

## IDENTIFYING MANGANESE DEFICIENCY IN AVOCADO TREES

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We recently described a leaf chlorosis pattern that appeared in Hass and Bacon trees following soil application of iron chelate to correct iron deficiency (Wallihan and Miller, 1966). Leaf analysis revealed that the manganese concentration was low and the appearance of the leaves was similar to published photographs of manganese deficiency symptoms in the avocado (Lynch, 1941). We have now confirmed that the observed symptoms were actually caused by deficiency of manganese by the fact that symptoms disappeared when manganese sulfate was applied either to the soil, or to the leaves in the form of a spray.

In addition, more severe symptoms than previously observed have appeared so that we now have recorded a range of symptoms from mild to severe, corresponding to leaf manganese concentrations of 16 and 1 part per million, respectively. These are shown in Fig. 1, along with an intermediate pattern at 10 ppm of manganese. Similar symptoms in the Hass, Nowels, and Zutano varieties growing in Sicily were also reported earlier and the same relation between chlorosis pattern and leaf manganese concentration appears to apply. Thus, leaf analysis can be used to distinguish between chlorosis patterns caused by zinc or by manganese deficiencies. This is important because, at certain stages, the patterns can be similar.

In July of 1968, we collected leaf samples from Zutano trees in Ventura County that appeared to have manganese deficiency pattern. Leaf analysis showed 14 ppm of manganese and 50 ppm of zinc, thus establishing that manganese deficiency of avocados does occur in California. To the best of our knowledge, these trees had not received any iron chelate or other specific treatment that might have induced this condition.

When symptoms appear in an orchard and the diagnosis is in doubt, test sprays might provide the most satisfactory means of making a distinction. We used simple water solutions containing 300 ppm of either manganese or zinc. These can be prepared by dissolving 1 pound of fertilizer grade manganese sulfate or zinc sulfate in 100 gallons of water, or 1 teaspoon in 1 gallon. These would, of course, need to be applied during the growing season to get a response within a reasonable time, which would be 2 to 4 weeks.

There is a possibility that manganese and zinc can both be deficient, in which case complete correction could not be obtained with either element alone. A combination spray of both elements in the same solution, at the same rate, would then be needed.

These suggestions should not be taken as general recommendations for orchard

sprays. The concentration of 300 ppm of manganese has been shown to be effective on one occasion without causing injury. Avocado trees might tolerate several times that concentration but no information is available on this point.



Figure 1. Photographs of recently matured avocado leaves — 'Hass' variety, collected in mid-June — showing the observed range of symptoms of manganese deficiency. Mn concentrations in the leaves were:  
top row .....16 ppm  
middle row .....10 ppm  
bottom row ..... 1 ppm

#### LITERATURE CITED

- Lynch, S. J. 1941. Florida Agric. Expt. Sta. Ann. Rept. P. 194.  
Wallihan, E. F. and M.P. Miller. 1966. California Avocado Soc. Yearbook. 50: 95-98.