THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

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SOIL TESTING FOR OHIO LAWNS, LANDSCAPES, FRUIT CROPS, AND VEGETABLE GARDENS

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Soil tests provide more helpful information on soils than any other resource. It is an inexpensive way to maintain good plant health in lawns and landscapes, and to maximize productivity of vegetable gardens and fruit crops. Soil test results pinpoint plant nutrient needs and soil test lab recommendations guide fertilizer applications so just the right amount is used. Test results also provide information for making plant selection decisions based on “right plant—right place.” If good plants go bad, a soil test can help diagnose what went wrong.

Soil samples are sent to an accredited soil testing lab (see list at end). Results will be sent along with recommendations for taking corrective actions if needed. This includes the amount of fertilizers and other additives needed to support healthy plants. With an accurate soil sample and test, reliable fertilizer recommendations can help horticulture professionals and gardening enthusiasts improve plant quality and productivity, reduce nutrient runoff, and save money.

A standard soil test provides information on chemical properties of the soil that represents soil fertility. This includes the amount of positively charged plant nutrients (cations) found in the soil including phosphorous (P^{+}), potassium (K^{+}), calcium (Ca^{++}), and magnesium (Mg^{++}). These chemical elements are called “macronutrients” based on the amount needed and used by plants to maintain healthy growth and development. The test will also reveal the cation exchange capacity (CEC) of the soil, which is a measure of how well the soil holds onto these chemical elements. The higher the CEC, the better the soil holds onto cations against water leaching.

One of the most important chemical properties is soil pH. Figure 1 shows how soil pH influences the availability of important chemical elements to plants. The same amount of the nutrient is in the soil regardless of the width of the band; however, where the bands are wide, the element is in a water-soluble form to be taken up by plant

roots. Where the bands are narrow, elements are chemically bound into a non-soluble form that places them out of the reach of plant roots.

For additional fees, soil testing labs will provide information on other chemical properties of the soil such as the concentration of essential micronutrients (sometimes called trace elements). Micronutrient status is based on the amount of the element required by plants. These include iron (Fe^{++}), manganese (Mn^{++}); zinc (Zn^{++}), and copper (Cu^{+}) as well as a few other elements. Micronutrients are just as important as macronutrients for maintaining good plant health; a micronutrient deficiency can be just as damaging to plant health as a macronutrient deficiency. Although most labs charge an extra fee for a micronutrient analysis, the results are important to learning if you have a problem with this group of elements.

Soil texture is an important physical property of soil and is based on the percentage of sand, silt and clay in the soil. These are collectively known as the “mineral components” of the soil and are separated based on particle size with sand being the largest and clay being the smallest particles. Soil testing labs use sieves to perform a “soil texture test” by separating soil particles into the three size classes. Once the percent sand, silt and clay is known, your soil can be placed into a “textural classification” as they appear on the Soil Textural Triangle in Figure 2.

Soil labs usually charge an extra fee to perform a soil texture test; however, understanding the texture of your soil is important if you are planning to add additional soil such as buying and spreading topsoil. Water does not move freely between soils with extremes in particle size; the problem is known as “soil incompatibility.” For example, placing a silty-clay on top of a loamy-sand, or vice versa, could have serious consequences with water drainage.

