**California Avocado Society 1988 Yearbook 72: 127-131**

# *Phytophthora citricola:* another Cause of Avocado Decline

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In the last fifteen years, a "new" disease caused by *Phytophthora citricola* has begun to cause increasing devastation in avocado groves throughout California (4). Trees affected by the problem lose their leaves, branch dieback occurs, and they eventually die (Fig. 1). The symptoms are very reminiscent of root rot caused by *Phytophthora cinnamomi.* However, a careful visual examination of the feeder roots fails to reveal any obvious evidence of disease—especially, the presence of black brittle diseased roots close to the sprinkler, which are characteristic of *P. cinnamomi.* In fact, the root system of the avocado tree affected by *P. citricola* often appears very healthy, contrasting with the very unhealthy appearance of the tree's sparse foliage. The only clue that a fungus is attacking the tree is the occurrence of a canker, or rot, at the base of the tree. This canker may be quite prominent and characterized by production of a white sugary exudate; and if the bark is cut away, a deep brown rot is usually exposed (Fig. 2). However, this canker is often very inconspicuous, and only careful examination of the crown of the tree, with removal of some of the bark, will reveal the nature of the problem. Although *P. citricola* is generally found on older trees, typically over ten years old, it is sometimes seen on much younger trees (Fig. 3). In these cases, a grower should suspect that the trees were already infected with the *Phytophthora* when they came from the nursery. Unfortunately, there is no certification program for *P. citricola* of the type which operates for *P. cinnamomi.* If you are considering replanting, it would probably pay you to have the trees checked by a good commercial lab that specializes in *Phytophthora* detection. It is usually quite easy to recover from feeder rots using *Phytophthora-selective* culture media (8). At the present time, it is estimated that about 20 percent of avocado groves in California are affected by the problem. In the worst scenarios, trees are lost in large numbers every year. Certainly the disease is most serious on heavier soils, particularly clay soils, but it also occurs on sand and loam soils; and at the present time, we are uncertain as to why the disease strikes. It may lie relatively dormant in the soil for many years, presumably completing its life cycle on the feeder roots, but not causing a canker on the crown or trunk of the tree. Conceivably, the serious canker phase of the disease is triggered by a stress, or series of stresses. After the severe cold spells of the winters of 1986 and 1987, we did observe a marked increase in the number of trees declining due to the canker problem in groves that we had under observation. Another factor that may well be involved is salinity stress (2). Poor quality irrigation water and the growing trend toward more restricted use of water may well predispose the avocado tree to attack by *P. citricola.*

*Fig. 1. Typical severe symptoms of* Phytophthora citricola *on a Hass avocado. The foliage is chlorotic and branch die-back is occurring.*

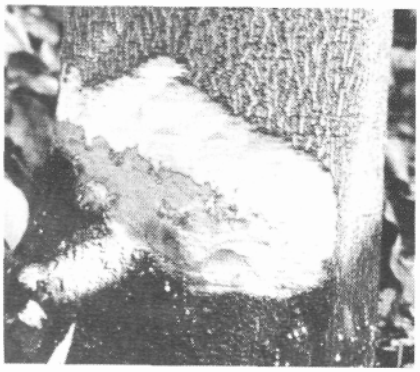

Fig. 2. *A trunk canker caused by* Phytophthora citricola. *There is a characteristic white sugary exudate present. The bark has been cut away to reveal a firm brown rot which extends into the wood of the tree.*

Fig. 3. *Symptoms of* Phytophthora citricola *on a 2-year-old tree. A collar rot is present which completely encircles the tree trunk.*

The earliest publication recording a bark disease of avocado was that of Howard S. Fawcett, plant pathologist at the Citrus Experiment Station, Riverside (5). He recorded how, in May 1914, his attention was called by K. A. Ryerson to such a problem, which he stated was present on avocados at a number of locations in southern California. A

fungus, which was identified as *Pythiacystis,* was recovered, and it was demonstrated that it was responsible for the disease. *Pythiacystis* is an old name for what we now call *Phytophthora.* Fawcett believed the avocado fungus was related to another fungus, which we now know as *Phytophthora citrophthora,* that causes gummosis on citrus.

