

*Cachexia and Xyloporosis
Are They Caused by the Same Virus?*

XYLOPOROSIS WAS DESCRIBED as a disease affecting sweet lime, *Citrus limettioides* Tanaka, in Palestine by Reichert and Perlberger in 1934 (7). Moreira (6) in 1938 reported the occurrence of xyloporosis in Brazil. In 1950, Childs (2) in Florida described a disease of the Orlando tangelo, *C. reticulata* Blanco x *C. paradisi* Macf., with symptoms resembling xyloporosis. Since then, several investigations have been carried out in different citrus areas with the aim of determining whether cachexia and xyloporosis are caused by the same or distinct viruses. Despite these investigations, the matter has not been completely settled (1, 3, 4). This paper reports additional data on this problem obtained from tests carried out at the Limeira Experiment Station beginning in 1957. The relationship of xyloporosis to the bud-union ring shown by certain scion-rootstock combinations (4, 5) was also studied.

Testing Trees for Xyloporosis and Cachexia

As part of a tristeza-tolerant rootstock experiment, each of three Orlando tangelo seedlings was budded with a bud from a different Barão sweet orange tree, the young trees being transplanted to the field in 1950. All three parent trees were carrying xyloporosis virus, as shown by the sweet lime test. Seven years later, only one of the daughter trees was found showing the wood pitting and gummy-pegs of the disease. Several other varieties of tangelo were included as rootstock in this experiment and tests revealed that about 62 per cent of the trees were healthy. These observations suggested that one of the parent trees was carrying cachexia and xyloporosis viruses and the other two, xyloporosis

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virus only. Buds were taken from the three trees on Orlando tangelo and budded onto sweet lime, Orlando tangelo, Florida rough lemon (*C. jambhiri* Lushington), and Rangpur lime (*C. limonia* Osbeck) seedlings in November, 1957. Five seedlings of each variety were used for each source of budwood. Examinations made by taking out a strip of bark at the bud-union up to August, 1963, about six years after budding, revealed symptoms only in the Orlando tangelo and sweet lime seedlings that had been budded with buds from the diseased parent tree. All other test plants were healthy. The trees on Rangpur lime rootstock propagated from the diseased parent tree are expected to show symptoms in subsequent inspections because the incubation period is longer in this rootstock.

Grant *et al.* (4) reported the finding of an abnormality (bud-union ring) in Pera sweet orange trees on trifoliolate orange [*Poncirus trifoliata* (L.) Raf.] and Florida rough lemon, in Brazil. The authors discussed the possibility of relating the abnormality to xyloporosis-cachexia virus. To clarify this point, buds from the same old line and from a nucellar line of Pera orange were grafted on seedlings of Orlando tangelo, Florida rough lemon, and Mazoe rough lemon. Five seedlings of each rootstock were budded with the old line and another five with the nucellar Pera orange in November, 1957. Five years later, all trees on Orlando tangelo were showing no bud-union ring nor cachexia symptoms. All trees on the two rough lemon rootstocks developed bud-union ring. Trees of that old-line Pera orange on sweet lime rootstocks, 28 years old, were inspected and found to be free from xyloporosis symptoms. These trees showed, below the union, tissue degeneration resulting from tristeza virus, which could be confused with the gum discoloration symptoms of xyloporosis.

In another test, ten trees representing ten citrus varieties (Barão, Shamouti, Jaffa, Washington Navel, Robertson Navel, and Seleta de Itaborai orange, Temple tangor, Tahiti lime, Dancy tangerine, and Red Blush grapefruit) were tested for virus of xyloporosis and cachexia by budding them onto Palestine sweet lime, Orlando tangelo, and Florida rough lemon seedlings. Rough lemon was used to verify the occurrence of bud-union ring and its relation to cachexia-xyloporosis viruses. Budding was carried out in November, 1959. Six seedlings of each indicator plant were used for buds of each variety. The results of examinations (August, 1963) at the bud-union of the different scion-rootstock combinations are summarized in Table 1. All varieties showing cachexia symptoms on Orlando tangelo also showed xyloporosis symptoms on the Palestine sweet lime rootstock.

