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EFFECTS OF THE DECEMBER 1962 FREEZE ON LULA AND TAYLOR AVOCADO FRUITS

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SUMMARY

After the freeze of December 1962, Lula and Taylor avocados were collected from groves in Dade and Highlands counties, Florida, and evaluated for extent of freezing injury. Fruit was then held at 50°, 60° and 70° F. until soft, then cut, and evaluated again for freezing injury, days to soften, and weight loss when soft.

Slight external injury was characterized by dark streaks, principally along the neck of the fruit; slight internal injury was evidenced by a separation of the skin from the flesh, also in the neck area, but with little or no discoloration of the flesh. Severe external injury was characterized by a shriveled neck, general darkening, and streaking of the skin. Severe internal injury was evidenced by extensive separation of the skin from the flesh, softening and discoloration of the flesh around the seed, and general dark grey discoloration of the flesh, especially in the vascular tissue.

The extent of internal injury was directly related to the extent of external symptoms. Lula avocados from an unheated grove at Lake Placid (Highlands County) were severely injured and had no market value. On the other hand, Lula and Taylor avocados from a heated grove near Avon Park (Highlands County) were slightly injured and had some market value. Lula and Taylor avocados from an unheated grove near Homestead (Dade County) were not injured and appeared normal in all respects. Temperatures in Dade County, however, were not as low as those in Highlands County.

Lula avocados from Highlands County softened more rapidly and lost less weight during softening than those from Dade County. Taylor avocados from Highlands and Dade counties softened at approximately the same rate and lost approximately the same percentage of weight during softening.

The marketability of slightly injured Lula and Taylor avocados may be quickly determined by accelerated softening at 70° F., or possibly higher, while the harvested crop is simultaneously stored at 50°.

INTRODUCTION

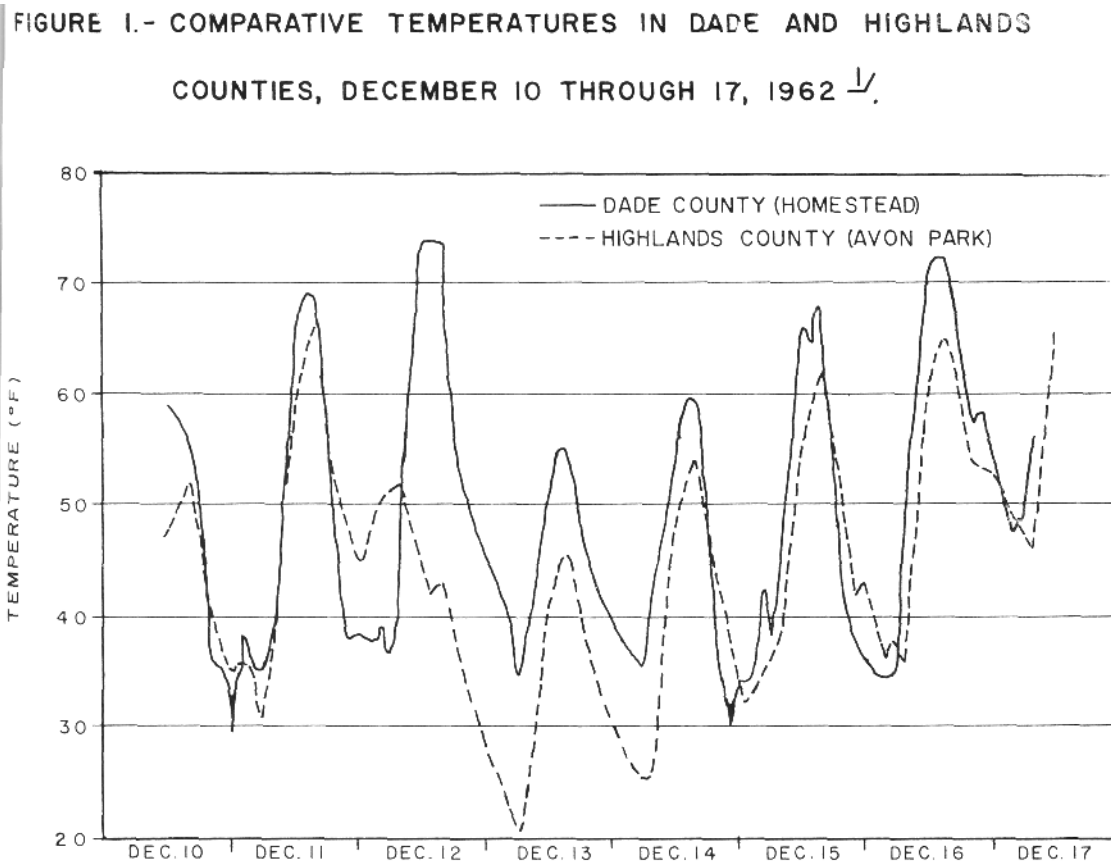
Agriculture throughout most of Florida suffered, during the week of December 9, 1962,

