

thousand boxes of Lulas and a smaller quantity of other varieties were salvaged.

This did not apply in equal measure to every variety, and it most certainly does not apply to the fruit we harvest earlier in the season. Observations in freezes occurring earlier in other winters show definitely that while Lula fruit will stand the cold well even early in the season, many varieties cannot be salvaged at all if the temperature drops as low as 28 degrees. The damage is not always manifested in the way just described, either. Fruit which appears perfectly good on the outside may "cut black" around the seed. And some varieties will drop badly after a cold spell which did not even damage the leaves. Oddly enough, some of the varieties which are quite susceptible to cold damage in November or December came through this cold as well as the Lula. I have in mind particularly the Booth 1, which will rain off the trees after temperatures no lower than 29 or 30 degrees early in the season; the fruit of this variety stood the cold in February as well as did the Lula. There may be a change in the fruit associated with full maturity which makes it able to stand more cold.

Any discussion of cold injury should include the subject of protective measures. Actually, in Dade County, aside from the clean

cultivation of young groves, and keeping all trees in healthy condition, there are not many things to do. In young groves, if the plants are small enough to be covered by hampers this should be done. It will prevent injury from mild freezes and will save the life of the plants at temperatures as low as 27 degrees. Older trees can be protected by firing, as in citrus groves, but this is not often done as the need for it is not frequent and the expense is great. The few groves that were protected by oil heaters last February came through with little damage, but where old automobile tires were burned, as is frequently done for truck crops, I could not see that they afforded much protection. Whether or not oil-firing is economically justified as a general practice would require a careful cost study; the answer is not available to us now.

We have no experience with wind machines, but it seems to me that this device may prove to be a valuable aid in protecting from most of our freezes.

I will conclude with the sober observation that except for what we have learned about keeping the trees healthy, the value of keeping the groves clean, and the possibility of salvaging fruit from injured trees, we are in about the same position that we were 25 years ago, when it gets cold.

COLD DAMAGE TO FRUIT TREES AT THE SUB-TROPICAL EXPERIMENT STATION, HOMESTEAD

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The numerous cold spells of the winter of 1957-58 provided an opportunity to evaluate the hardiness of some tropical and subtropical fruit plants. At the Sub-Tropical Experiment Station, Homestead, the December 9-12 cold spell reached a low of 32° F. but did very little damage except to sensitive plants and those still in active growth. During the January 8-9 cold spell two hours below 32° F. caused no damage. The February 4-5 cold spell, on the other hand, did considerable damage; temperatures below 32° F. lasted

for 13 hours and an official low of 26.5° F. was recorded at the Station. Except for one warm week the end of December and a few warm days during January, cool weather prevailed until February 22.

In most cases damage by the February 4-5 freeze was more severe than that of January 14-15, 1956, when temperatures below 32° F. lasted for 8 hours and an official low of 27° F. was recorded. Some plants, however, received more damage in 1956 than in 1958.

Susceptibility of plants to cold damage depends on several factors.

1. The nature of the species—some species are extra tropical, such as the breadfruit, Malay apple, and cashew, and will

sometimes be damaged by cold even without freezing temperatures.

2. The general condition of the plant from a nutritional standpoint — if chlorotic, lacking fertilizer, especially nitrogen, or weakened by insects or diseases, the plants will be more susceptible to cold injury than those in good healthy condition.
3. The stage of growth—a tree in active growth with tender leaves is more susceptible to cold than a tree in dormant condition.
4. The age of the tree—a well established plant 4 years or more of age can tolerate more cold than young plants only 1 to 3 years in the field.
5. Overhead protection — plants growing under large spreading trees or protected by nearby trees or buildings will not be hurt as much as trees in exposed situations.

Cold protection can be provided in several ways:

1. Clean cultivation—exposed rock or sand will permit more accumulation of heat during the day and allow more radiation of heat from the ground during the night than ground covered with mulch or weeds.
2. Wrapping the trunks of young plants with straw or some other material that is loose enough to allow circulation of air and to prevent accumulation of moisture will provide sufficient insulation to protect the trunks even if the top above the wrap is killed.
3. Planting sensitive plants where they will be protected by large trees.
4. Use of fire pots to raise the temperature a few degrees.
5. Covering small plants with hampers or similar containers.
6. Irrigation may be used to raise the air temperature; overhead irrigation or running water into ditches are both effective.

