MARYLAND COOPERATIVE EXTENSION

VOLUME 1,
ISSUE 2
AUTUMN 1994

NUTRIENT MANAGER

Newsletter of the Maryland Cooperative Extension Agricultural Nutrient Management Program

Focus On

Soil Testing and Nutrient Recommendations

When he sampled his fields last fall, farmer Joe Smith split each sample and sent one-half to lab A and one-half to lab B. Several weeks later, when he looked at the soil-test results and the nutrient recommendations from both labs, he was confused. Not only were the soil-test results different for every test requested, but the nutrient recommendations were also substantially different. Which lab was right? Which set of recommendations should he use?

The answers to these questions are complicated. It is possible that each lab is neither right nor wrong. However, one lab's results may be preferable to Joe Smith for any of several reasons. To determine if recommendations based on soil-test results will be useful or economically advantageous for a particular location, you must understand how different tests and nutrient-recommendation philosophies relate to your region. Consider the following information.

What is a soil test?

A soil test is a laboratory procedure that measures the plant-available portion of soil nutrients. This measurement is used to predict the amount of a nutrient or nutrients that will be available during the growing season. Soil-test results form the basis for nutrient recommendations.

How are soil tests developed?

Plant nutrients exist in a variety of forms in a soil. A soil test uses a chemical extracting solution to measure only the plant-available forms of these nutrients.

After measuring the plant-available nutrient or nutrients, the relationship or correlation between the soil-test values and plant yield must be determined by conducting research on a variety of crops, soils, locations, and weather conditions. Finally, the soil test must be calibrated with the amount of nutrients needed to achieve optimum yield. This requires extensive field research in the state or region in which the soil test is used.

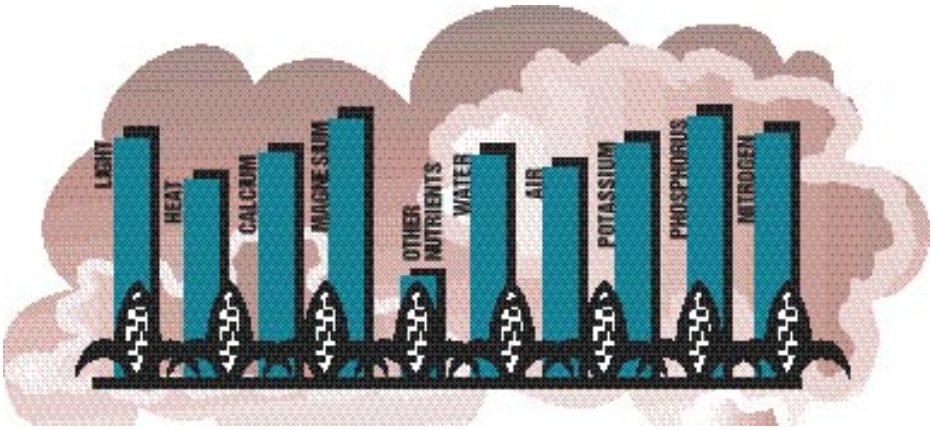
Soil fertility specialists at each state's land-grant university have conducted research to determine the most suitable extraction solutions, to correlate soil tests and crop yields, and to calibrate soil tests with nutrient recommendations.

