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A RAPID METHOD FOR CURING CHLOROTIC AVOCADO TREES

A. Kadman and A. Cohen
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The iron-deficiency type of chlorosis in avocado trees may appear in different degrees of severity, in many cases due to lack of so-called "active iron" within the leaves. In light cases, chlorosis may hardly be recognized, whereas in severe cases the trees lose most of their leaves and may degenerate completely. Very often chlorotic trees can be cured by a sufficient amount of certain iron compounds, applied to the trees by the right method.

In previous experiments (3), application of iron chelates through the soil was successful in curing chlorotic avocado trees. In some cases, however, it took quite a long time before the trees recovered. Furthermore, soil application usually requires the use of large amounts of compounds, some of which are very expensive. In some experiments (4) various iron compounds were applied by foliar spray, but in most cases the results were poor. Preliminary experiments to apply the iron compounds directly into the trunk or branches showed some promising results.

Of the various methods developed for the injection of materials into trees (2), a modification of the method developed by Cohen (6) seemed to be the most suitable for our purpose. In the present paper the efficiency of this method is compared with that of other treatments.

MATERIALS AND METHODS

Plant Material

All experiments were carried out on 12-13-year-old Wurtz and Edranol avocado trees in the Bet Dagan experiment orchard, during the summer and fall of 1972 and the spring of 1973.

Application Methods

Sequestrene 138-Fe was applied to the trees by one of the following methods.

a. Infiltration — the equipment consists of a bottomless inverted bottle connected to a latex tube by means of a rubber stopper and glass tube. The other end of this tube is firmly connected to a wall plug overlapping one third of the plug's length. The wall plug is forcefully inserted into a 50-mm-deep, 8-mm-wide hole drilled into the trunk. The overlapping latex tube is curved, as shown in Fig. 1, between the tree surface and the extended end of the plug. This type of connection prevents any loss of solution. The bottle is attached to the trunk approximately 50 cm above the hole (Fig. 2). Using this method 450 cc of 1% Sequestrene 138-Fe solution entered the tree by gravity and its suction within 48 h.

b. Pressure injection — 450 cc of either 0.5% or 1% chelate solution is forced into a 12-mm latex tube (2.5 mm wall thickness), through a wash bottle by means of compressed air. The solution produces a bulbous protrusion about 60 mm in diameter and 200 mm in length. The pressure within the tube is about 1.4-1.5 atm. This tube is attached to the tree by means of a wall plug as described previously. The bulb should be wrapped with aluminum foil to prevent its bursting (which is accelerated by direct sunshine), (Fig. 3). Using this method, the 450 cc of solution entered the tree within 16-24 h.

c. Soil application —50 g. of the chelate powder is placed in a shallow ditch around the tree and watered.

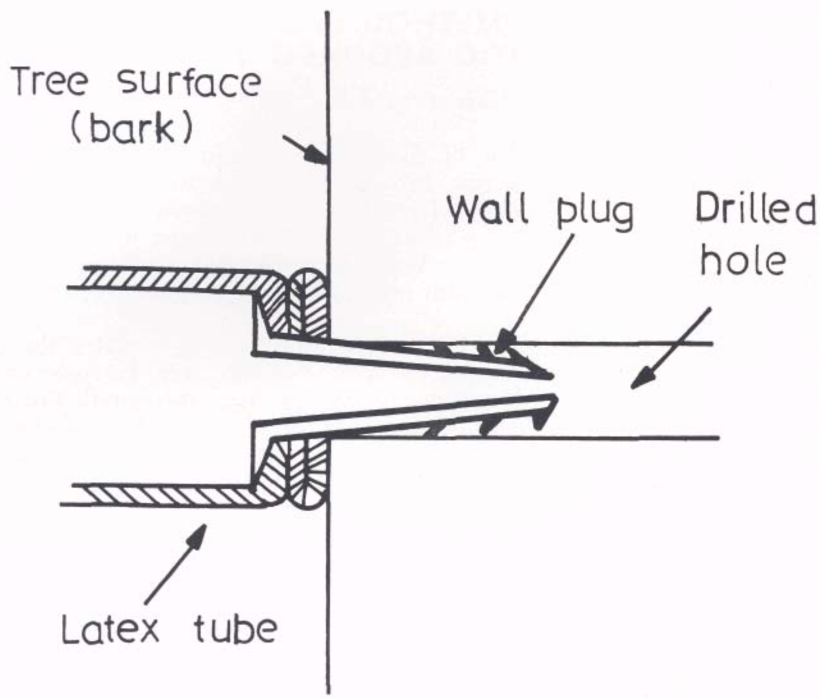

Figure 1. Schematic presentation of the method by which the latex tube is connected to the tree.

Leaf Analysis

Chlorophyll content — was determined by a modification (1) of the Mackinny method (5), using a Bausch and Lomb "Spectronic-20" spectrophotometer.

Iron content — The leaf samples were carefully washed several times with tap and distilled water, dried for 24 h at 65° C, and ground through a 40-mesh screen. One gram of dried-out leaf powder was burned to ash and analyzed by the Orthophenantroline method (7). The readings were carried out with a Bausch and Lomb spectrophotometer.

