15. Chlorosis

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Many trees in the Great Plains suffer from nutrient deficiencies induced by alkaline soils. One symptom commonly produced by these deficiencies is a yellowing of the foliage, called chlorosis.

Hosts and Distribution

Chlorosis of foliage may develop wherever trees are grown in alkaline soils. Chlorosis generally is most severe in the western two-thirds of the Great Plains where highly alkaline soils are common. Chlorosis is also common in urban areas where excavation during construction of buildings brings alkaline subsoil to the surface.

Many tree species are susceptible to chlorosis. Pin oak and silver maple are commonly affected. Also susceptible are other oak and maple species, birches, cottonwood, poplars, elms, pines, junipers, yews, walnut, peach, and apple.

Symptoms and Signs

The degree of yellowing varies from a yellowish-green of leaves only slightly chlorotic to lemon-yellow and almost white in leaves severely chlorotic. In some cases the leaves have a slight reddish or "fall" coloration. The yellowing is most intense in the interveinal areas of leaves (fig. 15–1); brown, necrotic areas often develop in these areas on severely affected leaves, giving the appearance of leaf scorch.

Symptoms of chlorosis may be uniform throughout the entire tree or be confined to one or a few branches (fig. 15–2). Generally, leaves formed in early spring are normal in both color and size, but leaves formed later in the season become increasingly chlorotic and are smaller. If chlorosis continues for several years, shoot growth is reduced, branches begin to die back (fig. 15–3), and the tree eventually dies.

Figure 15–1. Chlorotic pin oak leaves showing typical green veins and chlorotic interveinal areas.

Cause

Deficiency of iron is the most common cause of chlorosis of trees in the Great Plains. In most cases, iron in the soil is present in sufficient quantity; but under alkaline conditions (pH greater than 7.0), it is in an insoluble form. Reduced availability of nutrients occurs commonly in alkaline soils. Even if absorbed, these nutrients may remain in a form that the tree is unable to use. Iron is used in the production of chlorophyll, thus a deficiency of iron prevents the leaves from producing the normal amount of chlorophyll.

Deficiencies of other nutrients such as zinc, manganese, or nitrogen can contribute to chlorosis or in some cases they are the primary cause of chlorosis. Factors such as low temperature and high soil moisture, and excessive amounts of copper, manganese, zinc, and phosphorus can cause or contribute to development of chlorosis.

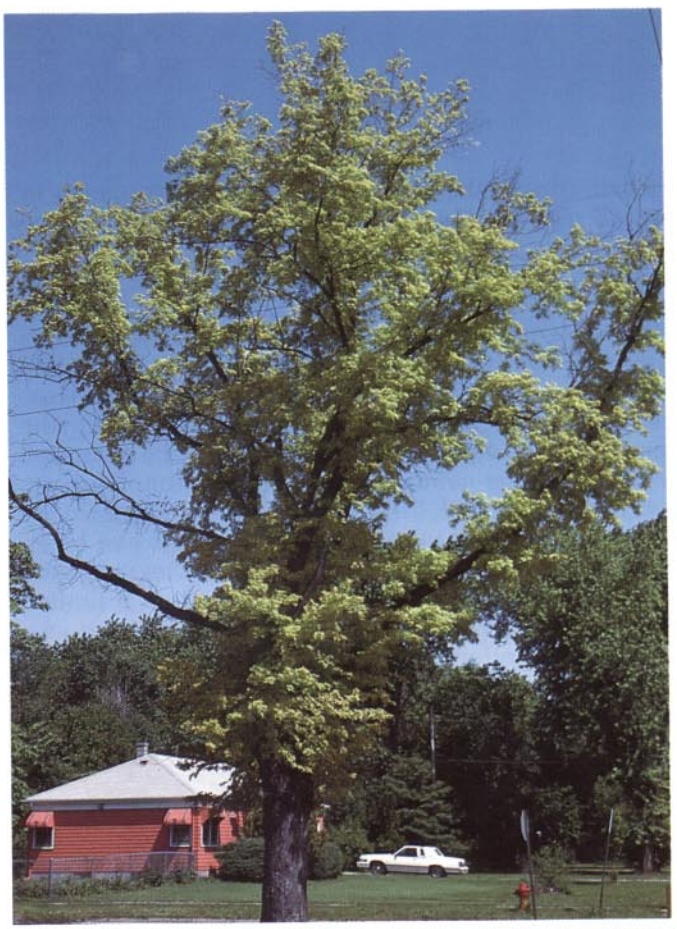

Figure 15–2. A moderately chlorotic silver maple with some branch dieback.

Figure 15-3. A severely chlorotic pin oak with extensive branch dieback (left).

Figure 15-4. The same tree as in fig. 15-3 showing the improvement in leaf color and crown fullness 2 years after a trunk injection with ferrous sulfate (right).

Damage

Homeowners with chlorotic trees commonly spend $20 to $50 per tree every 3 or 4 years for therapeutic treatments. Without treatment, the trees would continue to decline and die. In many areas of the Great Plains some species, especially pin oak, are no longer being planted because this disorder severely reduces their chance of survival.

Control

Three methods can be used to treat chlorosis caused by iron deficiency: (1) spraying the foliage with a solution of ferrous sulfate (iron sulfate) or chelated iron; (2) incorporating ferrous sulfate and sulfur, or chelated iron into the soil; and (3) injecting ferrous sulfate or chelated iron into tree trunks.

Spray treatment gives the quickest response, but is the most temporary. This treatment only improves the condition of leaves present when foliage is sprayed. It has little or no effect on leaves formed after spraying, and the effectiveness does not carry over into the next growing season. This treatment is not recommended for long-term control of chlorosis. It is only used on trees when chlorosis is extremely severe and a quick response is desired.

Soil treatment provides the most permanent control of chlorosis. A single soil treatment is often effective for 4 to 5 years. The disadvantages of this treatment are that it may not become effective until the next growing season, and it requires considerable labor and materials. This treatment is often recommended for shrubs and trees that are too small for trunk injections, and in cases where the landowner wants to avoid making the wounds required for trunk injections. The recommended materials and rates are: (1) 2 to 2.5 pounds per inch tree diameter of a mixture of equal parts ferrous sulfate and sulfur, or (2) an iron chelate used at the rate indicated on the label. Several chelated iron materials are available.

Trunk injection is the most commonly used treatment for chlorosis. This treatment involves drilling holes into the lower trunk and either placing capsules of powdered material into the holes, or injecting a liquid solution through the holes. Trees usually respond within 3 to 4 weeks, and the treatment is generally effective for 2 to 4 years (fig. 15–4). More information on procedures and materials is available from most nurseries and garden stores. Some materials can be applied easily by the homeowner, while others are applied only by trained arborists. Follow label recommendations for application rates.

Selected References

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