

Nutrient Management

NM-8
September 2008

CORN STALK NITRATE TEST

Introduction

The Corn Stalk Nitrate Test (CSNT) is an end-of-season test that provides a retrospective assessment of the season's nitrogen management, answering the question "Did the corn have too much nitrogen this year?" Corn plants show no visual evidence of over fertilization; therefore, the CSNT can provide this valuable information, allowing producers to know when a field received more nitrogen than needed for maximum yield. After a few years of collecting CSNT data producers can adapt their nitrogen management strategy to increase efficiency and profitability.

How Does the CSNT Work?

After pollination, nitrogen from the plant leaves and stalk is mobilized and transported into the developing grain. During this process, nitrate uptake from the soil into the plant also continues. If more nitrogen is available to the plant than needed for maximum yield, nitrate accumulates in the stalk, particularly the lower stalk.

When are Samples Collected?

When using the CSNT for a **corn grain** crop, samples should be collected

- from one to three weeks after 80% of the kernels on most ears are at black layer, typically late August to late October.

When using the CSNT for a **corn silage** crop, samples should be collected

- just before harvest.

Educating People To Help Themselves

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What is Black Layer and How Can It Be Identified?

When corn grain reaches physiological maturity, a black layer forms at the base of each kernel. The black layer is composed of a waxy material that seals off the kernel from further transport of nutrients and water.

If you slice a kernel or chip at its base, the black layer is obvious, as shown in Figure 1 below.

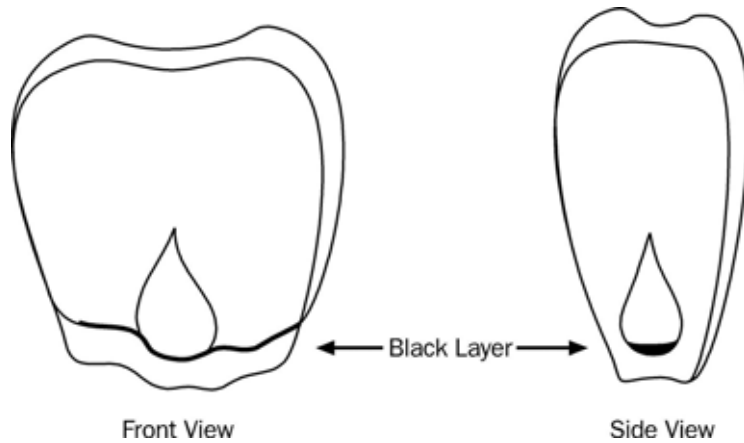


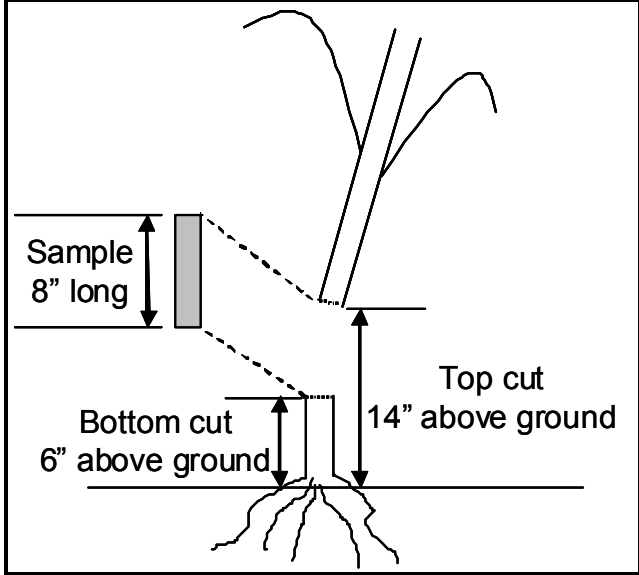
Figure 1. Black layer at the base of the kernel.

How are Samples Collected?

Follow the steps in Table 1 below to collect samples for the CSNT.

Table 1. Sample collection for the CSNT

Step	Action
1	Collect one (1) representative sample per management unit.
2	Follow a random sample pattern similar to the collection of soil samples (see Figure 2 below). <div data-bbox="755 1369 1117 1738" style="text-align: center;"> </div> <p data-bbox="548 1787 1289 1854">Figure 2. Sampling pattern that covers the entire area of a management unit.</p>

3	<p>Collect at least 15 representative samples per management area. The samples should be collected from 6" above the soil surface and 8" long. (<i>Note: Avoid diseased stalks, stalks with shriveled ears and stalks with serious insect infestation.</i>)</p>  <p>Figure 3. The bottom and top cuts should be made at 6" and 14" above the ground, respectively.</p>
4	Remove leaf sheaths.
5	Cut stalks in 2-inch pieces.
6	<p>If possible samples should be rapidly air-dried (not oven dried) prior to shipping. Otherwise samples should be placed in a paper bag and shipped to the lab as soon as possible. Do not use plastic or airtight containers as this will encourage molding, which severely interferes with test results. If samples cannot be shipped immediately they should be kept refrigerated (not frozen) until they can be shipped.</p>

What Labs Offer Analysis?

