Agronomy Facts 70

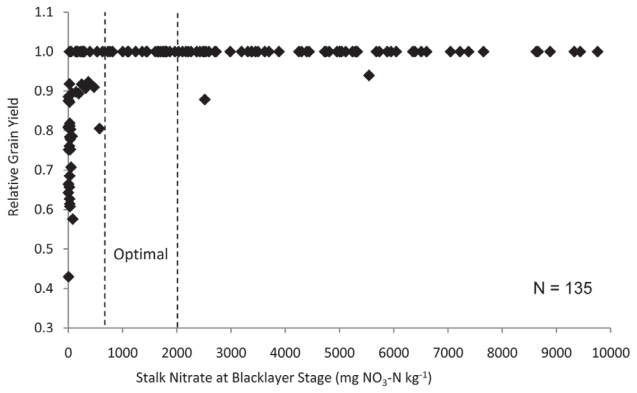
Late Season Cornstalk Nitrate Test

Nitrogen (N) management is one of the most difficult decisions in corn production because of the many factors that influence nitrogen behavior, including materials, timing, and, especially, weather. This is particularly true when manure is used as a nitrogen source. Standard recommendations try to account for many of these variables, and in-season tests such as the Pre-sidedress Soil Nitrate Test (PSNT) and Chlorophyll Meter test are very helpful in reducing the uncertainty in nitrogen recommendations where sidedressing nitrogen is a management option. While uncertainty can never be eliminated, with experience it can be minimized. A key to improving nitrogen management over time is having reliable feedback on how well your nitrogen management is working. Good yields and dark green plants are good indicators of adequate nitrogen, but they cannot identify overfertilization of nitrogen, which can be a problem, especially with manure. Also, some visual symptoms of nitrogen deficiency late in the season may not always indicate a yield loss.

The Late Season Cornstalk Nitrate Test has been shown in research at a number of locations across the country, including across Pennsylvania, to be a reliable end-of-season indicator of crop nitrogen status. The graph below, from Pennsylvania research, shows how this test clearly separates fields that were short on nitrogen from fields that had adequate or more than enough nitrogen. Most of the fields represented by the points on the graph to the left of the optimal range had less than maximum yield (relative yield less than 1). When the test level is optimum or above, the relative yield is almost always maximum. Only 2 of 135 field sites tested optimum or above that were actually not optimum or above.

This test provides a good assessment of whether the crop had the right amount of nitrogen, too much nitrogen, or was nitrogen limited. This information combined with records of nitrogen management can be very useful for making future management decisions. While you could test all fields, regularly testing a few representative fields will probably be adequate to provide a good assessment of your overall nitrogen management program.

Figure 1. Research data from Pennsylvania showing how the Late Season Stalk Nitrate Test clearly indicates when nitrogen was short versus adequate. Source: Piekielek and Fox, Penn State



SAMPLING PROCEDURE

Just as it is with soil testing, sampling is critical and needs to represent the field in order to be useful. Sampling instructions should be followed carefully. Sampling can be done anytime between ¼ milk line, which is just before silage harvest, to about 3 weeks after black layer formation. Figure 2 shows how to determine the kernel milk line.

Figure 2. Determining kernel milk line. When an ear of corn is broken in half, the tip half (left) shows the smooth endosperm, while the butt end (right) shows the embryos. The arrow points to the "milk line," which is the border between the milk and starch layers on the *tip end* of the ear. Source: *Penn State Agronomy Guide*

