

THE COYO: A ROOT STOCK FOR THE AVOCADO?

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(Ed. note—The project which is the subject of this report by Mr. Feister is being carried on under the auspices of the Committee on Foreign Exploration, California Avocado Society. Additional reports on the work will be included in future Yearbooks, as there are new developments.)

In regions where climatic conditions are favorable—and I am thinking not only of California but of tropical and sub-tropical America in general—there is probably no other factor which at the present time is restricting the expansion of avocado culture to such an extent as "root rot" or "tree decline," as it commonly has been called in California. Deficient drainage and/or the presence of the fungus *Phytophthora cinnamomi* are considered, by various investigators, to be behind this trouble.

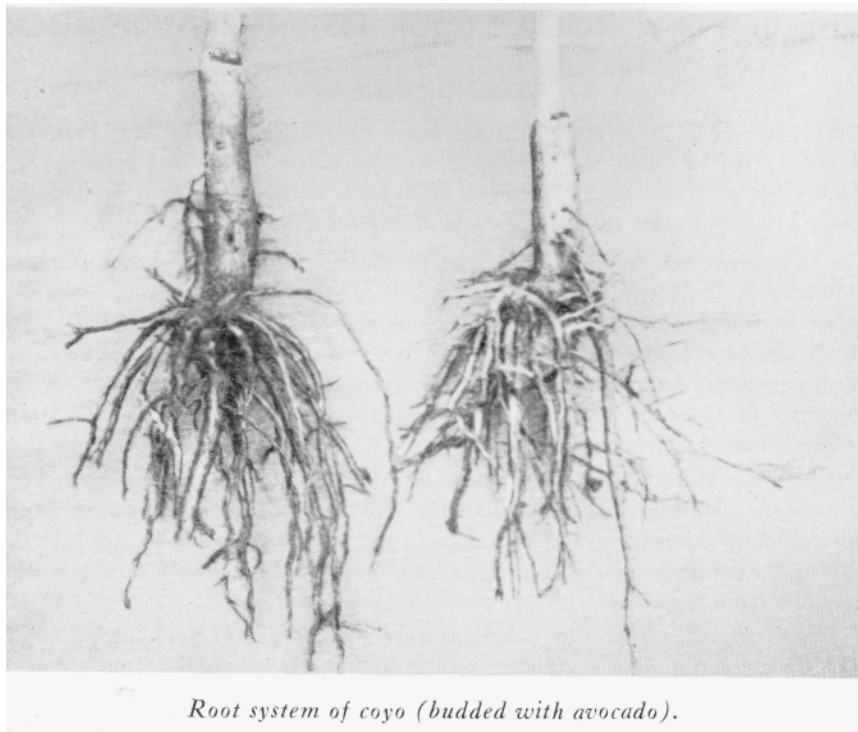
At least three means of solving the problem of root disease have been suggested: (1) improved drainage or the avoidance of soils which do not admit of satisfactory drainage; (2) attack from the pathological angle; and (3) the use of rootstocks which will produce healthy trees on lands where avocados now die from one or both of the causes suggested.

In California, several investigators have worked on the pathological angle. Dr. Bowen S. Crandall conducted an investigation in a very different region—the Amazonian drainage of Peru. So far as elimination of the disease through improved drainage is concerned, little progress seems to have been made. Tests of rootstocks, other than those of the cultivated forms of *Persea americana*, have been difficult to undertake in the United States because of restrictions on the importation of seeds of the avocado and its relatives from other parts of the world.

It is for the last-named reason that we have undertaken, here at the Escuela Agricola Panamericana, to assemble wild forms of *P. americana* and as many of the avocado relatives as possible, and to carry out preliminary rootstock trials. We consider that our conditions are favorable for this project, since we have heavy soils on which the commercial varieties of the avocado grafted on "West Indian" rootstocks usually die at three to five years of age. Whatever may be the conditions which favor root disease, we should have them here—although we cannot be certain that the same factors are the cause of the trouble here as in California, for no pathological investigation of our situation has been made.

We have assembled from Mexico, from Guatemala, and from Honduras species of the *Persea americana* alliance—one of them the "wild avocado of Tecpan" from Guatemala, which grows at the highest elevation (9300 feet) yet recorded for trees of this alliance in tropical America. We have assembled seedlings of *Persea Schiedeana* from Orizaba in

Mexico, Coban in Guatemala, Nuevo Ocotepeque in Honduras, and San Jose in Costa Rica. We have a wild species of *Persea* from Aquila, near Orizaba, Mexico, which Dr. Louis O. Williams has determined as *Persea floccosa*. We have a wild tree from Honduras (probably the same as one found by Wilson Popenoe in Costa Rica, many years ago, and called by him the "wild avocado of San Isidro" in one of the Yearbooks of the California Avocado Society) which has strongly anise-scented leaves and large thick-skinned fruits, which Dr. Williams now thinks may not be a *Persea*, but a member of a closely-related genus. We have also *Persea Donnell-Smithii* and several species of the closely related genera *Nectandra* and *Ocotea*.



