

## OBSERVATIONS ON THE JANUARY 1940 COLD INJURY TO TROPICAL AND SUB-TROPICAL PLANTS

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The effects of the cold on tropical and subtropical plants in Florida from the January 1940 freeze is becoming more apparent as the occasional rains and warming spring weather are stimulating growth in the uninjured tissues. On a good many plants I doubt that the full extent of the injury can as yet be measured. However, from the plants observed through South Florida shortly after the freeze and in counties lying in the extreme southern end of the state during the past several weeks, some notes of comparative hardiness can be made.

There are several points affecting cold injury observation that made these notes at best but generalities. Tropical and subtropical fruits, with the exception of citrus, avocados, guavas and mangos, are in such small plantings in any one locality as to make cold injury counts unreliable. This 1940 freeze was quite spotty in its effect, as were all of the previous freezes reported in the Proceedings of the Florida State Horticultural Society. For example, avocado trees of a given variety in the same condition of growth showed injury on branches one inch in diameter in one portion of a five-acre block, and in another portion with apparently no better cold protection they suffered the loss of but a few leaves. The condition of the tree as to its vegetative activity, the age of the tree, and among young trees, the degree to which the roots are established, affect the resistance to cold. Disease and insect injury also make a difference in cold resistance, as weakened trees receive a greater injury from cold than do healthy trees of the same variety located near by. The location of the planting in relation to physical protection from cold such

as windbreaks, buildings, water, etc., must also be taken into consideration.

Avocado plantings are sufficiently extensive to permit the drawing of general conclusions as to the relative cold resistance between races and among the more widely planted varieties. As stated before, a considerable variation in resistance to cold was noticed within a variety in any particular grove. This variation in a variety in different groves is sometimes more pronounced, but can be accounted for in part by differences in cultural treatment, tree conditions, and slight differences in temperature. Young trees under two years old were much more seriously damaged in proportion to their size than older trees of the same variety. The small trees have much more succulent wood in proportion to their size than do the older trees; and also their root systems are not as well established as those of older trees, thus appreciably reducing their vigor of growth. Old trees with grafted tops less than two years old are also susceptible to cold injury due to the vigorous succulent type of growth of the scion.

The three races of avocado and their hybrids, with minor exceptions in almost every group, ranged in hardiness during the 1940 freeze in descending order, as follows: Mexican, Mexican-Guatemalan hybrid, Guatemalan, Guatemalan-West Indian hybrid, and West Indian. This agrees with observations reported before the Florida State Horticultural Society by Wilson Popenoe in 1919, W. F. Ward in 1928, and H. S. Wolfe in 1935. Interesting exceptions to the above range of hardiness include the Schmidt, which, although a Guatemalan variety, is as tender as the West Indians. The fruit itself is also tender. Tem-

peratures between 29 and 31 degrees F. for eight hours caused the fruit to show black areas in the pulp from cold damage. This susceptibility to cold damage is quite general among the West Indian varieties, as was reported to the Florida State Horticultural Society last year after a cold storage study by A. L. Stahl and the writer. The Winslowson, a West Indian-Guatemalan hybrid, is as tender to cold as the tenderest West Indian variety observed.

Among the principal varieties of avocado grown in Florida following this freeze, the Taylor and Lula again proved the hardiest. On the lower east coast generally they suffered only minor leaf damage, and are now putting out a generous bloom. A little less hardy but suffering somewhat more leaf injury were Itzamna and Nabal. These should also have a normal bloom on the lower east coast this year. Next in hardiness was the group containing many of the Guatemalan-West Indian hybrids. They suffered from 20 to 40 percent leaf damage and had many of the tender outer twigs injured by cold. Collinson and Hickson belong with this group but suffered slightly more leaf and twig damage than the others in the group. All seven varieties are blooming on about three quarters of the original twigs and will probably set a satisfactory crop on the lower east coast.

The varieties which proved least hardy and which suffered the loss of practically all their leaves, small twigs and a portion of their small branches include Schmidt and Winslowson, and the West Indians such as Waldin, Fuchsia, Trapp, Pollock, and Simmonds. Bloom is appearing on the uninjured small twigs and branches but in instances where cold injury extended to large limbs no bloom is appearing. How much of the fruit will set and mature will depend to a great extent on whether the new foliage will develop soon enough to offer protection and manufacture food.