Most of the notes on cold damage to the fruit plants were made at the Experiment Station in Homestead, but some notes were made on plants in our fruit planting at the Ft. Lauderdale Field Laboratory. At Ft. Lauderdale the plants are set out on 50 foot beds

with irrigation ditches between. During cold spells water was run into the ditches and allowed to flood the beds. Unfortunately we do not have any temperature records in the flooded area, but the official temperature on higher ground February 5 was 27.5° F. with 6 hours below 32° F. It was quite evident that the water kept the temperature above freezing, as very little damage occurred to these plants, except for some that were situated at the ends of the beds which were not flooded. One star-apple in this location was injured severely, but star-apples that were flooded showed little injury. This was also true of Kent and Zill mangos planted in this same area. At the Sub-Tropical Station in Homestead, many of the fruit plants were protected by fire pots and the trunks of young plants were wrapped with straw.

In the following lists the plants are grouped according to the amount of injury. In most cases both old and young plants are represented; if there was any injury to young plants and not to the older ones, this is noted.

1. Species showing little or no damage.

Averrhoa carambola, carambola

Butia capitata, jelly-palm

Carissa grandiflora, Natal-plum. Mature healthy plants were uninjured, but a row of Gifford carissa that were slightly chlorotic, infested with scale insects, and overgrown with weeds, showed some leaf burn and twig injury.

Casimiroa edulis and *C. tetrameria*, white-sapote. Old plants were unaffected, but 1-year old seedlings at Ft. Lauderdale had a little leaf-burn and twig injury.

Ceratonia siliqua, carob

Clausena lansium, wampi

Dovyalis caffra, kei-apple

Dovyalis hebecarpa, Ceylon-gooseberry

Dovyalis hebecarpa X *D. abyssinica*, hybrid dovyalis

Elaeagnus philippensis, lingaro

Eriobotrya japonica, loquat

Eugenia aggregata, cherry of the Rio Grande

Eugenia dombeyi, grumichama

Eugenia luschnathiana, pitomba

Eugenia uniflora, Surinam-cherry

Feijoa sellowiana, feijoa

Macadamia ternifolia, macadamia nut

Myrica rubra, strawberry tree

Prunus persica, red Ceylon peach

Psidium cattleianum, strawberry guava
Rhodomyrtus tomentosa, downy myrtle
Rubus albescens, Mysore black raspberry
Triphasia trifoliata, lime-berry
Zizyphus mauritiana, Indian Jujube

2. Species showing only slight injury.

Antidesma dallachyanum, Herbert River-cherry. This species proved to be hardier than *A. bunius*; young plants in exposed places in the same vicinity showed very little damage. Young plants at Ft. Lauderdale had more leaf and twig damage.

Diospyros discolor, mabolo. Old plants were unaffected, but young plants had leaf burn and some twig injury.

Eugenia pimenta, all spice. Old plants were not damaged but young plants were injured.

Litchi chinensis, lychee. Old plants in dormant condition were not damaged; new vegetative flushes and flower shoots were killed. Young plants 1 to 2 years in the fields were killed back to the straw wrap and a few of the weaker plants were killed completely.

Malpighia glabra, Barbados cherry. Large plants of the Florida Sweet and other clones which had been fertilized in October were in perfect condition all during the winter. A few clones and a number of seedlings, especially those which had received no October fertilizing, had some injury to the exposed branches. In some cases one year old plants were killed to the ground or to the straw wrap.

Myrciaria calliflora, jaboticaba. Plants in good condition and protected by larger trees had no injury. Plants in exposed places showed some leaf burn and twig injury.

Phyllanthus emblica, emblic. Young plants in dormant condition and without leaves had some injury to the terminal twigs.

Syzygium cumini, Java-plum. Some leaf burn and twig injury observed on both old and young plants, mostly on those not in healthy condition.

Syzygium jambos, rose-apple. Some leaf burn on young plants.

Tamarindus indica, tamarind. Old plants were unaffected but young plants in exposed places showed some twig injury.

3. Species showing injury moderate to severe leaf burn and twig injury.

Achras zapote, sapodilla. Old trees were unaffected and grafted trees 4 years in the field were not injured. Small plants in exposed situations were killed to the ground or to the straw wrap.

Artocarpus hypargyrea, kwai muk. Large trees had only a little leaf injury; smaller plants showed considerable leaf burn and twig injury.

