

AN EXPANDED AVOCADO VARIETY IMPROVEMENT PROGRAM

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Abstract

An avocado improvement program, primarily for developing cold-hardy varieties for home plantings, has resulted in varieties that will tolerate temperatures as low as 15 to 20F (—9.4 to —6.7C). In the course of this work several selections and varieties with moderate cold hardiness and commercial potential have been obtained and evaluated. This has led to a program for developing commercial varieties for the citrus area of Central Florida. The program involves the evaluation of selections from other avocado areas and open-pollinated seedlings from the cold-hardy variety collection at Gainesville. The thin-skinned Mexican varieties have been the most cold-hardy but they tend to crack when they mature during Florida's hot, wet summers. All selections with commercial potential appear to be Guatemalan X Mexican hybrids.

Commercial avocado (*Persea Americana* Mill.) production in the United States is mostly limited to the continuously warm areas; however; the avocado has a considerable range in cold-hardiness. Limited cold-hardy avocado variety investigations in Florida started with the introduction of several Mexican seedlings in the 1920's (6) but this work was abandoned many years ago. In 1960 I noted a large seedling tree of one of the early introductions still growing well on the Gainesville campus, despite lack of care and protection from cold. Also, there were younger but large specimen trees of 'Brogdon', 'Topa Topa' and 'Mexicola' growing in the teaching orchard that had been planted by Dr. H. S. Wolfe. The presence of these trees led to the initiation of investigations of cold-hardy avocado materials from various sources. A characterization and evaluation of cultivars in this collection was reported in 1970 (3).

Other research was directed at rooting stem cuttings of cold-hardy avocados to avoid the problem of having plants frozen to below the graft union. 'Gainesville' and 'Brogdon' were rooted from stem cuttings (5), but attempts to root several other cold-hardy selections and commercial Florida cultivars (cvs) failed, even though all could be rooted by air layerage (2). Fortunately, however, it was found that the use of seedling rootstocks of the cold-sensitive West Indian race, did not reduce the cold-hardiness of the scion cvs (4) and that the trees grew satisfactorily when planted with the graft unions slightly below the soil surface to protect them from cold.

Since the initial report in 1970, additional selections from the avocado breeding program in California and from other sources have been added. The purpose of this paper is to present evaluations of new material and discuss the potential for commercial avocado production in Central Florida.

Materials and Methods

Cold-hardy avocado selections from various sources, all grafted on West Indian seedling rootstock, were planted in the cold-hardy avocado collection at the Archer Road Unit (ARU) of the Department of Fruit Crops at various times since 1969. Minimum temperatures were recorded during nights freezing temperatures occurred and freeze damage was evaluated as indicated in Table 1.

Table 1. Evaluation of recent cold-hardy avocado acquisitions

	Cultivar or selection				
	CRC 195-36	CH ₂	Teague	Bacon	Zutano
Fruit					
weight (g)	400	350	300	300	300
shape	LOv	LOv	P	Ov	Ov
color	G	G	G	G	G
cracking	Res	Res	Res	Res	Res
matures	Oct	Aug	Jul	Nov	Nov
Seed					
tightness	T	T	T	T	T
size	Lar	Med	Sm	Med	Med
Plant					
Est. cold tol.	20F (-6.7C)	20F (-6.7C)	20F (-6.7C)	23F (-5 C)	25F (-3.9C)

Weight: A common size, not average. Shape: Ov, ovate; LOv, long-ovate; P, pyriform. Color: G, green. Cracking: Res, resistant. Tightness: T, tight; some loosen when overmature. Size: Sm, small; Med, medium; Lar, large. Estimated cold tolerance based on lowest temperatures at which no serious damage occurred.

In order to obtain additional cold hardy material, about 100 seedlings of 'Brogdon', 'Gainesville', 'Mexicola' and 'Topa Topa', collected from trees in the cv. collection at Gainesville were grown in pots through the winter and planted in June 1973 at a spacing of 10 x 20 ft. (3.0 x 6.1 m) at the Horticulture Unit (HU) of the University of Florida, which is often several degrees colder than the ARU. These seedlings were evaluated for cold damage in the winters of 1973 and 1975.

Results and Discussion

Field tests. The performance of selections planted at the ARU is presented in Table 1 and the performance of the seedlings at the HU in Table 2. Unfortunately, temperatures below 20F (-6.7C) have not been experienced at the ARU since the main body of the new selections have been planted. In 1973 and 1974, the only 2 years fruiting of the new selections fruited at Gainesville, the winters were particularly mild. Even so, minimum temps of 22F (-5.5C) and 25F (-3.9C) occurred in the 1973 and 1974 respectively. Moreover, 'Choquette', and 'Tonnage', planted for comparison have been killed almost to the ground each year since 1970.

The performance of 'Brogdon', 'Gainesville', 'Duke', 'Mexicola' and 'Topa Topa' remained essentially the same as reported previously (3), except the quality and size of 'Gainesville' has been found to be better on young (4to 10-year-old) trees that have been well cared for than was previously reported.