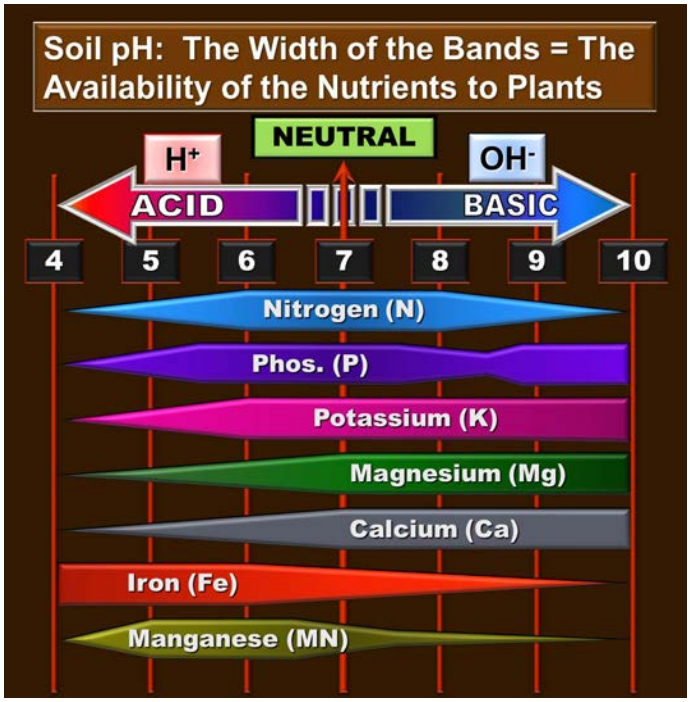

Figure 1: Soil pH influences the availability of certain nutrients for plants to uptake. Graphic by Joe Boggs, Ohio State University Extension.

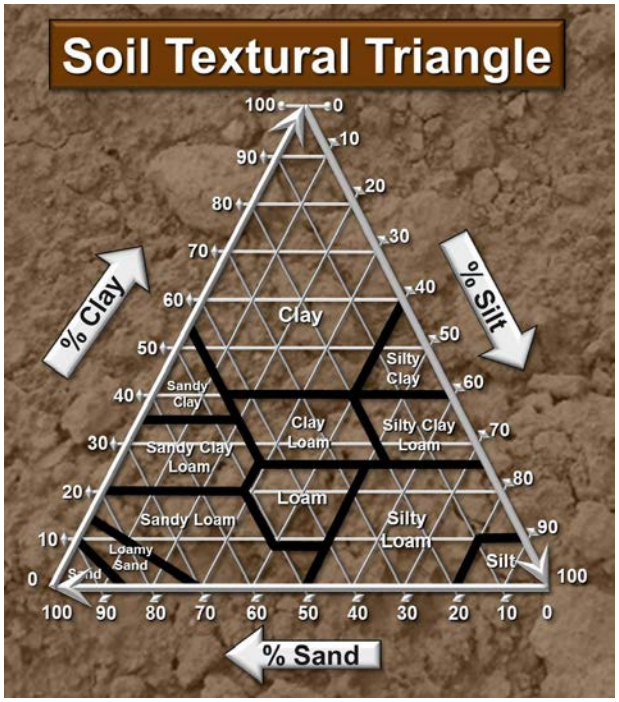

Figure 2: Soil textures and percentages. Graphic by Joe Boggs, Ohio State University Extension.

Why Do I Need to Soil Test?

The guidance provided by soil tests to horticulture professionals and gardening enthusiasts is sometimes compared to the guidance that blood tests provide to physicians. In this vein, a soil test is like a “blood test for the soil.” Soil tests can be used for four purposes: maintaining proper soil fertility; guiding plant selection; performing plant problem diagnostics; and for conforming to industry approved standard practices.

1. **Maintaining Proper Soil Fertility**. Healthy plants need certain levels of soil nutrients to thrive. During the growing season, the soil nutrients and fertility may fluctuate. This is influenced by the quantity and availability of plant nutrients that are altered by the addition of fertilizers, manure, compost, mulch, and lime or sulfur, in addition to leaching. Furthermore, large quantities of plant nutrients are removed from soils as a result of plant growth and development, and the harvesting of crops.

   A soil test will determine the current fertility status and provide the necessary information to maintain optimum fertility year after year. Soil tests take the guesswork out of fertilization and are very cost effective; they eliminate wasteful spending on unnecessary fertilizer products. Test results and recommendations help protect our environment by discouraging the overapplication of plant nutrients. Excess nutrients not used by plants may escape into groundwater, streams and lakes.

2. **Guiding Plant Selection**. Some plants will grow in a wide range of soil pH levels, while others require a narrow range of pH. Most turfgrasses, flowers, ornamental shrubs, vegetables, and fruits grow best in slightly acid soils which represent a pH of 6.1 to 6.9. Plants such as rhododendron, azalea, pieris, mountain laurel, and blueberries require a more acidic soil to grow well.

   A soil test will determine whether the soil is acidic or alkaline. It is the most cost effective way to match the pH requirements of plants that you select with the pH of the soil you’re planting them in.

