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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, Plant and Pest Center, modern chemical analyses are combined with up-to-date research to make each lime and fertilizer recommendation. Levels of Mehlich 1 extractable nutrients present in the soil are determined in the laboratory, while nutrient needs and fertilizer responses of the major soil types across the state are determined at the AgResearch and Education Centers. As a result, the university's soil testing program is geared to the crops and soils in Tennessee and provides a vehicle for delivering the latest scientific information to individual growers.

Information Sheets and Sample Boxes

Information sheets, soil sample boxes and sampling instructions can be obtained from your local UT Extension office or online at http://soilplantandpest.utk.edu/soil/index.htm. These materials provide necessary information and guidelines for collecting and mailing samples to the laboratory. The UT Extension form, "F 394: Soil and Media Information Sheet" (available online), should be filled out as accurately as possible.

For each sample ID listed in the left column of the form, you may request up to four recommendations. Use the UT crop codes listed at the online site to determine the appropriate codes to list under the "Crop Code(s)" column. If your crop is not coded or if you are uncertain about which code to choose, list the name of the crop in place of a code. When codes are not used for perennial crops, you also must indicate whether the recommendation is needed for the establishment or maintenance of an existing crop.

Soil sample boxes should be labeled properly with identifications corresponding to those shown in the sample ID box on information sheets. Numbers are often used for the sample ID, but a descriptive ID such as "north" or "south" also is appropriate.

The Sampling Area

Soil test results are 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 consisting of small portions of soil taken from approximately 20 locations should be collected. 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, areas under different management within the same field, or portions of fields where crop response is significantly different should be sampled separately, provided the area can be fertilized separately. For example, if a small portion of a larger field had been used to produce a crop with vastly different fertility, like tobacco, then it should be sampled separately. Other examples would include old home sites, areas of animal confinement or where fence rows were removed to make a larger field.

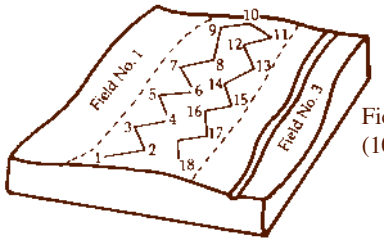

***Figure 1**. Sampling pattern for collecting a representative soil sample.*

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.

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). Then, a 1-inch strip of soil the length of the slice is

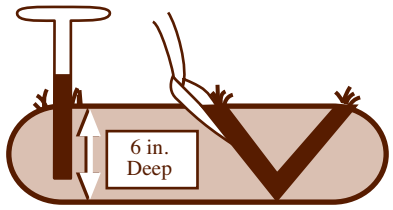

***Figure 2**. Soil sampling tools and depth to sample for pH, P, K and micronutrients.*

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.

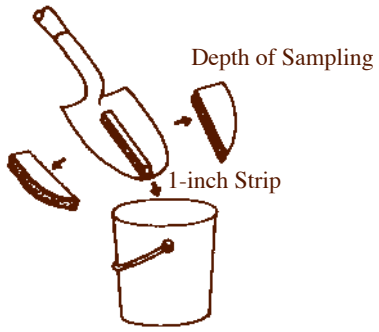

***Figure 3**. Removing a portion of soil from a soil slice.*

Remove organic debris, rocks and trash from the soil surface before collecting the sample. For determination of pH, P, K, Ca, Mg, 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 the 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 in a clean container (not zinc coated if determining Zn) and mixed thoroughly. Then, remove enough soil to fill a sample box (Figure 4). When sampling for nitrate-nitrogen, the sample should be air-dried thoroughly within 36 hours to obtain the best results.

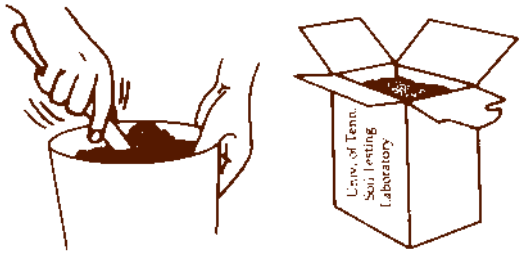

***Figure 4**. Mixing and packaging a soil sample.*

When to Sample

Although soils can be tested at 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, there is less error when comparing 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 on 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.
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.

Soil, Plant and Pest Center lime recommendations should be applied once, but, unless otherwise specified in the recommendation, fertilizer recommendations should be followed until the next soil sampling date.

