leaf. Using plant sensing, however, means that supplemental N will need to be applied with high-clearance equipment. Rainfall after late N applications will be important for plant uptake. If the applied N is within the active root system, and if there is a need for the N, corn yield can be increased with N applied at, and shortly after, silking. 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.

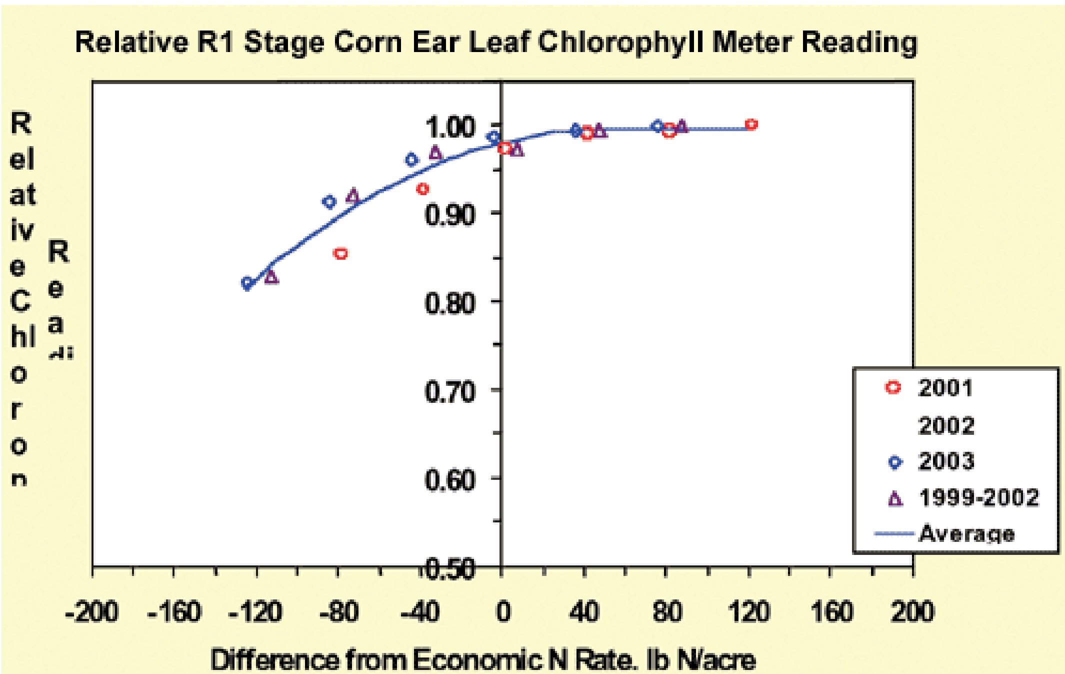

Figure 1. Relationship between relative Minolta 502 SPAD chlorophyll meter readings and N rate deviation from the economic optimum N at 51 sites and averaged for different seasons and projects where corn followed soybean in Iowa (1999-2003).

Calculating nitrogen loss

First, estimate the amount of fertilizer-N converted to nitrate. By late May, one could assume fall applications to be 80-100 percent converted to nitrate and spring preplant N applications approximately 50-75 percent. Recent ammonium applications (within the last two weeks) would still be predominantly in the ammonium form, especially for anhydrous ammonia. Less conversion to nitrate would occur with use of a nitrification inhibitor. Second, estimate the percentage of nitrate-N loss (using factors given in the previous article). The amount of N loss is calculated from these two estimates. For example, if one assumes that all of a 120 pound fertilizer-N application is converted to nitrate, and soils were saturated for five days when warm, then the N loss estimate would be (120 pounds N per acre x 5 percent per day/100) x (5 days) = 30 pounds N per acre.

Table 1. Relative Minolta SPAD chlorophyll meter reading and N rate to apply.

Relative SPAD Reading*	

lb N/acre	N Rate To Apply**
< 0.88	100
0.88 - 0.92	80
0.92 - 0.95	50
0.95 - 0.97	20
> 0.97	0

*Readings should be taken approximately from the V15 to R1 corn growth stage.

** Suggested N rates are limited to a maximum of 100 pounds N per acre.

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Links:
[1] http://www.extension.iastate.edu/Publications/PM1714.pdf