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SEASONAL CHANGES IN CONCENTRATIONS OF MICRONUTRIENTS IN FUERTE AVOCADO LEAVES

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Leaf analysis is being widely used as an aid in diagnosing the micronutrient status of avocado trees. Fluctuations of micronutrients in the leaves in relation to age must be known if the leaf analysis is to be used effectively as diagnostic tool either experimentally or commercially. This paper presents data showing the relationship between the age of Fuerte avocado leaves and the micronutrient concentrations in them.

MATERIALS AND METHODS

The experimental orchard previously described (3, 5) is sprinkler-irrigated, non-tilled, and located on acid soil. Weeds under the trees are controlled with oil herbicides. Prior to the establishment of the experiment, the avocado trees received 3 pounds of elemental nitrogen per tree per year from sulfate of ammonia broadcast under the trees.

The 14 fertilizer treatments (71, 73, 74, 76, 77, 78, 79, 80, 82, 83, 85, 86, 87, and 88) considered in the present report have been described previously (3). Each of the 14 treatments is replicated 5 times in single-tree plots. Leaf samples for micronutrient chemical analysis were obtained from each plot at monthly intervals over 3-year period—from June, 1952, to January, 1954; and from May, 1957, to April, 1958, inclusive. Samples consisted of leaves developed during the spring and early summer. At each sampling date, 10 outside leaves of the desired age were selected from non-fruiting shoots around each tree at a height of 4 to 6 feet. Shoots sampled did not have a cycle of leaves younger than those sampled. The samples included both the petioles and blades of the leaves. It would have been highly desirable to sample and analyze leaves separately from each plot for each sampling date. This could not be undertaken with the resources then available because of the physical limitations of labor and expense. Therefore, a decision was made to obtain leaf samples at monthly intervals from each replication separately on each sampling date and to pool the leaves from the 5 replications into one sample.

Methods of preparing leaf samples for chemical analysis and of analyzing of leaves for zinc, copper, boron, and manganese were the same as those used previously (4, 8).

The data obtained from the chemical leaf tissue analyses were analyzed statistically (11). There were no significant interactions between fertilizer treatments and age of leaves on micronutrient concentrations in the leaves of this experiment. Since the

influence of fertilizer treatments on concentrations of micronutrients in the leaves has been reported previously (5), only the mean effects of 14 observations of age of leaves on the micronutrient concentrations in the leaves are presented at each point on the curves.

RESULTS

Zinc:—The zinc concentration in the leaves sampled from May, 1953, to January 1954, did not change significantly during that season (Fig. I). The concentration of zinc in the leaves sampled in June, July, August, September, and October, 1952 (1, 2, 3, 4, and 5 months old, respectively) increased slightly and after that decreased with the age of the leaves. The zinc concentration in the leaves sampled in May, June. July, and August, 1957 decreased very rapidly for the first four months, then leveled off for the following six" months, and then decreased again for another two months.

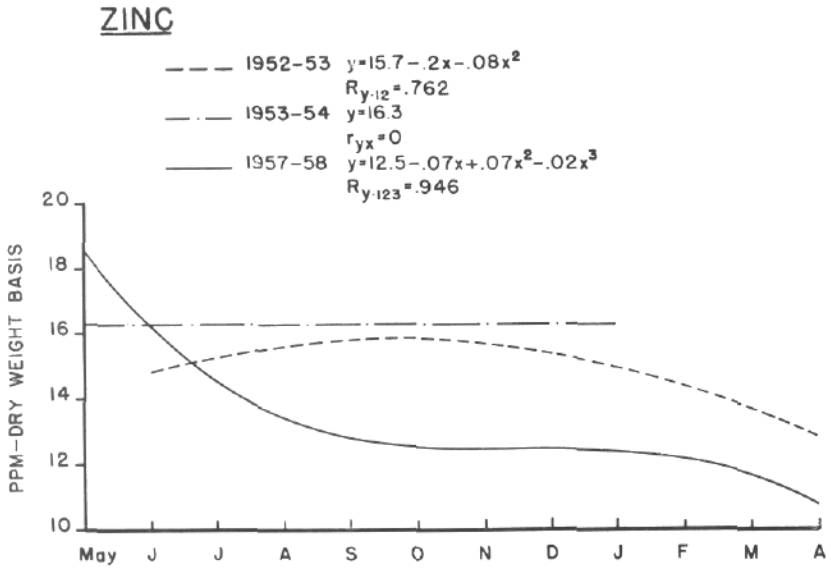

Fig. 1. Seasonal changes in zinc concentration in Fuerte avocado leaves as affected by the age of the leaves.