Laboratory Tests and Fees

The University of Tennessee Soil, Plant and Pest Center is located at the Ellington Agricultural Center in Nashville, Tenn. It is equipped for routine soil analysis to make lime and fertilizer recommendations and offers its services to all Tennesseans. Currently, the laboratory uses the Mehlich No. 1 (Double Acid) extractant for nutrient determinations and a Buffer for determining lime requirements.

Available soil tests and their costs per sample are listed in Table 1 with guidelines for selection listed in Table 2.

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

Test	Cost Per Sample
1. Basic [pH, Buffer pH, phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg)]	$7
2. Basic Plus [all the above plus zinc (Zn), manganese (Mn), iron (Fe), copper (Cu), sodium (Na) and boron (B)]	$15
3. Ca, Mg, Zn, Mn, Fe, B, Cu or Na	$3 each
4. Organic Matter	$6
5. Soluble Salts (1 Soil:2 Water V/V)	$4
6. Sulfate-sulfur (SO_4)	$5
7. Nitrate-nitrogen (NO_3)	$5
8. Carbon:Nitrogen ratio	$10
9. Particle Size Analysis (% sand, silt and clay)	$14

**Check online at http://soilplantandpest.utk.edu/soil/index.htm to verify current listings and pricing.*

Table 2. Guidelines for Selecting Laboratory Tests

Test	Crop	Location	General Conditions
Basic	All	The basic soil test is suggested for all crops, lawns and gardens for developing and maintaining fertilization programs.	
Basic Plus	All	The basic plus soil test is suggested for precision ag and specific problem-solving applications.	
Calcium (Ca)	Tomatoes, Peppers, Eggplant, Watermelon	Vegetable-producing areas	Sandy or light-textured soils. Where blossom-end-rot is an annual problem.
Magnesium (Mg)	Tomatoes, Tobacco, Cabbage, Grapes	Cumberland Plateau, Highland Rim	Sandy or light-textured soils. Magnesium deficiencies in each of these crops may be induced by excessive amounts of potassium or ammonium fertilizers.
Zinc (Zn)	Corn, Snap Beans	Cumberland Plateau, Middle Tennessee	When soil pH is above 6.0 or lime is applied and phosphate is high.
Iron (Fe)	Ornamentals (only)	Isolated or problem areas	High soil pH.
Manganese (Mn)	Soybeans	Isolated or problems areas	Sandy or light textured soils with a pH above 7.0.
Boron (B)	Tobacco	All	All
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.	
Others listed in Table 1 or online	All	Problem-solving in trouble fields/Provide basic information/Other	

Routine tests for other nutrients are not offered for two reasons: First, UT research and field trials may not have indicated a crop response to their use, and, second, recommendations are made more accurately based on soil conditions and specific crop needs (nitrogen, molybdenum).

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 that 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.

Computer Soil Test Report

Results of each soil test and corresponding recommendations are printed by computer and emailed and/or 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. Some other labs may report nutrients tested in parts per million (ppm). For a 6-inch soil sample this value can be converted to pounds per acre by multiplying by two.

Recommendations for field crops are reported in pounds of plant nutrients and tons of agricultural limestone to apply per acre. For lawns and gardens, 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. Growers should keep a file of all soil test reports arranged by fields or areas.

Pre-sidedress Nitrate-N Soil Test

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 $5, and dry samples must be received for valid results. Growers should complete the UT Extension form, "F 394: Soil and Media Information Sheet," when submitting samples for analysis. See UT Extension fact sheet, "SP 427: Using Pre-sidedress Nitrate-N Soil Test for Nitrogen Management," or BESS #105 for detailed information on the PSNT procedures.

Greenhouse Container Media

Tests available for greenhouse media and their costs per sample are indicated in Table 3. When submitting samples, growers should complete the UT Extension form, "F 394: Soil and Media Information Sheet," to indicate the test(s) desired. However, soil boxes may be used for media samples. Two completely filled soil boxes per sample are needed to provide sufficient media for the completion of the container media test.

Table 3. Laboratory Tests and Fees for Greenhouse Container Media

Test*	Cost Per Sample
pH, P, K, Ca, Mg, ammonium and nitrate nitrogen, soluble salts	$20

**Determinations made using saturated media extract procedure.*

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 specialist. Fertilizer recommendations are prepared by the specialist and mailed to the grower.

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