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EFFECTS OF THE 1977 FREEZE ON AVOCADOS AND LIMES IN SOUTH FLORIDA

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Abstract

This paper reports the effects of the 1977 freeze, which is considered one of the 5 most destructive of this century. Weather data, including minimum temp and duration are given for 3 locations in the Homestead area. Comparative cold tolerance ratings for 160 avocado cultivars are given and various aspects of cold injury discussed. Effects of cold temp in relation to pruning of several 'Tahiti' lime clones are presented. Various aspects of plant regrowth and recuperation are also discussed. The results of protective measures, such as sprinkler irrigation, are mentioned and compared.

The area south of Lake Okeechobee, between latitudes 25° and 27° N, and a narrow coastal strip stretching further north for about 125 miles on both sides of the Florida peninsula are climatically considered almost frost-free in character. The temp does drop to freezing or below nearly every winter, but for such short duration that the damage to tender tropical plants is minor or negligible. Few major freezes have occurred in South Florida in this century. The most damaging occurred in the winters of 1916-17, 1934-35, 1939-40 and 1957-58 (3), all with devastating effects to the commercial tropical fruit industry of this area. As the acreage and crop values have gradually increased over the years, the losses due to each succeeding freeze have multiplied accordingly. The recent freeze can be considered the fifth major freeze of the century and certainly one of the most destructive in terms of the value of crops destroyed and damaged in South Florida.

Evaluation of cold tolerance of some avocado cultivars has been discussed in the past, usually following one of the freezes mentioned before (4, 5, 8, 12). However, no comparative evidence of cold tolerance has been offered; there have been no systematic observations in an avocado collection containing a large number of cultivars. This paper supplies that information and also discusses the effects of pruning techniques, such as mechanical hedging and topping, on the cold tolerance of avocados and limes. The 1977 freeze also offered a good opportunity to evaluate trickle irrigation for cold protection and contrast it with sprinkler irrigation which has been well documented to protect plants against injury from temperature in the twenties (°F) (-1° to

-7°C) which sometimes occur in the Homestead area.

Materials and Methods

The temp during the months of November and December, 1976 declined in the normal manner for winter conditions without severe or prolonged dips below 40°F. Most avocados and limes were already blooming or initiating flowering buds as they normally do for this time of year. Table 1 contains weather data from official stations at the University of Florida, Agricultural Research and Education Center (AREC), Homestead and at Immokalee, where considerable plantings of avocado and lime have been made in recent years. Temp are presented as they occurred during the night and the morning of Jan. 19-20, 1977.

Table 1. Weather data observed at Official stations at AREC, Homestead, and Immokalee, Florida on Jan. 19-20, 1977.

Time	Temperature (°F): Immokalee thermograph[z]	AREC thermograph[z]		AREC thermocouple			AREC dew point[w]	AREC wind speed[v] (MPH)
	5 ft	5 ft[x]	2.0 in[y]	5 ft	10 ft	30 ft	5 ft	50 ft
5:00 PM	—	—	—	—	—	—	22.0	—
6:00 PM	40.0	41.5	40	—	—	—	23.5	7
7:00 PM	35.0	37.0	32	—	—	—	23.5	3
8:00 PM	33.0	35.5	31	35.9	36.8	37.5	24.5	4
9:00 PM	31.5	34.0	30	—	—	—	26.0	4
10:00 PM	30.0	33.5	29	33.3	34.4	35.2	26.5	2
11:00 PM	29.0	32.0	28	30.4	32.1	33.6	27.0	2
12:00 PM	28.0	32.0	27	32.8	33.5	33.8	28.0	2
1:00 AM	27.0	32.0	27	32.9	33.6	33.8	28.5	2
2:00 AM	27.0	31.0	26	31.6	32.0	32.4	28.5	3
3:00 AM	26.0	30.5	25	—	—	—	29.0	2
4:00 AM	26.5	29.5	24	—	—	—	29.0	1
5:00 AM	26.0	28.5	24	—	—	—	28.5	1
6:00 AM	26.0	28.0	25	—	—	—	28.0	1
7:00 AM	26.5	27.0	26	—	—	—	28.0	1
7:30 AM	—	—	—	28.3	28.8	29.8	—	—
8:00 AM	27.5	30.0	25	—	—	—	31.0	2
9:00 AM	35.0	38.0	—	—	—	—	34.0	4