from the most severe freeze of the present century. Only protected areas in extreme southern Florida and along the southeast coast escaped the devastating cold.

After most severe freezes, the effects on various plants are usually reported. Although observations have been recorded concerning damage to avocado trees in Florida (1, 2, 4, 5, 6, 7, 8, 9, 10), little has been recorded concerning the effects of cold injury to the fruit (5).

Krome (5) reported that Lula avocados in Dade County were picked and successfully marketed after the February 1958 freeze in a grove where the temperature reached 26° F. and 1 inch wood was killed. Almost all of the samples taken within 2 days after the freeze had no internal or external injury. He stated that where fruit was injured, discoloration identified the damage by the second or third day, which permitted grading out the damaged fruit before it left the packinghouse.

The objectives of the present study were to determine the softening characteristics and quality of Lula and Taylor avocados which had been exposed to various temperatures in Dade and Highlands counties, Florida, during the 1962 freeze, and to evaluate their market quality.



^{1/} Data obtained from thermograph records of the Sub-Tropical Experiment Station in Homestead, Dade County, Fla., and from Ward's Nursery Inc. in Avon Park, Highlands County, Fla.

MATERIALS AND METHODS

In the avocado-producing area of Highlands County, temperatures were unusually low during the night and morning hours from December 10 through 17 with the coldest temperatures occurring the morning of December 13 (fig. 1).

On December 19, avocados were picked from two groves in Highlands County. Lula and Taylor avocados were picked from one grove at Avon Park and Lula avocados only were picked from the other grove at Lake Placid, about 30 miles south of Avon Park. The grove at Avon Park was heated at the time of the freeze. The grove at Lake Placid was not heated and because thermometers were not placed throughout the grove, temperature data were limited to those obtained from one thermometer adjacent to the grove. Thermograph readings were not available from the Lake Placid area; however, a low of 24° and 5 hours under 26° were reported (3). The lowest temperature reading near the grove in Lake Placid was 25°, on the morning of December 13. The lowest temperature in the heated grove in Avon Park, was 23° briefly and below 26° for about 5 hours. Thermograph readings in the Avon Park area were taken several miles away from the grove and showed a low of 21° P. on the night of December 12 and morning of December 13. Temperatures remained below 26° for 6 hours and below 32° for about 9 hours (fig 1).

Avocado trees in the grove at Avon Park had a dense canopy of foliage and were partly surrounded by other trees serving as a windbreak. The grove at Lake Placid had little canopy, no windbreak, and was exposed on a hillside.

Temperatures in the avocado-producing areas of Dade County were not as low, freezing temperatures did not last as long, nor were these temperatures as frequent as in Highlands County, which is about 200 miles farther north (fig. 1).

On December 20, Lula and Taylor avocados were picked from trees at the University of Florida Sub-Tropical Experiment Station near Homestead in Dade County. The grove was not heated. Thermograph readings showed that the lowest temperatures were about 29° F. during the early morning of December 11. They were 30° the night of December 14 and early morning of December 15 (fig. 1). The grove at the Experiment Station had some canopy but no windbreak.

At least 90 each of Taylor and Lula fruits were picked at each grove except at Lake Placid, where only Lula fruits were obtained. Most of the Lula fruits from Avon Park were selected within arm's reach, from low branches, while most Taylor fruits from the same grove were selected wherever available, many from high branches. Fruit from Lake Placid and Homestead were selected from high as well as low branches.

Fruit from each source was divided into lots of 30 fruits each, evaluated for extent of external freezing injury, weighed, and stored at 50°, 60° and 70° F. When soft, each fruit was again evaluated for extent of external freezing injury, weighed, and cut for evaluation of internal freezing injury and for flavor.