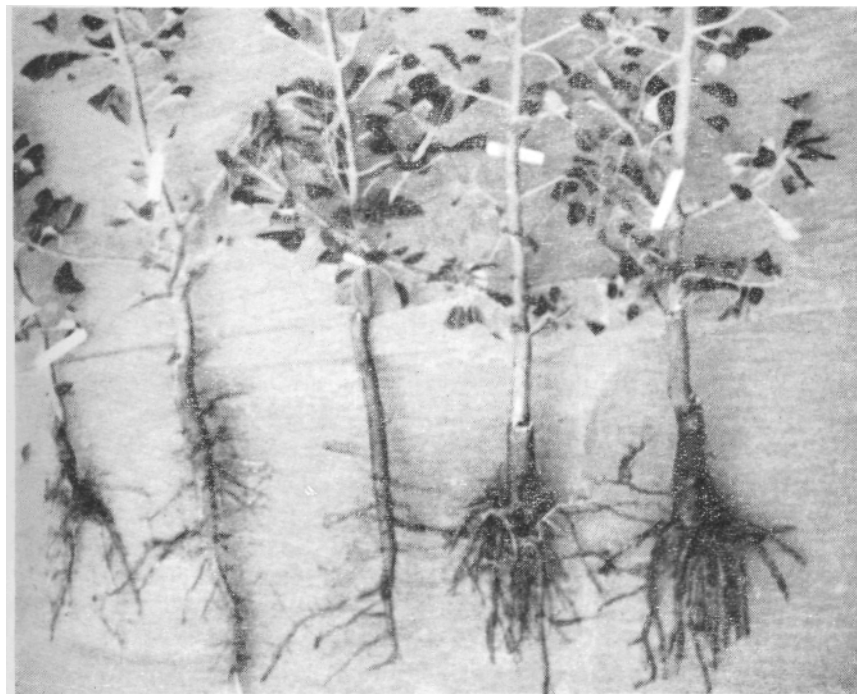
Root system of coyo (budded with avocado).

Our experiments with *P. Schiedeana* have reached the point where it seems worth while to go into some detail. This tree, known by various names in Mexico and Central America—chinini and chinene in Mexico, coyo and kiyau in Guatemala, chucte and supte in parts of the latter and in Honduras, and yás in Costa Rica (to mention only the better known ones) is so new, horticulturally, that it may be well to quote the following botanical description from the "Flora of Guatemala" by Standley and Steyermark, who state that it grows in moist or wet mixed forest, often in open fields or pastures, at 900 to 2700 meters:

"Usually a tree of 15-20 meters but sometimes as much as 50 meters high, with a large crown, the branchlets stout, densely tomentose with mostly ferruginous, sometimes grayish pubescence; leaves on slender petioles 1.5 to 4.5 cm long, thick membranaceous or chartaceous, obovate to elliptic-obovate or oval, 12-30 cm long, 7-15 cm wide, broadly rounded and apiculate to subacute at the apex,

broadly rounded or obtuse at the base, penninerved, green above, glabrous or nearly so in age, when young often tomentose, paler or glaucous beneath, densely pilose with short spreading velutinous hairs; panicles long or short, densely grayish-tomentulose, mostly 10-12 cm long, long-pedunculate, the slender pedicels 8-15 mm long; perianth greenish yellow, 6-8 mm long, densely grayish-tomentulose, the segments subequal, lance-elliptic, subacute; filaments pilose; staminodia pilose, the stipe subulate, 2-3 times as long and about as thick as the elliptic obtuse head; ovary densely pilose ; fruit similar to that of *P. americana*, variable in size and shape, the skin thick but leathery and pliable, the flesh brownish white, of fine oily texture, permeated by numerous coarse fibers; cotyledons rose-pink (whitish in *P. americana*)."

An extensive discussion of this fruit, as it is seen in Guatemala, may be found in "The Avocado in Guatemala," by Wilson Popenoe (Bul. 743, U.S. Dept. of Agriculture, 1919). The coyo (this might well be adopted as the simplest common name) has received a limited amount of horticultural attention in the tropics and subtropics of America, but its possibilities as a root-stock for the avocado are little known.



On left, three grafted avocados on West Indian roots; on right, two grafted avocados on coyo roots.

In 1916-17, while exploring for the U.S. Department of Agriculture, Wilson Popenoe sent to Washington seeds and budwood from Guatemala. George B. Cellon, father of the avocado industry in Florida, budded this species on *P. americana* at his place near Miami. Dr. David Fairchild, in a recent letter to Wilson Popenoe, throws some light on this experiment. He says "I always felt interested in trying the coyo as a stock but the

few efforts that Ed Simmonds (superintendent of the U.S. Plant Introduction Garden at Miami) made to establish the coyo on the avocado were not very successful. We had no seeds at the time to try as rootstocks for the avocado, for Cellon's coyo tree bore only once or twice, I think, and the fruits were seedless, perhaps because of lack of cross-pollination. I once picked up a few fruits under his tree but they were seedless and not one-third as large as the coyos you have in Guatemala."

