SOUTHERN REGIONAL FACT SHEET

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USE OF SOIL TESTS FOR NITRATE-NITROGEN IN THE SOUTH

Introduction

States returning survey forms report that soil nitrate-nitrogen test results are used: (1) with the corn pre-sidedress nitrogen test (PSNT); (2) to credit residual soil nitrogen; (3) with the cotton Gossym Comax program and (4) for troubleshooting or per grower request. Use with the PSNT and nitrogen credit programs are detailed in this fact sheet.

Tennessee, Virginia and Alabama report use with the PSNT. Very limited use of the PSNT is reported by Kentucky . Oklahoma and Arkansas report use with a nitrogen credit program. North Carolina and South Carolina report limited use for trouble shooting purposes. Louisiana reports assistance with interpretation of results upon grower request.

PSNT

The pre-sidedress nitrate-N soil test (PSNT) is a late-spring nitrogen-management tool for use in corn production systems. **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 value is shown to be highly related to the yield of corn over a range of soil types.

How to Use the PSNT

The PSNT is primarily a diagnostic tool for nitrogen management decisions at sidedress time where animal manures are being used 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 you 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.

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 usually 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 should be considered for the best results. You also need 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, you 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. You 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 you may benefit from a different nitrogen management strategy. For example, this may indicate that soil conditions in that field favor nitrogen loss, so 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 always the most efficient, profitable nor 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 four to six weeks after planting.

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; and **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 you must 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 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.

Soil sampling tubes or, less conveniently, a shovel, may be used to collect the sample. A 15-inch tube is required 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. To correctly sample with this size tube, you must 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 from the rest of the field, such as poorly drained spots, should be sampled separately.

At each of 20 random locations, remove surface litter. Using a soil tube or similar sampling device, obtain a small portion of soil to a depth of 12 inches. Place each small portion of soil into your clean container and thoroughly mix the 20 small portions obtained from the sampling area into one uniform sample. After mixing, remove about a cup full of soil to dry and send to the Soil Testing Laboratory.

Sample Processing: The soil must be completely air-dry within 36 hours of sampling (preferably sooner). 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 often not be analyzed because of the uncertainty in results**.

Interpreting your soil nitrate-N soil test results in Tennessee

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 as provided on a PSNT information sheet.

(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.

(2) Soil Test Level: The following soil nitrate-N interpretations are made for fields 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

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

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 (supplied on the PSNT testing information sheet, F784) 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.

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

Soil Nitrate-N when corn is 6 to 12 inches tall (ppm in 0-12 inch depth)	**Maximum Yield Potential** Grain (bu/acre)/Silage (tons/acre)			
	125 Bu/A or 15 tons silage	150 Bu/A or 16-18 tons silage	175 Bu/A or 19-25 tons silage	175+ Bu/A or 25+ 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*	0 to 40	0 to 50	0 to 60	60 to 90
25 to 34	0	0	0	40 to 60
35 to 46**	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 per acre.

Interpreting your soil nitrate-N soil test results in Virginia

Following the determination of the soil nitrate-N content of the sample, the following guidelines for interpreting the results are based on two years of field research.

Nitrate-N Content	Interpretation
<11 ppm	Apply full rate of sidedress N that is needed for the realistic yield goal for the particular soil.
11-20 ppm	Possible reduction of the normal sidedress N application rate by 25-50 percent. This area is uncertain and decisions must be made on a site-by-site basis and should take into account previous field history, organic N additions and management practices.
>20 ppm	No sidedress N is needed.

The recommendations provided in this chart should by no means substitute for common sense and an understanding of the roles of soil properties and management practices in influencing N availability to crops.

Interpretation in Alabama

In Alabama, the Tennessee interpretation (table 1) may be used in the northern part of the state. The PSNT is not applicable to the coastal plain soils of South Alabama. These Coastal Plain soils rarely retain enough preplant or manure nitrogen and nitrogen applications should always be split applied.

Interpreting your soil nitrate-N soil test results (states other than Tennessee, Virginia or Alabama)

Other states using the PSNT do not report a published interpretation at this time.

In what situations is the new soil test not suitable?

Tennessee and **Alabama** suggest that the soil test **not 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 new technology that producers are advised to adopt with caution. A good way to start is to use the new 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.

In **Virginia**, the test should be conducted only on fields that have had only a starter fertilizer application (25-30 lbs. N/acre). Fields that have received high rates of preplant N fertilizer should not be tested. Fields that have received manure can and should be tested prior to sidedressing.

NITROGEN CREDIT PROGRAMS

How nitrogen credit approach is used

Soil nitrate-nitrogen test results are used in some states with a nitrogen credit type program. All or some portion of the residual nitrate-nitrogen found by soil testing the field is credited against the specific crop nitrogen fertilizer recommendation for that season. Although a surface sample is sometimes used, best results are obtained by sampling the entire rooting zone for that particular field.

Oklahoma

In Oklahoma, the nitrogen fertilizer rate is calculated by subtracting the soil test nitrogen value from the nitrogen requirement for a selected crop and yield goal. For deep-rooted non-legume crops such as wheat or bermudagrass, a sample representing the 7 to 24 inch subsoil layer should accompany the surface soil for a separate available nitrogen test. If the subsoil sample depth is other than 7 to 24 inches, the actual depth should be recorded on the sample bag and the test can be adjusted for the difference. The subsoil need only be tested for nitrogen unless sulfate is tested in the surface, in which case subsoil sulfate should also be included. Yield goals should be sufficiently greater than long term average yields to insure nitrogen will not be the factor limiting production during years with better than average growing conditions. As a rule of thumb, the highest yield from the last five years is an appropriate yield goal.

Forage production under grazing conditions can be roughly estimated by assuming 1000 pounds of small grain forage or 1500 to 2000 pounds of other types of forage will be required to produce 100 lbs. of beef. The actual conversion rate varies depending on the quality and condition of the pasture and livestock. If small grain is used for grazing and grain production, additional N needs to be considered to replace N removed as beef. Two pounds of N are still needed to produce one bushel of grain, but 30 pounds of N are needed to produce 100 pounds of beef or 1000 pounds of forage grazed. Therefore, N requirement for dual purpose wheat is:

N (lbs per acre) = [[2 lbs N per bu X yield goal (bu/acre)] + 0.3 X beef (lbs per acre)] - soil test N (lbs per acre)

Seasonal nitrogen requirements for actively growing sorghum sudans and bermudagrass pastures may be split to provide 50 to 60 pounds of actual nitrogen every 4 to 6 weeks. The same split application should be made for each cutting of sorghum sudan hay. For bermudagrass hay, the total seasonal nitrogen requirement can be applied in early spring except on very deep sandy soils under high rainfall or irrigation.

Small grains following alfalfa generally will not need nitrogen for one year. Credits should be given to available nutrients from animal manure and biosolids applications.

Arkansas

In Arkansas, the nitrogen credit program is used in cotton production systems. The soil samples are collected in early spring prior to nitrogen application and after a warming period. They should be immediately dried. Samples should be collected to at least a 12-inch depth.

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