[z]Accuracy of readings from thermograph are ± 0.5° F, and ± 1.0° F for dew point.
[y]Readings from a thermograph placed in a weather shelter and calibrated with official max. and min. thermometers.
[x]Same as y, plus several other readings including the official minimum taken on the morning of Jan. 20, 1977.
[w]From a recorder corrected with wet-dry bulb data and readings adjusted consistent with air temperature recorded in the official shelter.
[v]Average wind speed during the previous hour recorded as elapsed miles on an anemometer recorder.

Systematic observations of tree injury and their subsequent recovery were made in several orchards, but particularly in a 3.5 acre avocado germplasm collection containing 3, 10-year old trees of each cultivar. This collection, located at AREC, Homestead, is 150 m from the weather station and presumably uniformly exposed to similar climatic conditions. It is under trickle irrigation and does not have sprinkler irrigation for frost protection, thus providing a unique opportunity for comparing the relative cold tolerance of about 160 cultivars. Ratings of tree injury were made subsequent to Jan. 20 on several occasions. However, only those tabulated in Table 3 were considered representative of the effects of the freeze. They include: Tree injury: Feb. 14, 1977 and March 18, 1977; Presence of bloom: Apr. 1, 1977; and recuperation rate and production: Sept. 20. 1977.

Several 'Tahiti' lime orchards, without frost protection, were also evaluated for the effects of the freeze. However, our attention was focused on one orchard for 2 reasons: 1) it was undergoing several tests of mechanical hedging and topping, and 2) it consists of the following blotch-free (7) certified clones: 37-1-8, 38-11-14, 38-10-14, F-31-8, F-40-10, F-41-10 and F-31-8[2] planted in randomized blocks. This was a good opportunity to ascertain differences in cold tolerance among these clones and the effects of pruning systems on cold susceptibility. Hedging and topping treatments were as illustrated in Fig. 1. Pruning was done 4 months before the freeze, so that normal regrowth and various stages of flowering existed on Jan. 19-20, 1977.

Results and Discussion

Meteorological data in Table 1 show that air temperatures went down rapidly after 6:00 PM on Jan. 19, 1977 and conformed with published rates of decline (6). The official minimum air temperature (at 5 feet) was 26.9° F in Homestead and 25.5°F in Immokalee. Temp near the ground were generally 4-5°F colder than at 5 feet. In Homestead thermocouples located at 5, 10 and 30-foot heights indicated a discernible inversion layer. This is substantiated by unprotected, tall avocado trees which subsequently bloomed and fruited adequately only above 20 feet. Relatively little wind movement occurred at both locations during the night, mostly from the NW, and generally decreased as the night progressed, indicative also of a temp inversion.

At AREC, Homestead the minimum dew point of 22°F was reached at 5:15 PM, and increased gradually, until approximately midnight, when the air temperature reached the dew point. Water condenses on any surface cooler than the dew point, thus by midnight the first frost was observed on exposed metal surfaces and foliage. Thereafter, most leaves had a fine, but visible, cover of ice. The first light of early morning revealed a heavy cover of frost in all orchards not under sprinkler irrigation. This is relevant since a persistent frost condition increases the formation of ice in plant tissue and results in greater damage and dehydration of fruit tissues, particularly citrus (11).

As Table 2 indicates, at AREC, Homestead the temperature remained below freezing for over 9 hours, and represented a typical "radiative" freeze (9) of subtropical latitudes. The "sky temperature"[3], a measure of the intensity of infrared radiation as a cooling factor, was 12.5° F at 8:00 PM, indicating good conditions for frost accumulation on any exposed surface with a temperature lower than the clew point. Exposed thermometers in tomato fields at 12-18 in. from the ground registered consistent temp in the lower twenties throughout most of the night. Many lower areas of Dade County, such as glades which are a few feet lower than the dominant fiat countryside, had even lower temperatures as illustrated in Table 2.