3. **Performing Plant Problem Diagnostics**. Soil tests are an important tool for learning why good plants go bad. For example, if trees are exhibiting yellowing (chlorotic) leaves or needles during the growing season, a soil test may reveal whether the symptom is caused by a lack of an essential nutrient or a problem with the soil pH; or both. As shown in Figure 1, most soil nutrients are readily available when soil pH is at 6.5. When pH rises above this value, nutrient elements such as iron (Fe), copper (Cu), zinc (Zn), and manganese (Mn) will become less available. However, when soil pH drops below 6.5, the release of certain elements such as manganese (Mn) can reach a toxicity level for some sensitive plants.

An example of using a soil test for diagnosing a plant problem is illustrated with the yellowing of inner needles on a Colorado blue spruce in figure 3. The symptom is consistent with a manganese (Mn) deficiency. The lack of Mn could be due to a deficiency of Mn in the soil, high soil pH making Mn unavailable to the tree, or both. Blindly applying Mn to correct a perceived Mn soil deficiency or applying a soil acidifier to lower the soil pH to release Mn without testing the soil could have damaging consequences—excessive Mn can be toxic to plants. In this case, a soil test showed that the soil pH was 6.8 meaning the deficiency was not a pH problem. However, the test also

Figure 3: Colorado blue spruce showing symptoms of manganese (Mn) deficiency. Photo by Joe Boggs, Ohio

revealed the soil to be extremely deficient in Mn. The problem was corrected with an application of Mn based on the soil test recommendation. The slight acidity of the soil meant Mn would be readily available to be taken up by the tree.

State University Extension.

Another example of why soil testing is so important for correctly diagnosing plant problems is shown with figures 4 and 5. The red maple symptoms are consistent with a Mn deficiency in the foliage and the problem is often blamed on a high soil pH. Likewise, the chlorosis (yellowing) on the oak is frequently diagnosed off-the-cuff as an iron (Fe) deficiency that is likewise blamed on an alkaline soil condition. However, both symptoms could be caused by a nutrient deficiency in the soil as well as other soil or root related issues. A soil test is the first step in diagnosing the true cause of the symptoms. Otherwise, you are just guessing. As the old axiom states, “don’t guess, soil test!”

Figure 4: Red Maple Chlorosis. Photo by Joe Boggs, Ohio State University Extension.

Figure 5: Oak Chlorosis. Photo by Joe Boggs, Ohio State University Extension.

4. **Conforming to Industry Approved Standard Practices**. The American National Standards Institute (ANSI) is a private non-profit organization that oversees the development process and approval of voluntary consensus standards for the private sector in the United States. The Tree Care Industry Association (TCIA) is accredited by ANSI to develop the actual standards known as ANSI A300 Tree Care Management standards. They are the generally accepted industry standards for tree care practices.

   Following are recommendations from the ANSI standards specific to soil testing:
   A300 (Part 2)-2011 Soil Management
   14.4.4 *Soil testing should be done prior to designing, plant selection, planting, and/or developing management plans for landscapes.*
   15.2 *Soil and/or foliar nutrient analysis should be used to determine the need, formulation, and rate of fertilizer.*
   15.6.3 *When new plants are specified, they should be tolerant of the native soil pH.*

   A300 (Part 6)-2012 Planting and Transplanting
   63.3 Plant and site inspections for transplanting
   63.3.5 *Soil at the installation site should be analyzed and tested for pH, structure, texture, density, nutrients and percolation.*

When Do I Soil Test?

A soil test is used as a planning tool and the first step in learning what you need to do, or not do. Soil samples can be taken any time of the year, as long as the soil is workable. However, you should allow plenty of time to receive and evaluate your soil test results, and then take action to improve your soil fertility. Any recommended adjustments, such as a fertilizer application, should be made at the appropriate time of the year. For example, fall is the best time of the year to make a lime application to raise the soil pH, while spring is the most appropriate time of the year for a sulfur application to lower the pH.

How Frequently Should I Soil Test?

