

Nitrate Meter

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Instrument for Rapid Nitrogen Testing in Corn: Nitrate Meter and Chlorophyll Meter

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This information summary sheet describes two instruments that can detect nitrogen deficiency in corn.

NITROGEN (N) is an essential mineral nutrient important for crop growth and yield. Manure, crop residues, and fertilizer are important sources of soil N. Soils provide N to crops when soil organic matter decays. Variables that can have effects upon soil N levels include weather, fertilizer application equipment design, N mineralization rate, and the availability of appropriate fertilizer products during critical times.

Corn plants that are deficient in N have pale green leaves, poor growth, and reduced yield. Excess N fertilizer application increases the chances of surface and ground water contamination. Many farmers in eastern South Dakota use a pre-season soil nitrate test to adjust N fertilizer rates to specific corn yield goals. Use of new instruments that instantly estimate corn plant N levels may allow farmers to precisely target N fertilizer applications to changing weather and crop conditions during the growing season.

Corn crops have their greatest need for N starting about 30 to 45 days after emergence. Fertilizer N utilization efficiency is increased when N is applied near the time of greatest need by the crop. Side-dress application of N fertilizer when the crop is 10 to 20 inches tall (about the 6th leaf stage) is a common practice for eastern South Dakota corn producers. Leaf tissue testing at that time would help farmers adjust fertilizer N rates to meet the demands of the crop *and* prevent the application of too much fertilizer.

RAPID NITROGEN TESTING METERS

Figure 1. Closeup view of SPAD 502 Chlorophyll meter (left) and Cardy Nitrate Meter.

Two meters that estimate plant N are the Minolta SPAD 502 Chlorophyll Meter¹ (left)



and the Cardy Nitrate Meter¹ (right). Both meters are available from Spectrum Technologies, Inc. (1-800-248-8873; www.specmeters.com)⁽¹⁾.



The SPAD Chlorophyll Meter sensor clamps on intact leaves and instantly measures leaf chlorophyll "greenness". Because there is a close relationship between chlorophyll level and leaf N, the Chlorophyll Meter readings are an indicator of leaf N level.

The Nitrate Meter has a sensor that measures the nitrate concentration in liquid extracts of plant tissues. In the corn plant, nitrate moves from roots to leaves where it assimilated into amino acids and proteins. The Nitrate Meter will measure the leaf nitrate-N concentration (in ppm) but does not measure leaf amino acid and protein level.

METER READINGS AND LEAF N LEVEL

Our research objective was to determine how accurately the two meters estimated corn leaf N concentration. Corn plants grown under various N fertilizer and crop rotation treatments were sampled at the 6th leaf stage (17 June 1999). The youngest fully-expanded leaf that had a collar exposed was measured with the SPAD Chlorophyll Meter (six replications per data point). All leaves were then removed from the plants by cutting at the collar, and the sap was expressed using a hydraulic plant press. The sap was measured for nitrate concentration with the Nitrate Meter. SPAD Chlorophyll and Nitrate Meter readings were compared with actual leaf N concentration data (obtained using the Kjeldahl method) as performed by a plant analysis laboratory. Data are shown below.

graph.jpg (26905 bytes)

Figure 2. Relationship between leaf N concentration and readings obtained with the Cardy Nitrate Meter (top) and the SPAD Chlorophyll Meter (bottom) on corn plants sampled at the 6th leaf stage (June 17, 1999).

These graphs reveal that both meters provide data which are related to leaf N concentration. Meter readings increased in a straight-line relationship as the leaf N concentration increased. The r value, which is a statistic that describe how well data fit a linear relationship, suggest a closer association between leaf N concentration and the readings made with the Chlorophyll Meter than between leaf N concentration and the readings made with the Nitrate Meter.

FIELD ID OF CORN N DEFICIENCY

Because many factors (such as corn variety, crop growth stage, temperature, moisture stress, etc.) affect leaf greenness and nitrate-N level, it is impossible to provide absolute meter

readings that indicate corn crop N deficiency. The meters need to be calibrated for each corn field before obtaining relative data on crop N deficiency within that corn field. One way to calibrate these meters is to maintain several adequately fertilized zones (called reference strips) in each field and then compare meter readings from these reference strips with meter readings taken in the portions of the field outside the adequately fertilized strips (called bulk areas). Plug the results into the following equation:

equation.jpg (6133 bytes)

A corn N index value of less than 0.95 usually indicates a crop N deficiency that may lead to a yield reduction (J. Prod. Agric. 8:56).

measure.jpg (42111 bytes)

Figure 3. Chlorophyll Meter being used to measure corn plant leaves. The sensor is placed midway between the base and the tip of the youngest leaf with a collar. It is recommended that average meter reading values be obtained for at least 30 plants per sample site.

1. Vendor and manufacturer names are provided as a benefit to the reader and do not constitute an endorsement by
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