Artocarpus integrifolia, jackfruit. Very large trees were not hurt except for some exposed branches on one side of tree were killed; one and two year old seedlings were killed.

Blighia sapida, akee. Large trees had some leaf burn and twig injury but this was not as severe as the cold damage in 1956.

Carissa carandas, karanda. Both old and young plants in exposed situations had considerable leaf and twig injury.

Diospyros ebenaster, black sapote. Both large and small plants were injured, especially branches that were exposed.

Euphoria longana, longan. Old trees were not affected, but a number of 3-year old seedlings in a windbreak were injured, some killed to the ground, others showed injury only on the terminal branches.

Garcinia livingstonei, imbe. Old plants which were protected by nearby large trees were unaffected; plants in exposed situations had considerable twig injury.

Pouteria campechiana, canistel. Old trees were not injured; young grafted trees 5 years in the field had some injury to the branches but this was not as severe as in 1956 at which time some of the plants were killed to the ground.

Psidium guajava, guava. Large trees had leaf burn and twig injury but not as severe as in 1956; other younger plants had considerable injury to the branches.

4. Species most severely injured.

Anacardium occidentale, cashew. Young plants were killed.

Annona squamosa (sugar-apple), *A. reticulata* (custard-apple), *A. muricata* (soursop), *A. diversifolia* (ilama), and *A. cherimoya* X *A. squamosa* (*atemoya*), were all severely injured and in several cases the plants were killed. The soursops, even under the protection of overhead trees, were killed back half way.

Annona montana, mountain soursop, had less injury with only leaf burn and some twig die back.

Antidesma bunius, bignay. Old plants protected by surrounding vegetation were not injured, but those in exposed places had a number of branches killed. This injury was not as severe as in 1956. At the Ft. Lauderdale planting young plants were severely injured.

Calocarpum sapote, mamey sapote. Both old and young plants had considerable damage to the branches, but it was less severe than in 1956.

Chrysophyllum caimito, star-apple. Old and very large trees were severely damaged as well as younger plants in exposed places.

Eugenia malaccensis, Malay-apple. Two medium-sized trees even under the protection of larger trees were severely damaged.

Flacourtia cataphracta, paniala. Older trees in a protected location showed no damage, but younger trees in exposed places were killed.

Flacourtia indica, governor's plum. Large plants in protected locations were not injured. The thornless variety growing in the

field with no protection showed considerable damage, some plants killed outright, others nearly to the ground.

Flacourtia inermis, lovi-lovi. Young plants killed.

Melicocca bijuga, Spanish-lime. Two large trees with nearby protection of large spreading candle-nut trees were not injured and, in fact, produced a good crop of fruit this year. Two large trees in a more exposed location were killed nearly to the ground. At Ft. Lauderdale young plants suffered leaf burn and twig injury.

Muntingia calabura, capulin. Medium size trees were killed to the ground, even plants with overhead protection. At Ft. Lauderdale plants showed leaf burn and twig injury.

Pouteria caimito, abiu. Young plants in exposed area were killed; those protected by neighboring plants showed very little damage.

Spondias cytherea, ambarella. Very large trees were severely injured with large branches killed. At Fort Lauderdale younger plants had considerable leaf burn and twig injury.

EFFECT OF BEDDING AND MULCHING ON LAKE EMERALD GRAPES UNDER CULTURE ON SOUTH FLORIDA FLATWOODS SAND

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Historical.—References to desirable vineyard locations, soil types and drainage are found frequently in literature on viticulture. Many vineyards in Europe are set on slopes and hillsides, and not infrequently narrow vine terraces cling precariously to steep mountain sides. Most of the successful grape plantings in California, New York and Michigan are established on either rolling or steeply sloped lands that are well drained.

Florida grape growers have long been interested in topography and drainage, and references in early bulletins and public reports

indicate that rolling land was generally preferred. Authentic statements on this are found as far back as 1894 when George W. Wright, chairman of the Standing Committee on Grapes of the Florida State Horticultural Society said: "Seven years ago (1888) the planting of grape began quite largely in South Florida. A large acreage was planted mostly to White Niagara, and up to the last year there were 500 acres in Orange County alone, and at least half that amount in adjoining counties."

Following the remarks by Wright, a Mr. Mott had this critical comment to make concerning the vineyard site selection in that day: "They have picked out the land that has been under water: land that was never

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