A soil test every two to three years is usually adequate for maintaining soil fertility. Sample more frequently if you desire a closer monitoring of the fertility levels, or if you grow plants that require more nutrients. Soil tests for diagnostic purposes can be made as needed.

What Soil Sampling Tools Do I Need?

1. **Soil Probe**
   A soil probe is the easiest tool for taking soil samples. Soil probes quickly extract samples to a consistent depth simplifying the job of taking soil samples, especially when taking multiple composite samples. Soil probes are also useful for assessing soil moisture to monitor irrigation needs and for evaluating other physical properties of the soil such as compaction. Purchasing a soil probe is a good investment for horticulture professionals and serious gardeners. Figure 6 shows typical soil probes available for purchase. The T-handle step probe is recommended for more compacted soils or when collecting samples in a large area such as a lawn. The longer length and welded step reduces back and shoulder strain from bending over and applying pressure to insert the probe into the soil.

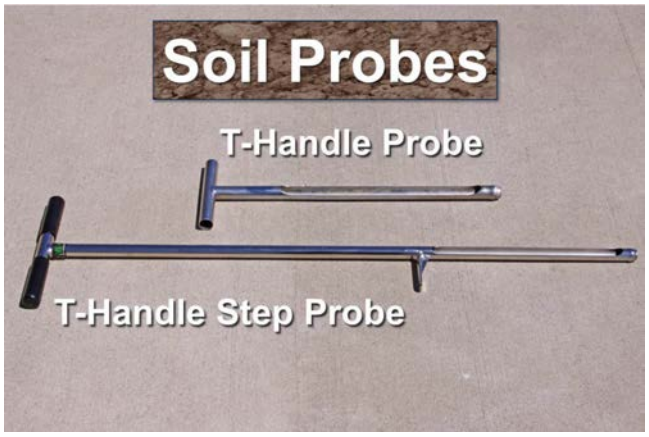

Figure 6: The T-handle probe or T-handle step probe provide a simple method for collecting soil samples. Photo by Joe Boggs, Ohio State University Extension.

2. **Garden Spade, Knife, or Hand Trowel**
   A garden spade, heavy gauged knife (e.g. soil knife), or hand trowel as shown in figure 8 can also be used to take thin slices or sections of soil for gathering soil samples. These tools require more time, effort and skill for taking precise soil samples compared to a soil probe. However, they are effective if you are sampling loose soil such as in vegetable gardens and flowerbeds. They are also cost effective for lawns and landscapes if you are only performing plant nutrient maintenance tests over small areas every few years.

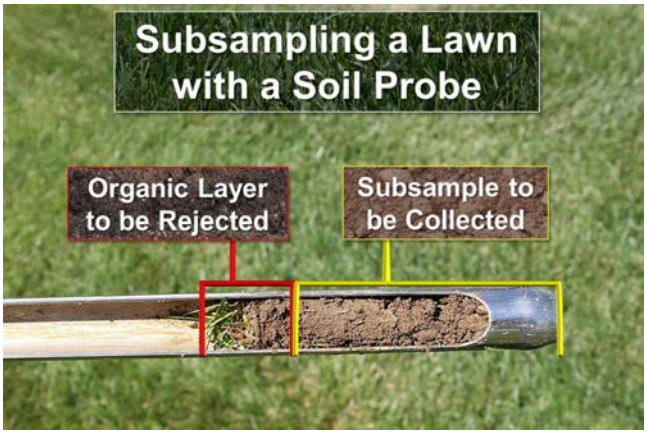

Figure 7: Soil probe for soil sampling. The organic layer will be explained in the section below on sampling tips. Photo by Joe Boggs, OSU Extension.

Figure 8: Hand trowel for soil sampling. The organic layer will be explained in the section below on sampling tips. Photo by Turf Roots.

3. **Plastic Bucket**
   Soil samples should be collected in a clean plastic bucket or box as shown in figure 9. Metal buckets, such as aluminum or zinc plated buckets, should never be used as the metals may leach into the samples and influence the test results.

How Do I Take Soil Samples?

