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Observations on a Second-Generation Progeny of a Mexican x West Indian Cross

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A class of avocado that has been largely neglected is the Mexican x West Indian hybrid. Apparently, the only named avocados in this class were developed by W.E. Sexton of Vero Beach, Florida in 1927. The fruits were described as attractive and of good quality, but they matured in early fall when better varieties (technically "cultivars") were already available. Mr. Sexton did register as new varieties in this class: "Indian River, "Vero," and "Waldo."

In the early 1920s, Joseph E. Sexton of Goleta, near Santa Barbara, California, introduced budwood and seeds from selected West Indian parent trees in Hawaii. The fruiting failure of his plantings, under the most favorable climatic conditions California can provide, indicated the commercial futility of pure West Indian varieties in this state.

In 1955, Peter A. Peterson, avocado breeder from the University of California, Riverside, propagated trees of the West Indian varieties "Pollock," "Simmonds," and "Waldin," and of the Mexicans "Courtright" and "Gottfried," with scionwood received from Florida, intending to incorporate them into the breeding program. However, before any of the West Indians fruited, they were killed by a fairly severe frost in the winter of 1960-61. The two Mexicans escaped unscathed, as also did all of the Mexican x Guatemalan hybrid seedlings in the same orchard. In early 1955, one of us (W.B.S.) sent scionwood of "Jalna" and "Clifton," both registered as Mexican, to Edward T. Fukunaga, Superintendent of the University of Hawaii Kona Branch Station at Kainaliu. He topworked them on an unnamed West Indian tree. In late 1956, he sent seed from "Jalna" and "Clifton" to UCR. When the seedlings from these fruited, the results were reported (Storey and Bergh) in the 1963 Yearbook. None was sufficiently promising to merit further commercial testing.

In 1967, one of us (W.B.S.) brought scions of the West Indian varieties "Princessa," "Infante," "Adolfo," "Redondo Morado," and "Largo" from Venezuela, and "Esparta" from Costa Rica. The trees propagated from them were planted in 1970 in an orchard which also contained two seedling West Indians grown from seeds sent in from the Philippines, the Hawaiian West Indian "Chrones," and "Booth 8," a Guatemalan x West Indian variety from Florida. The severe winter of 1978-79 killed all of the trees except "Booth 8" which suffered only slight injury. Up to the time of this event, only "Booth 8" had produced a crop; in fact, three very good crops. None of the West Indians had so much as bloomed—except "Infante" which bore two fruits in one year, and which thereby indicated that it may not be pure West Indian.

In 1965, we sent scionwood of the Mexican race variety "Mexicola" to Robert M. Warner of the University of Hawaii in Honolulu. He topworked it on "Chrones." In 1967, Warner sent 14 seeds from "Mexicola" back to us. Only one of the trees had fruited by 1973, when, for budgetary reasons, the orchard could no longer be maintained and the trees were destroyed. It was quite apparent from the tree which fruited that natural hybridization had taken place. Some characteristics of "Mexicola," "Chrones," and the hybrid between them ("F_1") are described in Table 1.

Table 1: Characteristics of the Parents and the FI of a Mexican x West Indian Hybrid.

	MEXICOLA	CHRONES	F_1
Race	Mexican	West Indian (some Guatemalan)	Hybrid
Foliage odor	Anise	None	Anise
Fruit stem	Mexican type	West Indian type	Mexican type
Skin color	Black	Green	Green
Skin Surface	Smooth, glaucous	Smooth, shiny	Smooth, shiny
Average Weight	4 oz; 112 gm	16 oz: 450 gm	9 oz; 252 gm
Flavor	Rich; slight taste of anise	Good but not rich; no taste of anise	Very good; no taste of anise
Season	Aug.-Oct.	Oct.-Dec.	Sept.-Oct.
Tree Type	A	Unknown	A

A second generation ("F_2") of 67 seedlings of the hybrid was planted in an orchard in 1974. By 1978, seven had died from various causes. Surprisingly, not one of the remaining 60 was severely injured during the 1978-79 freeze. This can be attributed to cold tolerance imparted to the progeny by the Mexican grandparent, since the location should have been no more favorable for cold air drainage than that of the nearby killed West Indian older trees noted above. The segregations of various characteristics among the trees in this progeny set are summarized in Table 2. Disparities in total seedling numbers resulted from all trees being classifiable for leaf anise, but 9 failed to flower, and of those that did flower, 15 failed to set fruit.