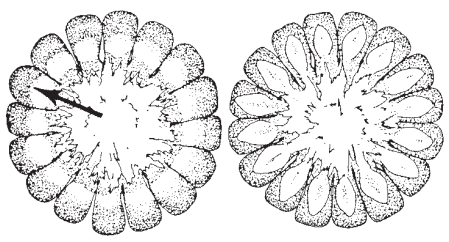


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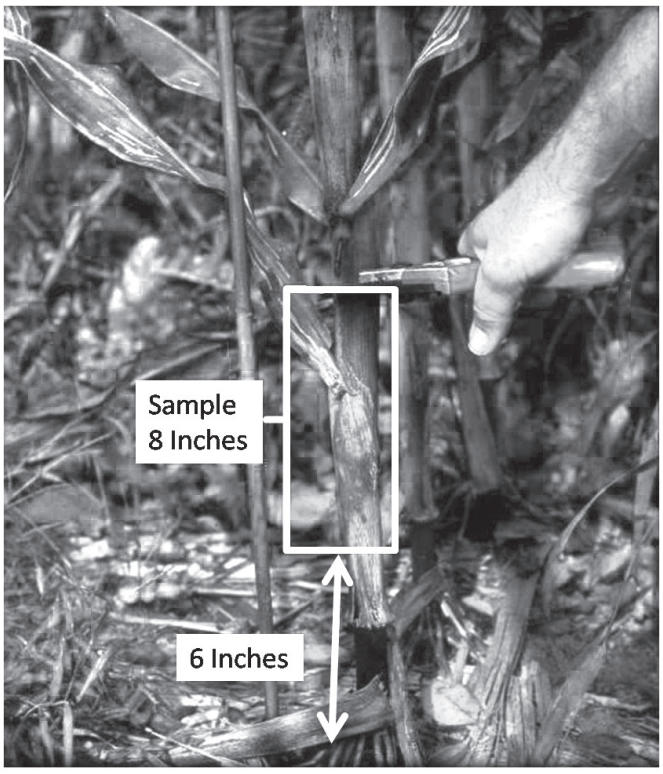
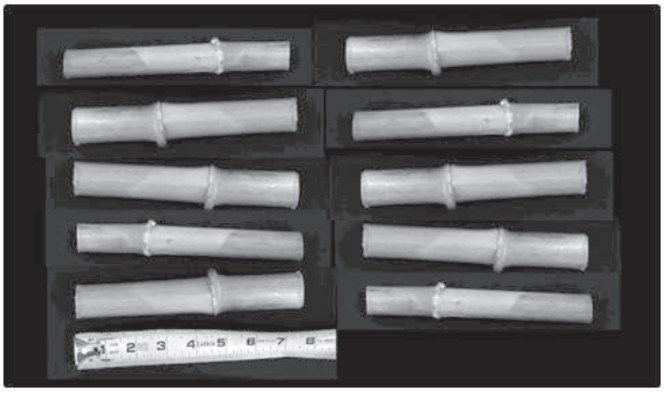
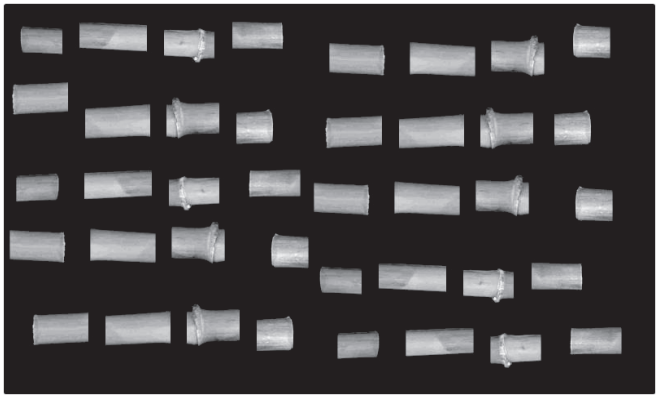
Figure 3. Procedure for collecting and processing samples for the Late Season Cornstalk Nitrate Test.



Sample location on the stalk



Complete sample of stalk segments from a field (above) and samples processed for the lab (below)



To collect a sample, cut 8-inch-long sections of corn stalk starting 6 inches above the ground from 10 randomly selected representative plants. Pruning shears usually work well for taking these samples. Subsequently cut these samples into 1- to 2-inch-long segments to facilitate drying. If possible, dry the samples immediately or send them to the lab as soon as possible after collection. If there is more than a day between sampling and sending, refrigerate (don't freeze) the samples until you can send them. Keep the samples in paper (not plastic) bags. Figure 3 illustrates the sampling procedure.

To submit samples for this test, contact your lab for a submission form. To submit samples to the Penn State Agricultural Analytical Services Laboratory, call the lab (814-863-0841) and request a submission form or print the form from the Web at **www.aasl.psu.edu/Corn%20stalk%20nitrate%20sub%20form_web.pdf**. Send the completed submission form and samples with payment to the lab as soon as possible after sampling.

INTERPRETING THE RESULTS

Table 1 provides interpretations of the results of the Late Season Cornstalk Nitrate Test. Unlike many tests we use in crop production, this is a test that tells us how we did, not what we need to do. This historical data on nitrogen management can be helpful in planning your nitrogen management in upcoming years.

A key to maximizing the value of this test is having good records of your nitrogen management and growing conditions for the whole season prior to the test. Important records include:

- Previous crop
- Fertilizer material, analysis, rate, timing, and application method
- Manure type, analysis, rate, timing, and application method
- General weather patterns through the season (rain and temperature)
- Other cultural practices, especially if they were unusual (e.g., population, pests, pH, compaction)
- Signs of nitrogen deficiency during the growing season

The common visual symptom of nitrogen deficiency on a corn leaf is a yellowing (eventually the area will die and turn brown) beginning at the tip of the leaf and going back the midrib in an inverted "V" shape. The symptoms will show up on the bottom leaves of the plant and as the deficiency becomes more severe leaves higher up on the plant will show the symptom.

