Sulfur Applications *(cont'd)*

Broadcast Sulfur Application

High rates of sulfur can be used in a broadcast application to lower the pH of the soil over a large area. This method is generally more effective on sandy soils than on clay soils.

Apply granular sulfur to the soil below the canopy of the tree in spring or fall at a rate according to the table below. If applying to a mulched area, apply the sulfur and rake in to help increase contact with the soil. Water thoroughly after application.

If applying to turf, aerate to increase sulfur contact with the soil, and apply sulfur at half the rate for two successive years. Water thoroughly after application and during hot, dry weather to prevent turf damage.

Annual applications of sulfur at half the rate will help maintain lower pH levels.

Pounds of elemental sulfur per 100 square feet*	
sandy soils:	1 - 3
heavy (clay) soils:	2 ½ - 4 ½

**Higher rates may be necessary in soils with particularly high pH levels (greater than 8.0). Soil pH can be determined by commercial or university soil-testing laboratories.*

Iron Chelates

Iron chelates provide iron in a compound more easily picked up by plants. Look for products containing EDDHA (FeEDDHA),† which work better than other chelates when soil pH is greater than 7.2. Examples include Sequestrene 138, Sprint 138, Sequestar 6% and Millers FerriPlus.

Iron chelates are generally effective for only one season and may be expensive. Follow label directions for application.

†EDDHA or FeEDDHA is often listed on product packages as ethylenediamine di-(o-hydroxyphenylacetate).

Trunk Injections and Implants

Injections*:* Holes are drilled into the trunk flare, and a liquid iron compound is injected into the holes; or the compound is delivered to the tree through a needle-like injection.

Implants*:* Plastic cartridges containing a powdered iron compound are placed into holes drilled into the trunk.

Injections and implants are effective for one to three years or more and are most effective on pin oak. Other trees do not respond as well to these treatments.

One major disadvantage to injections and implants is the physical damage caused by the drilling and the internal damage caused by the chemical itself. Injections should not be re-applied until the drill wounds seal over with new trunk tissue (this may take more than a year). Injection methods that use small, shallow holes are less damaging. ***Injections should be applied by a certified arborist who is well-trained in the procedure.***

Trade names listed in this publication are examples of available products. No endorsement is implied.

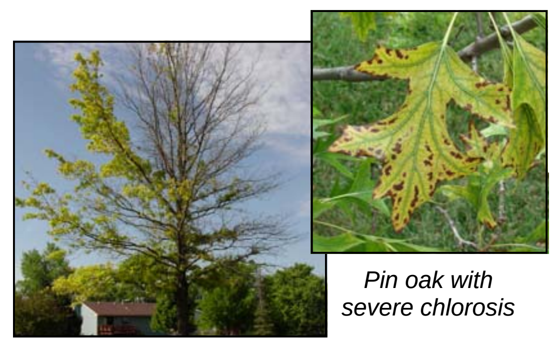
Laurie Stepanek and Mark Harrell
Nebraska Forest Service
For more information: www.nfs.unl.edu

Nebraska Forest Service

Chlorosis of Trees in Eastern Nebraska

Chlorosis describes any condition in which leaves or needles develop an abnormally light green or yellow color. The most common cause of chlorosis in trees is a deficiency of iron in the tissues. Other causes of chlorosis include over-watering, over-fertilizing, damage to roots, and deficiencies in manganese or other micronutrients.

Symptoms of iron chlorosis include yellow or pale green leaves with green veins, browning along leaf edges or between the veins, and branch dieback. Severely affected trees may die over a period of several years.



Pin oak with severe chlorosis

FH11-2010

University of Nebraska

Susceptible Trees

Commonly affected:

pin oak
silver maple

Also affected:

amur maple
red maple and hybrids
(Red Sunset, Autumn Blaze, etc.)
birch
crabapple
cottonwood
swamp white oak
baldcypress
ornamental juniper
eastern white pine

Causes of Chlorosis

High pH soils (pH over 7)

Soils in Nebraska typically have high pH levels (alkaline soils), especially soils in urban areas or where the topsoil has been lost. Most trees prefer a pH range of 5 to 7, but in Nebraska levels of 7.5 to 8.5 are fairly common. Iron and other micronutrients are usually present in the soil in sufficient quantities, but the high pH ties up the iron and makes it unavailable to trees.

