

COLLECTING AVOCADOS IN CENTRAL AMERICA FOR DISEASE RESISTANCE TESTS

George A. Zentmyer

Associate Plant Pathologist, University of California, Citrus Experiment Station, Riverside.

The California Avocado Society provided financial assistance to help make the trip possible.

Deep appreciation is due to many people in Central America and Mexico who were helpful in many ways in facilitating the work; particularly to Dr. Wilson Popenoe, Dr. L. O. Williams, Dr. A. S. Muller, and Dr. V. C. Dunlap in Honduras; to Dr. E. P. Imle, Dr. John Carpenter and Mr. Robert Worley in Costa Rica; to Dr. J. Guiscafne-Arrillaga in El Salvador; Dr. F. LeBeau and Mr. R. Lorenz in Guatemala; and to Dr. J. Niederhauser and Dr. Lee Heidrick in Mexico. Also appreciation is expressed to those who propagated the material that was sent in: Robert J. Drake and William A. Thorn at Riverside, and Ted Frolich at U.C.L.A.

During the summer of 1952 a trip was made to native avocado areas in Honduras, Costa Rica, El Salvador, Guatemala and Mexico in an attempt to find rootstock material resistant to the avocado root rot disease.¹ Avocado trees and trees of related species of *Persea* grow wild in many different areas in Central America and Mexico; the fruit has been used by natives of these countries for centuries.

The primary objective was to make collections from trees growing in swampy locations or in very wet, heavy, poorly drained soil. It is felt that trees in such locations should have a better chance of resistance than trees growing in well-drained or relatively dry sites. In addition, collections were made from trees of species of *Persea* that had not yet been tested for root rot resistance, regardless of the site in which they were growing.

Locations for some of the collections were found by going through the herbarium collections of Central American species of *Persea* in the Chicago Natural History Museum and the Missouri Botanical Garden. From these herbarium collections exact locations were noted for specimens that had been collected in notably wet or swampy places. Similar data was provided from herbaria at the Smithsonian Institution, New York Botanical Garden, and at the Gray Herbarium, through the courtesy of the curators of these herbaria

In addition to this approach to the problem, root cultures were made from all trees from which budwood or seed were collected, as well as from other avocados or related species of *Persea*, to determine the distribution of the root rot fungus (*Phytophthora cinnamomi*) in Central America and Mexico. The ideal type of material for resistance would be a healthy tree growing in poorly drained soil in the presence of *P. cinnamomi*. Also, other diseases of avocado were observed and investigated in some cases.

Budwood was collected from 41 trees representing six species of *Persea* (*Persea americana*, *P. gigantea*, *P. Donnell-Smithii*, *P. schiedeana*, *P. Skutchii*, and *P. Popenoei*), and one species in the related genus *Phoebe* (*P. mexicana*). Seed was collected from 13 trees representing three species of *Persea* (*P. americana*, *P. schiedeana*, *P. Skutchii*), one species of *Phoebe* and one species of *Cinnamomum*. Nineteen of the budwood collections and five of the seed collections were from trees growing either in swamps or in very heavy, wet soil. Three of the budwood collections were from locations where *P. cinnamomi* was also present. *Persea Donnell-Smithii* is predominantly a swamp species, growing at moderately high elevations (4,000 to 5,000 feet) while *P. schiedeana* is also often found in very wet locations.

Root samples were collected and cultures made from 106 trees in Honduras, Costa Rica, El Salvador, Guatemala and Mexico. *Phytophthora cinnamomi* -was found on 18 of these trees. Most of these were cultivated trees showing obvious symptoms of root rot, but in three cases in Mexico the fungus was found on the roots of healthy trees in very wet, heavy soil.

Typical cases of avocado root rot were found in Honduras, Costa Rica and Mexico. Other avocado diseases observed and studied were avocado scab, several leaf spots, a new and serious seedling blight in Honduras caused by another species of *Phytophthora*, powdery mildew, and mistletoe. A number of insect pests were also noted, including the avocado seed weevil, leaf gall insects, a leaf-tying insect, and a borer that invades fruit and brandies.

In the approximately six and one-half weeks involved in the trip approximately 10,000 miles were traveled. The major distances, as between countries, were covered by air. Within the various countries varied means of transportation were used, including jeep, bus, truck, and train.

COLLECTIONS IN HONDURAS

Headquarters in Honduras were made at the Escuela Agricola Panamericana, near Tegucigalpa. Dr. Wilson Popenoe is Director of the Escuela, an excellent school of tropical agriculture established and maintained by the United Fruit Company. Wonderful facilities are available at the Escuela; many of the collections in Honduras were made from there, root cultures and microscopic examinations of materials were carried out in the laboratories, and much use was made of the fine library and herbarium.

