

## THE EFFICACY OF AERIAL APPLICATIONS OF ZINC TO AVOCADO TREES

**B. W. Lee**

*Farm Advisor, Ventura County*

Zinc deficiency, or "mottle leaf" as it is often called, occurs in many avocado orchards in Ventura County. The avocado tree may decline and even die without the small but essential amount of zinc—a micronutrient.

### SYMPTOMS

The earliest symptoms are mottled leaves developing on a few of the terminals. The areas between the veins are light green to pale yellow. As the deficiency progresses, the yellow areas get larger and the new leaves produced are smaller. In advanced stages a marginal burn develops on these stunted leaves, twig dieback occurs, and the distance between the leaves on the stem in new growth is shortened, giving a crowded "feather-duster" appearance. Yield is reduced and some fruits may be more round than is normal for the variety.

### CONTROL

To maintain tree vigor and production, it is necessary to apply zinc as a spray to the foliage. Soil applications of zinc have been successful only on acid soils in San Diego and Santa Barbara Counties.

A major problem when applying zinc as a foliage spray is getting good coverage where orchards are inaccessible to ground equipment due to overcrowding as trees mature.

### FIELD TRIAL

A field trial was initiated to compare the costs and effectiveness of foliar applications of zinc sulfate and zinc chelate by helicopter and by ground equipment using hand guns.

A mature twenty-year-old Hass avocado orchard on Mexican root-stock located two miles west of Santa Paula was used for the trial. Trees were graded for size and vigor. Then blocks of uniform trees were selected for differential treatments. Treatments were applied in June when the spring flush leaves were two-thirds to fully expanded. Maximum absorption by the leaf occurs at this stage of growth.

### METHOD

Each tree was visually divided into sections—top, middle, and bottom. Just prior to spraying, 25 pairs of opposite leaves in each section were selected for leaf analysis. Usually, the third or fourth pair from the terminal bud was selected. One leaf from each pair was collected immediately. The other leaf was tagged with plastic tag used to seal wrappers of loaves of bread and collected seven days after spraying.

## MATERIALS. RATES. AND COSTS

Two zinc compounds were used. Both are commercially available and commonly used by growers—zinc sulfate (36% metallic zinc) and zinc chelate (14% metallic zinc). Table I.

TABLE I: MATERIALS AND RATES BY METHOD OF APPLICATION

| <i>Material</i> | <i>Helicopter</i>                                     | <i>Ground Equipment</i>   |
|-----------------|---|---|
| Zinc sulfate    | 16 lbs.<br>3 ozs. spreader<br>20 gals. water per acre | 2 lbs.<br>1 oz. spreader<br>100 gals. water per acre <sup>1</sup> |
| Zinc chelate    | 8 lbs.<br>3 ozs. spreader<br>20 gals. water per acre  | 1 lb.<br>1 oz. spreader<br>100 gals. water per acre <sup>1</sup>  |

(<sup>1</sup>) Formula for hand application is for 100 gallons of water. Eight hundred (800) gallons per acre were applied.

A comparative study of the costs of materials and application methods are reported in table II.

TABLE II: COSTS COMPARISONS OF MATERIALS AND METHODS OF APPLICATION

| <i>Material</i>                           | <i>Helicopter</i>              | <i>Ground Equipment</i>         |
|---|--------------------------------|---------------------------------|
| ZnSO <sub>4</sub>                         | 16 lbs. @ \$0.18/lb = \$ 2.88  | 16 lbs. @ \$0.18/lb. = \$ 2.88  |
| Spreader                                  | 3 ozs. @ \$0.0625/oz = \$ 0.19 | 8 ozs. @ \$0.0625 = \$ 0.50     |
| Application                               | 20 gallons per acre = \$ 8.00  | 800 gallons per acre = \$15.00  |
|   |                                | = \$18.38                       |
| Total Materials and Application = \$11.06 |                                |                                 |
| Zn Chelate                                | 8 lbs. @ \$1.18/lb. = \$ 9.44  | 8 lbs. @ \$1.18/lb. = \$ 9.44   |
| Spreader                                  | 3 ozs. @ \$0.0625/oz = \$ 0.18 | 8 ozs. @ \$0.0625/oz. = \$ 0.50 |
| Application                               | 20 gallons per acre = \$ 8.00  | 800 gallons per acre = \$15.00  |
|   |                                | = \$24.94                       |

Total Materials and Application = \$17.62.

## RESULTS

One week after spraying, the tagged leaves were collected from each section (top, middle, bottom) and analyzed for zinc. Reported in Table III are the before and after results of each treatment in ppm of zinc.

Each value is the mean of six individual determinations.

TABLE III

Zinc Sulfate

|        | <i>Helicopter</i> |       | <i>Ground Equipment</i> |       |
|--------|-------------------|-------|-------------------------|-------|
|        | Before            | After | Before                  | After |
| Top    | 21                | 106   | 23                      | 47    |
| Middle | 20                | 112   | 21                      | 78    |
| Bottom | 19                | 179   | 23                      | 90    |
| Ave.   | 20                | 132.3 | 22.5                    | 71.6  |

Zinc Chelate

|        | <i>Helicopter</i> |       | <i>Ground Equipment</i> |       |
|--------|-------------------|-------|-------------------------|-------|
|        | Before            | After | Before                  | After |
| Top    | 23                | 30    | 21                      | 32    |
| Middle | 23                | 33    | 24                      | 42    |
| Bottom | 23                | 36    | 21                      | 39    |
| Ave.   | 23                | 33    | 22                      | 37.6  |

Zinc sulfate resulted in a substantially higher amount of zinc in the leaves than the zinc chelate. This is probably related to the concentration of metallic zinc in each of the formulations applied. Zinc sulfate at 16 pounds per acre supplied 5.76 pounds of metallic while 8 pounds of zinc chelate supplied 1.12 pounds. Formulas of near equal concentrations of metallic zinc would require 5 times less zinc sulfate (3.2 lbs.) or 5 times more zinc chelate (40 lbs.) per acre. The effect of the latter concentrations on effectiveness, phytotoxicity, and costs needs to be investigated.

**DISCUSSION**

Through experience gained thus far in leaf analysis, the ranges for zinc in avocado leaves have been tentatively established at 10-20 ppm for deficient, 30-150 for adequate, and 300 or more for excess.<sup>1</sup>

The zinc content of the leaves in all blocks prior to treatment was at or near the deficient range of less than 10-20 ppm.

The zinc content of the leaves in all blocks after treatment ranged from 33 to 132.3 ppm or in the adequate range for avocados.

From the data developed from this field trial, it is apparent that:

- Zinc sulfate is more effective than zinc chelate at the concentration used.
- The helicopter is an effective method of application.
- The cost of aerial application is \$7.32 per acre less than ground equipment using hand guns.

**ACKNOWLEDGEMENTS**

The author is indebted to the late Kelly Thille for the test site and to Dr. C. K. Labanauskus, Horticulturist, and R. G. Platt, Extension Subtropical Specialist, for their cooperation and assistance.

## **LITERATURE CITED**

1. Goodall, G. E., et. al. 1965. Avocado Fertilization. California Agricultural Experiment Station and Extension Service Leaflet 24 Rev. (Third Printing)