Wet, compacted soils with poor aeration

Roots need oxygen to function. Soils that are overwatered or compacted have low oxygen levels, which affect the ability of roots to pick up iron and other micronutrients. Extensive rains in spring can cause temporary chlorosis.

Root damage

Roots are less able to pick up nutrients if they are damaged from trenching or digging, are buried too deeply under soil, or are decayed.

High nitrogen or phosphate levels

An excess of some nutrients, especially nitrogen and phosphorus, can bind iron in the soil and prevent it from being picked up by roots.

Low levels of iron or other micronutrients

On occasion there may be insufficient levels of iron or other micronutrients in the soil, which causes chlorosis.

Correcting Chlorosis

Iron chlorosis is difficult to correct. Soils resist changes in pH, and there may be several factors involved that contribute to the chlorotic condition.

Water when soil is dry, but don't overwater. If it does not rain, apply 1 inch of water per week in heavy soils, or 2 inches in sandy soils. Water only once or twice a week, soaking the soil well. Allow the soil to drain between waterings to allow oxygen back into the soil. Do not overwater. Automatic sprinklers that run daily or every other day can severely stress or kill trees.

Mulch with woodchips to improve soil conditions for the roots. Maintain 2-4 inches of mulch over as large an area as possible around the tree, but do not pile mulch against the trunk.

Avoid excess fertilizer. Trees generally ***do not*** need extra nitrogen fertilizer if the lawn is already being fertilized.

Consider planting trees that are less likely to develop iron chlorosis:

most white oaks *(bur, white, chinkapin, English)*
some red oaks *(black, northern red)*
some maples *(Norway, tatarian)*

linden	Kentucky coffeetree	elm
hawthorn	Ohio buckeye	spruce
hackberry	eastern redbud	fir
honeylocust	eastern redcedar	ginkgo

Use proper planting techniques. Dig a wide, shallow hole. The main roots should be level with the soil surface, not deep in the hole. Remove all twine, wire and burlap, and spread the roots out as much as possible.

Mulching large areas of the root zone with woodchips can help correct chlorosis.

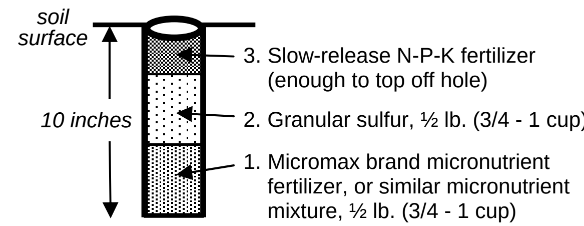
Sulfur Applications

Most soil treatments for chlorosis use granular sulfur to lower the pH of the soil, allowing iron to be converted to a form more easily picked up by tree roots. The process is slow (symptoms may not improve for a year or two following treatment), but the effects can last for several years.

Two methods are described below in which sulfur is combined with iron sulfate or other fertilizers and placed into holes dug in the ground around the tree. Pockets of soil are created that are rich in readily-available iron and other micronutrients.

Whitcomb's Method:

Dig holes in rings around the tree beginning 3 feet from the trunk. Dig the holes 10 inches deep and 2 inches wide. The number of holes should equal the diameter of the trunk in inches (e.g., a 12-inch diameter tree needs 12 holes). Fill the holes with the following materials in the order shown below:



Iron Sulfate + Sulfur Application:

Dig holes 2 inches wide and 6-9 inches deep in a grid pattern around the tree. Fill holes with iron sulfate (20% Fe) and sulfur according to the table below. Top off with soil and thoroughly water in.

Tree diameter (inches)	Total amount of iron sulfate + sulfur (pounds)	Number of holes in ground around tree
2	2	8
4	6	12
6	12	24
10	20-30	30-60
15	30-45	40-90
20	40-60	50-120