Interpreting LeafAnalysis and Deficiency Symptoms of Pecans

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Keeping records of foliage nutrient levels gives an indication of trends developing in your orchard. Levels of some nutrients routinely applied, i.e. nitrogen and zinc may build up and cause problems. It also may happen that your fertilization program is not up to your orchard's needs and nutrient levels may be dropping to levels where they are reducing crop production without showing deficiency levels. This is usually known as hidden hunger (figure 1). Recording leaf tissue analysis and fertilization practices over a number of years will give a good indication of the effect of additional applications. Comparing records with yields and condition of trees over a number of years will provide you with an index for measuring the effectiveness of your fertilization program.

When considering the elements needed for pecan nutrition, besides the elements carbon, hydrogen and oxygen which are provided by air and water, there are 13 essential elements needed for normal growth and production. They are usually classified in two groups known as major elements (nutrients), needed in large quantities by the tree, and minor (micro) elements, needed in relatively small quantities. Nitrogen, phosphorus, potassium, calcium, sulfur and magnesium are considered major nutrients. Micronutrients include zinc, iron, manganese, copper, boron, chlorine and molybdenum.

There are four ranges used to indicate the nutrient level found in a tree. These ranges are expressed in terms of their effect on growth and production of pecan trees. In this way, adequate information for diagnosis of the tree's nutrient balance is provided. Leaf analysis and visual symptoms will indicate if a shortage or excess is a problem.

The definition of these terms is as follows:

Shortage-trees show clear, visible symptoms of nutrient deficiency. Tree growth and development is impaired, crop is substantially decreased.

Below normal-Trees are normal in appearance but will probably respond to fertilization with this element. Sub-optimum yields are produced.

Normal-Trees are normal in appearance and optimum yields may be obtained. However, imbalances may occur.

Excess-Trees show clear, visible symptoms of toxicity. Yields will be reduced and tree death may occur.

The nutrients usually found to be deficient in pecan orchards in the southwest are mainly nitrogen, and zinc, sometimes iron and manganese. Those which are usually found at toxic levels in pecan trees are boron, chloride and sodium. Toxicity of the last two elements is related to salinity hazard in some orchards.

The grower should have enough knowledge to identify the below normal range for the major fertilizer elements related to pecan nutrition. In problem areas of the orchard, or with individual trees, the grower should use leaf analysis as a tool

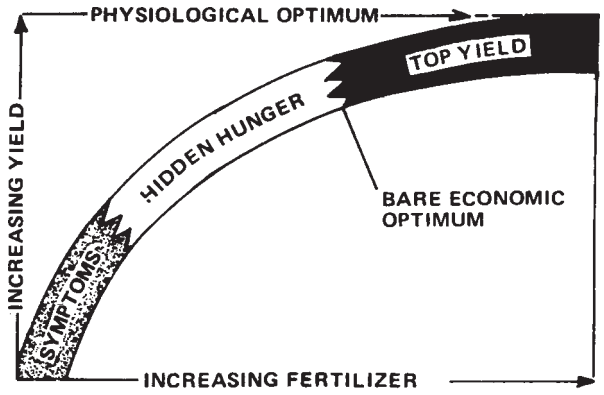

Fig. 1. Hidden hunger is a term used to describe a situation in which a crop needs more of a given element, yet has shown no deficiency symptoms.

to identify a nutritional imbalance. He is best qualified to know if other factors are causing deficiency-like symptoms such as excess water, herbicide injury, rodent damage or chemical spray injury.

Soils in the Southwest are calcareous (high levels of calcium). These soils have pH values ranging from 7.0 to 9.0. The major pH effect is to decrease the availability) of micronutrients such as iron, manganese, and zinc. The Southwest pecan grower should be aware this phenomenon exists and must continually monitor trees for shortages of these nutrients. Soil application of minor elements is usually ineffective unless it is in chelated form because it is rendered unavailable by soil chemical action. The macronutrients are usually available for root absorption at most pH ranges.