Table 2. Comparisons of air temp at 3 sites in Dade County for the freezes of Feb. 4-5, 1958 and Jan. 19-20, 1977 (1, 10).

Location	Year	Min temp (°F)	Hours below				
			32°	30°	28°	26°	24°
South Miami	1958	28	8	6	4	0	0
	1977	25	11	10	8	2	0
AREC, Homestead	1958	27	12	11	6	0	0
	1977[z]	27	9	4	1	0	0
East Glades	1958	30	8	3	0	0	0
	1977	23	15	12	11	10	3

[z]University of Florida, AREC, Homestead records.

Air temp at several locations in Dade County are compared for the 1958 and 1977 freezes in Table 2. The data show a peculiar variability between relatively close locations and illustrates the difficulty of comparing one freeze with another. Other freezes with official minimum temp of 26°. or 27° F at AREC, Homestead were: Jan. 15, 1956: Feb. 16, 1943; March 2, 194-1; and Dec. 13, 1934.

Avocado tree response to the freeze is tabulated in Table 3. Cultivars are classified according to their relative susceptibility or tolerance to cold starting with the resistant group of Mexican types and hybrids. Two intermediate groups are made up mostly of Guatemalans arid Guatemalan X West Indian hybrids. The approximate racial lineage of cultivars is also indicated. As can be noted, cultivars do not fit into the general concept that all Mexican are cold-tolerant and all West Indian are cold-susceptible. Response to cold, weather appears to depend on several factors, the most important of which is probably *racial ancestry,* but also includes: 1. Size and age of tree: young trees are most susceptible, increasing in tolerance with age. 2. Physiological condition of tree or vigor: iron chlorotic trees are weak and thus more susceptible to cold. 3. Trees with a heavy crop of fruit or directly after one are much more susceptible than during or after a light crop or during an "off" year. 4. External factors, such as the incidence of diseases or injuries caused by insect’s lower tolerance to cold. Cercospora spot, by causing severe and constant defoliation, particularly among California selections in Florida, reduces natural tolerance to cold. 5. The location of an orchard in relation to buildings, windbreaks, and large bodies of water, such as canals, also influences ultimate injury. 6. The presence or absence of weeds or a cover crop modifies the degree of injury by influencing the radiation of heat from the soil. This is especially important with young plants.

None of the West Indian cultivars bloomed after the freeze. The cold destroyed flower buds and the young branches on which they were borne. On the other hand, the flowering response was variable among the cultivars in the other groups. Not all hardy cultivars (rating 0.5 to 1.0) bloomed equally well, and fruit set was not necessarily associated with degree of flowering and apparent cold tolerance. Some with a moderate number of flowers set and matured a considerable crop of fruit but the majority did not set fruit regardless of the amount of flowers. Noteworthy hardy Florida cultivars which matured a substantial crop are listed in Table 4. Young avocado trees with only trickle irrigation in the sandy area of Immokalee went through the freeze with comparable damage as those in Homestead. However, their recuperation rate appeared to be faster in the deeper soils of Immokalee.

Table 3. Evaluation of avocado cold injury following the freeze of Jan. 19-20, 1977. A[z]: Tree damage, three weeks after freeze (Feb. 14, '77), B[z]: Tree damage, two months after the freeze (Mar. 17, '77), C[y]: Amount of flowers present 70 days following freeze (Apr. 1, '77), D[w]: Recuperation and production rating 8 months after freeze (Sept. 20, '77).