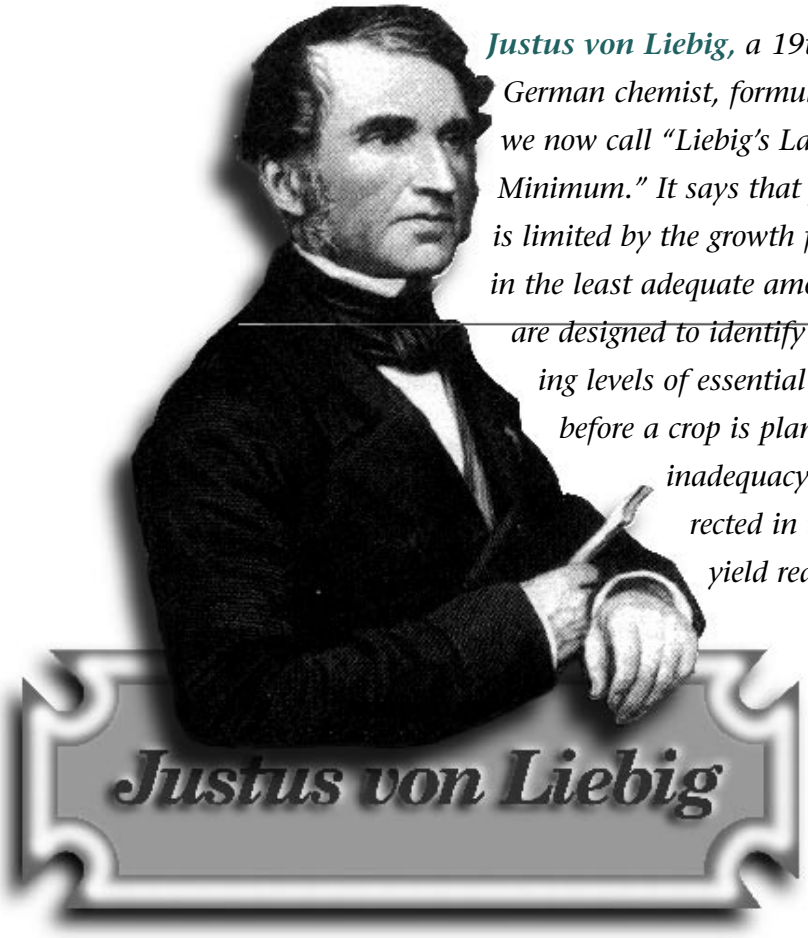
Soil tests are not intended to measure all forms of a nutrient in a soil, but only those forms that are plant-available.

Why do different labs use different chemical extractants?

A variety of chemical extractants are used by soil-test labs to measure the same nutrient or nutrients. Each extractant measures a different portion of the plant-available nutrient pool. Results from a particular extractant must be used with the appropriate interpretive index. Also, labs that use the same extractant may follow different procedures or express the nutrients in different forms (phosphorus or phosphate) or use different units of expression (pounds per acre or parts per million). Results must be converted if units of expression differ from units used in the interpretation system.

A good extractant measures only the plant-available forms of a nutrient or nutrients and relates to crop response in your area.





Justus von Liebig, *a 19th century German chemist, formulated what we now call "Liebig's Law of the Minimum." It says that plant growth is limited by the growth factor present in the least adequate amount. Soil tests are designed to identify growth-limiting levels of essential plant nutrients before a crop is planted so that the inadequacy can be corrected in time to prevent yield reductions.*

What do soil-test values really mean?

Soil-test values are used to determine the relative (not actual) levels of plant-available nutrients in a soil. These values are often expressed in parts per million (ppm) or pounds per acre (lbs/A). Expressing soil-test values as pounds per acre had led to the idea that soil tests measure the actual pounds of plant-available nutrients in a soil: This is not true. A soil-test value should be viewed as a relative index of plant-available nutrients (not as the total nutrient content). Nutrient levels can be grouped, based on field research, into nutrient status classes: low, medium, optimum and excessive. By knowing the nutrient status class, one can approximate the yield response to additions of a nutrient and, based on research, the quantity of a nutrient that should be recommended for optimal yield.

Nutrient recommendations can differ for the same soil

Every soil-test lab has an approach or philosophy that is conveyed in its nutrient recommendations. Different labs may have different philosophies.

The major approaches to nutrient recommendations are the maintenance approach, the cation saturation ratio approach, and the sufficiency approach. Each of these approaches is based on valid principles and is legitimate under specific circumstances. However, there is no research to indicate that any one approach is applicable under all conditions.

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Followers of the **maintenance approach** advocate replenishing soil nutrients removed by crop harvest regardless of soil-test levels. Generally, those who use the maintenance approach add enough nutrients to

attain high soil-test levels and thereafter add maintenance amounts of nutrients. This approach was promulgated in the years after the Dust Bowl in response to widespread exploitation of soil resources in many regions of the country. The major shortcoming of this approach is that it ignores the nutrient reserve capacities of many soils. If this approach is used on soils already containing adequate levels of nutrients, it can decrease profitability.

Adherents of the **cation saturation ratio approach** believe that there is an ideal ratio of exchangeable cations in soils that must be maintained to ensure high productivity. The ideal soil is believed to contain the following exchangeable cations: 65 percent calcium, 10 percent magnesium, 5 percent potassium, and 20 percent hydrogen and aluminum. This information can also be expressed as the following ideal ratios: 6.5/1 for Ca/Mg, 13/1 for Ca/K, 2/1 for Mg/K. Unfortunately, research in a number of states has shown no consistent relationship between crop yields and cation ratios. Furthermore, this approach can lead to unrealistic nutrient recommendations—that increase production costs with no concurrent increase in yields.

