COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

SOIL TESTING:

What It Is and What It Does

W.O. Thom, K.L. Wells, L.W. Murdock, and F. Sikora, Department of Agronomy

What Is Soil Testing?

Soil testing is a special chemical analysis that provides a guideline for lime and fertilizer needs of soils when considered in conjunction with post-fertilizer management and cropping history. A soil testing service is available to every Kentucky citizen through the University of Kentucky Agricultural Experiment Station and Cooperative Extension Service. There is a small service charge to cover the cost of handling and laboratory operation.

Why Soil Test?

Different soil types, different fields, and often areas within the same field vary in the availability of plant nutrients. Also, a field may contain a low level of one nutrient and a high level of another nutrient. Such variations are usually due to differences in:

- previous fertilizer and lime applications
- cropping history
- nutrient contents of the parent materials, and
- losses of surface soil through erosion.

Soil testing is the best way to identify these differences and to adjust liming and fertilization practices.

Soil test results should be included in a record system for each production field on a farm, along with the amounts of lime and fertilizer applied each year, the crops grown, and the yields obtained. In an effective sampling program, each production field should be tested at least every three to four years. Some intensive cropping systems should be sampled every two to three years. Annual sampling is preferable for high cash crops, e.g., alfalfa and double-crop silage production. Only through such a record system can fertility and/or production levels be monitored over time. This is valuable information when making decisions on fertilizer investments and production practices.

How Does It Work?

Soil samples, carefully collected according to instruction (see Kentucky Cooperative Extension Service publication AGR-16, *Taking Soil Test Samples*), are delivered with the necessary information to the local county Extension office. Samples are then sent to the laboratory for testing. After considering soil test levels, past fertilization and liming, cropping history, and the crop to be fertilized or limed, county Extension agents base their lime and fertilizer recommendations on guidelines in Kentucky Cooperative Extension Service publication AGR-1, *Lime and Fertilizer Recommendations.*

For correct lime and fertilizer rates, the soil test must be calibrated with crop yield responses to lime and fertilizer applications. Personnel from the University of Kentucky Department of Agronomy annually conduct field experiments throughout Kentucky to provide a basis for the guidelines published in AGR-1. Recommendations in AGR-1 apply only to test levels obtained in laboratories under supervision of the University of Kentucky College of Agriculture and **should not be used for soil test values from any other laboratories where testing procedures may differ.**

What Tests Are Made?

- **Routine Soil Test**—All samples tested by the University of Kentucky labs are routinely analyzed for pH (water), pH (buffer), and extractable phosphorus, potassium, calcium, magnesium, zinc, and an estimated CEC.
- **Greenhouse Saturation Test**—This special test includes pH (water), pH (buffer), nitrate-nitrogen, soluble salts, and extractable phosphorus, potassium, calcium, and magnesium.
- **Other Special Tests**—See your county Extension agent for details.

Why Is Additional Information Needed?

Along with the soil sample, you need to submit the appropriate "information form" (available at your county Extension office) for either:

- agricultural soils
- home gardens, lawn, and turfgrass
- commercial horticultural crops, or
- greenhouse crops.

Your county Extension agent needs the information on the appropriate form to make recommendations.

What about Nitrogen Tests?

Neither the amount of organic matter nor the amount of nitrate has proven to be a reliable indicator of available nitrogen for field crops grown under Kentucky conditions. For this reason, present nitrogen recommendations for field crops are based on past cropping history, soil management, soil properties, and experimental data.

The University of Kentucky Soil Testing Lab does provide an optional "organic matter" and a "greenhouse saturation" test (the latter includes nitrate-nitrogen). These tests are most useful for greenhouse, landscaping, and specialty crops. However, the nitrate-nitrogen results from this test may be used in unusual situations to help determine if large amounts of nitrogen have been lost during extended wet periods or flooding, or if nitrogen levels are adequate for crop growth from heavily manured fields.

More recently, some states have used soil nitrate concentration when corn is 8 to 12 inches high to adjust N fertilizer rates at sidedressing. Kentucky has limited research data to demonstrate consistent results from this testing. The greatest opportunity for this test may be in fields receiving manure or organic N nutrient sources.

What about Tests for Secondary Nutrients and Micronutrients?

Predicting deficiencies for secondary nutrients and micronutrients from a soil test is much more difficult than for the major nutrients. Most micronutrient tests and recommendations were developed for specific soil types and conditions, and it is difficult to adapt these tests to a wide range of soil types and other conditions.

Calcium and magnesium levels are determined routinely in the Soil Testing Lab. Calcium deficiency in field crops has not been observed in Kentucky. Many field trials have been conducted with applications of magnesium on several Kentucky field crops. These trials have shown only slight yield increases at a few locations where testing has indicated extremely low magnesium levels and have shown no response to additional magnesium at locations with low magnesium soil tests. However, the soil test will indicate when the possibility of a response exists.

The **zinc** test can detect low soil levels but does not always reliably determine when crop yield responses will occur in a specific year. As in the case for many of the micronutrients, weather and soil conditions strongly influence the availability of soil zinc to the plant. Field trials in Kentucky have indicated that low zinc test levels in Central and South Central counties are more likely to indicate zinc deficiency (corn and snapbeans) than in other areas of the state. Low zinc levels combined with high phosphorus and pH levels are usually associated with zinc deficiency. Guidelines for interpreting the zinc soil test for corn are listed in AGR-1.

Deficiencies of **boron, molybdenum, and manganese** in certain crops do exist in some areas of Kentucky. Because of the rather specific crop needs for boron, molybdenum, or manganese, producers should contact their county Extension agent about the need for these micronutrients.

For field crops grown on Kentucky soils, the addition of **iron, copper, or sulfur** has resulted in no measured yield increase. The University will continue to monitor these nutrients in crops and soils but will not offer testing until economic yield or quality increases have been shown.

What Is Cation Exchange Capacity?

Because of the negative charges in their chemical structure, most clay minerals and soil organic matter have the ability to attract or retain positively charged ions (cations) of calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^{+}), aluminum (Al^{+++}), hydrogen (H^{+}), and others. Attraction between the clay minerals and these ions is weak enough that an exchange between ions can occur; those ions most strongly attracted or occurring at higher concentrations in the soil solution may displace other ions from exchange "sites" on the clays.

The capacity of a soil to retain cations under specific conditions is called the "cation exchange capacity" (CEC). This property affects the availability of potassium, calcium, and magnesium to plants. The term used to report CEC is milliequivalents/100 grams (me/100g) of soil.

A recent addition to the Kentucky soil test results reports a "calculated CEC" that uses results from the current extractant in the Kentucky Soil Test Lab (Mehlich III). This extractant is different from most standardized research procedures used to measure CEC. The information on the soil test report is strictly an "estimate" of potentially exchangeable ions based on the amount of potassium, calcium, and magnesium extracted by the Mehlich III extractant, and an "estimate" of hydrogen from the buffer pH reading. Therefore, the CEC reported as part of the soil test results is usually higher and should not be directly compared to results conducted by the research method.

Fortunately, most Kentucky agricultural soils are rather uniform in their CEC due to the vast majority having a silt loam texture. The few high-clay soils occurring in certain areas have much higher CEC's, and the rare sandy loams have much lower CEC's. Because these variations are localized, county Extension agents can use their personal knowledge of the local soils to make any adjustment in fertilizer rates for those occasional soils with unusually low or high CEC's.

Issued 4-1977, Revised 8-2000, Last printed 8-2000, 3000 copies, 40000 copies to date.