Cultivar	Approx racial lineage[v]	A	B	C	D
	Cultivars highly tolerant to cold (Rating of 0.0 to 1.0)				
Brogdon	M x WI	1.0	1.0	3	3 FFF
Capac	M x WI	1.0	1.0	1	3
Duke	M	1.0	1.0	1	3 F
Egas	M x WI	1.0	1.0	0	3
Ettinger	M x G	1.0	1.0	1	3 FFF
Gainesville	M	0.5	0.5	3	3 FF
Ignacio	M x G	1.0	1.0	3	3 F
Irving 134	M x G	1.0	1.0	0	1
J. P. Young	M	0.5	0.5	3	3 FFF
Mexicola	M	0.5	0.5	3	3 FFF
Mexican No. 1	M	0.5	0.5	—	3
Mexican No. 2	M	0.5	0.5	—	3
Mexican No. 3	M	0.5	1.0	—	3
Nena	M	1.0	1.0	2	3
Streamliner	M	1.0	1.0	0	3
Tamayo	M x WI	1.0	1.0	1	3
Topa-Topa	M	1.0	0.5	3	2 FFF
	Cultivars tolerant to cold (Rating of 1.0 to 2.0)				
Ajax	G x WI	1.5	1.5	2	3
Arue	WI	1.8	2.0	0	2
Avon	G x WI	2.0	2.0	1	2 F
Bacon	M x G	1.5	1.5	1	2
Bonita	G x WI	1.8	1.5	1	2 F
Booth 1	G x WI	1.5	1.0	2	3 FF
Booth 2	G x WI	1.5	1.5	2	3 F
Booth 3	G x WI	1.5	1.5	1	3 F
Booth 4	G x WI	1.5	1.5	1	3 F
Booth 5	G x WI	1.5	1.5	1	3 F
Booth 6	G x WI	1.8	2.0	1	3 F
Booth 7	G x WI	1.5	1.8	1	3 F
Booth 8	G x WI	1.8	1.5	2	3 FF
Booth 9	G x WI	1.8	1.5	1	3
Booth 10	G x WI	1.8	1.5	1	3
Burnecker	WI x G	2.0	2.0	0	2
Camp	G x WI	1.5	1.8	3	3 FF
Camulas	G	1.8	1.5	1	2 F
Chica	G x WI	2.0	2.0	0	2
CH 4	G x M	1.8	1.0	1	2 F
CH 5	G x M	1.8	1.0	2	2 F
Choquette	G x WI	1.5	1.0	3	3 FFF
Collins	G	1.5	1.5	1	3 F
Collinson	G	1.5	1.8	0	2
Connor	G x WI	1.8	1.5	3	3 FFF
Courtright	WI x M	1.5	1.5	3	3 FF
CRC-1411 (Teague)	G x M	1.5	1.8	1	3 F
CRC-23-18-2	G x M	2.0	1.8	0	2
Day	G x M	1.5	1.25	1	3
Dwarf Lula	G x WI	1.5	1.5	0	3
DeBedts	G x WI	2.0	2.0	1	3 F
Edmonds	G x WI	1.8	1.8	1	2
Fairchild	G x WI	2.0	2.0	0	2
Fuerte	G x M	1.8	1.5	1	3 F
Goering	G x WI	1.5	1.5	2	3 FF
Gottfried	WI x M	1.5	1.0	1	3
Greenstem	G	2.0	2.0	0	2
Gripiña 13	G x WI	1.5	2.0	0	3
Hall	G x WI	1.5	1.5	2	3 FFF
Hass	G x M	1.8	2.5	0	1
Itzamna	G	2.0	2.0	0	2
Kahalu (30-15)	G x M	1.8	1.8	0	2
K-L	M x WI	1.5	1.5	0	1
Kampong	WI x G	2.0	1.8	2	3 FF
Kashland	G	2.0	2.0	2	2
Las Pozas	G	2.0	2.0	0	2
Linda	G	1.5	1.8	0	2
Lownsbury	G	1.5	1.5	0	3
Lula	G x WI	1.5	1.5	2	3 FFF
Manik	G	1.8	2.0	1	2

Table 3. (Continued).