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Adherents of the **sufficiency approach** believe there is a critical soil-test level for every nutrient above which there is no yield increase when additional nutrients are applied. If soil-test levels are above the critical values, no nutrients are applied. Research in several states has shown that the sufficiency approach does not rapidly deplete soil nutrients. It is, however, advisable to test soil regularly. Soil test labs associated with most land-grant universities adhere to the sufficiency approach because it is agronomically and economically defendable.

Maintenance Approach
- *Replenish nutrients removed by crops.*
- *Fertilize the soil.*
- *Apply nutrients regardless of soil test.*

Cation Saturation Ratio Approach
- *Maintain ideal nutrient ratios.*

Sufficiency Approach
- *Fertilize the plant.*
- *Apply nutrients only when soil test is below critical level.*

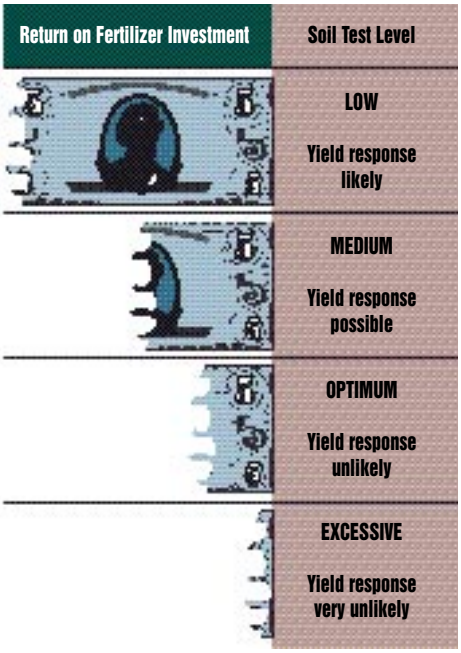
Regional differences

Approximately 10 years ago, the staff at a farming magazine split soil samples from fields in Pennsylvania and sent subsamples to labs across the country. They then published a series of articles on how variable the soil-test results and nutrient recommendations were, implying that the soil tests were unreliable. Though well intended, the expose was seriously flawed. A laboratory in Colorado or Iowa should not be expected to use extractants or make nutrient recommendations appropriate for the Middle Atlantic Region.

Laboratories in different parts of the country use different extractants for the same nutrient because the plant-available forms of a nutrient can vary from one soil region to another. Even if labs use the same extractant for a nutrient, follow the same procedure, and share the same philosophy, labs in different regions may give different recommendations. Many aspects of crop production, including the productive potential of the soils, the climate, the crop varieties, and the crop management practices, can differ from state to state and region to region.

Correlations between soil tests and crop-yield responses are only valid for circumstances similar to those under which the correlation was developed. Use of correlation data from regions with different circumstances may lead to erroneous interpretation. Likewise, nutrient recommendations from research based in one region may not be valid in another region.

Is More Fertilizer Worth the Investment?



Be an Informed Consumer!

Consumers of soil-testing and nutrient recommendation services need to ask laboratories the following questions:

- Are the chemical extractants the lab uses appropriate for the plant-available nutrients in soils like mine?
- Are the chemical extractants correlated with crop responses on soils in my region?
- Are the nutrient recommendations based on field research in my region?
- What is the lab's approach to or philosophy of nutrient recommendation?

Reasons for Selecting a Soil Testing Lab

Good Reasons

- Test results are reliable and accurate.
- The chemical extractants the lab uses measure the available nutrients in soils in the area where the producer farms.
- The soil-test results are calibrated with yield responses on soils in the area where the producer farms.
- The lab's nutrient recommendation philosophy is acceptable to the producer.

Bad Reason

- It is free (or cheap).

For nutrient management planning services, call your Cooperative Extension educator at the county Extension office.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Maryland, College Park, and local governments. Bruce L. Gardner, Interim Director of Maryland Cooperative Extension, University of Maryland.

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Nutrient Manager is published by Maryland Cooperative Extension, University of Maryland, College Park and University of Maryland, Eastern Shore. This issue was co-written by former Communications Coordinator Jean Leslie and is in its fifth printing. The masthead sailing photo is courtesy of Skip Brown.

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If you do not receive this newsletter by mail and would like to, contact your county Extension office or the address above. The Maryland Cooperative Extension Agricultural Nutrient Management Program is funded by the Maryland Department of Agriculture.

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March 2004

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