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Soil testing for fertilizer recommendations—

what's behind a reliable test

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Quick Facts

Many different approaches may be used in developing a soil test.

Selecting a reliable test (or correlating soil nutrients to plant use) and developing fertilizer recommendations (or calibrating tests to field conditions for individual crops) are the steps in determining a reliable soil test.

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.

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.

Many people do not have a clear understanding of soil testing. The confusion revolves around the fact that total nutrient content of soil seldom is important in testing for fertilizer recommendations because of the diverse chemical forms of nutrients in soil. Plants are able to utilize only certain forms which amount to a very small portion of the total. Therefore, tests frequently are called "availability indexes." Such indexes are developed to 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 must be a continuing program.

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

Selecting a Reliable Test (Correlation)

There are many types of chemical solutions that may be used to extract nutrients from a soil in the laboratory. The key is to find one that will extract an amount of a nutrient that is 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.

Developing Fertilizer Recommendations (Calibration)

Soil and climate characteristics can exert a great influence on 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 characteristics 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 in experiments on farm fields treated with the nutrient being evaluated at rates from zero to more than adequate for maximum yields. By conducting a series of these experiments (usually over a period of 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. Since the various crops have different growth habits and nutrient requirements, the same procedure must be followed for each of the important crops in an area.

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Obviously, 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, of course, 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 half to each. Since individual laboratories are not necessarily using the same soil test procedures their "availability indexes" can and frequently differ (the reported available nutrients). However, if both laboratories have 1) reliable tests, 2) sound interpretation and 3) the same philosophy about fertilizer recommendations, the recommended nutrients should closely agree.

Fertilizer recommendations may be based on one of several philosophies. One regarding 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 fertilizers for maximum yields obtainable on a field, so that in no case is the crop underfertilized. In this case, the probability of overfertilization is large. 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 on a yearly basis. Therefore, differences in philosophy of fertilizer recommendations 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. Soil testing for the purpose of fertilizer recommendations is an evolving process. As science and technology in fields of 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.