Cultivar	Approx racial lineage[v]	A	B	C	D
Major	G	2.0	2.0	2	3 FF
Marcus	G	1.5	1.5	2	3 FFF
Mesa	G	1.8	1.8	1	2
McDonald	G x M	1.0	1.5	2	3 F
Montgomery Late	G x WI	1.5	1.0	2	3 F
Mt-4	M	1.5	1.0	1	3 FF
Nabal	G	1.5	1.5	1	2 F
Naranja	G	1.8	2.0	2	3 FF
Nesbitt	WI	1.8	2.0	0	2
Nezahualcoyotl	M x G	1.5	1.0	1	3 F
Nimlioh	G	1.8	1.8	2	3 F
Nirody	G	2.0	2.0	0	2 F
Norman	G x WI	1.8	1.8	1	2
Paute	G x WI	2.0	2.0	1	3 F
Persea schiedeana	—	2.0	2.0	0	1
Peterson	WI	1.8	1.8	0	2
Pope	WI x M	2.0	1.8	1	2
Queen 8	G	2.0	1.8	1	2
Queen 9	G	2.0	1.8	1	2 F
Reinecke 1	G	1.8	2.0	1	2 F
Shaff	G x WI	1.5	1.0	3	3 FFF
Sartini	G x WI	2.0	2.0	0	3
Scotland	G x M	1.8	2.0	0	2
Steffani	G x WI	2.0	1.8	0	2
Tappen	G x WI	1.8	1.8	1	2
Taylor	G	1.5	1.5	2	3 FFF
Tocha	M x G	1.5	1.5	3	3 F
Tovva	G x M	1.8	1.8	1	2 F
Turner	G	1.8	1.8	3	3 FFF
USDA 21	G x WI	1.5	1.5	3	3 FFF
Vaca	G x WI	2.0	2.0	0	2
Vero	G x WI	1.8	1.8	2	3 FFF
Waldo	G x WI	2.0	2.0	2	2 F
Wagner	G	1.8	2.0	0	3
Winter Mexican	M x WI	1.5	1.5	1	3 F
Yama 3	M x G	1.5	1.0	1	2
Yama 381	M x G	1.5	1.0	2	3 F
Yama 423	M x G	1.5	1.0	3	3 FF
Yon	G x WI	1.5	1.8	2	3
23-19	WI x G	2.0	2.0	0	2 F
27-24	WI x G	1.8	1.8	1	2 F
	Cultivars moderately tolerant to cold (Ratings of 2.0 to 3.0)				
Black Prince	G x WI	2.0	2.5	0	2
Brooks Late	G	2.5	2.5	0	1
Buccaneer	G x WI	2.0	2.5	0	2
Chandler	WI x G	2.5	2.0	0	2
CRC 14-16	G x M	2.5	2.0	0	2
CRC 17-51	G x M	2.5	2.0	0	2
Cristina	G	2.0	2.5	0	2
Dunedin	G x WI	2.0	2.5	1	2 F
Herman	G x WI	3.0	2.5	0	2
Irving 78	G x M	2.5	2.5	0	1
Kalusa	WI	2.5	2.0	0	2
Kalusa Sdlg.	WI	2.5	2.5	0	2
Llorón	WI x G	2.5	2.0	0	2
Margerite	G x W	3.0	2.5	0	2
McArthur	G	2.0	2.5	0	2
Nichols	G x M	2.5	2.0	0	2
Reinecke 12	G	2.0	2.5	1	2
Tela	WI	2.5	3.0	0	1
Trinidad	WI	2.5	3.0	1	1
Winslow	G x WI	2.5	2.0	0	2
Winter Late	G x WI	2.5	3.0	1	2
	Cultivars Susceptible to Cold (Rating of 3.0 or higher)				
Avila	WI	3.0	3.5	0	1
Bitte	WI x G	3.0	3.0	0	1
Catalina	WI	3.0	4.0	0	1
Du Puis #2	WI	2.5	3.0	0	1
Extra	WI	3.0	3.5	0	2
Family	WI	3.0	3.5	0	1
Fuchs	WI	3.0	3.0	0	1
García #1	WI	3.0	3.5	0	1
Hale	WI	3.0	4.0	0	2

Table 3. (Continued).