Budwood was collected from 12 trees representing five species of *Persea* (*P. gigantea*, *P. Popenoei*, *P. Skutchii*, *P. Donnell-Smithii*, and *P. americana*). Seed were collected from *P. Skutchii*; fruit were not present on the other wild species at the time of the trip. *P. Donnell-Smithii* collections were made from trees growing in a very wet, swampy location near Mt. Uyuca, *P. Skutchii* collections were made from a tree growing along the Rio de la Orilla, and the *P. Popenoei* and *P. americana* collections were made from heavy soil in the San Juancito mountains. Another *P. americana* collection was from a type native in the mountains near Lancetilla, where rainfall is commonly 120 to 125 inches per year.

Root cultures were made from 38 trees, with *Phytophthora cinnamomi* recovered from

10 of these. The 10 trees from which *P. cinnamomi* was isolated were all cultivated specimens, growing in the experimental plantings at the Escuela Agricola Panamericana and at the Lancetilla Experiment Station. These trees all showed typical symptoms of root rot, and included nursery trees and larger trees from 4 to 10 years of age. The disease was most severe in plantings in heavy soil, or in areas where rainfall is excessive, as at Lancetilla. This is in line with the recognized role of excess soil moisture in aiding disease development.

The seedling blight at the Escuela Agricola Panamericana caused heavy losses in the avocado seedbeds in 1951 according to Dr. A. S. Muller; the disease was causing light damage when observed with Dr. Muller in August, 1952. The causal fungus was found to be a species of *Phytophthora*, probably *P. palmivora*. The fungus invades the stem or the growing point of the seedling, causing cankers which rapidly girdle the stems. Affected stems then bend over and the tops die. The fungus then may grow down the stem and kill the entire seedling.

Several leaf spots were observed in Honduras, as well as powdery mildew and avocado scab (*Sphaceloma perseae*) on fruit and leaves at Lancetilla. Through the courtesy of the United Fruit Co., in particular Dr. V. C. Dunlap, Director of Research, some of the excellent research being carried out on banana diseases at La Lima, Honduras, was observed.

COLLECTIONS IN COSTA RICA

Headquarters in Costa Rica were made at the U. S. Department of Agriculture's Cooperative Rubber Plant Field Station at Turrialba, where excellent facilities were provided through the courtesy of Dr. E. P. Imle. Budwood was collected from 7 trees, of three species of *Persea* (*P. Skutchii*, *P. schiedeana*, and *P. americana*) and one species of *Phoebe* (*P. mexicana*). Seed were collected from 4 trees, representing two species of *Persea* (*P. Skutchii* And *P. americana*), and *Phoebe mexicana*. One of the *Persea schiedeana* collections in particular was growing in an exceedingly wet location. The local name for this species is "Yas." Additional collections of *P. Skutchii* were made as this species had not been previously introduced into California, and fruit were abundant in July. *P. Skutchii* has small bluish-purple fruit about the size of a pea.

Root cultures were made from 19 wild and cultivated avocado trees and trees of other species of *Persea* and *Phoebe mexicana*. *Phytophthora cinnamomi* was recovered from three seedling trees of *Persea americana* growing under semi-cultivated conditions in a grove near the town of Orotina, west of San Jose. A number of large seedling trees in this grove, and in adjacent plantings, were affected with root rot. In this same general area, avocado scab was observed on fruit in the markets.

Observations were made of diseases caused by species of *Phytophthora* on other tropical crops, including rubber trees and cacao. Other diseases of these crops were also observed, as well as diseases of coffee and abaca, through the courtesy of scientists at the Interamerican Institute for Agricultural Sciences at Turrialba.

COLLECTIONS IN EL SALVADOR

The fine laboratory facilities of the Centro Agronomia Nacional, Santa Tecla, were made available through the courtesy of the Director, Dr. J. Guiscafre-Arrillaga. Budwood collections were made from two trees representing two different types of *Persea schiedeana*, while seed were also collected from *P. schiedeana* (known as "Chupte" in Salvador). Root cultures were made from six trees; no *Phytophthora cinnamomi* was recovered. No cases of avocado root rot were observed in El Salvador.