The validity of soil test results and recommendations depend on the quality of the samples taken and sent to a testing lab. Soil fertility varies throughout a lawn, landscape, fruit planting, or vegetable garden. Because of this, the soil sample sent to the lab must be representative of the entire area. Submitting a *composite sample* reduces the influence of soil fertility variations. A composite sample is a number of individual subsamples collected over the entire test area. The subsamples are mixed together and a small amount of soil, about 1 pint in volume, is sent as a representative sample to the testing lab.

Figure 9: Soil samples should be collected in a clean, plastic bucket. Photo by Joe Boggs, Ohio State University Extension.

Figure 10 shows examples of subsample numbers and patterns to create a composite sample. The number of subsamples depends upon the size of the area being tested. In general, 5 to 10 subsamples are sufficient for small areas such as flowerbeds and 10 to 15 samples are recommended for larger areas such as lawns. Subsamples should be taken at random in a zigzag pattern over the entire area and each subsample should be taken to the same depth and soil volume.

Soil Sampling Tips:

1. Separate soil tests should be used for:
   - Areas that have received different applications for soil fertility programs.
   - Soils distinguishable by color (i.e. light vs. dark), drainage, or other factors.
   - Different types of plant cultivation (i.e. turfgrass, vegetable gardens, trees/shrubs, etc.). Figure 10 shows

different zones for soil sampling.

2. Sample when soils are suitable for spading or plowing.

3. Organic matter on top of the soil should not be included in soil test samples. This includes plants (e.g. turfgrass plants), the typical 1 inch or less “organic layer” typically found over Ohio soils, mulch, thatch, etc. Figures 6 and 7 earlier in the fact sheet show the organic layer when taking a soil sample.

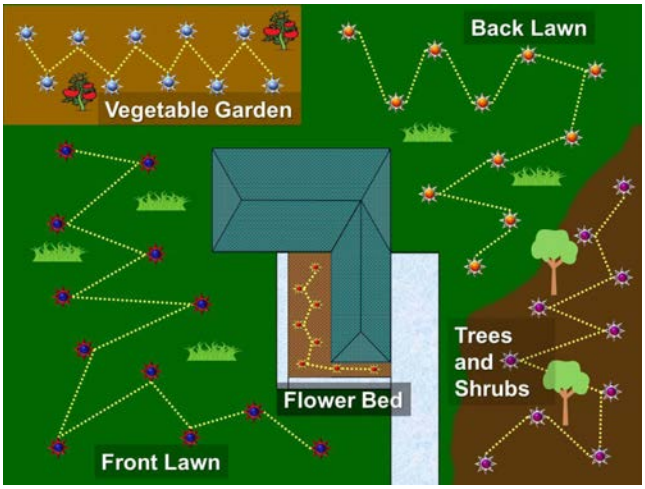

Figure 10: This graphic shows five zones that will be soil tested. The stars in the graphic show where the subsamples should be taken. The subsamples should be taken in a zig-zag pattern, shown by the yellow-dotted lines. Graphic by Joe Boggs, Ohio State University Extension.

Coarse organic matter such as mulch or thatch should be removed before taking a soil sample. The organic layer included in soil probe or hand trowel samples can be removed prior to dropping the sample into a plastic bucket. Soil should be sampled to root depth, which typically means 5 to 8 inches for trees, shrubs, flowerbeds, and vegetable gardens, and 3 to 4 inches for lawns. Of course, root depth may vary based on soil type and other conditions. Sample a vegetable garden between rows to avoid fertilizer bands where applications were made directly to plants.

How to Prepare Soil Samples for Submission

1. Contact a soil-testing lab for instructions, soil test kits, and appropriate forms. A list of accredited testing labs is at the end of this fact sheet.
2. Break up lumps and air dry the soil on parchment paper or butcher paper (do not use newspaper or colored paper) at room temperature with no artificial heat.
3. Dry until the lumps can be crushed to the size of wheat grains or smaller.
4. Mix well and remove roots and other large pieces of organic debris.
5. Take about one pint of the composite sample and place it in the sample bag associated with the kit.