Mangos at the time of the freeze were in bloom throughout most of South Florida. The trees in general suffered leaf, twig, and blos-

som injury. However, groves on Pine Island and a few small plantings in the Palm Beach and Ft. Lauderdale area were unhurt. On individual trees the injury in most cases was greatest on the top and on the south side of the trees. In the colder areas where the temperature dropped much below 29 degrees F., all of the bloom, practically all of the leaves, and many of the smaller branches were lost. In the coldest spots some large wood, four to six inches in diameter, was killed. From the bloom that escaped injury during the freeze some fruit is set, but the writer seriously doubts if much of this fruit will reach maturity, particularly on the Haden variety. Several hundred small Haden fruits, pea size and larger, gathered at random from trees in Dade County, have been dissected. All have failed to contain the normal sized seed which seems to be necessary for the fruit to size up and mature normally. Normal seeds were found in small fruits of the Brooks and Saigon varieties. Since the last week of February, a second bloom has appeared on the uninjured twigs of such varieties as the Haden, Mulgoba, Brooks, Sandersha and Paheri. In contrast to this, little or no second bloom has appeared on trees of the Saigon or Philippine type. It is of interest that the first mango bloom was mostly of staminate flowers, with a very low percentage of perfect flowers. The second bloom contains a relatively high percentage of perfect flowers.

Very little difference in hardiness among mango varieties appeared. However, the Brooks variety and the Saigon or Philippine type seemed to suffer slightly more damage to bloom and leaves than did adjacent trees of the Haden and Mulgoba varieties and the Turpentine seedlings. Young mango trees under two years old suffered much more cold damage than older bearing trees, of course.

In order that we could have a fair basis on which to judge the relative hardiness of some of the minor tropical and subtropical fruits, observations were based upon plants growing in the areas comparable in cold temperature to the Redlands section of Dade

County. Temperature readings at the Sub-Tropical Experiment Station, centrally located in the Redlands, showed a low of between 29 and 30 degrees F. for six hours on the morning of January 28. On the mornings of January 29 and 30 a minimum of 30 degrees F. was recorded, but only for a few minutes.

The tenderest of the tropical fruits observed were the cashew nuts *Anacardium occidentale* and the malay-apple (*Eugenia malaccensis*), small and medium sized specimens of which were frozen to the ground even under paper, burlap, and wooden coverings. The largest specimens observed, 6 to 8 feet tall, lost their leaves and branches, but will probably sprout again from the main trunk.

Trees of bearing age whose leaves and small branches were killed but are making new growth from the main branches and trunk include: akee (*Blighia sapida*), sapote (*Calocarpum mammosum*), Spanish-lime (*Melicocca bijuga*), soursop (*Annona muricata*), mountain soursop (*Annona montana*), star-apple (*Chrysophyllum cainito*), ambarella (*Spondias cytherea*), red nombin (*Spondias purpurea*) and common guava (*Psidium guajava*).

A number of fruit trees of bearing age suffered the loss of a few leaves with some injury to the fruit but were apparently otherwise unharmed. They include: carambola (*Averrhoa carambola*), muntingia (*Muntingia calabura*), jackfruit (*Artocarpus integrifolia*), mammee-apple (*Mammea americana*), imbe (*Garcinia livingstonei*), Ceylon-gooseberry (*Dovyalis hebecarpa*), canistel (*Lucuma nervosa*), black-sapote (*Diospyros ebenaster*), carissa (*Carissa grandiflora*), Otaheite-gooseberry (*Phyllanthus acidus*), jambolan (*Eugenia jambolana*), Surinam-cherry (*Eugenia uniflora*), tamarind (*Tamarindus*

*indica*), custard-apple (*Annona reticulata*) and sugar-apple (*Annona squamosa*).

Some of the fruit trees withstood the freeze without any apparent injury. The trees proving this hardy at bearing age are: long-an (*Nephelium longana*), Indian jujube (*Zizyphus mauritiana*), lychee (*Litchi chinensis*), woolly-leaf white-sapote (*Casimiroa tetrameria*), white-sapote (*Casimiroa edulis*), governors-plum (*Flacourtia ramontchi*), lingaro (*Elaeagnus philippensis*), bael-fruit (*Belou marmelos*), Queensland nut (*Macadamia ternifolia*), cattley guava (*Psidium cattleianum*), sapodilla (*Achras sapota*), rose-apple (*Eugenia jambos*) and Barbados-cherry (*Malpighia punicifolia*).

The ceriman (*Monstera deliciosa*) in exposed locations lost some leaves, but the fruit and climbing stems were unhurt. Some of the exposed fruits on loquat trees were damaged but the foliage was unhurt. Peach trees were in bloom and had set a few fruit. The small fruits about ½ inch in diameter were injured but the blossoms and the blossom buds survived unharmed. They have since set a good crop of peaches. Bananas lost their leaves, and in more exposed locations the stems were frozen. In almost every clump either new shoots from the roots or sprouting hearts of uninjured stems are making their appearance.

The 1940 freeze has taught us, as have previous freezes, that many of the tropical and subtropical fruits are decidedly not suited to localities subject to low temperatures. But many plants which are quite tender when young attain a certain degree of hardiness as they reach bearing age. This might warrant their culture in colder areas provided they can be protected during the first few years of their existence.