WHAT TO EXPECT FROM SOIL TESTS[1]

by T.R. Peck

Soil tests are different things to different people. To the architect it may connote the stability of soil for a structure; to the sanitary engineer it may connote the permeability of soil for waste disposal; to the agronomist it connotes the suitability of soil to grow field crops and to the horticulturist it connotes the suitability of soil to grow those aesthetic plants we all enjoy.

The first point I would like to make is that soil tests are designed for a purpose. Whether that purpose be road building or growing plants, and the usefulness of a soil test is directly related to the amount of research going into development of the test (i.e., useful interpretation of test results are dependent on a data base computed from similar case histories). Agronomists share with horticulturists the perspective of characterizing the growth medium for plants. We differ however in the nature of our plants, (i.e., extent of rooting and type of root system), rates of growth and length of growth. The state of affairs in soil testing today is in the hands of agronomists so their perspectives influence most programs. My perspective is that of an agronomist, but after 25 years work in soil testing and working with horticulturists off and on, I want to give my views on the application of soil tests for an arborist's problems.

Soil testing today is the outcome of having passed through about three stages of evolution. Pre 1900 soil testing generally involved total analysis of soil, which is useful in separating broad categories. But the high testing group supported such a range in plant growth, from good to poor, that the 1900 to 1930 era saw the development of soil tests designed to simulate plant root conditions. However the futility of attempting to telescope the growing season and duplicating the root environ was only a slight improvement over total analyses and gave way to the present day concept of identifying the chemical form of nutrients contributing most directly to the plant root, designing a soil test to measure all or a portion and to relate the soil test result to plant performance.

Soil testing is not a science in itself but it is a program for the application of research results where studies have been conducted to 1) *find out what influences plant growth,* 2) *is it measureable?* and 3) *what the desirable levels are.*

The data base for annual field crops is fairly extensive but often times inadequate to advise a grower with soils different from the majority of the state, hence the limitation of soil testing for arborists and horticulturists must be recognized, the research base for their plants and soil conditions is extremely small. Soil testing services are usually field crop oriented with test interpretations reflecting experience with fast growing, annual crops with a small root distribution as compared to trees.

Soil testing may fit into an arborist's program in two ways: 1) *planning,* i.e., site selection and/or species selection, and 2) *troubleshooting,* after the fact follow up to ascertain cause(s) of poor growth. In spite of the lengthy preceding comments concerning the limitations of soil tests, there are two tests that unequivocally will be useful. These are 1) *soil acidity* or pH test and 2) *soluble salt* test.

Depending on the length of time available to the arborist, soil samples may be sent to a soil testing laboratory or he may opt to use some type of do-it-yourself soil test kit. Often times we get the question, "how good are 'no-chemistry-needed' soil test kits?" No question about it the laboratory test results are more reliable, but this does not mean no one should consider a soil test kit. Frequently in urban situations an arborist may be dealing with a site having disturbed soil with great variability that collecting a representative sample would be difficult. Making soil tests at the site will be of use in assessing the variability, getting a cur-

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sory idea of the test level and securing a proper sample for laboratory testing if that is necessary. Here are some considerations about kit soil tests:

1. **Electronic soil acidity or pH measuring devices** belong in a laboratory setting. This equipment works best with frequent use (daily or at least 2-3 times per week). Checking the performance of the meters each time with soils of known pH is essential to know of proper performance on unknown soils. All electronic pH testing equipment is subject to temperature variations, hence the need for a laboratory or indoor setting. Inaccuracy, instability and erratic functioning of electronic pH meters contribute to their being a poor choice for in-the-field use. Generally they are not cost effective in terms of set up time, operation and reliability.

2. **Colorimetric chemical pH indicators** solutions or papers can be reliable to within one half pH unit or less. These are available in kits with interpretive color charts. Costs are less than electronic gadgets and can be used in the field with a minimum of time and training. With reasonable care the chemicals have a long shelf life. I recommend these for in-the-field use.

3. **Testing soil for soluble salts** involves the use of electronic equipment. The test is useful to diagnose situations of street drainage, contamination with winter de-icing materials and excess fertilizer usage. Unfortunately the soluble salt test is not readily adaptable to in-the-field because after positive identification of a salt problem it is useful to test additional samples to characterize the depth and extent of the problem. The soluble salt test is a relatively simple laboratory measurement that involves extracting the soil with water, separating the water from the soil and with a laboratory instrument passing an electric current through the soil extract. For *horticultural* purposes the problem salts are usually very soluble and a test may be the 1:5 (one part soil to five volumes of water). The following guides are useful: 0-1000 ppm salt on a soil basis are considered LOW and normal; 1000 to 2000 ppm are MEDIUM: 2000-4000 ppm are HIGH; and above 4000 ppm are EXCESSIVE. (In this test conductivity readings on the soil extract of 0.27 mmhos per cm indicate 1000 ppm salt on a soil basis; 0.53 mmhos = 2000 ppm and 1.05 mmhos = 4000 ppm). For *field* soil testing the problem salts are usually of very low solubility and a more appropriate soil test is the 1:1 (one part soil to an equal volume of water). The following guides are useful: 0-2 mmhos per cm are a NONSALINE (low and normal condition) soil; 2-4 mmhos are a VERY SLIGHTLY SALINE soil (sensitive plants may be restricted); 4-8 mmhos are a MODERATELY SALINE soil (many plants will be restricted); 8-16 mmhos are a STRONGLY SALINE soil (only tolerant plants will grow); and above 16 mmhos are a VERY STRONGLY SALINE soil (very few plants will grow).

The foregoing tests for soil acidity and soluble salts are items the arborist should have access to. If the testing is done through a commercial testing service, quite likely the report will show results for additional tests. For field crop usage, here is my assessment of the reliability and usefulness of different soil tests:

Soil Test	**Usefulness Rating**
pH	100 (most useful)
Phosphorus	85
Potassium	85
Organic Matter	75
Sulfur	40
Boron (alfalfa)	60
Boron (corn)	10
Calcium	40
Magnesium	40
Zinc	40
Manganese (above soil pH 7.5)	40
Manganese (below soil pH 7.5)	15
Iron (above soil pH 7.5)	30
Iron (below soil pH 7.5)	15
Copper (organic soil)	20
Copper (Mineral soil)	5
Molybdenum	0
Nitrogen (estimated from organic matter)	40
Nitrogen (total nitrogen)	45
Nitrogen (nitrate level)	50
Buffer pH	30
Salt pH	30
C.E.C.	60

The soluble salt test is not rated in the preceding list because the occurrence of salt problem in Illinois field soils are restricted to local conditions.

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