Colorado State University
Extension

Soil Testing

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Many people do not have a clear understanding of soil testing. The confusion revolves around the fact that the nutrient content of soil seldom is important in testing for fertilizer recommendations because of the many chemical forms of nutrients in soil.

Plants can use only certain forms of nutrients, which account for a very small portion of the total amount of that nutrient in the soil. Therefore, test results are often are called "availability indexes." Such indexes relate specific laboratory test values to availability as the growing crop experiences it in the field.

As new crop varieties are developed, or as other management factors are introduced which increase crop yields, and as the plant nutrient requirements change, the soil tests must be re-evaluated. Therefore, research on soil testing is a continuing program.

Many approaches may be used in developing a soil test. However, the two basic steps described below will give the reader an understanding of what it's all about.

Selecting a Reliable Test (Correlation)

Many types of chemical solutions may be used to extract nutrients from soil in the laboratory. The key is to find one that will extract an amount of a nutrient proportional to what a plant extracts. To determine this, experiments are carried out in the greenhouse where plants are grown in pots on soils typical of those to be submitted for fertilizer recommendations.

Following the desired growth period, the plants are harvested and analyzed. The amount of nutrient extracted by the plants is then compared with that extracted by the chemical solutions. The chemical solution that compares (correlates) best with plant uptake is selected.

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Developing Fertilizer Recommendations (Calibration)

Soil and climate can greatly influence the reliability of fertilizer recommendations based on a soil test. For example, a recommendation that is satisfactory in semi-arid Colorado (or the western United States), where alkaline, calcareous soils are common, may not be satisfactory for other parts of the country where soil and climate are very different. Therefore, once a test has been selected, it must be related (calibrated) to field conditions for individual crops.

This involves growing crops on fields treated with the nutrient being evaluated. Nutrient rates range from zero to more than adequate for maximum yields. By conducting a series of experiments, usually over several years, on a wide range of soils, it is possible to relate the laboratory soil test value to actual field yields and rates of fertilizer necessary to achieve maximum yields. Because crops have different growth habits and nutrient requirements, the same procedure must be followed for each important crop in an area.

Such work requires considerable time and effort. However, it is essential if a laboratory is to provide sound fertilizer recommendations. Once the relationship between soil test values, fertilizer rates and yield of a given crop is determined, it is possible to determine the most economical rate of fertilizer application for a given crop. This is based on estimates of the cost of fertilizers and prices of farm crops.

Laboratory Differences

It is not uncommon for a grower or fertilizer dealer to compare soil testing laboratories by splitting a sample and sending subsamples to each. Because individual laboratories do not necessarily use the same soil test procedures, their availability indexes (the reported available nutrients)

Quick Facts

- A reliable soil test correlates soil nutrients to plant use, and fertilizer recommendations calibrate tests to field conditions for individual crops.
- Once the relationship between soil test values, fertilizer rates and crop yield is known, it is possible to determine the most economical fertilizer rate.
- Soil testing requires not only reliable methods but also reliable field calibration data over a period of years.
- N fertilizer needs can be predicted more accurately with preplant and postplant soil sampling for nitrate tests.

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can, and frequently do, differ. However, if both laboratories have reliable tests, sound interpretation and the same philosophy about fertilizer recommendations, the recommended nutrients should closely agree.

Fertilizer recommendations may be based on one of several philosophies. One philosophy about nitrogen involves adding an amount of nitrogen fertilizer required for the average yield of the crop to be grown on a given field. If the growing conditions lead to above-average yields, then the crop will be underfertilized. The second philosophy involves adding nitrogen for maximum yields obtainable on a field, so that in no case will the crop be underfertilized. In this case, there is a greater possibility of overfertilization and groundwater contamination with nitrates.

Recommendations for phosphorus may be made for one or for several years. For example, for alfalfa we recommend fertilizers for a three-year period. Another laboratory may recommend that phosphorus be applied yearly. Such differences may result in different fertilizer recommendations.

In summary, soil testing for the purpose of fertilizer recommendations requires not only reliable soil test methods but also reliable field calibration data over a period of years. This is an evolving process. As science and technology in soil sampling, soil fertility, weather forecasting and economic projections advance, fertilizer recommendations will become more tailor-made to the requirements of each field on a given farm and each farm in a given county.

Recent Developments

Several companies sell quick soil test kits for nitrates and leaf chlorophyll meters. Farmers can use these tools to improve the prediction of crop nitrogen needs. Farmers must split-apply nitrogen fertilizers to crops. They must test the soil in the growing season and measure the leaf chlorophyll index to determine if crops need additional nitrogen fertilizers and their proper rates.

These developments will result in saving nitrogen fertilizers and will reduce further deterioration of groundwater quality by nitrates.