COLLECTIONS IN GUATEMALA

Headquarters in Guatemala were at the Instituto Agropecuario Nacional in Guatemala City. Root cultures and examinations of material collected were made in the excellent laboratories which are under the direction of Mr. Rolland C. Lorenz. From here a number of trips of several days duration were made into the highlands of Guatemala. Avocados and other species of *Persea* are abundant in Guatemala, both in the strictly wild state, and in semi-cultivation. Nearly every Indian dwelling has an avocado tree or two nearby, the seed either having been planted or merely thrown out and allowed to germinate.

Budwood was collected from 16 trees representing the species *Persea americana*, *P. schiedeana*, and *P. Donnell-Smithii*. Collections were made from the localities of San Jose Pinula, the finca Chocola, Coban, Tactic, Antigua, and San Pedro Jacopilas. Near Tactic, which is north of Guatemala City, is an extensive swamp in which specimens of *Persea Donnell-Smithii* were collected. *P. schiedeana* was collected from the edge of the swamp. Several collections of *P. americana* were made in very heavy, wet, poorly-drained soil in the department of El Quiche, near the town of San Pedro Jacopilas.

Seed were collected from two trees of *Persea schiedeana*, near Tactic and near Coban. This species is very abundant in the hills in this part of Guatemala, with considerable variation in fruit and foliage characteristics. It is known as the "Coyo" in Guatemala.

Root cultures were made from 33 trees, including the several species of *Persea* mentioned above. *Phytophthora cinnamomi* was not recovered from any of these cultures. The fungus is known to be present in parts of Guatemala, having been previously reported on cinchona trees on which it causes a stripe canker.

COLLECTIONS IN MEXICO

Through the courtesy of the Rockefeller Foundation, and in particular Dr. John Niederhauser, excellent laboratory facilities were made available in the Rockefeller Foundation laboratories in Mexico City. Budwood and seed were collected primarily in the state of Veracruz, in a locality where *Phytophthora cinnamomi* had been found on the trip in 1951. Budwood was collected from five trees of two species of *Persea* (*P. americana* and *P. schiedeana*.) Seed were collected from four trees representing the same species.

Three of these were healthy trees growing in heavy, wet soil in the presence of *P. cinnamomi*, and would thus seem to offer considerable hope for resistance.

Root cultures were made from 10 trees, with *P. cinnamomi* recovered from six of these.

Two of these cultures were from the area near Huatusco in Veracruz where trees were still healthy. The other four were from trees with typical symptoms of root rot near Villa Guerrero, southwest of Toluca. Governor Sanchez Colin, Governor of the state of Mexico, had been concerned about the dying of large numbers of avocado trees in this area from an unknown disease. The problem was investigated in August, 1952, with Ing. Humberto Rosado, Director of Agriculture, state of Mexico, and found to be *Phytophthora* root rot. An estimated 20,000 seedling trees are in various stages of disease in this area, with considerable loss to the Indians who derive much of their income from sale of the fruit.

PRESENT STATUS OF COLLECTIONS

Budwood collections were sent to California in polyethylene bags via air mail or air express from various locations in Central America. The Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, in July, 1952, granted the request of the Citrus Experiment Station to make Los Angeles the port of entry for these shipments rather than San Francisco, thus facilitating importation of the materials. All of the shipments were fumigated with methyl bromide by quarantine officials at San Pedro, then rushed to Riverside and U.C.L.A. for budding or grafting into avocado seedlings.² In spite of this, however, only seven of the 41 budwood collections were apparently established in California by December, 1952. The lack of establishment of many of the collections is believed the result of: (1) Fumigation injury, (2) Possible poor compatibility with avocado in the case of some of the other species of *Persea*, and (3) A combination of (1) and (2).

Experiments under way now are demonstrating that budwood of some of the wild species of *Persea*, notably *P. Schiedeana*, are severely damaged by the standard dosages of methyl bromide. Further information will be available from this investigation, which is a cooperative experiment with Drs. I). L. Lindgren, C. A. Schroeder, and J. M. Wallace, with the assistance of Robert J. Drake and William A. Thorn.

Seed have been successfully germinated and established at Riverside from 8 to 13 seed collections. As a result of requests by the Citrus Experiment Station, the Bureau of Entomology and Plant Quarantine cooperated in facilitating the entry of seed, in a manner which provided no danger to the California avocado industry, by permitting fumigation of the seed at El Paso, Texas, and subsequent shipment directly to Riverside. Permission for the modification of past quarantine procedures was obtained in August, 1952.

Most of the collections which have not been established in California can be relatively easily re-collected by people in Central America and shipped in again when safe means of fumigation treatment, both from the standpoint of prevention of entry of possible harmful pests and of non-toxicity to the budwood, are developed.

²This propagation was done by Robert Drake at Riverside and Ted Frolich at U.C.L.A.