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Archive

CONTROL OF IRON CHLOROSIS IN UTAH

EC 408

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Iron deficiency is a frequent cause of yellowing (chlorosis) in fruit trees, ornamentals, and shrubs (including raspberries, strawberries, and blackberries) in Utah. The primary symptom of iron chlorosis is yellowing between veins of younger leaves shown by a network of green veins on a very light green background. In extreme cases the leaf appears completely yellow and outer edges of the leaves appear "burned" as the plant cells die. Individual limbs and/or the entire plant may die.

Yellow leaves indicate a lack of chlorophyll, or the green pigment in the leaves which is necessary for photosynthesis. Any reduction in chlorophyll during the growing season may reduce yields significantly. In addition, chlorotic plants produce smaller fruits of poor quality with lower sugar content.

CAUSES

The causes of iron deficiency in plants are varied and not completely understood. The problem generally occurs in soils which contain "free lime" or calcium carbonate and is seldom seen in acid soils (pH less than 7.0). Most Utah cultivated soils have a pH range between 7.2 and 8.5. Iron efficiency is aggravated by very low and very high temperature, by high soil moisture, by excessive applications of phosphorus and relatively large concentrations of copper, manganese and zinc.

Chlorosis is often severe where top soil has been removed, and subsoil exposed. Examples are eroded soils or those subjected to land leveling for agriculture or housing.

Table 1. Susceptibility of crops to iron deficiency*

Highly susceptible	Moderately susceptible	Tolerant susceptible
raspberries	alfalfa	alfalfa
berries	barley	barley
citrus	corn	corn
field beans	field beans	grasses
tree fruits	grain sorghum	oats
grapes	grasses	potatoes
ornamentals	oats	soybeans
peanuts	soybeans	vegetables
vegetables	tree fruits	wheat

*Some crops are listed under two or three categories because of variation in soils, crop varieties, and growing conditions. Some ornamentals especially susceptible - Norway maples.

CONTROL

Control of iron chlorosis is not easy. Water reduction to avoid saturated soil is advised especially with peaches, grapes, raspberries, and strawberries. Three additional techniques have been used to overcome chlorosis, these include: (1) Soil application of iron sulfate, sulfur, sulfuric acid, iron chelates or other iron compounds (see table 2). (2) Foliar sprays of ferrous sulfate. (3) Injecting or placing an iron compound such as Ferric Ammonium Citrate into the trunk of large shrubs or trees.

The foliar and injection applications give a more rapid response than the soil application, but the soil application may last longer, up to two or three years. A foliar spray may be more useful if repeated several times during the growing season.

Table 2. Some common commercial sources of iron for agriculture.

Source	Trade name	iron%	Manufacturer
Inorganic Sources			
Ferrous Sulphate	-	20.5	numerous
Ferric Sulphate	-	20.0	numerous
Ferric Ammonium Citrate	-	17.5	Fisher Scientific
Ferrous Carbonate	-	42.0	Calcium Carbonate Co.
Acidified Mining residue	Iron-Sul	20.0	Duval
Iron Frits	-	40.0	Frit Industries
Chelates			
Fe EDTA	Sequestrene N_2Fe	12.0	Ciba-Geigy Chemical
	Hampene iron	9.0	Hampshire Chemical
Fe DTPA	Sequestrene 330	10.0	Ciba-Geigy Chemical
Fe EDDHA	Sequestrene 138	6.0	Ciba-Geigy
Fe HEDTA	Che-Gro Iron	5.0	Aidex Corp.
	Versonol Ag Fe	5.0	Dow Chem. Co.
Organic Complexes			
Lignin Sulfonate	Claw-EL Iron	6.0	Brandt Chem.
	Iron Ke-min	11.0	Georgia-Pacif Corp.

SOIL APPLICATION

The iron containing products should be applied in the early spring before new leaves appear. For best results mix equal parts ferrous sulfate and sulfur. Sulfur is acidic and will reduce the pH of the soil close to the roots. Acidified mining residues such as Duval's Ironsul have a very low pH. These compounds are most effective when applied in holes approximately 1 to 2 inches in diameter. Holes should be placed 12 to 18 inches apart and 12 inches deep around the drip line (outer edges) of the tree or shrub. Apply 1-2 pounds of material for each 1 inch of trunk diameter. A large maple tree may take up to 30 pounds of material. An overdose may cause some blackened leaves, however, the tree will recover and the new leaves should be green and healthy.

Raspberries, strawberries and small shrubs can be treated by digging a trench 2-4 inches deep with the corner of a hoe and filling the trench 1 inch deep with the acidified iron compound or ferrous sulfate/sulfur. More material is necessary for the larger plants and shrubs. Cover the trench and water well. These products are best applied in the early spring before the plants break dormancy. Use 1 Tablespoon of Ciba-Giegy's Fe-138 incorporated in the soil at the base of each raspberry plant. Table 3 indicates the amount of iron product to apply for trees and shrubs.

Table 3. Dosage for treating trees or shrubs* by soil application of a mixture of equal parts of iron (ferrous) sulfate and sulfur.

Tree Diameter	Total amount of iron sulfate and sulfur per tree	Number and depth of holes in ground around tree		Total amount of equal parts ferrous sulfate sulfur per hole
(inches)	(pounds)	(number)	(depth in inches)	(pounds)
1	1	4	12	0.25
2	2	4	12	0.5
4	6	8	15	0.75
6	12	12	15	1.0
8	16-23	16-23	18	1.0-1.25
10	20-30	20-30	18	1.0-1.25
15	30-45	30-45	18	1.0-1.25
20	40-60	40-60	18	1.0-1.25

*Trees in bad condition with some branches partially defoliated should receive only one-half the amount of the mixture given in the table.

FOLIAR APPLICATION

Iron compounds sprayed on the leaves give the most rapid response. Improvement can be seen in a matter of days. Repeated applications may be needed as new foliage appears. Use a 0.1% ferrous sulfate solution. Mix 2 1/2 ounces per 3 gallons, or 5 lbs per 100 gallons. Spray thoroughly as the plant approaches full leaf. Spray in the late afternoon on a cloudy day for best results. A few drops of liquid soap per gallon or a spray additive available at garden or farm supply stores will help keep the solution on the leaves. Commercial iron compounds are effective as foliar sprays but are much more expensive.

TRUNK INJECTION

If the previously described methods have not proven satisfactory, trees and large shrubs may be treated for iron deficiency with ferrous sulfate or ferric ammonium citrate. Inject a 1% solution of ferrous sulfate at about 3 ounces per year of solution per 1 inch of trunk diameter. The hole should penetrate the sapwood to a depth of 2 inches. Tree damage has been observed where injections with high pressure systems (300 psi) have been made, therefore, high pressure systems should be avoided. However, a premeasured amount of ferrous sulfate ferric ammonium citrate in gelatin capsule placed inside a 1/4 inch drilled hole covered with paraffin has corrected iron deficiency of fruit trees. Peach trees have been damaged or weakened by disease introduced by this method without proper treatment of the drill hole. Place the capsules at intervals around the circumference of the trees. (The usual dosage is .5 teaspoons per inch of trunk diameter.) Iron citrate salts are more soluble and tree response is rapid. Make the injection before the plant breaks dormancy. It will last for several years.

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