As more producers become interested in the CSNT, agricultural testing laboratories are adding it to their list of available tests. Contact your lab of choice and ask about the test.

CSNT Interpretation

Stalk nitrate levels of 2,000 parts per million (ppm) or higher are considered "excess." This means that the nitrogen application rate could have been reduced with no loss of yield.

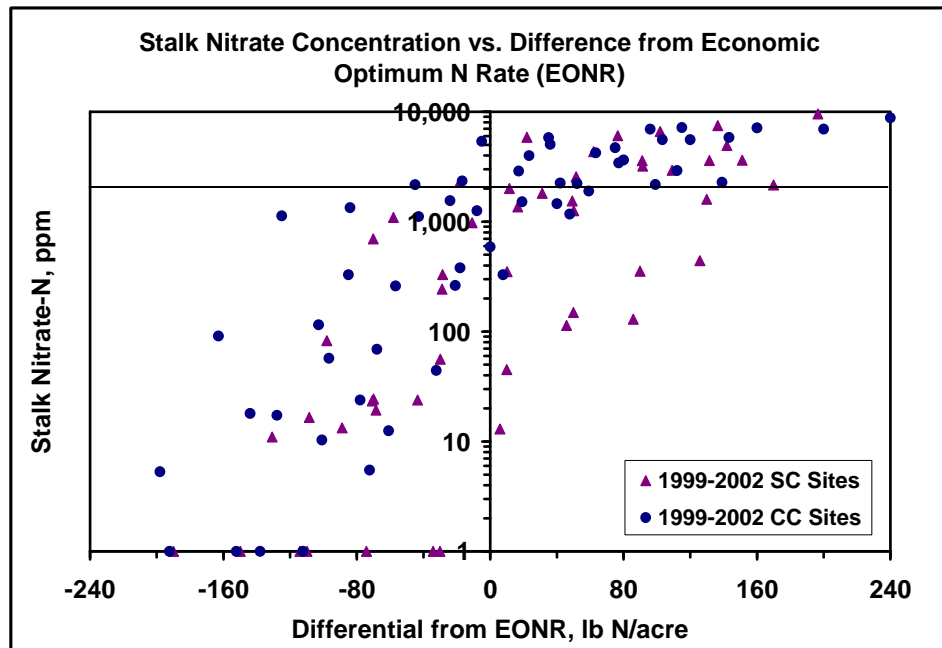


Figure 4. Corn stalk nitrate concentrations (on a log scale) as a function of economic optimum nitrogen rate (EONR) with corn following corn (CC sites) and corn after soybeans (SC sites). The EONR is the N rate at which no more economic return is gained from additional N input (Dr. John Sawyer, Iowa State University).

While some states use CSNT to determine if the N supply was *optimal*, *marginal* or *deficient*, recent research data indicate that this approach is risky. While stalk nitrate levels greater than 2,000 ppm indicate excessive N availability in a very high percentage of instances, stalk nitrate levels below 2,000 ppm are poorly correlated with nitrogen status or yield. Data from Dr. John Sawyer’s research in Iowa (Figure 4, above) clearly demonstrates the wide range of nitrogen adequacy at specific nitrate concentrations below 2,000 ppm. Figure 4 shows that stalk nitrate concentrations close to 2,000 ppm and below can occur across a wide range of N application rates. However, almost all of the very high stalk nitrate concentrations occurred when the N rate was greater than the EONR.

Responding to “Excess” CSNT

- If using fertilizer N only and yields met or exceeded your expectations, then
- ensure that the yield goal used to develop the current year’s nutrient management plan is actually based on long-term yields in the field.

If using manure and yields met or exceeded your expectations, then

- collect a representative manure sample at least yearly to confirm that the manure application rate is based on accurate information; and
- re-calibrate the manure spreader to ensure recommended application rate is applied.

After 3 – 5 years of “excess” CSNT and meeting the above conditions, discuss reducing your nitrogen rate with your nutrient management planner.

When is the CSNT Not Useful?

In situations where yield was limited in a field, excess stalk nitrate would be expected, but would not be reflective of nitrogen management. Examples of such situations are

- drought years; and
 - fields with serious and widespread disease or insect incidence.
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References

Binford, G.D., A.M. Blackmer, and N.M. El-Hout. 1990. Tissue test for excess nitrogen during corn production. *Agron. J.* 82:124-129.

Sawyer, J. 2006. Cornstalk nitrate interpretation. *Integrated Crop Management*, 9-18-06, Iowa State University.

Graphic Credits

Figure 1. Margaret Weichert (Department of Business Services, UMCP)

Figure 2. Jennifer Salak

Figure 3. Joshua McGrath
