RESEARCH LABORATORY TECHNICAL REPORT

BARTLETT TREE EXPERTS
SCIENTIFIC TREE CARE SINCE 1907

Micronutrient Deficiencies

E. Thomas Smiley, PhD, Urban Forestry

Diagnosing Deficiencies

Six elements are required in small amounts for the growth and development of plants. These are referred to as micronutrients: iron (Fe), manganese (Mn) copper (Cu), zinc (Zn), molybdenum (Mo), and boron (B). Only two of these, iron and manganese, are commonly found to be deficient in landscape trees and shrubs.

Iron and manganese are required for chlorophyll production and photosynthesis. A deficiency results in yellowing between the veins - interveinal chlorosis. Severe deficiencies can cause death of leaf tissue, stunting of growth and premature defoliation.

The lack of photosynthesis (energy production) caused by severe deficiencies can lead to twig dieback, especially at the top of the tree, and branch dieback if the condition persists. Secondary pests can attack the weakened leaf or twig and may accelerate decline. The decline syndrome may then lead to death of the entire plant.

Manganese deficiency of red maple

Manganese and iron deficiency are separated by visual symptoms, plant species or foliar nutrient analysis. With iron deficiency the fine veins in chlorotic leaves are often green. With manganese deficiency the fine veins typically become chlorotic.

Species can also differentiate susceptibility.

Iron deficiency susceptible:

- Oaks – especially pin and white
- Ericaceous plants – e.g. azalea, rhododendron
- Japanese black pine
- White pine
- Magnolia
- Photinia

Manganese deficiency susceptible:

- Birch
- Dogwood
- Maples – especially red and sugar
- Flowering cherry
- Sweetgum
- Sargent crabapple

Causes of Deficiencies

Several factors can contribute to micronutrient deficiencies. Typically in sandy soils, the critical nutrient may simply be lacking. In heavier soils, an excess or deficiency of water may reduce nutrient uptake resulting in deficiency. Stem cankers or root rots which limit nutrient uptake or movement in the plant, can also result in deficiency symptoms. Alkaline soil pH is, however, the most common factor predisposing to micronutrient deficiencies. This can happen in soils with a pH as low as 6.3 but is more common when the pH is above 7.0. With high pH,

micronutrients are converted to chemical forms that certain plants cannot absorb.

Treating Deficiencies

The first step in treating the deficiency is to determine the exact cause of the problem. This requires a soil or foliar nutrient analysis for micronutrients and soil pH. While collecting the sample, the soil moisture should be assessed. The additional step of determining if the soil is calcareous may also be conducted while collecting the sample. This is done by applying a drop of vinegar to the soil. If effervescence (bubbling) is seen with the vinegar, there are particles of lime in the soil - it is calcareous.

If the soil pH or moisture conditions are not correct for the plant species, replacement with a more suitable species may be the most practical solution. A list of plants that tolerate alkaline, clay soils is available from the Bartlett Tree Research Laboratories.

When soils are simply low in the nutrient, the problem can be treated with additions of the nutrient to the soil. If the pH is below 6.0, the addition of a fertilizer is sufficient. Useful fertilizers include Milorganite for iron, iron sulfate or manganese sulfate (*not* magnesium sulfate - Epsom salt). If the pH is higher, a chelate is required. Chelation of the nutrient prevents its conversion to insoluble forms.

If the cause of the problem is high pH - alkaline soil, the soil pH should be reduced with applications of sulfur. Chelates should also be added to increase the amount of nutrient available. Several application of sulfur may be required to lower the pH to an acceptable level. Soil analysis should be repeated in subsequent years to determine the need for additional applications. If the soil is calcareous, it will be very difficult or practically impossible to adjust the soil pH.

For trees with severe deficiencies, especially in areas with calcareous or very alkaline soils, an injection of iron and/or manganese directly into the tree is usually the best treatment option.

Severe iron deficiency of red oak

Injection of iron will typically green up medium and large trees within two to six weeks of application during the growing season. Trees may need to be retreated after two or three years when symptoms begin to reappear.

A longer lasting option is to inject in the fall or during the dormant season using a higher rate of iron. Higher rates typically provide results for three to five years following treatment.

Manganese injections made during the growing season *rarely* result in rapid greening. Greening is usually seen the following year. Fall applications at a higher rate may produce longer lasting results. Injections should never be made in the spring until leaves are fully expanded or during droughts.

Soil treatments with sulfur and/or chelates should be made following injection to extend the efficacy of treatment. Apply mulch around plants to help reduce soil pH and increase root density. Mycorrhizal applications may increase root density and improve micronutrient and water absorption.

Founded in 1926, The Bartlett Tree Research Laboratories is the research wing of Bartlett Tree Experts. Scientists here develop guidelines for all of the Company's services.