Table 2: Segregations of Pairs of Contrasting Characters in a Mexican x West Indian F_2 Progeny.

Pair	Character	No.	Character	No.
1	Anise odor present	22	Anise odor absent	38
2	Flower Type A	49	Flower Type B	2
3	Pedicel type, Mexican	28	Pedicel type, West Indian	8
4	Pedicel insertion straight	26	Pedicel insertion oblique	10
5	Fruit ovoid	22	Fruit pyriform	14
6	Fruit green	29	Fruit purple	7
7	Skin smooth	25	Skin slightly pebbled	11
8	Skin shiny	24	Skin dull	12
9	Seed tight in cavity	32	Seed loose	4
10	Seed coats adhere to seed	27	Seed coats adhere to flesh	9
11	Cotyledons rough	19	Cotyledons smooth	17

As Table 2 indicates, only 2 of the trees that flowered were B flowering type, all the rest A. To be certain of flower type classification, all trees were inspected both morning and afternoon, three times, at one-week intervals during the blooming period.

Observations not recorded in Table 2 include the following.

Fruit maturation: earliest—August 15; latest—November 15.

Fruit Size: smallest—30 g (1.1 oz); largest—350 g (12.5 oz); Figure 1.

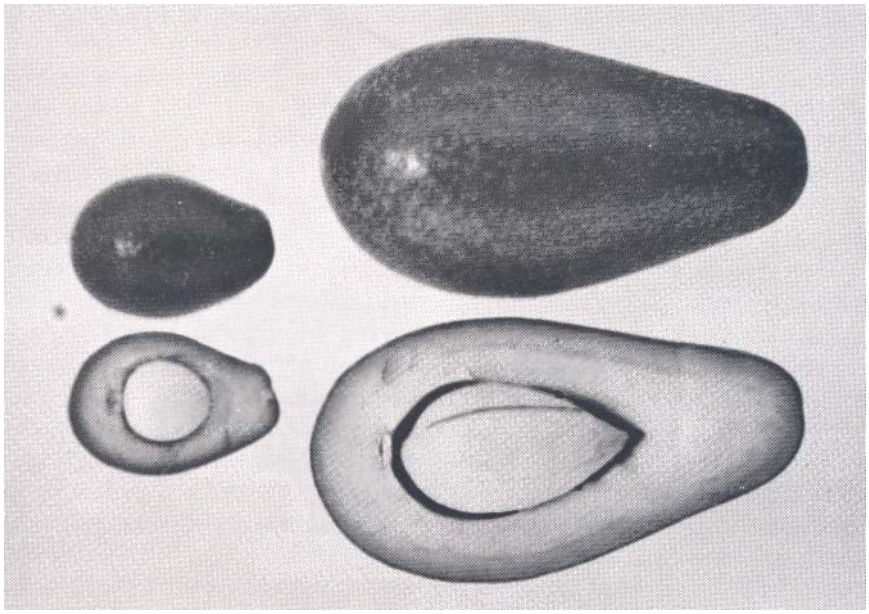

Figure 1. Smallest and largest fruits that segregated in the second generation of a Mexican x West Indian cross.

