

AVO Research



FOCUSED RESEARCH • GLOBAL COLLABORATION • MAXIMUM YIELDS

IRRIGATION AND IRON CHLOROSIS IN ORCHARDS • WINTER 2006

Guy W. Witney
Director of Industry Affairs, California Avocado Commission

Heavy winter precipitation in early 2005 in many areas resulted in wetter than normal soils at the start of the growing season. As a consequence, many trees and even entire sections of orchards may be showing symptoms of iron deficiency which began in early summer.

The signs are easily recognized as yellowing of new leaves (chlorosis) over the entire tree, or in just a few limbs. On closer inspection, the leaf veins normally remain green while the blade itself turns a bright yellow to white color. In the most severe situations, leaves may have burned margins and limbs or trees may defoliate. Iron is required for the production of chlorophyll and so a deficiency results in the absence of this green pigment in leaves.



Photo by: Guy Witney

Iron deficiency in avocado trees is expressed in new growth when a simultaneous restriction in root iron uptake occurs. The absorption of iron has been shown to be limited to the growing root tips of trees and so healthy roots are essential. Any restriction in root growth, such as waterlogged oxygen depleted soil conditions, will result in reduced uptake. It has also been shown that carbonates (HCO_3^-) in the soil restrict the uptake and movement of iron. High levels of carbon dioxide (CO_2) are required for the formation of HCO_3^- . Under conditions of poor aeration, such as in waterlogged soils, CO_2 accumulates from root and microbial respiration. This in turn results in elevated HCO_3^- and restricted iron uptake.

Iron deficiency in avocados is also called iron chlorosis. Symptoms in avocado may first be seen as lightening of the chlorophyll (green pigment) in leaves giving the tree a yellow washed-out appearance. Symptoms may be confined to just a few tree limbs, entire trees, or sections of a grove. The tree in the right foreground is showing iron deficiency symptoms a year after heavy rains cause this section of the grove to be waterlogged.



Carbonates are also formed in high pH calcareous soils which are common in some fruit growing areas of the West Coast. Orchards grown on these soils are likely to exhibit iron deficiency symptoms, particularly under wet conditions. Excessive lime applied to raise the pH of soils may also result in iron deficiency. The term "lime induced iron chlorosis" is frequently used for symptoms on trees grown under high soil pH conditions.

While all of this may sound complicated it boils down to a few main points. Under excessively wet conditions root growth is restricted and HCO_3^- accumulates. Both of these factors result in restricted iron uptake. Any growth occurring at this time will likely show iron deficiency symptoms.

Foliar and soil applications of iron rarely reduce the severity of deficiency symptoms and are considered only temporary measures. The application of inorganic iron salts to the soil is generally ineffective because the iron is rapidly oxidized and becomes insoluble. Foliar applications of inorganic iron salts are also generally ineffective. Sequestrene iron chelate has been shown to be effectively taken up as a soil dressing, but is generally an expensive remedy. Soil applications of EDTA iron chelate have occasionally been shown effective, but because of poor stability this form of iron may rapidly oxidize and become unavailable to the plant.

The best way to manage iron deficiency is to manage irrigation and soil pH. Excessive soil moisture resulting from heavy winter precipitation or spring irrigation is most often the cause of a temporary iron deficiency. If excessive irrigation is applied every spring chronic iron deficiency will result and production will suffer. Where soil pH is high, the use of acid fertilizers particularly ammonium fertilizers, can lower the soil pH, improve iron availability and depress deficiency symptoms. Remember, however, the uptake of other nutrients may be restricted if the pH becomes too low. Always check soil pH before embarking on an orchard nutrition program. Avocados generally prefer a soil pH of 6.0 to 6.5. Mulching trees with well composted organic material will improve root health and soil aeration and so may also provide some remedy where iron chlorosis is a chronic problem.



Photo by: Bob Platt

As the symptoms of iron deficiency progress most of the chlorophyll may clear from leaf cells leaving leaves a bright yellow color. In severe cases new growth is distorted and scorched with burnt leaf tips and margins (on right).



Photo by: Guy Witney

Generally, iron deficiency symptoms are first seen on new flush growth during periods when iron uptake by roots is restricted. This may be most common on spring flush growth after a wet winter and symptoms are chlorotic (yellow) new growth.



Photo by: Guy Witney

Under conditions of severe iron deficiency leaves may show tip and margin burn and leaf loss may occur. Complete defoliation of individual limbs may occur if deficiency conditions persist.