J. T. Barrett re-described the avocado *Pythiacystis* fungus as *Phytophthora cactorum* in 1916 (1). During the winter of 1940, the same type of bark disease, or trunk canker, was reported as causing a severe problem on avocados in the Whittier-Puente area (7). It was observed that the problem was severe on one Guatemalan variety, Spinks, but not on any other varieties in the area. The authors of this report noted, "This fact might not seem to be of great significance as this variety is not now highly esteemed, but it is probable that some other more valuable varieties may also be found to be susceptible." They described the problem as caused by *Phytophthora cactorum.*

In an article in the 1953 USDA Yearbook of Agriculture, George Zentmyer again described a trunk canker believed to be caused by *P. cactorum* or *P. cinnamomi* (9). He observed that the avocado trunk is not completely girdled and that the canker can extend several feet from the ground. Guatemalan varieties of avocado appeared more susceptible than Mexican varieties. He suggested that it was "desirable to bud these varieties high and to avoid covering the bud union with soil in low-budded trees."

The trunk canker disease of avocado continued to be described as caused by either *P. cactorum* (12), or more rarely by *P. cinnamomi* (10, 12), until the early 1970s. A new study was then conducted by Dr. Zentmyer at UCR in collaboration with a *Phytophthora* specialist from Ontario, Canada, Dr. C. J. Hickman. They identified the cause of a trunk canker on avocado in Vista as due to *Phytophthora citricola* (11). The problem had originally been brought to Dr. Zentmyer's attention by Randy Matson, an agriculture consultant working in San Diego County with avocado growers. The fungus also turned out to be identical to one sent to Zentmyer by Dr. Leopoldo Fucikovsky in Mexico in 1963. He isolated it from avocado fruit where it was causing a relatively serious problem and believed it was *P. cactorum* (6).

The confusion over *P. cactorum* and *P. citricola* was understandable. The experts of the time could not agree as to whether certain fungi were simply varieties off! *cactorum* or a separate species *P. citricola.* This is no longer the case, however, and we now regard *P. citricola* and *P. cactorum* as quite separate types of *Phytophthora.*

In the 1980s, we conducted a small survey of some avocado groves throughout California. The modern findings are that only two *Phytophthora* species are present on avocados: *P. cinnamomi* and *P. citricola* (8). No isolates of *P. cactorum* were recovered. Both *P. citricola* and *P. cinnamomi* were recovered from trunk cankers, but the former was by far the most commonly found. In isolations from feeder roots we have frequently recovered *P. citricola* even though no obvious symptoms are present on the avocado trees. In many cases *P. citricola* may be likened to a time bomb waiting to go off. The current estimate of 20 percent of groves affected by the disease does not take into account all these "hidden" cases. In addition, it is quite certain that many growers have only a poor idea of what *P. citricola* is, and how to recognize the problem. A few years ago, a grove manager on a large progressive estate in Corona phoned us at UCR. He had read a short account of the "citricola" disease in the farm press. He thought the

symptoms described matched those in one of his own groves. His initial diagnosis was correct, and for the first time he was aware of the real nature of the problem he had. How many more growers are there that are still largely unaware of *P. citricola* ?

In 1973, it was thought that *P. citricola* was quite limited in its distribution in southern California (11). In part, however, this might simply reflect the fact that the majority of growers at that time were largely unaware of the true nature of the disease, and therefore did not report the circumstances. In addition, there have been dramatic changes in the industry in the last 15 years. Avocado acreage has trebled since 1973, and the dominant variety is now the Guatemalan variety Hass, not Fuerte (3). The trees are grown on many new types of soil, some only marginal in their suitability for avocado culture. Water quality is a major factor now, and increased salinity has long been known to aggravate *Phytophthora* problems (2). Finally, the avocado industry was able to outrun many of the potential problems, at least in the short term, by continuing to expand with new plantings. Unfortunately, the avocado acreage is now more or less static, the industry has reached maturity, and the problems with *Phytophthora* need to be met face on and dealt with.

In the realization that we have a real threat with *P. citricola* (4) and very few answers still, research funding was finally specifically allocated by the California Avocado Commission in the last few years to provide some answers to the problem. Our current research program is endeavoring to come up with answers to the following questions:

1) Are there suitable rootstocks already developed for *P. cinnamomi* resistance that can be used?

2) Can we find new sources of resistance in avocado germ plasm specifically resistant to *P. citricola'?* Will this also provide resistance to *P. cinnamomi?*

3) How is the disease spread in the grove? What is the role, if any, of nurseries in introducing and spreading this problem?

4) Are other plant hosts involved in the spread of this disease as they are in the case of *P. cinnamomi?*

5) Do different isolates of *P. citricola* vary significantly in their ability to cause the trunk canker phase of the disease?

6) What is the role of increased salinity in triggering the trunk canker problem?

7) Can modern chemical control methods, such as trunk injection with phosphonate fungicides like Aliette® provide economic control?

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