The performance of some of the California cvs. and a selection has been good; however, tests to date are not conclusive and are published at this point only to serve as an indication of the potential for avocado cultivar improvement. The best of the lot have been CRC 195-36, CRC 14-11 (recently released as 'Teague') and CH₄.

CRC 195-36 has fruited heavily and withstood temperatures as low as 20F (-6.7°C) with only slight damage. CRC 195-36 is a handsome green fruit averaging over 400 g, resistant to cracking, long-ovate shaped, and it matures in October.

Table 2. Evaluations of seedling populations of cold hardy avocado cultivars

Seedlings of	% damaged		Non-Mex leaves
	1973 - 74 18F (-7.8C)	1974 - 75 22F (-5.5C)	
Mexicola	12	2	10
Topa Topa	15	3	4
Gainesville	10	1	7
Brogdon	65	42	57

Percent damaged: based on seedlings killed to the protective bank of soil. Non-Mex leaves: leaves much larger than those of the Mex race and with deep, reddish foliage.

Fruit quality is good. The seed is not loose but larger than desirable.

'Teague' (CRC 14-11) has not fruited because of shading from large 'Gainesville' trees in the vicinity but it has withstood temps as low as 20 °F (-6.7C) with only minor damage. Fruit evaluations were made in the test planting of Mr. Lawrence Zill of Delray Beach. This fruit is green, resistant to cracking, of excellent quality, small and tight-seeded and pyriform in shape. 'Teague' matures in July and weighs about 300 grams.

CH₄ has fruited only 1 year. It has also withstood temperatures as low as 20°F (-6.7°C) with only slight damage. CH₄ is a handsome fruit weighing over 300 g. The fruit is long-ovate, green, of good quality and with a tight seed unless over mature. CH₄ ripened in August.

'Bacon' and 'Zutano', well established California cvs, were damaged at 23 °F (-5°C) and 25°F (-3.9°C) respectively. Their fruits are quite uniform and commonly weigh about 300 g. They have been satisfactorily resistant to cracking and their seeds are neither excessively large nor loose in the fruit cavity.

'Yama' appears to be as cold hardy as 'Mexicola'. It does not crack but exterior appearance is poor and the peel sticks to the flesh. It should perform well as dooryard trees in areas in which 'Mexicola' and 'Gainesville' are grown and have the advantage of not cracking.

'Creelman', 'Irwin' and 'Camulos' have not been sufficiently cold hardy to reach fruiting size.

The young seedlings of the hardy Mexican race underwent temperatures of 18F (-7.8C)

at the HU in 1973-74 and 22F (-5.5C) in 1974-75. Seedlings of 'Mexicola', 'Gainesville', and 'Topa Topa' were damaged least with only 10 to 15% killed to the protective bank at 18°F (-7.8°C) and none at 22°F (-5.5°C). About 65% of the 'Brogdon' seedlings were killed to the protective bank at 18°F (-7.8°C) and 42% at 22°F (-5.5°C). The 'Mexicola', 'Topa Topa' and 'Gainesville' seedlings showed little variability in leaf shape, size and color but seedlings of 'Brogdon' segregated widely, with many having the large reddish leaves characteristic of the Guatemalan race. It is significant that many of the 'Brogdon' seedlings withstood temps lower than those of the parent.

The above tests present only limited evidence; however, they indicate that there is better cold-hardy material currently available than in the past and that open-pollinated seedlings of cold-hardy and moderately cold-hardy cultivars could well furnish additional material.

Future research. On the basis of performance to date, Mexican X Guatemalan hybrids appear to hold the most promise, with the Mexican parentage furnishing the cold hardiness and the Guatemalan parentage the thick skin that is resistant to cracking. Thus, emphasis will be placed on obtaining selections of this type.

Sites in Central Florida vary tremendously from the standpoint of frost hazard. Therefore, selections have been planted in a cold location with a commercial citrus grower in Central Florida and arrangements have been made to plant the most promising selections in a relatively warm location at the University's Agricultural Research and Extension Center at Lake Alfred.

More progress could be made if large numbers of controlled hybrids could be produced but as yet there has been little success in producing them (1). The California avocado breeding program, which is undoubtedly the most extensive in the world, has relied largely on seed from open pollinations. Bergh (1) points out that the procedure of continuing to plant seeds from superior fruit has resulted in most of the variety improvement made to date. He also points out that there are no sterility barriers in avocados and that it has been possible to impart such non-Mexican race characteristics as tight seededness into selections largely of Mexican parentage. Nevertheless, efforts to develop techniques for producing controlled hybrids will be intensified at Gainesville to enhance chances of improvement. In the meantime relatively large populations of seedlings from open pollinated seedlings will be grown out at several locations and new material introduced from other areas, including California, Texas and the breeding program at the USDA Subtropical Horticulture Research Unit at Miami.

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