Soil Testing
Kentucky GROW

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The goals of this module are:

To learn how to take soil samples, test soil for basic chemical parameters, and interpret the results of soil samples.

What you need:

- Soil sample (directions for sampling to follow)
- Soil test kit (will usually contain 30 to 40 tests)
- Distilled water (1pint per 10 soil kit tests)
- Timer or watch
- Soil test bags and information sheets from the Cooperative Extension Service
- Funds to pay for laboratory soil test. Typical fees are $4 to $6 per test.
- Teaspoon
- Old cookie sheet or small plastic tarp
- Garden trowel, soil probe, or shovel
- Clean, dry plastic bucket
- Ink pen

Time needed:

A total of 60 minutes at the demonstration site:

1. 10 minutes to take a soil sample
2. Several days to wait for the soil to air dry
3. Time to deliver soil sample to Cooperative Extension office
4. One to two weeks waiting for soil test results to come back from the lab
5. 30 minutes to test the soil using the soil kit
6. 20 minutes to discuss the test results

How to prepare:

It can take as much as two weeks to get a soil test report from the lab during the peak springtime season. Also, a few days will be required to dry the soil sample before sending it off or using the soil test kit. Instructors may want to consider taking a soil sample and drying it beforehand so participants can compare the lab results and their own results with the kit in one session. The procedure for taking soil samples can be demonstrated during the program, so participants will know how to take soil samples themselves.

The program:

How to Take Soil Test Samples

1. If an area is to be planted with different things, take a soil sample from each area. For example, if turf will be grown in the back yard and a vegetable plot in another part of the yard, take and submit a soil sample from each area.

2. Using a trowel or shovel, scrape off the top one to two inches of an area 6 inches by 6 inches. Push the dirt to the side. Dig down no more than 8 inches and remove about a cup of soil and place it in the bucket. Avoid touching the sample with your hands or smoking while collecting the sample. Take at least 9 more samples randomly around the area, and mix all the soil together in the bucket. If testing turf areas, dig down no more than 4 inches. Avoid sampling under the drip line of trees and near driveways or streets.

3. Break up any clods and remove any rocks or other debris. Spread the soil on a cookie sheet or plastic tarp and allow it to air dry. The soil should be dry enough to test within a few days.

Sending Samples to the Soil Lab

1. Fill the soil container provided by the lab with dried soil.

2. Fill out the information sheet titled, "Home Garden, Home Lawn, and Special Turf Soil Sample Information Sheet." Under Section II, TESTS TO BE MADE, check boxes 01, 02, or 03. Routine soil test (box 01) is adequate for most plantings. Check which plants will be grown in Section III. Finish by filling out Section IV. Skip Sections V and VI.

3. Give the soil sample and information sheet to the local Cooperative Extension agent, who will submit the soil sample for you.

Testing the Soil with a Test Kit

Open the soil test kit and follow the included directions, using dried soil. Within half an hour, this kit will give you the pH and the concentrations of nitrogen, phosphorus, and potassium in the soil sample.

Compare the results from the store-bought kit with the results from the lab. Are they the same? Which results are easier to understand? Which do you have more confidence in? Which will you use in the future and during which circumstances?

Understanding the Test Results

Soil pH (listed as pH in water on the lab soil test report) indicates the level of soil acidity or alkalinity. To a chemist, it is the negative log (or "p") of the hydrogen ion concentration of a liquid. Soil pH is actually a measurement of the hydrogen ion concentration of the water in the pores of the soil.

Chemists measure pH using meters and special probes for that purpose, but pH can also be measured using chemicals that change color depending on the pH.

pH is reported as a number from 0 to 14, with 7 being neutral. Values between 0 and 6.9 are considered acid, and values from 7.1 to 14 are basic or alkaline. It is important to remember that pH is not a linear measurement, but a logarithmic scale. A pH of 6 is **10 times more** acid than a pH of 7. A pH of 9 is **100 times less** acid than a pH of 7.

pH is of importance to gardeners because the pH determines the availability of certain essential elements. In acid soils (pH 6.9 and below), calcium, phosphorus, and magnesium become "tied up" and are unavailable to plants. In highly acid soils, manganese can concentrate at toxic levels. In basic soils (pH 7.1 and above), phosphorus, iron, copper, zinc, boron, and manganese become less available. Certain plants are called "acid loving" because they require higher levels of iron and flourish in soils where extra iron is available because of a lower pH. A soil pH between 6.2 and 6.8 is ideal for most flowers and vegetables, due to the adequate availability of almost all essential elements at that pH range.

The buffer pH measures the neutralizing value of the soil and helps the extension agent to calculate the amount of lime needed to adjust the soil pH. Lime is added to increase the pH; sulfur is added to lower the pH.

Nitrogen concentration is fickle and must be measured on site, so the testing lab does not report the concentration of this nutrient. This is not usually done since the concentration may change dramatically between time of measure and time of planting. The extension agent reviewing the lab report notes what will be grown and makes a recommendation based on published guidelines. Nitrogen is essential for leaf and stem production, and appropriate levels of nitrogen give strong, green plants. Too much nitrogen can harm and even kill plants. Excess Nitrogen may also prevent and delay flowering.

Phosphorus levels less than 40 pounds per acre are very low, 70 – 150 medium, and above 200 very high for home garden soils. Phosphorus aids in the production of flowers and seeds, and contributes to overall plant health.

Potassium levels less than 100 pounds per acre are very low, 200 – 300 medium, and above 400 very high for home garden soils. Potassium (also called potash) is important for root growth and food formation. Too much potassium may increase the likelihood of frost injury.