Figures 11–15 below illustrate a typical soil test kit that you will obtain from the lab. Make sure the information on the forms is complete so you receive recommendations for your lawn, landscape, fruit or vegetable needs. *Photos by Joe Boggs, Ohio State University Extension.*

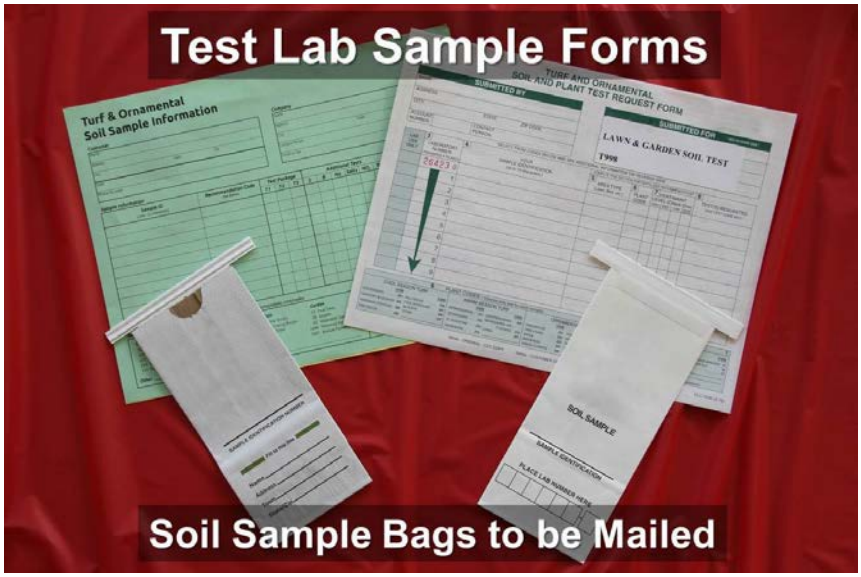

Figure 11: A typical soil test kit you will receive from the soil-testing lab.

Figure 12: Complete all forms required by the testing lab.

Figure 13: Take about one pint of the composite sample to be sent for testing.

Figure 14: The bag is filled and ready to be sent to the testing lab.

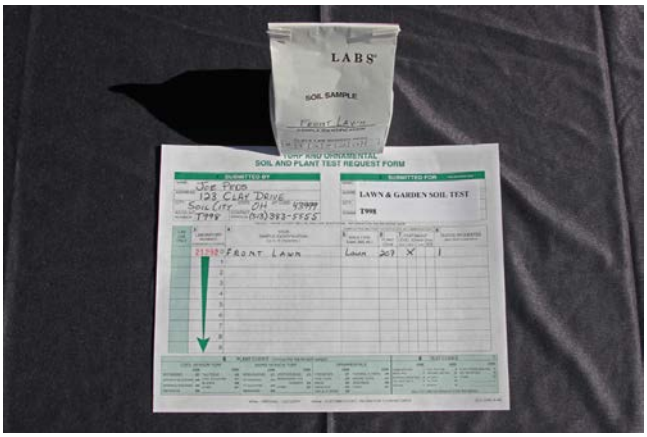

Figure 15: The form is completed and ready to be mailed with the filled bag.

Where Do I Send My Soil Sample?

Table 1 shows a list of soil testing labs in Ohio and neighboring states as well as the types of materials they will test. The labs listed belong to the North American Proficiency Testing (NAPT) program that is operated under the supervision of the Soil Science Society of America (SSSA). For a fee, these labs will provide basic soil testing. Some labs also offer more advanced testing such as an analysis of soilless media, compost, plant tissue, and water as well as tests for soluble salts and the amount of organic matter found in the soil.

Contact the soil-testing lab before collecting the soil samples. Generally, soil-testing labs will provide a complete set of instructions, either with sample kits or upon request. Follow the instructions carefully. You will need to mail soil sample(s), completed sample form(s), and appropriate payment to the soil-testing lab selected.

How Long Does the Soil Test Take?

Soil test results and fertilizer recommendations are usually mailed in two weeks, depending on the testing lab. Make sure you read and follow the directions for filling out the soil testing form(s) accurately and completely; incomplete forms may cause delays in receiving results and recommendations. For example, unless you fill out the form for the types of plants you grow or will be growing, no recommendations will be given.

What Kinds of Soil Tests Are Available?