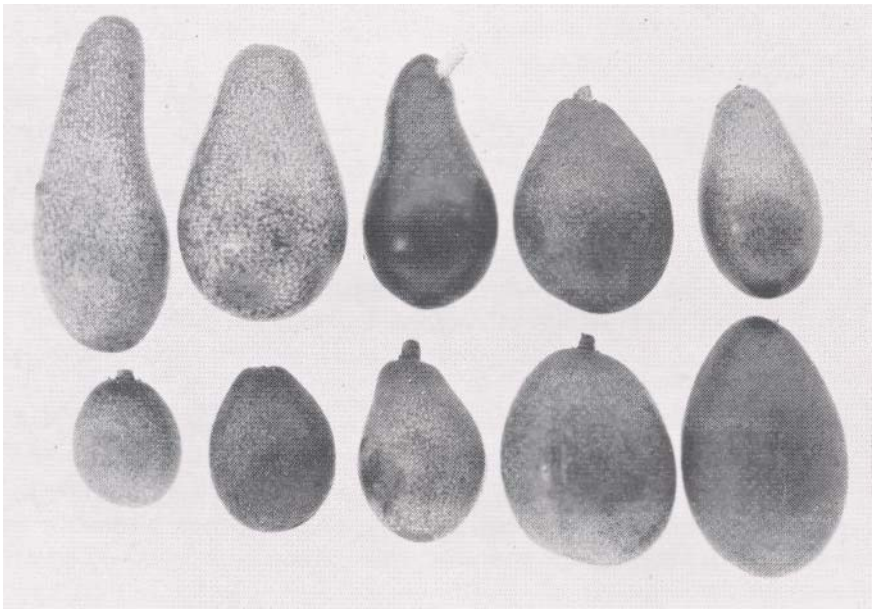

Figure 2. A representative sample of second generation variability in fruit size, shape, and color (all are green except for the middle fruit in the upper row.)

Figure 2 illustrates some of the differences in size, shape, and mature color in this second generation of hybridization.

This progeny set may be of commercial interest for both rootstocks and scion tops.

Scion Top. California has no really satisfactory variety for the autumn season. The "Hass" is increasingly sold at that time, but the old crop tends to off flavors from over-maturity while the new crop is bland from under-maturity. "Reed" has good quality later than "Hass," but by then its fruit is large for most of our markets. "Fuerte," "Bacon" and "Zutano" are still rather immature, and all have serious weaknesses. Pure Mexican ("Thinskins") are plenty early, but the fruits are small and the skins are too thin for good shipping. West Indians are equally early, with larger fruits and thicker skins. Conceivably, hybridization of the two races could permit selection for a variety combining superior traits of both.

Rootstock. In California, Mexican-race seedlings are the principal rootstocks on which commercial varieties have been grafted. Even among the newer clonal stocks tolerant of *Phytophthora cinnamomi* root rot, nearly all have been largely or entirely Mexican: "Duke 7," "Duke 6," "G6." And the seedling stocks under most California trees have similarly been overwhelmingly Mexican: "Topa Topa," "Mexicola," "Canter," "Northrup," and many others. Mexicans are preferred seedling rootstock source because the cold-hardy trees produce large numbers of small fruits with relatively large seeds. They are also superior to the other race adapted here, the Guatemalan, in being more resistant to chlorosis and to the diseases Dothiorella and Verticillium, and in maturing fruit before the season of frost hazard and severe wind.

However, the West Indian race is still more resistant to chlorosis and strikingly more tolerant of salinity. This latter consideration is significant for California, and likely to

become increasingly so as water cost increases and water quality decreases. Pure West Indians ordinarily do not even flower in California, so seeds of the hardier "Waldin" variety were imported commercially from Florida; they proved ill-adapted to our colder winter soils. Seeds of the Guatemalan-West Indian hybrid, "Lula," have also been tried here; they are large and produce vigorous seedlings, but average salt tolerance has not been outstanding.

For rootstocks under California conditions, the most promising would seem to be derivatives of West Indian x Mexican, combining the hardiness and other qualities of the latter with the tolerance of chlorosis and especially of salinity of the former. The progenies reported in this paper seem to support that promise.

The soil in which they were planted is perhaps the highest in salinity on the UCR campus, yet only a few of the trees have the foliage tip-burn symptomatic of salt toxicity. And, as indicated above, the trees are relatively cold-tolerant. Thus, these F_2 trees have effectively combined to some degree the hardiness of their Mexican grandparent with the salt-tolerance of their West Indian grandparent.

One of us (B.O.B.) has now planted out progeny sets from four of these F_2 trees selected for the above traits plus vigor and fruitfulness, for third generation (F_3) testing. Any superior rootstocks thus developed would probably be too genetically variable ("heterozygous") to be a good seedling stock; rather, it would be propagated asexually by the etiolation methods for uniform clonals.