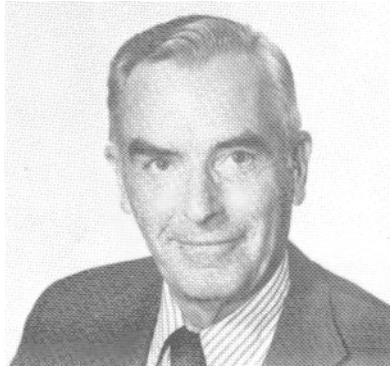


Persea indica

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Seedlings of *Persea indica*, a subtropical evergreen tree related to the avocado (*Persea americana*), have been used for many years for isolation of *Phytophthora cinnamomi* from soil. This article describes the origin of the tree, *Persea indica*, and how its usefulness as a "trap" for the root rot fungus was discovered, and details the method of using the seedlings for a root rot test.

In the early days of our investigation of the *Phytophthora* root rot problem on avocados (1940s), we had one primary method of determining whether a tree was infected with *P. cinnamomi*. This involved plating small feeder roots of suspect avocado trees on cornmeal agar in petri dishes in the laboratory.

Then in the 1950s, another method of isolating the pathogen was developed when I (G. A.Z.) found that green avocado fruit, such as Fuerte fruit, made very good "traps" for isolating the fungus directly from soil. This method was described in some detail in our University of California Leaflet 2440 on Avocado Root Rot, published in 1978. In this method the test soil is placed in a plastic cup approximately four to five inches in diameter, a firm avocado fruit is pressed down into the soil and the surface of the soil is flooded with water. Within a few days, if *P. cinnamomi* is present purplish-brown spots will appear at the water level; and the fungus can be easily isolated from these spots on agar in petri dishes.

In the 1950s I began our program of seeking avocado rootstocks resistant to *P. cinnamomi* by collecting and testing miscellaneous avocado varieties or cultivars and trees belonging to other species of the genus *Persea* and related trees in the family Lauraceae. In the course of this search, which primarily involved Latin America, we found unexpectedly in the Los Angeles area an unusual ornamental tree growing as a street tree or occasional attractive garden tree which we identified as a species of

Persea, *P. indica*. I first noticed this type of tree along several streets in West Los Angeles and Hollywood. The tree is evergreen, with a dense crown and glossy green leaves somewhat smaller than the avocado. The fruit are very different from the avocado, being small (approximately 1/2 inch in length), slightly elongated, and purplish-black when mature. Each fruit contains a single seed occupying much of the fruit tissue; the thin layer of flesh is not edible.

Persea indica is a native tree in the Canary Islands, a Spanish possession in the Atlantic west of northwest Africa. This is the only species of the large genus *Persea* in that part of the world; most of the species of *Persea* are native to Central and South America where some 80 species have been described. *Persea indica* is not a common tree in the Canary Islands, but occurs on several of the islands, notably Tenerife where some large old trees grow in the mountains. The history of the introduction of this tree into southern California is obscure.

In our early tests with this new species of *Persea* from Los Angeles, the seeds germinated very slowly, requiring several weeks to germinate even in the greenhouse. However, young seedlings then developed rapidly with a vigorous root system of small feeder roots resembling avocado roots. I included these seedlings in our tests for resistance to *P. cinnamomi* and was amazed and disappointed to find that, rather than being resistant, the seedlings of *P. indica* were very susceptible to the fungus. The *P. indica* seedlings were even more susceptible than our most susceptible avocado rootstocks such as Topa Topa. It then occurred to us that, rather than discarding this plant because of its lack of resistance, this plant might be very useful because of its high susceptibility. The small size of the seed and of the young plants was an advantage also, requiring a minimum of space for various disease tests that could be run in a relatively short time.