The kinds of available tests vary with different soil and tissue testing labs. Some of the common soil tests are lawn and garden, horticultural, agronomic, and soilless media test. Refer to Table 1 for a suggested partial list of soil and tissue testing labs and the types of tests available in Ohio and neighboring states. Please note the types of tests that individual labs offer may change without notice. Contact the lab for current tests available.

The inclusion of a lab on this list does not necessarily imply any endorsement by Ohio State University Extension, nor does the exclusion of a lab imply any condemnation. Hence, Ohio State University Extension does not assume any liabilities associated with the selection and use of these labs.

Table 1. A List of Soil and Tissue Testing Labs and the Types of Materials Tested.*

Name, Address, and Phone Number of Soil and Plant Tissue Testing Labs	Types of Materials Tested
Soil and Plant Nutrient Laboratory Michigan State University Department of Plant, Soil and Microbial Sciences Plant and Soil Sciences Building 1066 Bogue Street, Room A81 East Lansing, MI 48824-1325 Phone: (517) 355-0218 http://www.css.msu.edu/SPNL/	Soil, soilless media, plant tissue, compost, nutrient solution, and other special analysis upon request.
Agricultural Analytical Services Laboratory Penn State University 111 Ag Analytical Svcs Lab University Park, PA 16802 Phone: (814) 863-0841 http://www.aasl.psu.edu	Soil, soilless media, plant tissue, manure, compost, sludge, and other special analysis upon request.

University of Kentucky Soil Testing Lab 103 Regulatory Services Bldg. Lexington, KY 40506-0275 Phone: (859) 257-2785 http://soils.rs.uky.edu/index.php	Soil, soilless media, plant tissue, compost, nutrient solution, water, and other special analysis upon request.
Agri Analysis, Inc. 280 Newport Road Leola, PA 17540 Phone: (717) 656-9326 http://www.agrianalysis.com	Soil, plant tissue, feed, manure, compost and water.
Agri-Labs, Inc. 915 Cardinal Ct Auburn, IN 46706 Phone: (517) 369-6052 http://www.agri-labsinc.com	Soil, plant tissue, and manure analysis.
A&L Great Lakes Laboratories 3505 Conestoga Drive Fort Wayne, IN 46808 Phone: (260) 483-4759 http://www.algreatlakes.com	Soil, soilless media, plant tissue, feed, manure, compost, sludge, nutrient solutions, and other special analysis upon request.
Brookside Laboratories INC. 200 White Mountain Drive New Bremen, OH 45869 Phone: (419) 977-2766 http://www.blinc.com	Soil, soilless media, plant tissue, feed, manure, compost, sludge, nutrient solutions, water, and other special analysis upon request.
CLC Labs 325 Venture Drive Westerville, OH 43081 Phone: (614) 888-1663 No Website	Soil, plant tissue, water, and other analysis upon request.
Spectrum Analytic, Inc. 1087 Jamison Rd NW, Washington Court House, OH Phone: (740) 335-1562 Phone: (800) 321-1562 http://www.spectrumanalytic.com	Soil, soilless media, plant tissue, feed, manure, compost, sludge, nutrient solutions, water, and other special analysis upon request.
Logan Labs, LLC 620 North Main Street P.O. Box 326 Lakeview, OH 43331-0326 Phone: (937) 842-6100 http://www.loganlabs.com	Soil, plant tissue, water, and other special analysis upon request.
Star Lab Wooster, OH 44691 Phone: (330) 263-3683	Soil, soilless media, plant tissue, feed, manure, compost, sludge, water, and other special analysis upon request.

The Farm Clinic 2574 South State Rd. 39 Frankfort, IN 46041 Phone: (765) 659-1783	Soil

*Labs listed are part of the North American Proficiency Testing program —http://www.naptprogram.org/about/participants/all. The listing of laboratories in this fact sheet does not imply endorsement nor does exclusion of any lab imply any criticism or disapproval. Contact your local OSU Extension office or the lab of your choice for more information.

References

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- ANSI A300 (Part 6)-2012 for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices (Planting and Transplanting). Tree Care Industry Association, Inc., Londonderry, NH. http://tcia.org/business/ansi-a300-standards/part-6
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