California Avocado Society 1984 Yearbook 68: 59-60

5,000 Times Enlarged

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(This essay originally was taken from a talk given by the author at the Orange-Los Angeles Counties Avocado Institute, October 21, 1950, for publication in the 1950 Yearbook. Since a new generation of avocado growers now comprises the industry, the essay is re-presented here in a slightly modified version.)

If, by some mysterious means, we could be transported into a world where everything except ourselves was enlarged 5,000 times, we would see some amazing and wonderful sights. In this magical-state we would be able to obtain an excellent idea of the manner in which the avocado root rot disease develops in the soil, for example. Maintaining our present size, while everything else is enlarged 5,000 times, a mature avocado tree would be approximately 40 miles in height, with a trunk one and one-quarter miles in diameter; an average Fuerte avocado fruit would be about 1,000 feet long. With this same size relationship, the vegetative body of a fungus such as the cinnamon fungus (Phytophthora cinnamomi) would look much like a one-inch rubber hose.

If we could cut into a rotting feeder root (about 40 feet in diameter), we would see strands of this fungus "hose" winding in and out among the decaying cells. The spore-producing bodies (sporangia) of the cinnamon fungus would be about the size and general shape of footballs, formed on short side branches from the vegetative strands. We would see these sporangia forming in water in the soil or on the soil surface, but would only see these important structures if we were fortunate enough to make our visit at a time when soil temperatures were fairly warm (65° to 90°F). Thus, if we made our magic visit to the soil in the winter months, we would probably miss seeing these sporangia entirely.

Within these sporangia, we would see small swimming spores formed. These would be about the size of golf balls, with two small tails on each spore. Let us watch one of these motile spores; it emerges from the sporangium through a hole in the tip and swims about in water in the soil. We see that the spore is actually attracted to a small avocado root by chemicals (primarily amino acids) exuding from near the root tip. The zoospore settles down on the avocado root and begins to germinate, much as would a seed of the higher plants. After a few hours, the germ tube has penetrated the root and strands of the hose-like mycelium are invading the root tissue.

Then we would note the progress of the disease known as avocado root rot. Multiply this one spore by millions formed in the soil around an avocado tree under favorable

moisture and temperature conditions, and we would begin to see many more small avocado roots being invaded and decayed. We would see that, as a result of the rotting of these roots, the tree can no longer take from the soil the normal supply of water and various nutrients, such as nitrogen, phosphorus, potassium, and so forth.

By means of much laborious climbing up the trunk and branches of our 40-mile-high avocado tree, we would observe the effects of the rotting of roots. We note that the leaves are gradually becoming lighter in color instead of the normal dark green, because the roots are not taking up the necessary food materials. The new leaves and the fruit are not growing as large as they should, for the same reason. The cells in the branches also begin to slow down in activity and finally die, because of lack of food and water; we note that the tips of some of these branches have died back several miles! (This gradual deterioration normally would, of course, take place over a period of several years.)

Returning to the ground, we note that the hose-like strands of the fungus have grown into many feeder roots all through the zone, and most of these are completely rotted. The fungus rarely grows into the larger roots. Looking at an advanced stage of the disease, we have great difficulty in finding any healthy roots anywhere in the soil beneath the tree.

With recognition to the late Howard S. Fawcett, who so effectively developed the legendary microscipic character, "Mr. I. C. Bigg," for just this type of exploration.