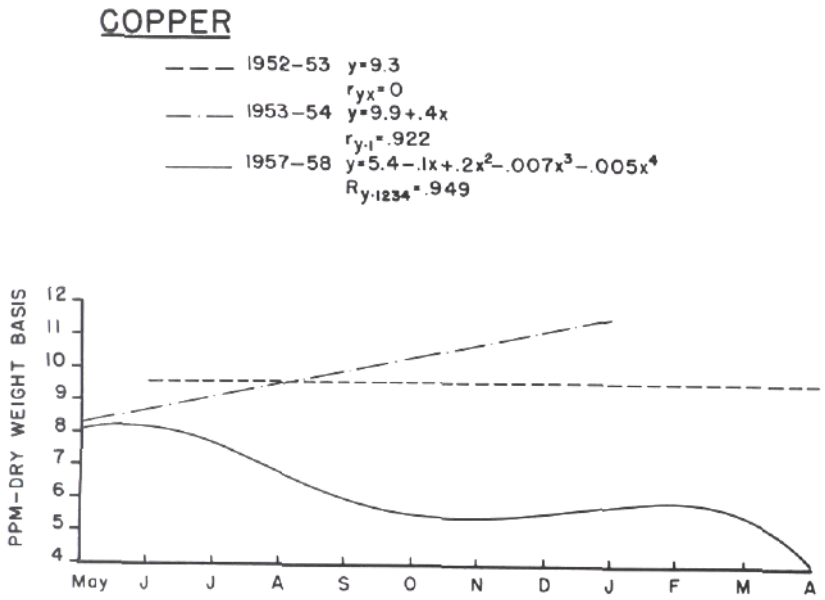

Fig. 2. Seasonal changes in copper concentration in Fuerte avocado leaves as affected by the age of the leaves.

Copper:—The data presented in Fig. 2 show that avocado leaves sampled in 1952-53 did not show any significant changes in copper concentration. The leaves sampled in 1953-54 indicate that the copper concentration in the avocado leaves increased with the age of the leaf. On the other hand, the copper concentration in the leaves sampled on 1957-58 increased in the first three months of the season and after that decreased for the rest of the season.

Boron:—The data presented in Fig. 3 show that leaves from avocado trees sampled in 1952-53 contained Just about the same concentrations of boron during the growing season, The concentration of boron in avocado leaves sampled in 1953-54 and 1957-58 seasons decreased with the age of the leaves. It is not known, however, whether this trend in the boron concentration in avocado leaves is typical of avocado trees when grown under high-level boron conditions. The concentration of boron in the leaves of this particular Fuerte avocado orchard was quite low as compared to other avocado orchards sampled in different parts of Southern California.

Manganese:—The data presented in Fig. 4 indicate that the manganese concentration in avocado leaves tended to increase with the age of the leaves sampled in 3 different years. However, it is not known whether this trend in the manganese concentration in avocado leaves is typical of avocado trees growing under low-level manganese conditions. Manganese concentration was found to be much greater in avocado than citrus leaves growing under similar soil conditions (6).

The concentrations of zinc, copper, and manganese were higher and boron lower in the leaves sampled in 1952-53 and 1953-54 seasons than those found in analogous leaves of the same trees sampled in 1957-58. Primarily, this is due to the acidifying effects of ammonia sulfate used prior to the establishment of the experiment in 1951 after which

date different fertilizers were used (3). There is strong reason to believe that soil applications of 3 pounds of elemental nitrogen from ammonia sulfate for many years increases soil acidity and, as a consequence, zinc, copper, and manganese became more available to the plant, while boron under the same conditions was leached out more readily. In addition such seasonal factors as temperature and rainfall, and related plant factors such as yield and vegetative growth, affect the concentrations of micronutrients in the leaves.

DISCUSSION AND SUMMARY

The micronutrient data as affected by the age of the leaves pertaining specifically to tree crops are limited. The relation of the concentration of zinc, copper, and manganese in avocado leaves to age of the leaf coincide partially with findings of Bingham (1) on avocados under controlled and field conditions, of Bradford and Harding (2) on Valencia orange, and of Labanauskas et al (7) on Washington Navel orange under field conditions. All of these writers found that zinc and copper tended to decrease and manganese to increase with the age of the leaf through the growing season.

