Iron Sulfate + Sulfur

Iron sulfate and other micronutrients are often used in combination with sulfur to correct chlorosis. Typically these materials are applied in holes dug or drilled into the ground around the tree. This method lowers the pH of a small area of soil in several locations within the root zone of the tree while providing a ready supply of iron or other micronutrients. This method is labor-intensive and may be slow to work, but can provide several years of control.

Dig holes in the soil in a grid pattern under the crown of the tree. Make the holes 6-9 inches deep and 2 inches in diameter, and spaced about 2 feet apart. Avoid damaging large roots. Apply equal parts of iron sulfate (20% Fe) and elemental sulfur to the holes according 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

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).*

Calcareous, Sodic and Saline Soils

Calcareous soils contain high levels of free lime (calcium carbonate), and are extremely difficult to correct. Excessive amounts of sulfur are needed to neutralize the free lime before the pH can be lowered. To test for free lime, place a spoonful of dry soil in a cup and moisten with vinegar. If the mixture fizzes or bubbles, it has free lime.

Accumulation of salts on the soil surface may indicate high levels of sodium (sodic soils) or high levels of other soluble salts (saline soils). Correcting these soils is difficult. Consultation with a soil specialist is recommended.

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

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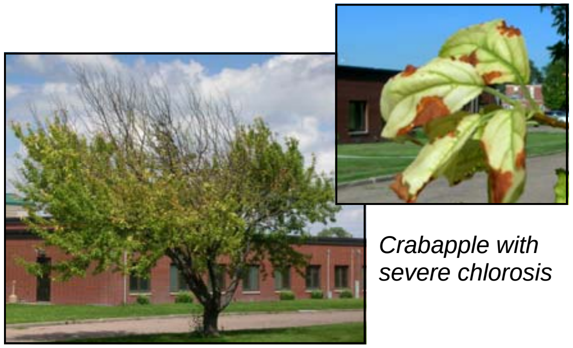
Chlorosis of Trees in Central and Western Nebraska

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.



Crabapple with severe chlorosis

FH10-2010

University of Nebraska

Susceptible Trees

Commonly affected:

silver, red and Freeman maples
(Red Sunset, Autumn Blaze, etc.)
pin oak

Also affected:

red oak group *(northern red, Shumard, etc.)*

amur maple	birch
crabapple	catalpa
hawthorn	ornamental juniper
pear	baldcypress
cottonwood	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.

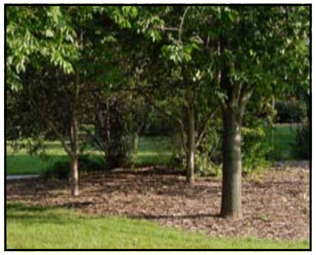
Avoid excess fertilizer. Trees generally ***do not*** need extra nitrogen fertilizer if the lawn is already being fertilized.

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

most white oaks *(bur, white, English)*
lindens *(American, littleleaf, silver)*
American elm *(disease-resistant cultivars, hybrids)*

hackberry	Norway maple
honeylocust	Rocky Mountain juniper
Ohio buckeye	eastern redcedar
Kentucky coffeetree	spruce

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 Application

Elemental sulfur can be used to lower soil pH and help correct chlorotic symptoms in trees. The process is slow (symptoms may not improve for a year or two following treatment), but the effects can last for several years.

Apply 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.

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.*

Annual Follow-up Treatments:

To help maintain lower pH levels, apply elemental sulfur in the spring or fall at half the rate suggested above. This application can be incorporated into the annual lawn fertilizer schedule if one exists.

Some lawn fertilizers include iron and sulfur as added components. Choose granular products that contain high levels of these elements such as 12% iron (Fe) and 16-18% sulfur (S). Liquid products are usually lower in iron and are less effective.

If annual sulfur applications are not made, the soil pH will gradually increase and re-treatment will be necessary after a number of years.