RESULTS AND DISCUSSION

The characteristics of slight external and internal freezing injury were similar in Lula and Taylor avocados. Slight injury was characterized externally by dark streaks, mostly along the neck of the fruit, and internally by a slight separation of the skin from the flesh, especially in the neck, but little or no discoloration of the flesh. Slight internal injury did not detract greatly from the internal appearance of Lula and Taylor avocados. Flavor was not impaired.

Severe external injury was usually characterized by a shriveled neck and by darkened and streaked skin. Severe internal injury was characterized by extensive separation of the skin from the flesh, softness around the seed, and generally a dark grey discoloration of the flesh, especially in the vascular tissue and around the seed. Because of rancid odor and poor appearance, severely injured fruits were not tested for flavor.

Lula and Taylor avocados from the Experiment Station at Homestead were in excellent condition in all respects. No external or internal cold injury was evident either when the fruit was picked or when it was soft after storage (table 1). Trees also showed no cold damage.

Generally, foliage and wood on the Lula and Taylor avocado trees at Avon Park were injured by the freeze, although numerous branches adjacent to heat sources escaped damage. Where little or no injury existed on foliage and wood, fruit also escaped injury. When picked, Lula Taylor fruit showed an average of 1 and 6 percent external injury respectively; most of the injury was slight and none of the fruit had dropped. No internal injury was apparent in the few fruit which were cut at time of picking.

Lula avocados from Avon Park were generally in good condition, when soft; 20 percent showed slight internal injury after storage at 70° F. and only 3 percent showed internal injury after storage at 50°. The same fruit showed 17 and 20 percent slight external injury, respectively, when soft.

From Avon Park, more Taylor avocados than Lula avocados showed injury, but generally the softened Taylor avocados were in fair condition. When soft, 33 percent of the Taylor avocados showed slight internal injury, after storage at 70° F., and none showed injury after storage at 60°. When soft, 57 percent of the Taylor fruit, after storage at 50° showed slight external injury, which was manifested mostly as slight shriveling at the neck of the fruit.

For both Lula and Taylor avocados, the evidence of cold injury increased during softening and generally more injury developed in fruit softened by 70° F. than in those softened at 50° and 60° (table 1), with the exception of Taylor fruit from Avon Park, softened at 50°, which developed much more external injury than comparable fruit softened at 70°.

External injury was more prevalent than internal injury; fruit showing internal injury usually also showed external injury. The sorting and culling out of avocados showing external injury would, in turn, reduce the number of fruit showing internal injury.

Table 1.--Percentage weight loss during softening, number of days required to soften, and percentage of chilling injury for Lula and Taylor avocados at several softening temperatures after exposure to the December 1962 freeze^{1/}

Variety	Softening temperature °F.	Source	Average initial weight Ounces	Average weight loss during softening Percent	Number of days to soften		Chilling injury ^{2/}				
							Range	Average	Initial	When soft	
									(external) Percent	(external) Percent	(internal) Percent
Lula:	70	Homestead	13.5	6.8	4-6	5	0	0	0		
		Avon Park	12.6	4.8	4	4	3	17	20		
		Lake Placid	12.1	3/---	4	4	97	100	100		
	60	Homestead	12.4	5.1	11	11	0	0	0		
		Avon Park	12.4	1.6	5-8	5	0	17	13		
		Lake Placid	12.5	3/---	4	4	90	100	100		
	50	Homestead	12.0	11.1	44-46	45	0	0	0		
		Avon Park	12.2	3.0	7-16	10	0	20	3		
		Lake Placid	11.4	3/---	7-20	13	93	100	100		
Taylor:	70	Homestead	12.1	6.2	3-6	4	0	0	0		
		Avon Park	8.9	5.7	5-8	5	10	17	33		
	60	Homestead	12.2	4.5	7	7	0	0	0		
		Avon Park	9.6	4.3	5-12	8	3	13	0		
	50	Homestead	12.2	3.6	7-19	17	0	0	0		
		Avon Park	9.1	4.9	6-20	12	6	57	3		

^{1/} 30 fruits were tested at each softening temperature from each source.

^{2/} At time fruit was picked external injury was mostly slight in fruit from Avon Park and severe in fruit from Lake Placid. At the time fruit was soft, external and internal chilling injury had increased; it was mostly slight in fruit from Avon Park and mostly severe in fruit from Lake Placid.

