Interpreting a K-State Soil Test for Tree and Shrub Beds

A soil test is an inexpensive yet valuable tool to help manage soil nutrients. It eliminates the need to guess which nutrients, if any, need to be added to the soil. Currently, there are few recommendations for interpreting soil tests for woody plants. The following guidelines are a compilation of the available information and an interpretation as to how they relate to Kansas and woody plants. Your ability to interpret these guidelines and make recommendations based on a soil test shows your clients they are dealing with a professional. This document is intended to accompany *Fertilizing Trees in the Landscape* (MF-2707).

The standard K-State soil test includes pH, Phosphorus (P) and Potassium (K) analysis. Under normal circumstances these three tests provide an adequate picture of your soil nutritional status. In unusual circumstances testing for other nutrients may provide additional useful information. In situations where nutritional deficiencies are evident or extensive soil disturbance has occurred, additional tests may be recommended.

Soil pH

Knowledge of the soil pH is just one tool the landscape manager can use to maintain healthy growing conditions. A soil pH test should be included in any and every soil test. It provides information on the acidity or basicity of your soil. Most soil nutrients are available in a pH range from 5.5 to 6.5, but in Kansas, a range between 6.0 and 7.0 should be manageable. Soil pH below or above that range can influence the availability of many mineral nutrients, and would indicate that the landscape manager may need to watch for nutrient deficiencies. There are several guides and recommendations for amending soils to adjust pH (dolomitic lime to raise pH and sulfur to lower pH) that will not be discussed here (see *A Guide to Turfgrass Nutrient Recommendations Based on K-State Soil Test Results*, MF-2311).

Nitrogen (N) analysis

Nitrogen is rarely tested in soil analysis. It is very dynamic in the soil and its concentration changes quickly. Therefore it is difficult to obtain an accurate concentration given the lag-time from sample collection to receiving your report. In a typical landscape situation, N is the nutrient most limiting growth and therefore is typically included in any fertilization program (see *A Guide to Fertilizing Trees in the Landscape*, MF-2707). Nitrogen analysis is not recommended for the typical soil test.

Phosphorus (P) analysis

Phosphorus moves in the soil profile very slowly. So much so, that it is generally considered immobile. Therefore, plant roots must grow and contact phosphorus in order to absorb this nutrient. For these reasons, it is highly recommended that in new plantings phosphorus should be incorporated into the root zone, but only when a soil test indicates application would improve plant growth. This method ensures phosphorus is present where the plant roots are actively growing. Phosphorus applied to the soil surface after planting moves so slowly that it is not available to the plant for years in some instances. However, surface application is adequate for general maintenance practices, and often the only option in established plantings.

Not all soil tests are the same. The method used to determine the concentration of phosphorus in your soil sample may vary from one lab to another, and should be based on the characteristics of your soil. Therefore, it is important that you know what test was used before determining if your soil has adequate levels of phosphorus. The three common tests are Mehlich 3, Bray 1-P, and Olsen.

In most situations, Mehlic 3 is sufficient and is the default test performed at the K-State Soil Testing Lab. For comparison, Bray and Olsen minimum concentration are listed in the table on page 2. Phosphorus will rarely be deficient in Kansas soils. Mehlich 3 soil phosphorus should be greater than 30 ppm. Below 30 parts per million (ppm) a high P fertilizer should be used. If your soil test determines a deficiency of P, add 2.0 lbs of P per 1,000 ft^2 of root zone. Incorporate only if tilling the soil will not damage the roots of established plants. Otherwise, a surface application will have to suffice. The time of year is not important.

Potassium (K) analysis

Potassium does not move readily in soils either. However, it is more mobile than P, and in sandy soils can move by 'bulk flow' in the soil solution. Potassium application should be based on the results of a soil test to ensure adequate amounts are present. Deficiencies are rare in Kansas soils. A minimum soil concentration of 75 ppm K is adequate. If your soil test determines a deficiency of K, add 1.0 lbs of K per 1,000 ft^2 of root zone in late winter to early spring. Over applying K can cause fertilizer burn.

