Interpreting the West Virginia Soil Test Report

The West Virginia University Soil Test Report is an important tool in making fertilizer and lime application decisions for field crops and forage production. This guide will help you understand the soil test report and make the results more useful in your farming operation.

The three components to soil testing are: a) soil sampling, b) laboratory analysis, and c) interpretation of results and recommendations for soil fertility management. Improper soil sampling and limited information about field history and intended use of the soil test may severely limit the usefulness of a soil test report.

The most important step in using a soil test is to make sure that the soil sample that you collect truly represents the field. Instructions for collecting a representative soil sample are given on the back of the questionnaire that is a part of the WVU soil test kit. These instructions on soil sampling are provided in a fact sheet titled "How to Take a Good Soil Sample." This fact sheet answers questions about time, method, depth, and frequency of soil sampling. It is important to follow the instructions for obtaining a representative soil sample.

The first part of the soil test report contains information that identifies the soil sample with the field or sample location. This information includes the field name or number, field size, soil texture, tillage method, liming history, and previous crop in the field. This information is taken from the soil test questionnaire that the farmer fills out and submits with the soil sample. Also included in the questionnaire is the crop for which fertilizer recommendations are needed. It is important to have the information about previous liming and cropping history of the field for making correct interpretation of soil test values.

The second part of the soil test report contains information on soil test results. The regular soil test includes information on soil pH, phosphorus, potassium, calcium, magnesium, cation exchange capacity, base saturation, and lime requirement. In addition to the above listed elements, the micro-nutrients zinc, copper, and manganese are also analyzed when a request is made for that analysis. The soil test report contains information on amounts of phosphorus, potassium, calcium, and magnesium that is extracted by a mixture of sulfuric and hydrochloric acid. The values for these nutrients are given in pounds per acre. Although these nutrients are often referred to as available nutrients, the numbers for nutrients in the soil test report are index numbers or scale for determining nutrient status of a soil.

In addition to the numerical values for the nutrients (P, K, Ca, and Mg), soil test values are classified into "low," "medium," "high," and very "high" categories. The meaning of each of the interpretation levels follows.

LOW- A nutrient or pH level listed as "low" has a "high" probability of limiting plant growth and yield. A recommendation will be made to substantially increase the soil level of that component. If the level is very "low," several years of corrective fertilizing or liming may be necessary to achieve an optimum nutrient level in the soil. Close monitoring by yearly soil testing is suggested in this case. For row crops, banding of fertilizer near the row becomes critical at this test level to ensure efficient use and maximum nutrient availability within the rooting zone of the crop.
MEDIUM- A nutrient or pH level listed as "medium" may be adequate for some "low"-demand crops in some cases. This is taken into account in the recommendation for those specific crops. A "medium" level may limit plant growth or yield by the end of the growing season in years of very good growing conditions. There can be many soil types in which a nutrient testing "medium" may not be adequate for meeting crop nutrient requirements. Corrective fertilizing or liming is usually recommended in moderate amounts to cause a slight increase in soil level after the crop has been harvested or to support exceptional yields in a very good year.

HIGH- A nutrient or pH listed as "high" is in the theoretical ideal range to support plant growth and maximum yield. Corrective fertilizing is not recommended. Any amendments or fertilizers applied for a soil test component listed as "high" are to compensate for crop removal so that the optimum levels may be maintained from year to year. A small amount of starter fertilizer containing the nutrient may also be recommended for giving the crop a good start.

VERY HIGH- A level listed as "very high" for a plant nutrient may indicate levels higher than those needed to support optimum crop growth and production. Growth and yield may be inhibited by the soil nutrient that is testing in the "very high" range, either because of direct toxic effects to the plant or because excess of one nutrient may interfere with the uptake or availability of other nutrients. Crops grown on soils testing "very high" in phosphorus are known to show zinc deficiency symptoms. Additional application of a nutrient testing in the excessive level will only increase the likelihood of reduced yield. There will be no recommendation for further additions of a nutrient to soils testing "very high". One exception is the optional application of a very small amount of starter phosphorus on corn to compensate for cold soils in the spring. Crop removal and other natural losses over time should eventually reduce the nutrient levels to a "high" range. However, there have been some reports that suggest that once a soil tests "very high" in phosphorus it may be many years before it will again respond to phosphorus application.

The soil test report also contains a section marked "for office use only". The information in this section is used for interpreting soil test results. This section contains information on relative amounts of nutrients in the soil. This information is useful specifically for making recommendations for magnesium application. If a soil has a very "low" magnesium saturation (magnesium saturation less than 10%), recommendations are made for using dolomitic limestone. This section also has information on cation exchange capacity (CEC) of soils and percentage base saturation (BS) of a soil.

The numerical values for a given nutrient depend upon the method used to extract and determine soil nutrients. Thus, laboratories using different extraction methods can have very different numerical values for the nutrient content of a soil. These values are used as a check on the accuracy of the procedures in the laboratory. An explanation of each of the measurements in a soil test result follows.

