Effects of various

IRON TREATMENTS ON LEMON TREES

R. M. BURNS · S. OLIVA · G. MING

Applications of iron to the soil, or in the irrigation water, have generally not been commercially satisfactory for treating iron deficiencies in lemon trees. Foliar sprays of available iron materials presently show the most promise. In one large-scale trial on mature lemons near Oxnard, yearly low-volume sprays of three iron compounds have shown increases in yield and fruit size. Leaf analysis for iron was found to be a poor indicator of response. A completely satisfactory method of correcting iron deficiency in lemons is still not available.

IRON DEFICIENCY is a problem in many citrus-growing areas of California. It is often called "iron chlorosis," and has been termed "lime-induced iron chlorosis" when it occurs on calcareous soils. This deficiency is frequently associated with over-irrigation or prolonged periods of wet soil conditions. Slight to moderate iron deficiency reduces tree vigor and affects yield to some extent. In severe cases the leaves become small and lose all their green color, and the fruit is small and chlorotic. Often twig and branch die-back occurs (see photo).

Citrus rootstocks vary in their ability to take up iron. A test showed, for example, that trees on Alemow (*C. macrophylla*)—presently the most popular lemon rootstock—contain appreciably more iron than did trees on sweet orange (*C. sinensis*). Although no iron treatment for deficiency symptoms has yet proved completely effective in the field, a number of commercial iron materials are in use.

Foliar sprays are the most common method of applying iron to citrus trees in the field. The effectiveness of foliar sprays can be increased substantially by adding efficient surfactants at concentrations 25 times that ordinarily used. The trials reported here were initiated due to the difficulty growers have had in obtaining a response from iron treatments on lemon trees.

Soil application

A four-year field trial (Trial A) testing commercial iron materials was started in April 1968 in the Somis area of Ventura County. The soil pH ranged from 6.5 to 7.5, and the mature lemon trees were moderately affected by iron deficiency. There were ten treatments on single trees, replicated five times. The materials used were: (1) 5 lbs Best Super Iron Brand (12% iron) in the spring only; (2) 5 lbs Best Super Iron Brand in the spring and fall; (3) 10 lbs Best Super Iron Brand in the spring only; (4) 5 lbs Leffingwell Vitatone Iron (14.2% iron) in the spring only; (5) 5 lbs Leffingwell Vitatone Iron in the spring and fall; (6) 10 lbs Leffingwell Vitatone Iron in the spring only; (7) 1 lb Geigy Sequestrene 138 (6% iron) in the spring only; (8) 1 lb Geigy Sequestrene 138 in the spring and fall; and (9) 2 lbs Geigy Sequestrene 138 in the spring only. Materials were placed in a narrow chisel furrow six inches deep at the drip line on opposite sides of the trees.

Evaluation of treatments was by leaf analysis, following standard procedures, and by observation of tree condition. Yield data were not obtained because of the difficulty of collecting such data from individual trees which are harvested four to six times a year.

Treatments produced no significant difference in leaf content of iron. The range in leaf iron content for all treatments was 70 to 90 ppm—the checks contained 84 ppm. Values were higher than the 30 ppm iron that had previously been suggested as a threshold for reduced production of navel oranges. The lemon trees in this trial all showed symptoms of iron deficiency, however. Periodic visual tree evaluations showed no significant differences due to treatment.

Irrigation application

In Trial B, Geigy Sequestrene 138 (6.0% iron) was applied in June 1971 to furrow-irrigated mature lemon trees near Oxnard. The soil is calcareous (pH of

Lemon tree with severe, "lime-induced," iron deficiency showing the typical shortage of leaves and twig die-back.

8.0) and the trees were very chlorotic. Treatments were applied to two rows of 20 trees each, separated by guard rows.

The first row received 10 lbs of Geigy 138 in one furrow (on one side) each year for two years (treatment 1). This was equivalent to one-half lb of the chelate per tree per year. The second row received 10 lbs of the chelate in one furrow (on one side) in the spring, and 10 lbs in the furrow on the other side in the fall (treatment 2). This was equivalent to 1 lb per tree each year. The check row (treatment 3) received no iron.

Almost all trees in all three rows continued to appear chlorotic throughout the trial; however, a visual evaluation in the fall of 1972, almost 1½ years after the first treatment, showed slightly better vigor, leaf color, and estimated crop on treatment 2 (two sides of tree) than either of the other two treatments. Leaf analysis at the same time showed trees treated on one side only contained 70 ppm iron, those treated on two sides were 84 ppm, and the checks contained 82 ppm iron.

Foliar applications

A foliar spray trial (Trial C) was initiated on another row in this same grove in September 1970. In this annual spray trial, there were four treatments of individual trees, replicated ten times. Treatments were: (1) check (no spray); (2) Leffingwell Sorba Spray ZIP (3.0% iron) at 1 gallon/30 gallons water; (3) Niagara Iron Kemin (4.4% iron) at 1 gallon/30 gallons water; and (4) ITT Rayonier Penetrant spray (1270 ppm iron) at 1.5 gallons/30 gallons water.

Leaf analysis in the fall of 1972 showed average iron determinations of 83 ppm in the check trees; 120 ppm in the ZIP treated trees; 109 ppm in the Kemin treated trees; and 145 ppm in the Rayonier treated trees. Periodic visual tree evaluations for chlorosis have favored the Rayonier treatment. The differences have not been significant, however.

Trial D took place in the Point Mugu area near Oxnard, where mature Eureka lemon trees were growing in silty clay loam that was moderately calcareous (pH 7.0 to 8.2). Since subsoil permeability was somewhat restricted, a relatively high water table developed during rainy winters. Foliar sprays were applied each year using a low-volume sprayer on blocks averaging 270 trees. Evaluations included leaf analysis, yields in boxes per tree, and fruit-size measurements.

Treatments started in the spring of 1970 and included: (1) ZIP (3.0% iron) at 1 gallon/45 gallons water; (2) Rayonier I (1270 ppm iron) at ½ gallon/90 gallons water; (3) Rayonier II (1270 ppm iron) at 1 gallon/90 gallons water; (4) Rayonier III (1270 ppm iron) at 1½ gallons/90 gallons water; (5) Check (no spray); (6) Kemin I (4.4% iron) at ½ gallon/90 gallons water; (7) Kemin II (4.4% iron) at 1 gallon/90 gallons water; and (8) Kemin III (4.4% iron) at 1½ gallons/90 gallons water. Leaf analysis for 1971 and 1972 show no significant differences in iron—the range of all treatments was from 77 to 220 ppm. Yields have generally been greater, and the fruit size larger, from the foliar spray treatments; the data are not statistically significant, however.

R. M. Burns is University of California Agricultural Extension Farm Advisor (Citrus), Ventura County. S. Oliva is Assistant Manager, Oxnard Pest Control Association, Oxnard. G. Ming is Ranch Manager, Rancho Sierra Vista, Point Mugu.

Kenneth Gray, ITT Rayonier, Shelton, Washington; James Davis, Leffingwell Chemical, Santa Paula; James McKelvie, Niagara Chemical, Santa Paula; Robert Austin, Geigy-CIBA, Los Angeles, and Robert Needham, Pacific Pest Control, El Rio, California, supplied chemicals and assisted with these trials. U.C. Agricultural Extension Soils and Water Specialist Roy Branson assisted with the manuscript, and Farm Advisor Robert Brendler provided statistical assistance.