

## 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?

Nitrate-nitrogen is mobile within a plant, which means it can move from one part of a plant to another. After pollination, nitrate-nitrogen from the plant leaves and stalk is mobilized and transported into the developing grain. If more nitrogen is available to the plant than needed for maximum yield, nitrate-nitrogen 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:

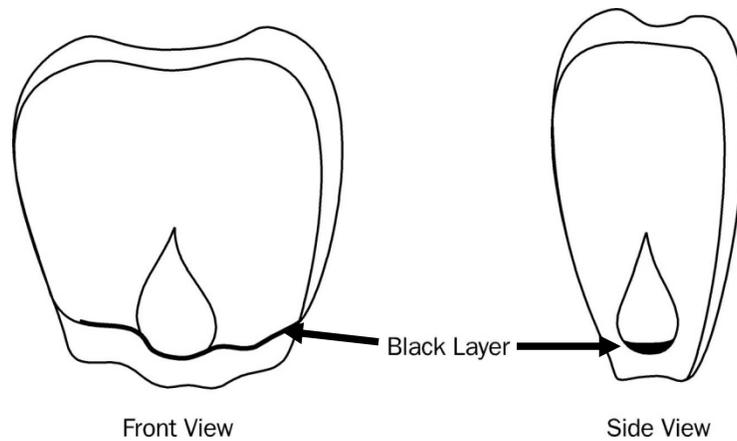
- just before harvest.
-

**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 (Figure 1).

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



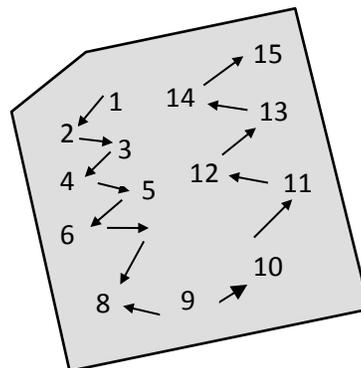
Source: Margaret Weichert, 2008, University of Maryland College Park, Department of Business Services.

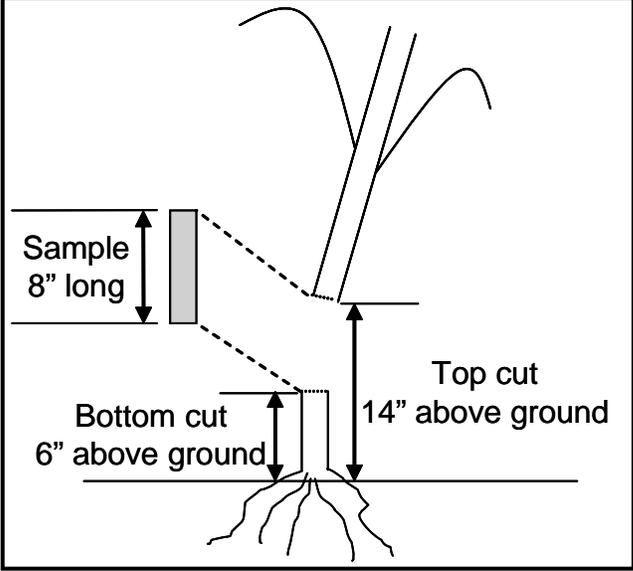
**How are Samples Collected?**

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 an unbiased sample pattern similar to the collection of soil samples (Figure 2).  <b>Figure 2. Sampling pattern that covers the entire area of a management unit</b>



3	<p>Collect at least 15 representative stalk samples per management area. The stalks 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><b>Figure 3. The bottom and top cuts should be made at 6" and 14" above the ground, respectively</b></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.</p>

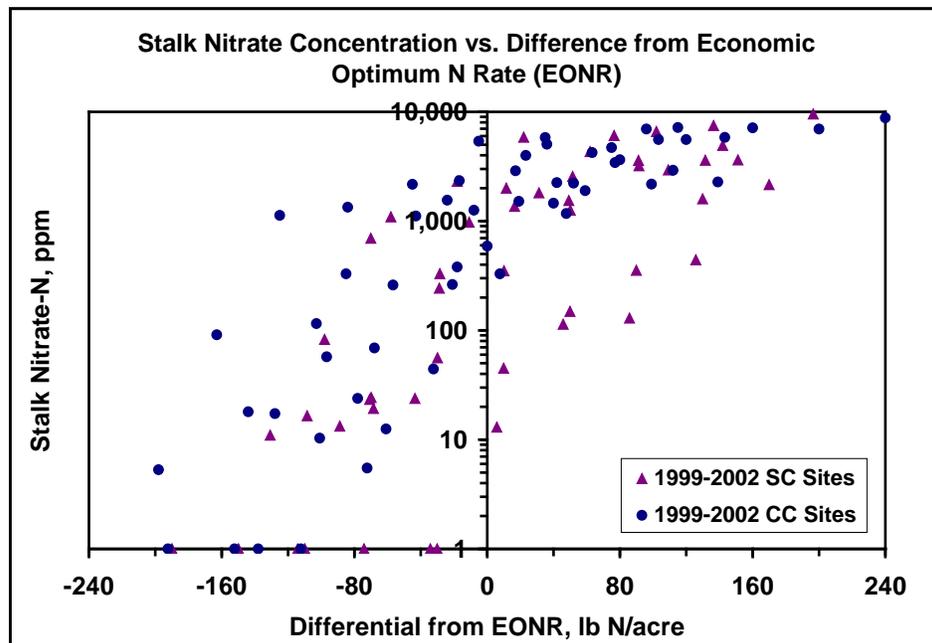
**What Labs Offer Analysis?**

As more producers become interested in the CSNT, agricultural testing laboratories are adding it to 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 in that particular year.

**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.**



Source: Dr. John Sawyer, 2010, Iowa State University. Used with permission.

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 below 2,000 ppm 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 was 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.
- 

**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. 2010. Cornstalk Nitrate Interpretation. Integrated Crop Management, 9-14-10, Iowa State University.  
<http://www.extension.iastate.edu/CropNews/2010/0914sawyer.htm>

Woli, K.P, S. Rakshit, J.P. Lundvall, J.E. Sawyer, and D. Barker. 2013. On-farm evaluation of liquid swine manure as a nitrogen source for corn production. *Agron. J.* 105:248-262.

---

Original publication date: September 2008 as NM-8

**Patricia Steinhilber (psteinhi@umd.edu) and Joshua McGrath (josh.mcgrath@uky.edu)**

This publication, *Corn Stalk Nitrate Test (NM-8)*, is a series of publications of the University of Maryland Extension and the Agricultural Nutrient Management Program. The information presented has met UME peer review standards, including internal and external technical review. For more information on related publications and programs, visit: [www.extension.umd.edu/anmp](http://www.extension.umd.edu/anmp). Please visit <http://extension.umd.edu/> to find out more about Extension programs in Maryland.

The University of Maryland, College of Agriculture and Natural Resources programs are open to all and will not discriminate against anyone because of race, age, sex, color, sexual orientation, physical or mental disability, religion, ancestry, or national origin, marital status, genetic information, or political affiliation, or gender identity and expression