

ZINC DEFICIENCY OF THE AVOCADO

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Little-leaf or "mottle-leaf" of the avocado appears to have been first reported in California in 1928 by Coit¹, who gave it the descriptive name of "frizzles". Parker² described the disease more completely in 1936, and stated that it responded to the application of zinc sulfate sprays under California conditions.

It has been demonstrated during the past year that zinc sulfate sprays also will correct little-leaf of avocado trees growing in the limestone soils of Dade County, Florida.

The disease has apparently not been recognized in Florida as a zinc deficiency trouble up to the present time. It has occurred in Florida for a number of years, according to several growers. It has been observed that temporary partial recovery occurred in some instances without special treatment.

Little-leaf has become increasingly evident during the past two years, which have been notable for the occurrence of long drouthy periods during the winter and spring months. It has been especially severe in certain groves where the nitrogen applied in the fertilizer for several years has been mainly or entirely synthetic.

Symptoms

Mild cases of zinc deficiency on the avocado are difficult to diagnose with accuracy, since there are other factors responsible for the development of chloroses on the foliage.

Chlorotic areas appear between the veins of the leaves, which are somewhat smaller than normal, in early stages of the trouble. In severe cases, leaves become markedly smaller in size (Plate 1), are somewhat trough shaped with a tendency to become recurvate, and are chlorotic or slightly bronzed in color particularly between the veins. The twig growth is also considerably reduced so that the leaves are close together, resulting in a rosette appearance (Plate 2). Severely affected old leaves frequently develop many small dead spots in the leaf blades.

Fruit on severely affected branches is usually small, with a decided tendency to sunburn and develop dead spots in the skin. These spots are usually invaded by fungi before the fruit reaches maturity, and the flesh breaks down rapidly with fungus decay after the fruit is harvested.

Terminal twigs may die back from a few inches to several feet in case the condition is of long standing and severe. Fruit is either not produced at all or the crop is extremely light in trees showing considerable dieback. The reduction in leaf surface may result in more or less severe sun-burning of the branches or even of the main trunk of the tree.



Plate 1. Little-leaf of Lula avocado on left; normal leaf on right





Plate 3. Correction of little-leaf condition on Lula avocado following zinc sulfate spray. Photo taken September 6, 1939; spray applied in May, 1939.

The severity of the trouble may vary considerably in different branches in the same tree or from tree to tree, ranging from mild to very severe. Symptoms are usually more pronounced during the period when the crop is maturing. Mild cases of little-leaf tend to disappear more or less during the summer rainy seasons, and even severely affected trees may put out some normal leaves at this time. Thus far, no trees have been observed to die from the trouble.

Experiments

The first applications of zinc sulfate sprays to affected trees were made in May, 1939, in an old grove near Homestead. This grove was a mixed planting of varieties of avocado, with Lula, Waldin, Wagner, Collinson, and Taylor: predominating. A few orange and mango trees were scattered among avocado trees in one corner of the grove.

The trees had borne good crops generally until the 1938 season, when a large block in the northwest corner, and scattered trees throughout the remainder of the grove, began to show severe little-leaf symptoms, according to a statement from the present owner of the property. The severity of the condition increased in trees originally showing the trouble, and additional trees became affected during 1939. Crop production was definitely curtailed as a result. The sources of nitrogen used in the grove for the past

several years have been almost entirely synthetic.

None of the avocado varieties was entirely free of the little-leaf condition, but trees of the Lula and Waldin varieties were showing the severest symptoms. The orange trees in the grove showed severe "frenching" characteristic of zinc deficiency on citrus. The mango trees also showed a little-leaf condition indicative of a nutritional disorder.

A zinc sulfate-lime spray, made from 10 pounds of zinc sulfate (89%), 5 pounds of hydrated lime, and 100 gallons of water, with spreader added, was applied with a power sprayer on May 15 to thirteen severely affected trees. Eight additional trees, similarly affected, were sprayed with manganese sulfate combined with lime, and six trees were sprayed with a solution of iron sulfate.

The trees sprayed with zinc sulfate were showing marked evidence of recovery by July 1. The small chlorotic leaves never increased in size, but were decidedly greener in color except for the small necrotic spots mentioned under symptoms. New twig growth was normal in length and the new foliage was of normal size and color (Plate 3). Improvement continued in these trees throughout the summer and a good bloom appeared in March, 1940, in those not severely injured by the January freeze. The trees sprayed with manganese sulfate or iron sulfate showed no improvement over unsprayed trees.

Ten additional severely affected trees were sprayed with the same formula of zinc sulfate-lime on September 6. Several of these were showing dieback and one Lula tree in particular was in extremely bad condition (Plate 4). A normal leaf could not be found on this entire tree and a large area on the trunk was sunburned severely. Due to lateness in the season, no new growth appeared immediately following the applications, but the foliage showed decided improvement in color within 30 days. New growth which appeared subsequent to the January freeze was normal and luxuriant on trees which escaped damage by the cold. The Lula tree which showed extreme symptoms before spraying made a remarkable recovery (Plate 5).

Blocks of many of the leading commercial varieties of avocado are maintained as fertilizer test plots at the Sub-Tropical Experiment Station. A number of trees in the Lula, Trapp, and Waldin blocks have developed a severe little-leaf condition during the past two years, and many other trees of these varieties have been showing symptoms suspected of being mild cases of zinc deficiency. The most pronounced symptoms of zinc deficiency occurred in the plots receiving a zero percent organic nitrogen formula as the fertilizer treatment. Six trees of each fertilizer plot in the Trapp block were sprayed on September 6 with the zinc sulfate-lime formula, leaving three trees in each fertilizer plot as checks. Little new growth appeared in these trees following the treatment, probably because of serious infestation of *Dictyospermum* scale which occurred generally in the block. Some improvement in color of the foliage was evident in the sprayed trees by January 1, 1940. The January freeze severely damaged many of the trees in the block so that further observations have been suspended for the present.



Plate 4. Severe zinc deficiency symptoms on Lula avocado tree. Photo taken September 6, 1939.



Plate 5. The Lula tree shown in Plate 4 after spraying with zinc sulfate. Photo taken March 18, 1940; spray applied September 6, 1939.

Discussion

It would appear from the experimental work to date that little-leaf of the avocado is a severe manifestation of zinc deficiency, and that it may be corrected readily by applications of zinc sulfate combined with lime as a spray. Experimental work has not

been continued long enough to answer definitely the question of optimum times and amounts of zinc to apply. It is probable, from the results obtained in experimental tests on other crops by other workers, that the most effective time to apply the spray is just before a major growth cycle. For the present, the 10-5100 formula of zinc sulfate-lime is tentatively recommended for the correction of severe cases of zinc deficiency, and one-half that amount is recommended for the correction of mild cases of the trouble. Experiments to be conducted during 1940 should determine, to a large extent, the quantity of zinc necessary for maintenance of correction.

Observational evidence is strongly indicative that the use of synthetic forms of nitrogen to the exclusion of organic sources of this element is conducive to the development of zinc deficiency symptoms. It is entirely possible that the synthetic forms of nitrogen may be used without abnormal growth response, provided the zinc requirement of the trees is satisfied by application of sprays or by other means. It is also evident that drouthy periods are favorable to the development of zinc deficiency symptoms, provided adequate water is not supplied by irrigation.

1 Coit, J. Eliot. Pests and diseases of the Avocado. California Avocado Assoc. Yearbook for 1928: 18 - 21.

2 Parker, E. R. Mottle-leaf and sun-blotch control. California Avocado Assoc. Yearbook for 1936: 149 - 151.