A2638

Oak and other trees disorder: Chlorosis

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Chlorosis is a very common problem of oaks in Wisconsin, particularly in southern and eastern sections of the state. Pin oaks are most susceptible, but many white oaks also show this condition. Numerous valuable oak trees die from this disorder each year.

Other trees, shrubs, and plants also can develop chlorosis, which is usually caused by a micronutrient deficiency. Many maples and birches in eastern Wisconsin are particularly affected, though other deficiencies sometimes contribute to the symptoms.

Symptoms and effects

The first indication of chlorosis is a yellowing of the foliage. Symptoms range from mild yellowing between leaf veins to severe yellowing; the death of leaves, branches, and the whole tree may follow. Except in extreme cases, leaf veins remain prominent and green, a sign of micronutrient deficiency. In extreme cases, the leaf tissue is more white than yellow, and the leaf margins and interveinal tissue die.

The symptoms may be limited to one or a few branches, but usually the entire tree is affected. Mildly affected trees do not always show symptoms each year. However, trees with marked symptoms are more likely to show more severe deterioration the next season. Each year, severely affected branches die off until the entire tree dies or its aesthetic value is destroyed.

Trees that have yellow foliage (chlorotic) are often deficient in iron or other micronutrients.

Chlorosis usually occurs on alkaline soils (those with a pH above 7.0) that are heavy rather than sandy. Other site conditions conducive to chlorosis include extensive soil fill or removal, soil compaction, or construction injury, any of which may damage root systems. Older oaks are especially susceptible to the latter type of injury.

You may find that a soil test to establish the pH is helpful in supporting your diagnosis (for instructions see Extension publication *Sampling Lawn and Garden Soils* [A2166]). Laboratory analysis of plant tissues is not generally recommended. However, you can confirm your diagnosis by submitting affected leaves, along with information concerning the tree's life history, to your county Extension office for a visual inspection.

Chlorotic leaves of white oak seem to be more susceptible to fungal diseases such as anthracnose. These diseases can attack normal as well as chlorotic leaves, but the resulting symptoms may be somewhat different. The chlorotic appearance may still exist, but anthracnose increases the amount of tan-colored, dead tissue.

Cause

Iron deficiency is the most common reason for chlorosis, but deficiencies of other micronutrients, as well as other problems, may also cause the disorder. In Wisconsin, where iron is adequately abundant in most soils, obstacles to iron uptake may cause chlorosis. Root damage restricts iron uptake as does extensive soil compaction or fill. Deficient micronutrients other than iron may be involved especially on soils low in organic matter. Some examples are calcareous (calcium-containing) sands and gravels, and soils where the natural recycling of leaf litter is prevented.

Research indicates that the high soil pH associated with chlorosis can cause both excesses and deficiencies of individual nutrients within the trees. For instance, a chlorotic oak may be especially high in phosphorus, potassium, or nitrogen, while low in iron, manganese, copper, or zinc. On the other hand, a chlorotic red maple may be low in manganese but high in potassium and iron. Consequently, treatments that add specific nutrients alone, such as iron or manganese, have frequently failed in the Midwest.

Control

Cultural

Prevention is the best control. Do not plant trees susceptible to chlorosis, such as pin oak, in soils with a pH above 7.0 or in soils low in organic matter. On construction sites, do not allow any disturbance within 12 feet of the trunk of any valuable tree, particularly oaks. You should also make sure decaying leaf litter on the soil surface is undisturbed to provide nutrients and sustain beneficial soil organisms.

Potassium and phosphorus excesses have been associated with chlorosis problems, so you should avoid applying these fertilizers around chlorotic trees unless actually required. Also, avoid nitrate-containing fertilizers, limestone- and lime-containing materials, and hard water.

