Agricultural Extension Service
The University of Tennessee
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Soil Testing

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Growers who follow soil test recommendations can expect higher fertilizer efficiency, more balanced nutrient levels for crops and optimum benefits from their lime and fertilizer investments. Thus, soil testing should be the first step in planning a sound fertilization program. With a soil test, the guesswork of knowing how much lime and fertilizer to apply is eliminated.

The Concept of Soil Testing

When you submit a sample to The University of Tennessee Soil Testing Laboratory, modern chemical analyses are combined with up-to-date research to make each lime and fertilizer recommendation. Levels of available nutrients present in the soil are determined in the laboratory, while nutrient needs and fertilizer responses are determined by the Agricultural Experiment Station on the major soil types across the state. As a result, the university's soil testing program is geared to the crops and soils in Tennessee, and provides a vehicle for carrying the latest scientific information to individual growers.

Information Sheets and Sample Boxes

Information sheets, soil sample boxes and sampling instructions should be obtained from your local county Agricultural Extension office. These materials provide necessary information and guidelines for collecting and mailing samples to the laboratory. The F394 Soil Testing Information sheets should be filled out as accurately as possible.

For each sample number listed in the left column, you may request up to three recommendations. Use the table on the back of the information sheet to determine the appropriate crop codes to list under the "Recommendations Desired" column. If your crop is not coded or if you are uncertain about which code to choose, then list the name of the crop in place of a code. When codes are not used, you must also, for perennial crops, indicate whether the recommendation is needed for establishment or for maintenance of an existing crop.

Soil sample boxes should be properly labeled with sample numbers corresponding to those shown on information sheets.

The Sampling Area

Soil test results can be no better than the sample collected. Thus, each soil sample submitted to the laboratory should be representative of the area for which fertilizer recommendations are to be made. A composite sample should be collected, consisting of small portions of soil taken from approximately 20 locations. For field crops, soil portions should be taken from an area not to exceed 10 acres (Figure 1). For lawns and gardens, soil portions should be collected at random from eight to 10 locations. Areas of contrasting soils, problem spots or

portions of fields where crop response is significantly different should be sampled separately, provided the area can be fertilized separately.

Sampling Tools and Depths to Sample

Several types of tools can be used for collecting soil samples. One is the soil tube or probe. A uniform portion of soil is collected rapidly and accurately by pushing the tube into the ground to the desired depth and removing a soil core (Figure 2).

The most common tool used is a shovel or spade. With this tool, a uniform portion of soil is collected by first making a V-shaped cut into the soil to the depth of sampling. Next, a 1-inch thick vertical slice of soil to the same depth is removed from the smoothest side of the cut (Figure 2). From this, a 1-inch strip of soil the length of the slice is removed as indicated in Figure 3. If other tools are used for sampling (garden trowel, auger, etc.), make sure that a uniform amount of soil is collected to the desired depth from a sufficient number of sites within the sampling area.

Remove organic debris, rocks and trash from the soil surface before collecting the sample. For determination of pH, P, K, micronutrients and organic matter, take soil samples to a depth of 6 inches. For NO-TILL row crops, collect the sample to a depth of 6 inches for pH and nutrient determinations and to a depth of 2 inches for organic matter determinations. For determination of soluble salts, sample within the rooting zone of the affected crop or the expected rooting zone if sample is taken prior to crop establishment. For the corn pre-sidedress nitrate-nitrogen test, collect samples to a depth of 12 inches.

Soil portions for each composite sample should be placed into a clean container and thoroughly mixed. From this, remove enough soil to fill a sample box (Figure 4). When sampling for nitrate-nitrogen, the sample should be thoroughly dried within 36 hours to obtain the best results.

When to Sample

Although soils can be tested any time during the year, fall is a very desirable time. Fields are usually drier and more accessible and the laboratory is less rushed than in the spring. Also, testing in the fall allows recommended rates of lime, phosphate and potash to be applied well in advance of spring planting. By sampling at approximately the same time each year, it is easier to compare soil test results with previous results from the same field.