Calcium and Magnesium are necessary for good plant growth and vegetable quality. Magnesium is a key element in the production of chlorophyll. An imbalance in the concentrations of calcium, magnesium, and potassium may prevent their uptake by a plant.

Zinc levels greater than 5 pounds per acre are adequate. This micronutrient is important in the cultivation of corn.

Can You Change A Soil's pH and Fertility?

Often gardeners wish to grow acid-loving plants such as rhododendrons, azaleas, and blueberries in alkaline soil. It is difficult to change the pH of a soil by two or more points, but a slight increase or

decrease can be accomplished by working in the recommended chemical. Gardeners can generally lower the pH faster than raise it but it will also shift back up quicker as well. Even after modifying the pH it can take six or more months for the change to occur. The soil should be retested for pH before planting.

Soil that is planted year after year becomes depleted of nutrients as rain, plants, and wind interact with the soil. It is important to have soil tested annually so that plants can have the optimal levels of nutrients available to produce beautiful leaves, flowers, and fruits. Too-high levels of some nutrients can actually harm plants and pollute water.

Included with the lab test results are recommendations by the Extension agent to amend the soil. They recommend the addition of fertilizers in **pounds per 1000 square feet**. However, bags of fertilizer report the concentration of nutrients in **percentages.** All fertilizers are labeled with three numbers. For example, a bag of fertilizer may be labeled "10-10-10." This means that the fertilizer is 10% nitrogen, 10% phosphorus (P_2O_5), and 10% potassium (K_2O). To make it easier for the homeowner to figure out how much pre-mixed fertilizer to apply, the lab results have a chart at the bottom of the page. For example, an agent might recommend adding 2 to 3 pounds of nitrogen and no phosphorus or potassium. In the chart at the bottom of the page, 6 pounds of 34-0-0 fertilizer per 1000 square feet is needed, or 4 pounds of 46-0-0 per 1000 square feet will work, too. The report lists fertilizers containing phosphorus and potassium, but if the soil analysis showed an abundance in the soil of these two nutrients, it is not necessary to apply a fertilizer that contains them.

Organic fertilizer is material that contains plants nutrients derived from plant or animal substances. Used improperly, it can damage a plant as easily as non-organic fertilizers. Often they contribute more than just nutrients and improve the texture and structure of the soil at the same time.

Other Activities:

- Contact the local extension office for samples of various types of local soils. Rub the soils between the thumb and finger when dry and when wet. Observe how "fine" or how "coarse" each type is. Are the colors different? Press the wet soil between the thumb and forefinger. If the soil sticks together, it probably has a high clay content. Compare the soil at the demonstration site with the soil samples. What type of soil does the demonstration site have?

- For a quick soil texture and structure test, dig a hole in the demonstration plot soil. The hole should be about a foot deep and wide. Pour in water up to the top of the hole, and observe how long it takes for the water to drain. If it drains in 10 minutes or less, the soil is drought prone. If it takes three to four hours, it is poorly drained, due either to a large percentage of clay or an impermeable layer of minerals below the surface that blocks water movement.

Accommodations for this program:

Assure that all paths and surfaces are accessible to everyone and that paths provide as direct a route as possible to this gardening activity. As with all Kentucky GROW programs, providing needed accommodations is an individualized process. Below are some ideas to get you started, but the best route to take is to listen to the person, as he or she will usually have the best ideas of all!

For those with mobility impairments, use of proper tools will ensure success of this activity. If the person uses a wheelchair or walker, ergonomic, long handled tools are needed. A cup with a handle can also be used as a digging tool. By their nature, the tools used to retrieve a soil sample are typically fairly long, but those with limited strength may need assistance in loosening the soil to retrieve a sample. In short, work with the individual to assess his or her needs. For those who may have difficulty bending or kneeling, a bench or chair can provide an adjustable height option and keep the person from having to sit on the ground while providing closer access.

For those who have cognitive impairments, consider working as a team for this module. Use photos or pictures to demonstrate each step. Provide opportunities for choice and enable participants to determine what activities they wish to engage in.

For those with learning disabilities, provide the information in a variety of methods. Some individuals learn best by hearing the instructions, others will prefer to see the step by step procedure in writing with pictures or photos, or have the instructions on tape. Written instructions will also be helpful for those with hearing impairments.

For individuals with visual impairments, review placement of the needed materials. Don't move items without informing the person. Provide any written instructions in large print. Ensure that no tools are left in the path of a person with a visual impairment, as they present unforeseen obstacles. Handles on all tools should be brightly colored.

Where to go from here:

University of Kentucky Cooperative Extension Service Publication AGR-16, "Taking Soil Samples," by W.O. Thom, K.L. Wells, and Lloyd Murdock.

University of Kentucky Cooperative Extension Service Publication AGR-57, "Soil Testing: What it is and What it Does," by W.O. Thom, K.L. Wells, and L.W. Murdock.

University of Kentucky Cooperative Extension Service Publication AGR-19, "Liming Acid Soils," by Monroe Rasnake and Lloyd Murdock.

University of Kentucky Cooperative Extension Service Publication ID-128, "Home Vegetable Gardening in Kentucky," pages 6-9.

"How's Your Soil Texture?," by Wayne Cahilly, *Fine Gardening*, March – April 2000, No. 72, pages 67-69.

University of Kentucky Cooperative Extension Service Publication ID-72, "Principles of Home Landscape Fertilization."

This material is available in alternate formats. Contact Kentucky GROW for more information.