Use the Late Season Cornstalk Nitrate Test to evaluate your nitrogen management. If the test results are low, look at the rate of nitrogen applied. Total available nitrogen for corn from all sources (fertilizer, manure, legumes) should be around 1 pound of nitrogen per bushel of yield. If the rate seems correct, look at the materials, timing, and application methods. Some examples of common nitrogen losses include fertilizer or manure nitrogen applied well before the growing season. These applications can be subject to significant losses, especially with high early season precipitation.

Consequently, the nitrogen is lost before the crop can utilize it. Fall-applied manure nitrogen is subject to very significant losses if there is no cover crop on the field. Urea fertilizer and manure are both subject to significant losses of nitrogen by ammonia volatilization if they are surface applied and not incorporated by tillage or at least ½ inch of rain within a few days. Cultural practices such as low pH, poor weed control, or compaction can limit the crop's ability to take up nitrogen even if the right rate was applied at the right time and in the right way.

If the Late Season Cornstalk Nitrate Test results are high, again look at the rate and make sure excess nitrogen is not being applied as fertilizer and/or manure. Also look at the previous history of the field. If the field was in a legume in the previous year, this will contribute a potentially large amount of available nitrogen to the current crop. This should have been accounted for in determining the nitrogen recommendation for the field. Likewise, if the field has a history of regular manure applications there will be a significant amount of residual nitrogen available in the field. This should also have been accounted for in determining the nitrogen recommendation for the field. Other cultural practices should be evaluated. If some other factor such as pests, low pH, or compaction created lower yields than were fertilized for, this will result in excess nitrogen in the crop. Also, drought stress will often result in accumulation of excess nitrogen in the corn stalks.

This test will not tell you which management practices to change. However, this test provides vital feedback that is not otherwise available about how your nitrogen management is performing. The results of this test will become more valuable as you accumulate these over time. By using the test along with your management records you can see what is working and what is not. You can directly evaluate the impact of management changes by carefully adjusting management based on the latest management recommendations and in-season nitrogen tests such as the Pre-sidedress Soil Nitrate Test and the Early Season Chlorophyll Meter Test (see Further Information below). Nitrogen management and efficiency can be improved. These nitrogen savings can be even greater when utilizing the Late Season Cornstalk Nitrate Test as part of making nitrogen management decisions. Using these tests will result in greater nitrogen use efficiency and economic returns to management and reduce the potential for negative environmental impact from nitrogen that is not efficiently utilized by the crop.

Note: The Soil Fertility and the Corn sections of the current *Penn State Agronomy Guide* contain details on the management practices discussed here. The *Penn State Agronomy Guide* is available from Penn State Cooperative Extension county offices and on the Web at **agguide.agronomy.psu.edu**.

For information on this and other available crop and soil management tests, see the Penn State Agricultural Analytical Services Laboratory Web site (**www.aasl.psu.edu**) or call the lab at 814-863-0841.

FURTHER INFORMATION

Beegle, D., R. Fox, G. Roth, and W. Piekielek. *Agronomy Facts 17: Pre-sidedress Soil Nitrate Test for Corn*. University Park: The Pennsylvania State University, 1999. pubs.cas.psu.edu/FreePubs/pdfs/uc067.pdf.

Piekielek, W., D. Lingenfelter, D. Beegle, and R. Fox. *Agronomy Facts 53: The Early Season Chlorophyll Meter Test for Corn.* University Park: The Pennsylvania State University, 2008. pubs.cas.psu.edu/FreePubs/pdfs/uc147.pdf

Additional fact sheets and a video on collecting stalk samples for this test are available on the Penn State Crop Management Extension Group (CMEG) Web site, **cmeg.psu.edu**.

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Table 1. Interpretation of Late Season Cornstalk Nitrate Test.

Category	Result (ppm N)	Interpretation
Low	< 700	Nitrogen likely limited yield. Nitrogen management should be evaluated to determine why the nitrogen supply was inadequate and management changed accordingly. There is a good probability that there would have been a profitable response to more nitrogen in this field. Corn probably was showing nitrogen deficiency symptoms. As the test approaches the optimal range the likelihood of seeing a deficiency goes down.
Optimal	700–2,000	Nitrogen was adequate but not excessive for optimum economic yields in this field. Fields testing in this range are an indication of good nitrogen management. A goal of nitrogen management should be to consistently have your fields test in the optimal range. However, even under ideal nitrogen management it may not be possible to be in the optimal range every year, but the long-term trend in test levels should be close to the optimal range. There may be some yellowing on the lower leaves before the corn reaches maturity.
Excessive	> 2,000	Nitrogen in the field was in excess of what is needed for optimum economic yields. Not only might this represent an economic loss, but it may also indicate a potential for nitrogen loss to the environment. Nitrogen management should be evaluated to determine why the nitrogen supply was excessive and management changed accordingly. Corn grown on fields in this category will probably not show any yellowing in the lower leaves until the leaves start to naturally die off.

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