Nutritional status of pecan trees is assessed by leaf analyses. Chemical analyses of leaf samples establish the proper levels of nutrients needed by the tree, and provide a way to monitor these levels throughout the years. However, before comparisons are made, pecan growers must be sure that yearly sampling procedures used were the same. A consistent sampling procedure helps the pecan grower to better understand and utilize the pecan leaf analysis. Position of leaflets sampled, sampling date, soil type, variety and age should be given special consideration when sampling pecan leaves.

Before comparing leaf analyses, the grower should know how proper samples are taken. It is generally recommended to sample the middle pair of leaflets from a compound leaf in the middle of the shoot of current year's growth. Sampling young expanding leaflets close to the tip will give higher nitrogen readings than leaflets located in the middle of the shoot. The reason for this behavior is that nitrogen is a mobile element, easily translocated from older leaves to young leaves. Other mobile elements include phosphorus, potassium, magnesium and sulfur. Manganese deficiency also shows in older leaves. On the other hand, calcium concentrations decrease from basal to apical leaves on a shoot, and from basal to apical leaflets on the leaf.

Sampling time appears to be as critical as sampling procedure. The concentration of nutrients in a given leaflet changes as the season progresses or as the leaflet grows. Nitrogen is usually high early in the season (May). A general downward trend has been noted in July and August, with a rather sharp decrease in September. Phosphorus concentration is usually high in May and decreases through the season. Leaf zinc and manganese have also been noted to change drastically during the season, increasing rather sharply during August and September.

It is important to sample by soil-type areas in the orchard. Never compare leaf analyses from trees grown in different soil types: e.g. heavy clay soils vs. light sandy soils. Varietal variations in nutrient concentrations of pecan leaflets makes it a must to analyze and compare different pecan varieties separately. Rootstock differences could potentially contribute to some variation in leaf nutrient content. It is advisable to compare samples from young, non-bearing trees separately from samples of older, bearing trees. Concentration of some nutrients such as nitrogen and calcium tends to fluctuate with tree age.

The area where pecan orchards are located will also have some effect on the nutritional status of pecan trees. Nutrient content in pecan tree leaflets will be different in those orchards located in high pH soils of the arid West than those growing in low pH soils of the humid Southeast where liming is a common practice. Leaf nutrient content for the same variety, date and age will be different in Georgia, Louisiana and New Mexico. Therefore, nutrient content of orchards located in different growing areas should not be compared.

A discussion of each essential nutrient and its possibility for deficiency or toxicity follows.

Nitrogen must be applied annually and is responsible for terminal growth and production of dark, green leaves. It is the macronutrient most likely to become deficient because of its leachability under irrigated conditions. Nitrogen deficiency is characterized by small, pale green to yellow leaves. The normal range for nitrogen in pecan leaves in New Mexico is 2.5 to 3.0%. When the lower value is reached, nitrogen application should be increased to raise levels near 3.0%. Most mature orchards should receive 100-150 pounds of actual nitrogen annually per acre.

Potassium deficiency is not common, but does occur on some soils. Potassium is required for the

nut filling process and a shortage results in poorly filled nuts. Leaf scorch will occur in severe cases resulting in premature defoliation.

Potassium shortages can be corrected with applications of muriate of potash. However, care must be exercised in selecting rates, because high potassium levels in the tree can result in the induction of magnesium deficiency. The normal range for potassium in pecan leaves in New Mexico is 0.9 to 1.2%.

Phosphorus shortages in pecans in the Southwest are rare. The trees have the ability to absorb the proper quantities of this nutrient. A response to phosphorus application is rare. Phosphorus should not be included in a regular fertility program. In high pH soils it becomes highly insoluble when reacting with soil and soil components. Phosphorus should be incorporated into the soil before planting to insure root availability during the life of the orchard. Although no research data is available, soil incorporation of 100-150 pounds of actual phosphorus per acre is recommended. If a phosphorus shortage is detected through leaf analysis, a foliar spray of phosphorus is recommended. Applications of phosphorus can aggravate micronutrient (zinc and iron) availability and, considering the high pH values of desert soils, this is not warranted or needed. A phosphorus shortage is more likely to be found in sandy soils. The normal range for phosphorus in pecan leaves in New Mexico is .12 to .19%.