^{3/} Extensive deterioration of the fruit made weighing impractical.

Foliage and wood of the trees in the Lake Placid grove showed widespread and severe injury. Most Lula avocados had severe external freezing injury, as well as some internal injury, when picked, and many had fallen from the trees. Lula avocados showed 100 percent injury when soft; most of the injury, external and internal, was severe and the fruit had no market value.

Weight loss during softening was usually greater in fruit from the grove at Homestead (Dade County) than in fruit from the two groves in Highlands County. Uninjured fruit seems to require a longer period to soften than injured fruit (table 1). The greatest contrast in number of days required for fruit to soften was with Lula avocados held at 50° F. Fruit from Homestead required an average of 45 days to soften while the injured fruit from Avon Park and Lake Placid groves required only 10 and 13 days, respectively.

Heating operations apparently moderated temperatures in the Avon Park grove, although subfreezing temperatures did occur. The dense canopy and windbreak also probably afforded some cold protection. Observations in August 1963 showed that Lula and Taylor trees in the grove at Avon Park suffered injury, mostly in the tops where branches were killed back to wood 4 to 6 inches in diameter. Little or no wood damage was observed in the lower parts of the trees and the dead wood was pruned at approximately the 20-foot level. Some sound fruit were picked from low branches for several months after the freeze. Perhaps Lula avocados showed less injury than Taylor avocados because most of them were picked from low branches while many of the Taylor fruits were picked from high branches. For the forthcoming season, the trees have a light crop of fruit, which was set during the spring of 1963.

Observations, in August 1963, showed that Lula trees at Lake Placid were killed back to wood 12 to 14 inches in diameter. Entire trees were affected and pruning was done by dehorning main trunks 4 or 5 feet above the ground. No crop can be expected from this grove for several years.

Examination of individual fruits for actual injury appears to be more useful than temperature records in determining extent of fruit injury to Lula and Taylor avocados. Lula avocados, injured as severely as those at Lake Placid, were certainly unfit for harvest. Conversely, Lula and Taylor avocados, as slightly injured as those at Avon Park, may be harvested, especially from protected locations on the tree.

Discarding Lula and Taylor avocados that show external cold injury may remove many fruit which show, or will eventually show, internal injury, but this may not apply to other varieties. For example, Kanan seedling avocados, at the U. S. Plant Introduction Station at Miami, dropped within a few days after the freeze; none showed external cold injury, yet, when cut while still firm, all showed internal injury. The lowest temperature recorded at the Plant Introduction Station was briefly 31° F. with 32°, or below, prevailing less than 2 hours on the morning of December 11.

When freezing temperatures occur, avocados that appear to be sound should be harvested and stored at 50° F. In the meantime, representative samples could be softened at 70° F., in order to evaluate the extent of freezing damage.

LITERATURE CITED

1. Andrews, A. H. 1935. The December freeze and resulting damage to tropical fruiting plants in Lee County, Florida. Proc. Fla. Hort. Soc. 48: 167-170.
2. Beach, J. B. 1919. Climatic limitations on avocado growing in Florida. Proc. Fla. Hort. Soc. 32: 110-112.
3. Florida Citrus Mutual. December 15, 1962. Triangle Vol. 12, No. 23.
4. Goldberg, E. H. 1921. Avocado culture in South Dade County. Proc. Fla. Hort. Soc. 34: 81-85.
5. Krome, W. H. 1958. Observations on cold damage to avocados in Dade County. Proc. Fla. Hort Soc. 71: 338-341.
6. Lynch, S. J. 1940. Observations on the January 1940 cold injury to tropical and subtropical plants. Proc. Fla. Hort. Soc. 53: 192-194.
7. Popenoe, W. 1919. Avocados, particularly Guatemalan. Proc. Fla. Hort. Soc. 32: 88-104.
8. Steffani, C. H. 1935. Symposium on cold injury to avocados, mangos and other subtropical fruits and their care. Proc. Fla. Hort. Soc. 48: 170-171.
9. Ward, W. F. 1940. Observations on protection of avocados from cold injury. Proc. Fla. Hort. Soc. 53: 158-161.
10. Wolfe, H. S. 1935. Avocado varieties in the light of recent experience. Proc. Fla. Hort. Soc. 48: 157-159.