

## *Biosystems Engineering & Soil Science*

### **The Pre-Sidedress Nitrate-N Soil Test (PSNT) For Nitrogen Management In Corn Production Systems of Tennessee**

**Hubert J. Savoy, Associate Professor,  
Biosystems Engineering and Soil Science**

#### **Introduction**

The pre-sidedress nitrate-N soil test (PSNT) is a late-spring nitrogen-management tool that has been calibrated for use in corn production systems of Tennessee. **It is especially appropriate for those systems where producers are utilizing animal manures.** The soil test is used to determine the amount of nitrate-nitrogen in the top 12 inches of soil just prior to sidedress time. This nitrate-nitrogen value is shown in U. T. research and elsewhere to be highly related to the yield of corn over a range of soil types. This soil test is being used successfully in the northeast and midwestern United States as a tool for identifying those fields where corn may or may not respond to additional nitrogen fertilization at sidedress time.

Research data for this soil test were collected in Tennessee during 1991-1993. This publication provides guidelines for using the soil test based on those three years of study and farmer field experiences since that time in Tennessee.



## How to use the PSNT ?

The PSNT is primarily a diagnostic tool for nitrogen management decisions at sidedress time where animal manures are being utilized in the corn production system.

**The best use of the PSNT is to identify those fields which have received sufficient nitrogen from application of manures.** This is because the availability of nitrogen from manures can often be uncertain. There can be a high variability in manure analysis, rate of decomposition, uniformity, accuracy of spreading and other such factors. *Can I count on enough of that manure nitrogen being available when the corn needs it?*

This is a question for which the PSNT is ideally suited to provide a more objective answer for you.

Another use of the PSNT is to identify those fields which have not received sufficient nitrogen from the application of animal manures. Selection of the exact rate of nitrogen application for a nitrogen deficient situation is left up to the producer. When such a situation is identified, soil test nitrate-N values can be used as a guideline for a decision on the amount of additional nitrogen to apply at sidedress time. Other information such as field yield potential, cropping and fertilization history also needs to be considered for the best results. The producer is advised to consider the site specific yield responses that have been observed using the soil test in previous years.

The PSNT can assist with both pre-plant and sidedress nitrogen management decisions. The soil test can provide a more objective basis for those long-term nitrogen management decisions (ex. long-term rate adjustment, or split application versus all nitrogen at planting), even when animal manures are not a part of the production system.

For example, when soil nitrate-N consistently tests very high, the grower may benefit by somewhat reducing (no more than 10 to 15 percent of the recommended rate) preplant nitrogen fertilizer rates in that field during the next growing season. The grower should continue a soil sampling program during the next growing season to determine if further reduction in preplant nitrogen fertilizer is warranted.

If recommended amounts of nitrogen fertilizer are applied preplant or at planting and the

PSNT soil test consistently tests low, then the producer may benefit from a different nitrogen management strategy. For example, this may indicate that soil conditions in that field favor nitrogen loss and therefore a split or delayed application of nitrogen might be a better management strategy. Sidedressing every year to correct for losses from the full rate of nitrogen applied near planting is not the most efficient, profitable or environmentally sound solution in a field where soil conditions favor nitrogen loss.

**When should I collect the soil samples?**

The soil is sampled when the corn is between 6 to 12 inches tall as measured from the ground to the bottom of the opened part of the whorl. This is usually between the fourth to sixth fully matured leaf stage (V4 to V6) or about 4 to 6 weeks after planting. The growing point is just emerging from below the soil surface at V6 (see Figure 1 below).



Figure 1. Growth Stage V 6 Corn, Whole Plant and Dissected Plant Showing the Growing Point Just Emerging From Below the Soil Surface.

Soil nitrate-N levels can change dramatically during the spring. Increased levels result from the transformation of nitrogen in fertilizers, plant residues, animal manures and soil organic matter into the nitrate-N form. This can occur very rapidly in warm, moist and well aerated soils. Decreases in soil nitrate-N can occur for several reasons such as **leaching**, the movement of the nitrate-N through the soil; **denitrification**, the transformation in saturated and poorly aerated soils of the nitrate-N into gaseous forms (nitrous oxide and dinitrogen) which are then lost to the atmosphere; **immobilization**, when nitrogen is incorporated back into organic forms which are not available to plants.

Many of the factors controlling nitrogen transformations control plant growth. Therefore, basing sampling time upon plant growth allows maximum time for nitrate-N accumulation or loss before it is necessary to make a decision on further nitrogen fertilization. Greatly restricting the sampling time period (growth stage V4 to V6) minimizes the year to year change in soil nitrate-N values for a given set of soil conditions.

### **How deep should I sample?**

Depth of sampling is critical for the correct interpretation of the PSNT soil test. Nitrate-N is very mobile in soil. Therefore, soil test information for nitrate-N in Tennessee is based upon a 12 inch sampling depth. Soil samples representing thicker or thinner layers will result in incorrect interpretation of the PSNT soil test. Pounds of actual nitrogen per acre can be estimated by multiplying parts per million (ppm) nitrate-N in the surface 12 inches of soil by 4.

Soil sampling tubes or less conveniently, a shovel may be used to collect the sample. A 15-inch tube is required in order to collect a 12-inch soil core. Soil sample tubes having the old standard 12-inch tube can only collect a 9-inch soil core. In order to correctly sample with this size tube, it is necessary to probe the same hole twice. First, collect the top 0-to 6-inch section and place it in your bucket. Collect the next 7-to 12-inch section of soil by going back into the same hole. Place this subsample in your bucket and then proceed in a random fashion to the next sampling spot.