Cultivar	Approx racial lineage[v]	A	B	C	D
Hardee	WI	3.0	4.0	0	1
Hawaii	WI	3.0	3.0	0	2
Henry	WI	3.0	3.5	0	2
Herndon	WI x G	3.5	4.5	0	2
Irving 34	G x M	3.0	3.0	0	1
Irving 59	G x M	4.0	2.5	0	1
Irving 65	G x M	3.0	2.5	0	1
Irving 96	G x M	4.0	3.0	0	1
Irving 120	G x M	4.5	4.5	0	1
José Antonio	WI	3.0	4.0	0	1
Lawhon	WI	3.0	4.0	0	1
Marfield	WI x G	3.0	3.5	0	1
McGill	WI	3.0	3.0	0	1
Marshelline	WI x G	3.5	3.0	1	2
Nadir	WI	3.0	3.5	0	1
Pirincay	WI x G	3.0	3.5	0	2
Pollock	WI	3.0	4.0	0	1
Poropat	WI	3.0	3.5	0	1
Roberts	WI x G	3.0	4.5	0	1
Ruehle	WI	3.0	3.5	0	1
Russell	WI	3.0	3.5	0	1
Simmonds	WI	3.0	4.0	0	1
Tacho	WI	3.0	4.0	0	1
Waldin	WI	3.0	3.0	1	1
Winslowson	WI x G	3.0	3.5	0	1

[z]Rating for A and B:
0.0 = No damage
0.5 = Occasional tender young shoots killed
1.0 = Most tender shoots killed
1.5 = No more than 25% of leaves killed
1.8 = 50% of foliage killed
2.0 = About 80% of foliage killed
2.5 = More than 80% of foliage killed
3.0 = All leaves and few young branches killed
3.5 = Medium size branch plus all foliage killed
4.0 = Large framework branches killed
4.5 = Killed to the ground but sprouting from crown
5.0 = Completely killed

[y]Rating for C: 0: No bloom; 1: few flowers, 2: below normal, 3: normal bloom.

[w]Rating for D: Recuperation = 1: Poor, 2: Medium, 3: good Production = F: light crop, FF: medium crop, FFF: good crop.

[v]G = Guatemalan, M = Mexican, WI = West Indian.

Some of the California selections and cultivars, including 'Hass' and 'Fuerte' but particularly the 'Irving' numbers, are susceptible to Cercospora spot in South Florida. This disease causes premature leaf drop during the cool winter months leading to a weaker tree condition and thus to an increased susceptibility to cold.

No detectable differences among 'Tahiti' lime clones were found in their reaction to cold weather. All clones appeared to be equally intolerant of cold. One exception was a selection of clone 38-10-14 (ML-21), which by being-more susceptible to greasy melanose (*Micosphaerella citri* Whiteside) than ordinary[4], suffered more leaf drop and consequently more cold damage than the other clones.

The effects of pruning on cold damage were much more visible and dramatic. Injury was intimately associated with severity of pruning'. Thus, trees in treatment 1 (Fig. 1) which received more pruning than the others were the most affected by the freeze.

Correspondingly, those in the other treatments which received progressively less pruning were less affected than treatment 1. Plants in treatment 4, which only received a light pruning removing no more than 12-18 inch at either side of the trees, were least affected by cold weather.

One peculiar phenomenon worth reporting occurred a few weeks after the freeze. A widespread attack of citrus melanose (*Diaporthe medusaea* Nitschke) on all new growth and young fruit of Tahiti lime was recorded throughout the Homestead area. Growers were not able to control it adequately despite repeated applications of copper sprays. Ordinarily, this disease is not difficult to control; however, the amount of spore inoculum produced in the vast amount of dead wood was apparently so great that melanose had significant deleterious effects on the quality of the fruit for several months subsequent to the freeze.

Observations on the effect of pruning on avocado trees also revealed a correlation between severity of pruning and cold injury similar to what occurred with 'Tahiti' lime. Two speculative reasons which may explain this effect are: 1) pruning, by removing most of the canopy of the tree, allows ground and tree heat to escape, whereas unpruned trees trap radiation with their foliage. 2) Pruning has a weakening effect on trees which lowers their tolerance to cold. The degree of ultimate injury is undoubtedly influenced by a combination of both factors.

Avocado or lime orchards with working system of sprinkler irrigation delivering 1/4 inch of water per hour received sufficient protection against the cold and suffered no detectable damage. This amount of water turning to ice on the foliage releases heat (latent heat of fusion) and protects plant tissues against damage within a margin of ambient temperature which should not be lower than 22°F at wind speeds of 2 to 4 m.p.h. (2). Windy conditions nullify this protection by increasing the cooling effect of evaporation. Fortunately, as shown in Table 1, calm conditions are frequently a dominant factor in South Florida freezes.