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TABLE 1. XYLOPOROSIS, CACHEXIA, AND BUD-UNION RING IN TREES OF DIFFERENT SCION-ROOTSTOCK COMBINATIONS. SIX TREES WERE EXAMINED FOR EACH COMBINATION

	Xyloporosis on sweet lime	Cachexia on Orlando tangelo	Bud-union ring on Florida rough lemon
Barão sweet orange	6	5	0
Shamouti sweet orange	3	4	6
Jaffa sweet orange	4	5	5
Washington Navel sweet orange	0	0	0
Robertson Navel sweet orange	4	6	0
Seleta de Itaborai sweet orange	0	0	6
Temple tangor	2	5	0
Tahiti lime	0	0	0
Red Blush grapefruit	3	6	0
Dancy tangerine	5	6	0

Bud-union ring was observed on trees of Shamouti, Jaffa, and Seleta de Itaborai on Florida rough lemon rootstock. Also, two trees of Temple tangor and one tree of Seleta de Itaborai showed bud-union ring on Palestine sweet lime rootstock.

In a fourth test, young trees of nucellar Orlando tangelo on sweet lime rootstock were inoculated with xyloporosis-cachexia infected buds from different sources. These included a Seleta do Rio, a Coco, and a China orange and a Tahiti lime tree growing in the Citrus collection of the College of Agriculture in Piracicaba, a Cristal lime and a Washington Navel tree growing at the Limeira Citrus Station, and three Barão orange trees growing in a commercial grove.

Three test plants were inoculated with buds from each source in November, 1959. Periodical examinations revealed that symptoms started to appear first on the Orlando tangelo scion just above the bud-union three years after inoculation. In August, 1963, all test plants were showing xyloporosis-cachexia symptoms on the sweet lime rootstock and on the Orlando tangelo scion, except for the test plants inoculated with buds from one Barão orange tree. This tree was budded on Rangpur lime rootstock, 15 years old, and was showing very mild symptoms of xyloporosis-cachexia.

The test plants inoculated with xyloporosis-cachexia virus from three sources (the Cristal lime and two Barão orange trees known to be carrying a severe strain of the virus) developed, in addition to xyloporosis-cachexia, typical bud-union ring symptoms.

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Discussion

The xyloporosis-cachexia virus apparently has an uneven distribution in the citrus trees. This would account for the absence of symptoms in the two daughter trees on Orlando tangelo in the tristeza plot and the negative results of the daughter trees on indicator rootstocks.

The results of the tests summarized in Table 1 have shown that all varieties that induced cachexia symptoms on Orlando tangelo rootstock also induced xyloporosis symptoms on sweet lime rootstock. If cachexia and xyloporosis are diseases caused by the same virus, this would be expected. It would also be expected, however, if they are caused by different viruses and if both viruses happened to occur in all trees used as source of budwood.

The symptoms of xyloporosis-cachexia appeared earlier and were always more conspicuous in Orlando tangelo than in sweet lime. Other authors (1, 3) have already reported similar observation.

Symptoms of bud-union ring were found to occur independently of the presence of xyloporosis-cachexia virus. They occurred at the union of xyloporosis-virus-free trees on Florida rough lemon rootstock, and failed to occur on trees carrying this virus.

Symptoms resembling bud-union ring were found to develop on trees of Orlando tangelo on sweet lime rootstock following inoculation with certain sources of xyloporosis-cachexia virus. The bud-union, being a weak part of the tree, may be more easily affected by the xyloporosis-cachexia virus in certain combinations.

Conclusions

The results of the tests here reported strongly suggest that xyloporosis and cachexia are disease symptoms caused by the same virus on different hosts.

The bud-union ring exhibited by certain scion varieties on Florida rough lemon rootstock is not associated with presence of xyloporosis-cachexia virus.

Certain sources of xyloporosis-cachexia virus induce bud-union ring symptoms in trees of Orlando tangelo on sweet lime rootstock.

Healthy buds may occasionally be obtained from xyloporosis-cachexia infected trees.

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