Dr. Fairchild goes on to say: "What attracted me to that tree of Cellon's was its hardiness. In an old notebook of mine, I find an item about the coyo which would indicate that Cellon's small tree weathered the 1916-17 cold wave of 26° F. or probably less. Anyway, I recall being impressed by the fact that it was not killed, and lived for a good many years there and became a sizable specimen."

Along this same line, Wilson Popenoe wrote, in "The Avocado in Guatemala": "Like the Guatemalan race of avocados, the coyo is abundant at elevations of 4000 to 5000 feet; unlike the former, it is fairly common in the tierra caliente, or hot zone, at elevations of 500 to 1000 feet. Whether it will stand as much cold as the Guatemalan avocado cannot be stated, but everything indicates that it is reasonably hardy."

Now to come down to more recent times. In 1945, seedlings of a good strain of coyo were obtained near El Rancho, Guatemala, by the late Rev. Edward Haymaker, at the instigation of Dr. Fairchild. These were brought to Honduras, where they were planted by Wilson Popenoe in his dooryard at Escuela Agricola Panamericana. During the rainy season of 1947, the possibilities of the coyo as a rootstock for the avocado on heavy soils were brought to our attention by observing that these trees did not suffer, even when they were flooded for two weeks. Our soils here are heavy clays and sandy clays with poor drainage, and these trees were growing in one of the heaviest spots. Grafted avocados on similar soils here rarely survive more than three to five years.

During the same year, an attempt was made to bud avocados on secondary branches of these coyo trees, to see if the two species were compatible. This was unsuccessful, but was not considered conclusive in any way. Plans were made to obtain coyo seeds in quantity, grow seedlings, and bud them under normal nursery conditions, using several varieties of the avocado—one of them Fuerte.

On August 12, 1948 about a hundred coyo seeds were received from Nuevo Ocotepeque, Honduras. Half an inch was cut from the end of each seed to hasten germination. (It is of interest to note, in this connection, that coyo seeds are commonly about twice as large as those of Mexican avocados). The coyo seeds were germinated in flats of moss and then the young plants, when a few inches high, were set out in nursery rows in the field.

After approximately two months from planting in flats, the young plants were 15 inches tall and about 5/8 inch in diameter at the base. In view of the fact that Guatemalan x Mexican hybrids have given rise to the leading commercial varieties in California, it was decided that these would be used for trial. Ninety-one coyo seedlings were shield-budded as follows: 44 to Fuerte and 47 to Rodiles No. 1 (Williams No. 13515), this latter being one of the new selections made in Atlixco by the Committee on Foreign Exploration of the California Avocado Society.

On January 2, 1949 a check showed that 88% of the Fuerte buds and 68% of the Rodiles No. 1 buds had "taken" and were making good growth. Development of the budded trees since that time has been satisfactory in every way. The following comments can be made as a result of observations during the ensuing eleven months:

The coyo seedling seems to be an easier rootstock to manage in the nursery than avocado seedlings of any one of the three horticultural races—West Indian, Guatemalan, and Mexican, as far as we can judge by experience to date. It produces a stronger, thicker-stemmed plant than any of the avocados, and is ready for budding, therefore, at an earlier age. Buds have grown fully as rapidly on coyo as on West Indian rootstocks and the bud union appears to be as strong. After a year from time of insertion of the buds, there was a striking difference noticeable in the diameter of rootstock and scion, the former being much thicker than the latter. This would seem to indicate that the coyo is a stronger grower than the two varieties budded on it. The reverse has been the case when these same varieties were budded on West Indian seedlings here.

More interesting still is the observation that the root system of *P. Schiedeana* seems very different from that of *P. americana*. West Indian seedlings, as grown here, develop long tap roots, while the coyo does not do this, but develops a large number of main roots—four to seven—which spread out below the surface of the soil. Might this not be a factor in its favor, when we are considering avocado culture on heavy wet soils?

Of course it is too early to arrive at any conclusions, but from these trials with Guatemalan x Mexican hybrids on coyo rootstocks we believe it is safe to say that further work is warranted. Everyone has been afraid that the coyo is not sufficiently hardy to be used as a rootstock in California, even though congenial. As yet we have no proof of this.

Our main job now is to determine whether or not avocados budded on coyo roots will prove resistant to those conditions, whatever they are, which are responsible for "root disease" and "tree decline." In an effort to get information along this line, we have planted, on the exact spots where avocados budded on West Indian roots had previously been growing and had died out, many of the trees budded on coyo in October, 1948. It will be interesting to watch developments.