Calcium shortages have not been reported in Southwest pecan trees. It is not a problem, even in soils which have pH values below 7.0. Calcium levels in soils are more important than levels in leaves. Calcium application in the form of gypsum will offset salinity problems related to sodium accumulation and water permeability in soils. Calcium should not be applied to orchards on a routine basis unless a salinity hazard has been identified. The normal range for calcium in pecan leaves in New Mexico is 0.9 to 1.8%.

Magnesium shortages have not been reported in the desert Southwest. The amount of magnesium in the soil is related to salinity evaluation. Pecan orchards should not receive applications of magnesium unless leaf analysis dictates a below normal value. The normal range for magnesium in pecan leaves in New Mexico is .3 to .6%.

Sulfur deficiencies have not been reported for pecans in any area of the United States. Soils contain enough sulfur to satisfy the requirement of pecan trees. Sulfur may be applied as sulfuric acid in some orchards to offset sodium problems. Sulfur is usually applied in other fertilizer applications such as ammonium sulfate and zinc sulfate sprays in sufficient quantities to meet the needs of the tree. The normal range for sulfur in pecan leaves in New Mexico is .10 to .15%.

Zinc is the primary micronutrient which must be applied annually to pecan trees in the irrigated Southwest. Of all the nutrients, zinc is most likely to be deficient in most orchard or backyard situations, especially in ‘Wichita’ varieties. Zinc deficiency results in small and chlorotic leaves and a reduction in growth (little leaf). Zinc rosette is also a term commonly used in describing zinc deficiency symptoms in pecans. The rosette is formed because of shorter internodes between the small leaves. The zinc requirement of the pecan must be satisfied on an annual basis by using a judicious spray program beginning at bud break and continuing at two- to three-week intervals until terminal growth ceases during the growing season. The normal range for zinc in pecan leaves in New Mexico is 50 to 100 ppm.

Manganese deficiency occurs occasionally in pecan trees under irrigated conditions. It is found to a greater extent in the ‘Wichita’ variety compared to the ‘Western’ and other varieties. Sometimes, entire trees exhibit deficiency symptoms, but deficiencies occur more commonly on individual limbs within a tree. Leaves become malformed (mouse ear) and several limbs are often affected. Freeze injury in some trees will also cause malformed leaves, similar in shape to the mouse ear or manganese deficiency symptoms. The normal range for manganese in pecan leaves in New Mexico is 100 to 600 ppm.

Copper deficiency is rarely found in pecans in the irrigated Southwest. Deficiency symptoms are characterized by terminal die-back. Leaves do not become chlorotic as in zinc deficiency. Copper deficiency is easily corrected with copper sulfate sprays. No action should be taken unless leaf analysis detects a shortage. The normal range for copper in pecan leaves in New Mexico is 8 to 30 ppm.

Iron deficiency symptoms are found occasionally on pecan trees under irrigated conditions. These symptoms are not caused by a lack of iron in the soil but lack of availability in high pH soils where iron tends to be tied up in the soil. Iron deficiency symptoms can also be induced by overirrigation or too frequent irrigations, high or perched water tables, or poorly drained soils. In other words, any soil condition which results in waterlogged soils results in iron deficiency symptoms. The only solution to the problem is improvement of the internal drainage of the soil through ripping. Iron chelates should be used when iron is applied to the soil. The normal range for iron in pecan leaves in New Mexico is 50 to 250 ppm.

Boron deficiency is rare in any area where pecans are grown commercially. Boron toxicity is occasionally found in orchards in the irrigated Southwest and is associated primarily with high boron content of irrigation water. Boron toxicity is difficult or impossible to correct. Leaching is the major method of correcting high levels found in the soil. The normal range for boron in pecan leaves in New Mexico is 50 to 200 ppm.

Nutritional problems (deficiencies or excesses) in the irrigated Southwest are usually related to poor orchard soils, irrigation water, and orchard management rather than the tree's inherent physiology. If an orchard is established on poor soil or poor quality water is used for irrigation, growers can anticipate some problems in the orchard. Selecting good soil and a good orchard site, and irrigating with good quality water, will lead to a successful pecan orchard operation.

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