Soils should be dry enough to till when sampling. If wet samples are collected, they should be air-dried before being packaged and mailed. Wet samples are difficult to handle, more subject to being lost during mailing and greatly delay laboratory testing. Wet samples cannot be analyzed for nitrate-nitrogen.

How Often to Test Soils

The following general guidelines may be used to determine how often soils should be tested. However, the frequency can vary depending upon cropping intensities, soil types, fertilization rates, tillage methods, weather conditions and new research findings.

1. Continuous row crops (conventional) - every two to three years.
2. Double-Cropping Systems - every two years.
3. Continuous No-Till Soybeans (only) - every three to five years.

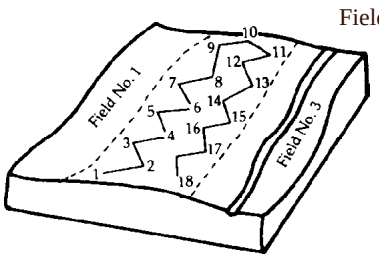
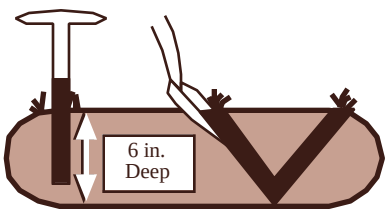


Figure 1. Sampling pattern for collecting a representative soil sample.



All crop establishment

Figure 2. Soil sampling tools and depth to sample for pH, P, K and micronutrients.

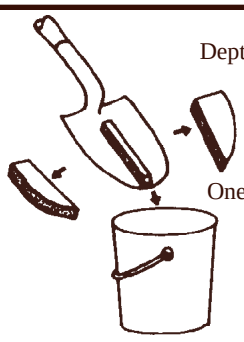


Figure 3. Removing a portion of soil from a soil slice.

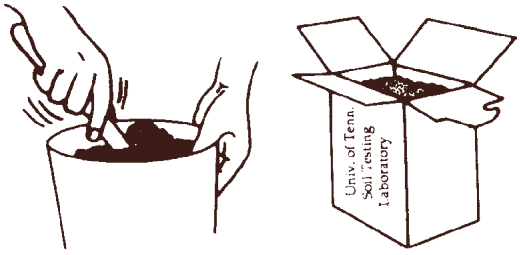


Figure 4. Mixing and packaging a soil sample.

4. Continuous No-Till Corn or Cotton - every two years.
5. Hay Systems - every two years.
6. High-Value Cash Crops (Tobacco, Vegetables) - annually.
7. Lawns, Gardens and Pasture Crops - every three to five years.
8. Any time a nutrient problem is suspected.
9. At the beginning of a different cropping rotation.

Laboratory Tests and Fees

The University of Tennessee Soil Testing Laboratory is located at the Ellington Agricultural Center in Nashville. It is equipped for routine soil analysis to make lime and fertilizer recommendations and offers its services to all Tennesseans. The Mehlich No. 1 (Double Acid) extractant for nutrient determinations and the Adams-Evans Buffer for measuring lime requirements are presently used by the laboratory.

Soil tests available and the cost per sample are listed in Table 1.

Routine tests for other nutrients are not offered because either University of Tennessee research and field trials have not indicated a crop response to their use, or recommenda tions are more accurately made based on soil conditions and specific crop needs (nitrogen, boron, molybdenum).

Table 1. Laboratory Tests and Fees for Field, Lawn and Garden Samples

Test	Cost per Sample*
Basic (P,K, water pH, buffer value)	$6
Calcium	$2
Magnesium	$2
Calcium + Magnesium	$3
Zinc	$2
Manganese	$2
Zinc + Manganese	$3
Iron	$2
Soluble Salts (1 Soil: 2 Water V/V)	$4
Organic Matter (Modified Walkley-Black)	$5
Nitrate-Nitrogen	$3 - $5**

**Add $1 additional per sample for reports to be faxed.*
***Rush test includes fee for fax.*

Selecting the Proper Tests

Most crop fertilization problems in Tennessee are associated with the lack of and improper use of nitrogen, phosphorus, potassium and lime. Therefore, the greatest need for soil test information arises from these four variables. The need for secondary and micronutrient soil tests is much less, since research and demonstrations indicate responses are limited to certain crops and soil conditions. Situations where the various soil tests are most likely needed are shown in Table 2. Tests desired for each sample must be indicated on the information sheet.