Calcium (Ca) analysis

Calcium moves very slowly in most soils and therefore is not subject to leaching problems. Rarely will calcium be deficient in Kansas soils. Generally, in a sandy soil 300 ppm Ca is sufficient. In clay soils, 1000 ppm Ca is sufficient. Excessive

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amounts of Ca can induce a Mg deficiency that will appear as interveinal chlorosis on older leaves. A Ca deficiency can be corrected with dolomitic limestone. However, soil pH can be altered. Calcium nitrate and gypsum are two options that add Ca to the soil without affecting pH.

Magnesium (Mg) analysis

In the soil, Mg behaves similarly to Ca, and therefore moves very slowly. As a result losses of Mg due to leaching is not likely. In addition to behaving similarly, Mg and Ca can compete with each other in the soil profile. In other words, too much Ca can cause a deficiency of Mg, and excessive amounts of Mg can cause Ca deficiencies. It is, therefore, important to maintain the correct levels of each. This does not mean equal concentrations of each in the soil, but the appropriate level of each. As it works out, there should be a greater concentration of Ca than Mg. Three to four times as much Ca as Mg would work well, although up to 10 times more Ca than Mg should not cause any harm. Minimum Mg concentration of 60 ppm on sandy soils and 250 ppm on clay soils is sufficient. If a deficiency is detected, dolomitic limestone can be added to the soil. However, soil pH will have to be watched carefully. Magnesium sulfate will add Mg to the soil without affecting pH.

Iron (Fe) analysis

Iron is rarely lacking in the soil yet frequently can be deficient in plants, or unavailable to plants. Iron deficiencies can readily be found in alkaline and calcareous soils. In most instances, a high soil pH translates into Fe deficiencies in the plant. Soil Fe concentration should be greater than 10 ppm. If deficiency symptoms still occur, check the soil pH. Corrective measures can be made with trunk injections or foliar sprays, however, they are only temporary. A sustained effort to adjust soil pH is often a better course of action.

Sodium (Na) analysis

Sodium will rarely be deficient and therefore rarely need application. Sodium concentration should be less than 92 ppm, above that value and on sandy soils, Na could occupy a large portion of CEC sites and interfere with Ca, Mg, and K uptake.

Copper (Cu) analysis

Copper is needed in very small quantities by plants. Copper deficiencies are rare but can occur in soils that are highly organic, highly alkaline, or highly calcareous. Soil pH greater than 7.0 can also negatively affect copper availability as can high soil concentrations of N, P, Zn, Mn and Mo. In most soils, the copper concentration should be greater than 2 ppm. However, if concentrations should approach 20 ppm, toxicity could be a concern.

Manganese (Mn) analysis

Manganese also is rarely deficient in the soil profile. At low pH (less than 5.5) Mn is most available and can become toxic in some soils. Fe and Mn have a relationship similar to that of Ca and Mg. They compete for uptake by the plant, and an excess of one can lead to a deficiency of the other. In general a ratio of Fe:Mn between 1.5 and 2.5 has proven to supply a sufficient amount of both nutrients to plants. Mn concentration should be greater than 5 ppm.

Zinc (Zn) analysis

Zn concentration should be greater than 1.5 ppm and will rarely be deficient.

Cation Exchange Capacity (CEC)

The CEC of your soil is a very important number. In short, it is a measure of your soil's ability to hold onto cations (elements or nutrients with a positive charge). But that is only part of the story. Because we know that soils high in clay content have higher CEC values than sandy soils, your soil texture can be estimated from the CEC value. Generally, sandy soils have CEC less than 5 meq/100g, and clay soils have CEC values greater than 10 to 12 meq/100g. The exception is that soils extremely high in organic matter will also have a high CEC. Your CEC is neither good nor bad, and it is very difficult to change. It simply is a fact and provides insight into fertility management strategies. Nutrients will leach from the soil faster in a low CEC soil than a high CEC soil.

Recommended minimum soil nutrient concentrations (ppm) from a K-State Soil test.

	Phosphorus										
	Melich	Bray	Olsen	K	Ca	Mg	Na	Cu	Fe	Mn	Zn
Minimum	30	10	10	75	300/1000*	60/250*	less than 92	2	10	5	1.5

*Ca and Mg recommended levels are for sand/clay soils respectively. Na ppm is a maximum concentration.

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