The following steps will help treat chlorosis by lowering the pH of the soil:

1. In fall to late winter, apply sufficient sulfuric acid to the soil surface to lower the topsoil pH to approximately 6.0. This is typically 6–9 gallons of 10% sulfuric acid per 100 square feet beneath the crown of the tree. Battery acid is often available locally. It has a 40% concentration of sulfuric acid and thus requires further dilution. Be aware that lowering the soil pH can damage your turf.
2. In early spring, apply 3 pounds of ammonium sulfate to the soil surface per 100 square feet beneath the crown and 12 pounds per 100 square feet beyond the drip line of the tree. This will cause extremely dark green and lush lawn growth, but no serious, permanent lawn injury has been observed.
3. Make auger holes 2 inches in diameter and 18 inches deep, spaced 18 inches apart, in at least two circles around the tree. The inner circle should be located a distance from the trunk equal to three times the trunk's diameter, measured just above where it flares outward at the base. The second circle should be located twice that distance from the tree. Fill each hole with 10% sulfuric acid to within 4 inches of the soil surface. Immediately add 1 teaspoon each of manganese sulfate and ammonium sulfate. These treatments are usually made during the spring or summer months, but the season may not be critical. Additional rings can be added.

Caution: Sulfuric acid is dangerous. To avoid injury when handling the compound, use an eye shield, rubber gloves and an apron, and take other necessary precautions. For instance, when preparing a dilution, add the acid to the water, rather than the reverse. If you are apprehensive about handling sulfuric acid, employ a certified arborist for the treatment.

Alternative approaches suggest modifying the soil environment and treating trees directly with micronutrients. For example, boulevard red maple trees in Green Bay, Wisconsin, have responded well to soil modification. Four inches of sod were removed, then 15 pounds each of granular sulfur and Milorganite fertilizer were applied per 100 square feet. Wood chips were then added to a depth of approximately 6 inches. Although the trees responded slowly at first, excellent root regeneration occurred within the bark-covered area. The trees started showing good

color and growth recovery within 2 years. Elsewhere, these approaches have resulted in varying degrees of success. Further information on the soil modification used in Green Bay can be obtained from their city forester or your county Extension office.

Soil or foliage treatments

Simpler treatments with iron or manganese have sometimes worked, but on other occasions they have not, probably because of the nutrient complex problem associated with high pH.

Soil incorporation of iron-containing compounds, particularly chelated iron, may be helpful especially for mildly chlorotic trees. Iron chelates are marketed under various trade names and in various formulations. Some are intended for soils of high pH, others for different limitations. If you wish to use an iron chelate, select one suitable to your conditions. Check your soil pH before treatment. Your county Extension office can offer instructions on how to do so.

You can use various methods to incorporate iron chelate into the soil. An arborist may use pressure soil injection devices for better distribution. A homeowner may use a root feeder. Another common method is to apply iron chelate in a series of holes made in a circle around the tree and under the outer branches (the drip line of the tree). Make the holes 3 feet apart and deep enough to hold 1 gallon of liquid. Around taller, more slender trees, locate the holes 2 feet instead of 3 feet apart. Prepare the solution by dissolving iron chelate in water at the rate recommended by the manufacturer. If you apply it during the dormant season, pour 1 gallon of the suspension in each hole and let it soak away (apply a maximum of ½ gallon during the growing season). Fill the holes with water several times, then refill them with soil. Follow label directions when incorporating iron chelate.

You can apply other iron-containing materials to the soil—ferrous sulfate, activated sewage sludge, and composts, for example—using one or more of the methods described above. However, where iron (ferrous) sulfate is used, much of the applied iron is fixed in the soil and thus is not available to the plants. The recommended rate is usually sufficient to overcome this problem.

Tablets are also available to treat the soil around trees and shrubs. Two such products are Fe-26 and Mn-21, manufactured by Remke Enterprises. They are advertised as effective in curing iron chlorosis; as of this printing, no research has been performed at the University of Wisconsin to evaluate the effectiveness of either product.

Soil treatments are often slow to produce results and you may need to reapply treatments in subsequent years. However, when trees do respond, the results usually are the most satisfactory and longest lasting of presently available treatments.

Foliar sprays with iron chelate or iron sulfate usually cause a more immediate but temporary response than soil incorporation of these compounds. However, most homeowners do not have adequate equipment to spray large trees. To use foliar sprays, follow the manufacturer's directions for iron chelate. If you use sulfate, dissolve 1 pound of sulfate in 25 gallons of water and add 1 cup of mild household detergent to increase the wetting capacity of the spray. For smaller amounts, add 2 ounces of sulfate to 3 gallons of water and add 2 tablespoons of detergent. Immediately after application, rinse equipment thoroughly, and hose off sidewalks, sides of buildings and similar structures to avoid any possible rust stain from the spray.

Foliar treatments have not worked as well in Wisconsin as in several western and southern states.

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