In Fuerte avocado leaves the relation of boron concentration to age does coincide with the findings of Bingham (1) on Hass avocado trees growing under controlled and field conditions. The data obtained in this experiment on the relation of boron concentration to age of Fuerte avocado leaves does not coincide with the findings of Smith et al. (10) and Bradford and Harding (2) with Valencia orange leaves, of Labanauskas et al. (7) with Navel orange leaves, or of McCIung and Lott (9) with peach leaves. All of these authors found that boron concentration tended to increase throughout the life of the leaf, except in the winter months. Boron toxicity or deficiency has not been observed in avocado trees growing in southern California. Citrus trees, however, are affected quite severely by boron toxicity in the later parts of the growing season in some of the citrus producing areas. In other words, boron concentration decreases with the age of the leaf while in citrus it increases with the age of the leaf. Seasonal changes of boron concentration in avocado leaves may partially explain why boron toxicity has not been observed in older avocado leaves and still may be quite severe on citrus. The possibility that oils which contain too much boron for good citrus production may be utilized satisfactorily for avocado production is being investigated.

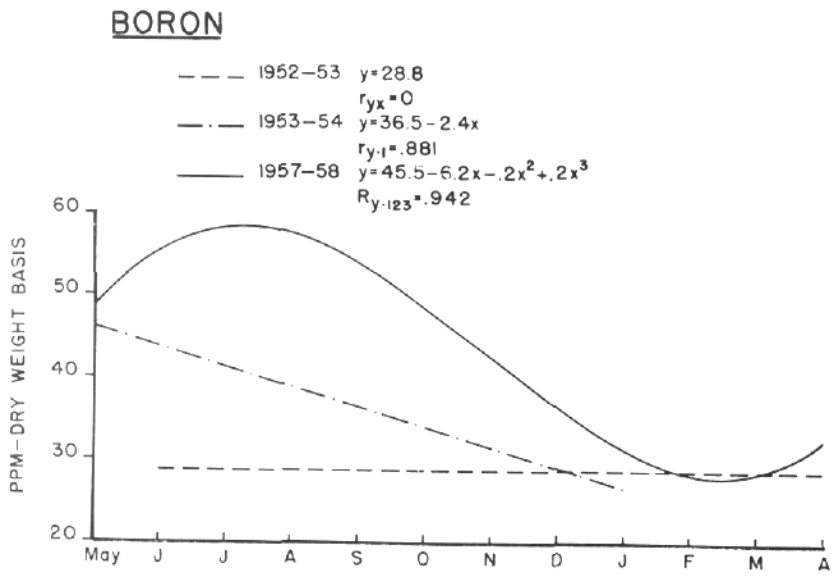

Fig. 3. Seasonal changes in boron concentration in Fuerte avocado leaves as affected by the age of the leaves.

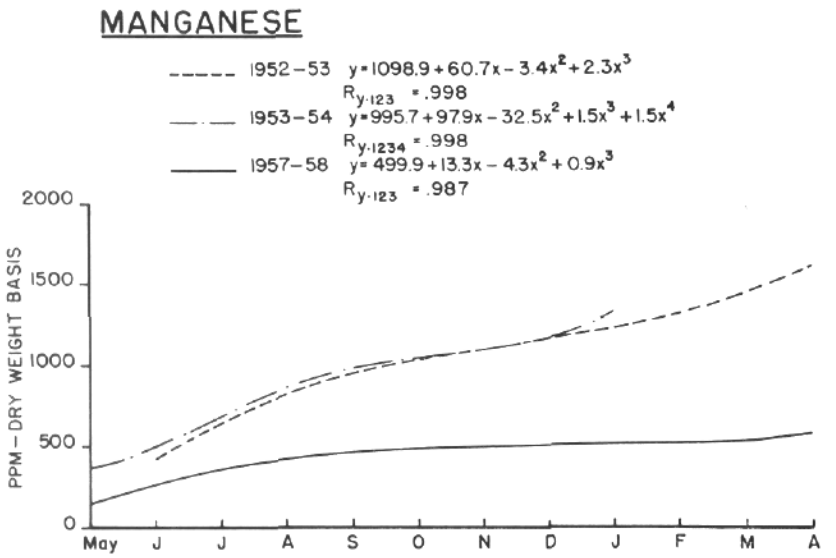

Fig. 4. Seasonal changes in manganese concentration in Fuerte avocado leaves as affected by the age of the leaves.

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