RESULTS AND DISCUSSION

Preliminary Observations

Pressure injection of Sequestrene 138-Fe was first tried in June 1972. For this trial three similar chlorotic trees were selected and into one of these the chelate was injected (trunk injection) under pressure and into the second without pressure; the third tree was left as an untreated control. The rate of penetration of the solution into the tree was much faster in the pressure injection, and the day after treatment some of the leaves of this tree showed reddish veins (produced by the red color of the iron solution). Less than one week after treatment the leaves of both treated trees were greener than those of the control tree. Later on, a new flush of growth started on both these trees, but it was much more profuse on the pressure-injected tree. The second summer flush was also dark green, whereas the control tree had hardly any new growth. However, the pressure-injected tree again had some chlorotic new growth, apparently due to the abundance and rapid development of the new growth with insufficient iron content.

Based on these observations, it was decided to study further only the pressure-injection treatments.

Figure 2. A close-up of infiltration into an avocado trunk. (For details, see text).

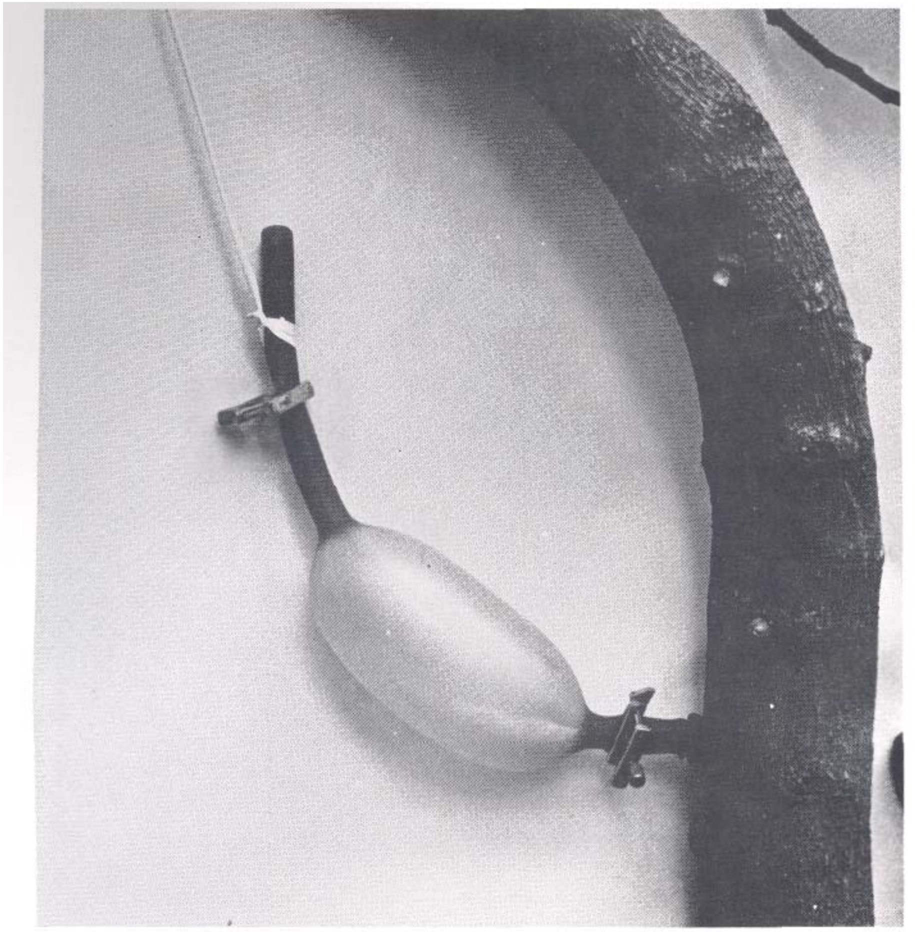

Figure 3. A closeup of pressure injection into an avocado trunk. (For details, see text).

In the second trial carried out during October 1972, pressure injection was compared with soil treatment. Each treatment was carried out on one tree of the Wurtz variety and one of the Edranol variety. The results of this trial were very similar to those of the previous one, namely, an early and rapid rate of greening of the pressure-injected trees which exhibited also abundant new growth. The soil-treated trees were slow to react, while the control trees remained chlorotic and had hardly any new growth.

Spring 1973 Experiment

In this experiment pressure injection was again compared with soil treatment. Each treatment was carried out on two Wurtz trees and one Edranol tree. The injection to the Edranol tree was given in the trunk, while that to the Wurtz trees was given in one of the two main branches. Chlorotic and green leaves were marked at the time of the treatment and were sampled for various determinations at later dates. The effects of these treatments on the chlorophyll level are presented in Table 1.