SOIL - pH is an indicator of the acidity or alkalinity of a soil sample. A pH below 7.0 is acidic and pH above 7.0 is alkaline. In the WVU Soil Testing Laboratory, soil pH is measured in a soil water paste made with distilled water. "Low" soil pH is an indicator of acidity, but does not by itself predict lime requirement. Also, pH is a master variable that controls the availability of most plant nutrients. Different crops require different soil pH levels for best growth and optimum production in terms of yield and economic costs. For most crops, optimum pH levels are between 6.0 and 7.0. Many row crops, small grains, and grass legume mixtures should be maintained in soils with pH between 6.1 and 6.6. Alfalfa requires a slightly higher soil pH of 6.6 to 7.0. Many pure grass stands do well with a pH of 5.5 to 6.0. Crop production may be severely reduced in soils with a pH at or below 5.0. As soil pH falls below 5.0, aluminum and manganese may increase to toxic levels. Also, phosphorus and molybdenum availability decreases as soil becomes more acid.

Pounds per acre extractable phosphorus (P) is an index for determining phosphorus availability. In West Virginia, the soil test for phosphorus is called the Mehlich-1 test. The test results are expressed in pounds of elemental P per acre. This test is a measure of relative availability of phosphorus for plant growth. The test does not measure the total amount of phosphorus that may be available to a crop. Soils testing "low" or "medium" for P will produce
economic yield increase with phosphorus fertilizer applications. However, if soil pH is "low", excessively "high" rates of phosphorus fertilizer will be required for obtaining yield increases. Thus, soil pH should be corrected with application of limestone before embarking on a phosphorus fertilization program. The "high" level for P for most crops is 50 to 80 pounds per acre. Soils testing "high" in P are not likely to produce economic yield increases with an application of additional phosphorus. When soils test in the "high" range, applying only a small quantity of phosphorus is suggested to maintain "high" fertility status. There is no economic benefit to applying phosphorus to soils testing "very high" in P, and WVU does not recommend it.

Pounds per acre extractable potassium (K), Calcium (Ca), and Magnesium (Mg) is an index for determining the availability of these three nutrients over the next growing season. The ratings of potassium soil test levels are similar to those made for phosphorus. Very "low" to "low" soil K levels strongly indicate that crop will respond to K. Band application of a portion of the total requirement may also be advantageous. "Medium" soil test K levels indicate that a crop may respond to potassium application if climatic conditions are favorable. Soils with "high" soil test K levels are not likely to respond to fertilizer application, but fertilizer may be applied to replace crop removals. Fertilizer application to soils testing "high" in K will maintain "high" fertility levels of the soil. Very "high" soil test K shows that you can allow crops to deplete K until soil test drops into the "high" range. "Low" calcium and magnesium are often associated with soils testing "low" in pH. Liming is recommended to supply these two nutrients. Magnesium is recommended if the present soil test levels is below 10% saturation of the cation exchange capacity of a soil. The most common and most economic source of magnesium is dolomitic limestone. Quite often when lime is not needed, no magnesium recommendation is made. Cases of acute magnesium deficiency in crops are quite rare, and the cost of other sources of this nutrient is often prohibitive. In most cases, it is acceptable to wait until lime is needed again and then apply a magnesium lime (dolomitic). Where forage is grown on "low"-magnesium soils, the cattle must be fed a magnesium-containing mineral mixture.

Lime requirement (LR) is determined by a buffer pH value. Limestone recommendations are made to correct the problem of soil acidity. The lime requirement determines the amount of ground limestone that should be added to a soil to raise its pH to 6.5. WVU liming recommendation are based on soil test and crops to be grown.

The third part of the soil test report is "recommendations to landowner for agricultural limestone and fertilizers." These recommendations are based on soil test values, previous cropping history of the field, yield goals, and estimated nutrient removal by crops. Recommendations are made for agricultural limestone, nitrogen, phosphorus, and potassium. Agricultural limestone recommendations are in tons/acre of calcitic limestone required for pH correction. Recommendations for nitrogen fertilizer are not based on soil testing. These recommendations are based on expected crop removals and fertilizer use efficiency. You should pay attention to the yield goals for which nitrogen recommendations are made. If expected yield in your field is different than those given in soil test report, you need to correct the recommended fertilizer rates for your situation. Credit should also be given for any manure added to the soil and contribution of a previous legume crop such as alfalfa or soybeans.

Phosphorus and potassium recommendations are based on soil testing. Recommendations for these nutrients are given in lbs/acre of P₂O₅ and K₂O. It is important to understand recommendations made are not in terms of pounds of fertilizer that should be added to a given field. You will have to calculate the amounts of fertilizer based on the nutrient analysis of the fertilizer that you are using.

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