Table 2. Guidelines for Selecting Laboratory Tests

Test	Crop	Location	General Conditions
Basic	All	The basic soil test is recommended for all crops, lawns and gardens for developing and maintaining fertilization programs.	
Calcium	Tomatoes and Peppers	Tomato and pepper producing areas	Sandy or light textured soils. Where blossom end-rot is an annual problem.
Magnesium	Tomatoes,Tobacco Cabbage, Grapes	Cumberland Plateau, Highland Rim	Sandy or light textured soils. Magnesium deficiencies in each of these crops may be induced by using high grade calcitic limestones or by excessive amounts of potassium or ammonium fertilizers.
Zinc	Corn, Snapbeans	Cumberland Plateau, Middle Tennessee	When soil pH is above 6.0 or lime is applied and phosphate is high.
Iron	Ornamentals (only)	Isolated or problem areas	High soil pH.
Manganese	Soybeans	Isolated or problem areas	Sandy or light textured soils with a pH above 7.0.
Soluble Salts		Isolated or problem areas	Excessive fertilizer rates.
Organic Matter		The organic matter test is offered as a guideline for the selection and use of certain HERBICIDES. Interpretations for other uses will not be made.	
Nitrate-Nitrogen	Corn	The nitrate-nitrogen test is offered to assist with nitrogen management decisions in corn production systems, especially when manures are being used.	

Computer Soil Test Report

Results of each soil test and corresponding recommendations are printed by computer and mailed to the grower. In addition, a copy of each report is retained by the laboratory and one copy is sent to the grower's county Extension office.

Each nutrient tested is reported in pounds per acre and assigned a soil test rating. The ratings for phosphorus and potassium are low (L), medium (M), high (H) and very high (VH). The secondary and micronutrients tested are rated as either sufficient (S) or deficient (D). Interpretations of ratings are printed on the back of the soil test report form.

Recommendations for field crops are reported in pounds of plant nutrients and tons of agricultural limestone to apply per acre. For lawns and garden, recommendations are reported in pounds of actual fertilizer grades and agricultural limestone to apply per 1,000 square feet. Recommendations for flowers and shrubs are reported in pounds per 10 and pounds per 100 square feet respectively.

Table 3. Laboratory Tests and Fees for Greenhouse Container Media

Test*	Cost Per Sample**
Standard (P,K,Ca,Mg,NO3, NH4, soluble salts, pH)	$12
Soluble Salts + pH	$5
Ammonium N + nitrate N	$5

**Determination made using saturated media extract procedure.*
***Add $1 additional per sample for reports to be faxed.*

Growers should keep a file of all soil test reports arranged by fields or areas.

Pre-sidedress Nitrate-N Soil Test (PSNT)

The laboratory offers a special soil test for nitrate-nitrogen to assist with nitrogen management decisions in corn production systems. Samples are analyzed for nitrate-N using an ion-selective electrode procedure. The cost of analysis (Table 1) is $3 per sample for regular processing or $5 for a guarantee of results phoned or faxed within three days of sample arrival to a number which you provide.

Growers should complete the form F784, "PSNT Information Sheet," when submitting samples for analysis. See Extension factsheet SP427 for detailed information on the PSNT procedures.

Greenhouse Container Media

Tests available for greenhouse media and the cost per samples are indicated in Table 3. When submitting samples, growers should complete the form "Container Growth Media Information Sheet" to indicate test(s) desired. Information sheets for soil samples should not be used for media samples. However, soil boxes may be used for media samples. Two completely filled soil boxes per sample are needed to provide sufficient media for completion of the container media test.

After testing, a copy of the laboratory results reported in parts per million (ppm) is mailed to the grower, the county Extension office and the Extension floriculture specialist. Fertilizer recommendations are prepared by the specialist and mailed to the grower.

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