TABLE 1

Effects of Pressure Injection and Soil Treatment with Sequestrene 138-Fe on the Chlorophyll Level in Avocado Leaves

Variety	Treatment	Leaf Condition at Time of Treatment	Chlorophyll A & B Level (on % dry weight) x		
			25.III.73***	10.V.73	8.IV.73
Wurtz	Control	Green	0.290	0.266	0.296
	P.I. *		0.249	0.277	0.260
	S.T. **		0.294	0.257	0.276
	Control	Chlorotic	0.056	0.081	0.106
	P.I.		0.052	0.104	0.162
	S.T.		0.042	0.138	0.206
Edranol	Control	Chlorotic	0.072	—	0.065
	P.I.		0.075	0.098	0.128
	S.T.		0.069	0.142	0.191

* *P.I.=Pressure injection: 2.5-5 g/branch or tree.*
** *S.T.=Soil treatment: 50 g/tree.*
*** *Date of treatment.*
x *Avg. of two samples, two determination per sample.*

As expected, the Fe-chelate had hardly any effect on the chlorophyll level of green leaves. As to the chlorotic leaves — an increase with time in chlorophyll was apparent also in the control trees of the Wurtz variety. No such increase occurred in the Edranol tree. In both varieties, however, the level of the chlorophyll in the chlorotic leaves was only about one third or less than that of the green leaves. The pressure injection treatment caused a much greater increase in the chlorophyll level than that of the soil treatment, and was apparent as early as 10-12 days after treatment. The faster and greater effect of the pressure injection was also very marked in the amount of new growth, which was again very abundant and had a healthy appearance. The effects of these treatments on the level of some other mineral elements were too erratic in this experiment to enable any definite conclusions.

Some information about the effects of the pressure-injection treatment on the Fe level was gained from the treatment of a very severely chlorotic, stunted Wurtz tree. This tree was treated twice, in one of the two main branches in summer 1972 and on the other main branch in spring 1973. Pressure injection of 250 cc 1% chelate 138-Fe was given each time. In both cases treatment was followed by a rapid red coloration (within 24 h) of the leaves, which abscised after a few days. About 10-14 days later, a very profuse new flush started, and this new growth had dark green leaves. In July 1973, about four months after the second treatment, the entire tree had a good green canopy and had grown in size. The levels of chlorophyll and Fe in the mature and young leaves of this tree are presented in Fig. 4.

The level of chlorophyll at the time of treatment was extremely low, but it rose very rapidly with time. The level of Fe rose immediately after treatment, but declined later in the young leaves. Still, these leaves retained a high enough level to enable the production of sufficient amounts of chlorophyll and new healthy growth. These observations are of great importance due to the fact that what seemed to be a doomed tree became, after two injections, a healthy, vigorously growing tree.

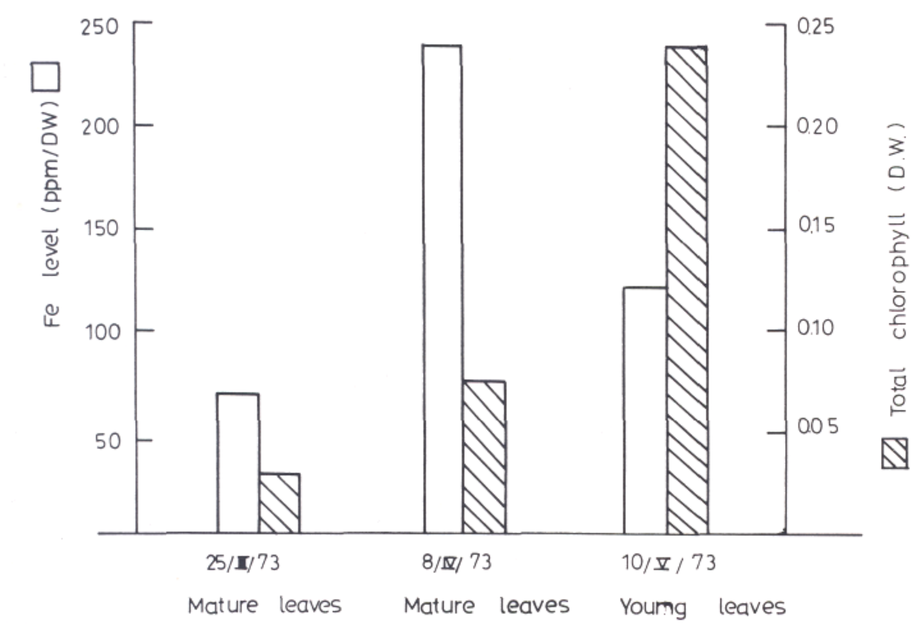

Figure 4. Effect of pressure injection of Sequestrene 138-Fe on the level of chlorophyll and Fe in the leaves of a chlorotic Wurtz tree.

CONCLUSIONS AND SUMMARY

Pressure injection of Sequestrene 138-Fe solution into avocado trunks or branches was found to result in a very rapid response, achieved with very small amounts of this expensive material. The duration of the effect was, however, in most cases relatively short, and more than one injection per tree seems to be needed in order to ensure good distribution of the material throughout the tree.

The pressure injection method, at its present stage of development, could therefore, be of benefit in those cases where rapid responses are required, especially in severely iron deficient chlorotic trees; it should be followed by soil treatment to provide effects of long duration.

Due to the rapid response of trees to the pressure injection, this method may also serve as a good diagnostic tool in those cases where iron deficiency is suspected.

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