Thus, *Persea indica* became very useful for a "trap" test for *P. cinnamomi* similar to the avocado fruit trap method. In this test, 25 to 100 grams (or 1/2 to 1 inch) of the suspect soil is placed in a plastic cup or similar container 4 to 6 inches in depth, the container is filled with water, and a bare-root seedling of *P. indica* is placed in the container. If the root rot fungus is present, in 4 to 5 days a black stripe appears on the stem of the seedling and *P. cinnamomi* may even grow out the leaf petioles and invade the *P. indica* leaves. The roots of the *P. indica* seedlings are also often rotted. Affected seedlings usually wilt severely in a short time. The stripe canker is the most striking and easily recognized phase of this test.

This discovery was the beginning of the extensive use of *P. indica* as a test plant to isolate and identify *Phytophthora cinnamomi* in any field situation, and in nurseries for example. This plant has also proved to be very useful in accelerated greenhouse tests of chemical, biological, or cultural control of *P. cinnamomi*.



Fig. 1. Seedlings of Persea indica (avocado relative from the Canary Islands) wilting within a week after bare-root seedlings were placed in cup containing 100 grams of soil infested with Phytophthora cinnamomi.

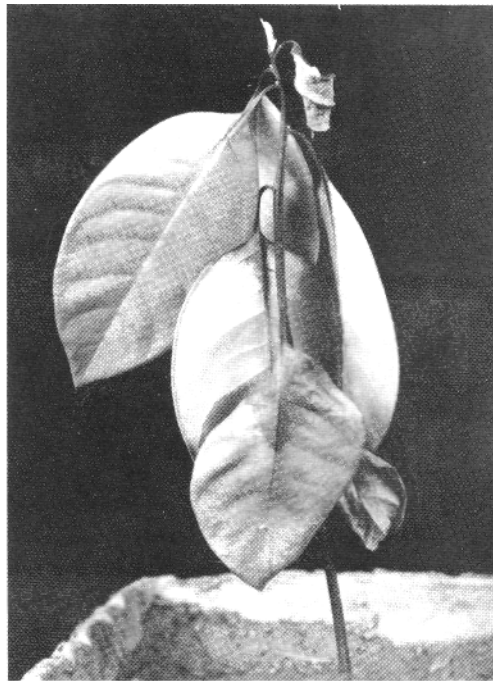


Fig. 2. Seedlings of Persea indica with stem and leaves invaded by Phytophthora cinnamomi. The fungus invaded the stem and roots from a soil trap and formed a black canker growing up the stem and into the leaves.

It has been known for some time that various species of *Phytophthora* can invade fruit or other plant organs. A number of plants have been tested for this purpose for use with *P. cinnamomi* for 40 years or more. Apple fruit are moderately successful, as are

avocado fruit as noted above. Seedlings of blue lupin (*Lupinus angustifolius*) were first tested for this purpose for isolation of *P. cinnamomi* from soil in pine forests in New Zealand. Blue lupin has been used extensively for this purpose in New Zealand and Australia, but we have found *Persea indica* seedlings to be more effective here. Other plants tested and used to some extent include pineapple leaf bases, eucalyptus seedlings, jacaranda seedlings, pine and deodar needles, eucalyptus seedling cotyledons, and avocado leaf pieces. In several of our tests, many of these different plants have been used. As an example, in one test naturally infested soil from an infected avocado tree in Fallbrook was diluted with sterile soil, at dilutions of 1:2, 1:4, 1:8, 1:16, 1:32, 1:64, and 1:128. Water was then added and *P. indica* seedlings, avocado fruit, and blue lupin seedlings were compared for their ability to detect the root rot fungus. *Persea indica* seedlings detected *P. cinnamomi* even at the dilution of 1:128; avocado fruit was effective at the 1:32 level, and blue lupin at the 1:8 dilution. *Persea indica* seedlings were also found to be effective in detecting *P. cinnamomi* when as few as 10 zoospores were placed in 250 ml of water.

Phytophthora citricola can also invade *P. indica* stems and roots so this species can also be detected by the *P. indica* "trap". Definite determination would have to be made by plating the diseased stem tissue from the cankers on *P. indica* onto selective agar media. Two other species of *Phytophthora*, *P. palmivora* and *P. parasitica*, were found in our tests to be slightly pathogenic to *P. indica*, but much less effective than *P. cinnamomi* and *P. citricola*.