## **What is the sample collection and processing procedure?**

**Sample collection:** Soil test results are no better than the sample taken to represent the field. Values of soil nitrate-N can be highly variable throughout a field. Therefore, it is important that the sampling area be as small as is practically possible.

Current recommendations suggest that small portions of soil be collected from approximately 20 random locations within an area not to exceed 10 acres. The sample should represent the average soil conditions of the sampling area. Areas of the field that are different than the rest of the field, such as poorly drained spots, should be sampled separately.

At each of the 20 random locations, remove surface litter. Using a soil tube or spade, obtain a small portion of soil to a depth of 12 inches. If a spade is used, dig a V-shaped hole, then cut a thin slice of soil from one side of the hole. Place each small portion of soil into a clean container and thoroughly mix the 20 small portions into one uniform sample. After mixing, remove about a cup full of soil to dry and send to the U. T. Soil Testing Laboratory.

**Sample Processing:** The soil must be completely air-dry within 36 hours (preferably sooner) of sampling. Failure to completely dry the sample can cause inaccurate results. To dry quickly, place a cup of soil on a paper plate in a well ventilated area or in front of a gently blowing fan. **Soils received moist at the laboratory will not be analyzed because of the uncertainty in results.**

Fill a soil sample box with the dry and properly mixed soil. Print name, address, telephone number and sample number on each box. Fill out Soil and Media Information Sheet, F394 as completely as possible. Forms can be obtained at your local Extension office or online at: <http://soilplantandpest.utk.edu/soil/index.htm> . The information that you supply on this form will be emailed to your local Extension office and to any agency paying for the soil test, along with a copy of the analytical results. Be sure that the sample numbers on the information sheets correspond with the numbers on your sample boxes. Keep a record of the area represented by each sample. You may want to make a copy of the information sheet (F394) to keep for your files. Submission of the form and payment can be done online or follow instructions given on F394 for

mailing of payment and sample to the Soil, Plant and Pest Center.

### **Interpreting your soil nitrate-N soil test results**

Interpretation of the pre-sidedress nitrate-N soil test value in Tennessee is made on the basis of (1) yield potential of the field (2) soil test level (low, medium or high) (3) field history.

**(1) Yield Potential of the field:** Yield potential of the field should be based upon a long term (3 to 5 year) yield average for the field.

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**(2A) Soil Test Level:** The following soil nitrate-N interpretations are made for fields consistently yielding **125 to 175 Bu/acre or 15 to 25 tons of silage per acre:**

- A. Below 17 ppm nitrate-N:                    **Low Soil Test** --- Good chance corn will show a yield response to more nitrogen
- B. 17 to 24 ppm nitrate-N:                    **Medium Soil Test** --- Corn may or may not respond to additional nitrogen
- C. 25 ppm or Greater:                        **High Soil Test** --- Good chance that corn will not respond to more nitrogen

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**(2B) Soil Test Level:** The following soil nitrate-N interpretations are made for fields consistently yielding more than **175 Bu/acre or 25 tons of silage/acre:**

- A. Below 35 ppm nitrate-N:                    **Low Soil Test** --- Good chance corn will show a yield response to more nitrogen
- B. 35 to 46 ppm nitrate-N:                    **Medium Soil Test** --- Corn may or may not respond to additional nitrogen
- C. 47 ppm or Greater:                        **High Soil Test** --- Good chance that corn will not respond to more nitrogen

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**Sidedress Nitrogen Rates:** At each level of yield potential, no additional nitrogen is recommended at sidedress time on those soils testing within the high ranges. Table 1 provides suggested rates of application within the medium and low testing categories. This information should be used along with pertinent field history information to arrive at a decision on the appropriate rate of nitrogen to sidedress. Selection of the exact nitrogen application rate for a nitrogen deficient situation is left up to the grower. The grower may want to consult with the local

Extension agent or other Agricultural professional that has used the test successfully in the past.

**Table 1. Suggested Rates of Nitrogen to Sidedress  
for Below Listed Soil Nitrate-N Values and Field Yield Potential**

Soil Nitrate-N when corn 6 to 12 inches tall (ppm in 0-12 inch depth)	<b>MAXIMUM YIELD POTENTIAL Grain (Bu/acre)/ Silage (Tons/acre)</b>			
	125 Bu/A or 15 tons silage	150 Bu/A or 16-18 tons silage	175 Bu/A or 19-25 tons silage	175 <sup>+</sup> Bu/A or 25 <sup>+</sup> tons silage
	-----Pounds of sidedress N per acre-----			
< 10	60 to 120	75 to 150	90 to 180	120 to 180
10 to 16	40 to 60	50 to 75	60 to 90	90 to 120
17 to 24 <sup>*</sup>	0 to 40	0 to 50	0 to 60	60 to 90
25 to 34	0	0	0	40 to 60
35 to 46 <sup>**</sup>	0	0	0	0 to 40
47 or Greater	0	0	0	0

\* Medium testing soil at Field Yield Potentials 125 to 175 Bu/A or 15 to 25 Tons Silage per Acre

\*\* Medium testing soil at Field Yield Potentials more than 175 Bu/A or 25 Tons Silage/Acre.

**In what situations is the new soil test not suitable?**

The soil test **cannot be used in fields where nitrogen fertilizers (i. e. anhydrous ammonia) or manures have been applied in a BAND APPLICATION.** It may be much less accurate when used on sandy soils or soils with poor internal drainage. This soil test is a technology that producers are advised to adopt with caution. A good way to start is to use the soil test in a few "strips" in selected fields. Evaluate results and in cooperation with your local Extension office, decide how to best use the soil test to assist with your nitrogen management program.

Notes:

**Visit the UT Extension Web site at  
<http://www.utextension.utk.edu>**

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