Avocado trees, particularly young ones with soft, brittle wood, sustained limb breakage due to the accumulation and weight of ice. This did not occur in lime trees.

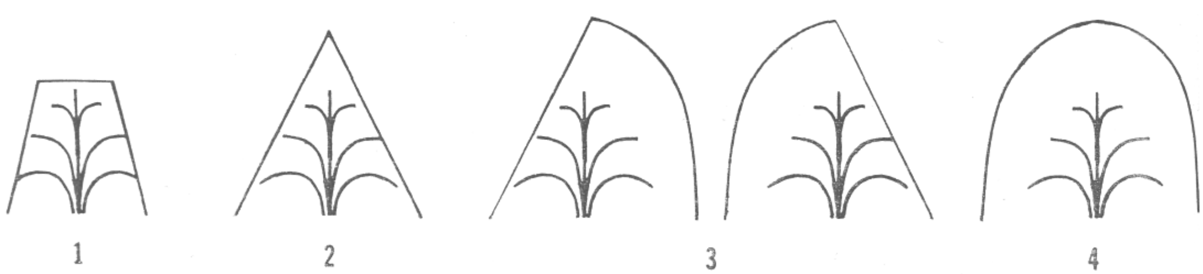

Fig. 1. Four pruning systems on Tahiti lime showing relative amount of foliage removal.

Many growers found that their power sources tended to malfunction due to the cold. It took much work arid attention to keep pumps constantly running. Some growers were also a few hours late in starting their pumps and their orchards showed the effect of their lack of diligence in a few days. Trickle irrigation, predictably, afforded no frost protection under the prevailing conditions of this freeze, although there has been some evidence that under a frost of short duration it has given a certain measure of protection. Observations of many growers concur that young plantings of avocado arid lime with trickle recuperated faster from this freeze than has been the case in the past without this type of irrigation. The ground water in South Florida remains at a constant 74°F during the winter. In spite of this, in some cases water froze in the hoses, stopping the system altogether.

Table 4. Evaluation of hardy Florida avocado cultivars which matured a crop after the freeze of Jan. 1977.

Most tolerant 1	2	3	Least tolerant 4
Brogdon[z]	Choquette	Booth 1	Booth 2
	Connor	Camp	Booth 3
	Hall	DeBedts	Booth 4
	Lula	Goering	Booth 5
	Marcus	Hickson	Booth 6
	Shaff	Kampong	Booth 7
	Taylor	Major	Booth 8
	Turner		Booth 9
	Vero		Booth 10

[z]The cultivars are grouped in 4 categories in descending order of tolerance. Differences between categories are minor but they are detectable in degree of injured foliage, flower production and particularly in yield of fruit normally matured.

Conclusions

1. The most important factor influencing susceptibility to cold in avocado cultivars is *racial ancestry.* Other factors are: a) size and age of tree, b) general vigor, c) occurrence of cold during or after heavy crops, d) presence of disease, such as Cercospora spot, e) location of orchard in relation to protective structures or water, and f) presence or absence of a ground cover.

2. There is no discernible difference among 'Tahiti' lime clones, all appear to be equally susceptible to injury.

3. There are significant differences among Florida avocado cultivars in tolerance to cold (Table 4).

4. Cold damage appears to be associated with severity of pruning. Thus, plants from which much foliage and branches have been removed can be seriously hurt by cold even several months after pruning.

5. Sprinkler irrigation, within certain recommended parameters, can protect avocados and limes even under the severest of cold conditions in South Florida. However, branch breakage due to ice accumulation can be a serious problem with avocados. On the other hand, trickle irrigation does not give sufficient cold protection to be considered of practical value during freezes of long duration.

6. In view of the virulence of citrus melanose on young growth and fruit of 'Tahiti' lime

after a freeze, it appears advisable to remove and dispose of all dead wood from trees as soon as convenient. In this way, sources of spore production will be eliminated also.

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[1]For metric conversions see Table near the front of this Volume. Ed.

[2]Florida Budwood Registration Program designations.

[3]"Sky temperature" is the temp of a substance, insulated from sources of heat, and free to radiate its heat to a dear sky

[4]Senior author's unpublished data.