Manure Technical Bulletin Series
University of California Cooperative Extension

Plant Tissue Sampling for Corn in Fields Receiving Dairy Manure

End-of-Season Cornstalk Test for Excess Nitrogen

The end-of-season cornstalk test involves measuring nitrate concentrations in the lower portions of cornstalks at the end of the growing season. The information below is excerpted from a University of Connecticut guide. The calibration of the cornstalk nitrate test has been found to be fairly consistent in several states in the Midwest and northeast US. This information is presented to provide a possibly useful tool to crop consultants in California for managing nitrogen applications with dairy manures.

Basis for the Test

Corn plants suffering from N deficiency remove nitrate from the lower cornstalks and leaves during the grain-filling period. The effects of N removal can be easily observed when the lower leaves turn yellow and die prematurely. Corn plants having more N than needed to attain maximum yield accumulate nitrate in their lower stalks at the end of the season. The test accurately measures the nitrate in cornstalks and will indicate deficient, optimal, or excess N availability during the growing season.

Why the Test is Needed

The underlying reason for overfertilization is that corn plants show no visual symptoms that enable producers to recognize when above-optimal rates of N have been applied. This means that producers can apply too much N year after year and never suspect a problem with their N management. The end- of-season cornstalk test makes it possible for producers to avoid this pitfall. Many producers associate a dark green plant with optimal rates of fertilization, and they fertilize to maintain dark green plants late in the growing season. This practice needs to be questioned, however, because corn leaves tend to lose their deep green color late in the season at economically optimal rates of fertilization. The end-of-season cornstalk test, therefore, helps producers distinguish between fertilizing to maximize greenness and fertilizing to maximize profits.

How the Test is Done

The portion of each plant sampled is the 8-inch segment of stalk found between 6 and 14 inches above the soil. Leaf sheaths should be removed from the segments. Stalks severely damaged by disease or insects should not be used. **It is extremely important to cut the stalks at the 6- and 14-inch height above the ground, because cutting lower or higher will result in incorrect assessment of nitrogen availability**. Consistently cutting below 6 inches will result in higher than expected stalk nitrate concentrations and consistently cutting above 14 inches will result in lower than expected stalk nitrate concentrations.

Fifteen 8-inch segments should be collected to form a single sample to be sent for analysis. These should be collected at random within an area not larger than 15 acres. Areas differing in soil types or management histories should be sampled separately. An easy method for collecting a sample is to collect 3 to 5 stalk segments from each of several small areas (less than an acre) that seem to be representative of larger areas within a field.

Samples should be sent to a lab for analysis as soon as possible after collection. Samples should be placed in paper (not plastic) bags to enable some drying and minimize growth of mold. The test results will be incorrect if the samples are stored for more than one day before shipment to the lab.

The results will indicate whether the availability of N during the growing season was low, optimal or excess.

Time of Sampling for the Test

Silage corn:

Collect stalk sections from one week before you plan to chop the corn until one day after the corn is chopped. The easiest method to collect a sample is to walk or drive across the field up to 24 hours after harvest and cut the stalk sections from the stubble. If stubble height is normally less than 14 inches tall, have the chopper driver raise the corn head for about 50 feet in a few places in the field and collect the stalk sections from the stubble in those areas.

Interpretation of the Test Results

Stalk nitrate concentrations can be divided into three general categories: LOW, OPTIMAL , and EXCESS. The LOW range indicates high probability that greater availability of N would have resulted in higher yields. It should be noted that concentrations in this range give little indication of the magnitude of yield increase that might be expected from more available N. Visual signs of N deficiency usually are present when nitrate concentrations are in this range. The OPTIMAL range indicates high probability that N availability was within the range needed to maximize profits for the producer. The EXCESS range indicates high probability that N availability was greater than when N was applied at rates that maximize profits for producers.

The stalk nitrate concentrations for each of the three ranges for both grain corn and silage corn are:

LOW = less than 500 ppm N
OPTIMAL = 500 to 2000 ppm N
EXCESS= greater than 2000 ppm N.

The concentration of nitrate in the stalk at the end of the season reflects all factors that influenced N availability and N needs during the growing season. Because many of the factors influence N availability after fertilizers are applied, it is unrealistic to expect any producer to attain OPTIMAL concentrations in all fields in all years. Indeed, experience has shown that the OPTIMAL range is difficult to consistently attain with existing management practices.

Who Should Use the Test

All corn producers should consider using the test on a few fields each year. Those who learn that their fields usually test in the optimal range will not need to continue testing or change their N management. Those who learn that they usually apply too much N to some or all of their fields will find it profitable to adjust rates of application. Thoughtful use of the test for a few years should help producers optimize rates for their fields.

All producers who grow corn on manured soils should use the stalk test. Recent studies indicate that many producers greatly underestimate the amount of N supplied by animal manures and apply unneeded fertilizer.

This bulletin is a modified version of: Tom Morris and Beth Hooker. Nov. 2007. Factsheet 5802. College of Agriculture & Natural Resources, University of Connecticut. http://www.edf.org/documents/5802_CornstalkNitrateFactSheet.pdf (confirmed April 2010)

Prepared by C.A. Frate and G.S. Pettygrove, U.C. Cooperative Extension, for a May 2008 workshop "Dairy Manure Nutrient Planning for Crop Management Professionals,"
A copy of this handout may be downloaded from http://manuremanagement.ucdavis.edu.

University of California Manure Technical Guide Series
for Crop Management Professionals

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Financial support for this publication was provided by the California Department of Food & Agriculture and the California Dairy Research Foundation. Contents of this publication and others in this series do not necessarily reflect the views or policies of the supporting organizations and sponsors listed above.

4/28/10