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Virus Content of Citrus Trees with Symptoms of Stubborn Disease

SINCE 1955 some citrus trees in California and Arizona that showed symptoms of stubborn disease (1) have been indexed for the following: tristeza, psorosis, vein enation, exocortis, cachexia, and xyloporosis viruses. Trees representing severe, moderate, and mild types of stubborn disease (1) and growing on various rootstocks were selected from the following varieties: sweet orange [*Citrus sinensis* (L.) Osbeck]—'Washington Navel', 'Robertson Navel', a local navel orange selection, 'Valencia', 'Mediterranean Sweet', 'Hamlin', 'Shamouti', 'Rico No. 1', 'Koethen', and an unnamed sweet orange; grapefruit (*C. paradisi* Macfad.)—'Marsh', 'Redblush', and 'Webber's Java Pink', an unlisted introduction made by W. T. Swingle; and Minneola tangelo (*C. paradisi* 'Bowen' x *C. reticulata* Blanco 'Dancy').

Although the indexing will not be completed for several years, preliminary results from 36 trees provide the first information on the virus content of trees affected by stubborn disease.

No evidence of tristeza, psorosis, or vein enation was found in any of the trees indexed for adequate periods on Mexican lime [*C. aurantifolia* (Christm.) Swingle], on sweet orange, or on sour orange (*C. aurantium* L.), indicating that the causal viruses of these diseases are probably not involved in the development of stubborn disease. Exocortis, as indicated by symptoms on seedlings of Rangpur lime (*C. limonia* Osbeck) and trifoliate orange [*Poncirus trifoliata* (L.) Raf.], was present in 19 trees. Cachexia, as expressed on Orlando tangelo (*C. paradisi* 'Bowen' x *C. reticulata* 'Dancy'), was found in 20 trees. Exocortis and cachexia occurred together in 15 trees. Indexing for xyloporosis on Palestine sweet

lime (*C. limettiodes* Tanaka) was abandoned as unreliable because at 2½ years of age all the 6 nonbudded control seedlings had developed conspicuous wood pitting that could be confused with symptoms of xyloporosis. No suitable substitute has been found for Palestine sweet lime unless one concurs with the view that xyloporosis and cachexia are caused by the same virus, or closely related viruses, and that, therefore, Orlando tangelo is an adequate indicator plant for both.

By August, 1960, 12 of the 36 trees had not yielded any evidence of an identifiable virus disease other than stubborn; this group included 5 trees with severe symptoms of stubborn disease, 5 with moderate symptoms, and 2 with mild symptoms. Indexing of these trees is being continued and in some cases will be repeated.

In searching for a specific indicator plant for a possible stubborn disease virus, budwood of 2 Marsh grapefruit trees with stubborn disease was used to inoculate seedlings of 59 species, varieties, hybrids, and relatives of citrus. The uninoculated control plants of 5 kinds failed to grow well. Plants of the other 54 kinds have grown satisfactorily for 3 to 5 years and have shown no definite symptoms of virus infection or symptoms that might be attributed to some unknown virus.

These preliminary results suggest that stubborn disease does not result from infection by the causal viruses of tristeza, psorosis, vein enation, exocortis, or cachexia, either singly or in combination. Likewise, these results provide no evidence that stubborn disease is caused by an unknown virus. Nevertheless, virus studies will be continued to complete current and planned investigations to determine the cause of stubborn disease and to clarify Fawcett's (2) report that stubborn disease is graft-transmissible and caused by the virus *Citrivir pertinaciae* Fawcett.

Literature Cited

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2. Fawcett, H. S. 1946. Stubborn disease of citrus, a virosis. Phytopathology 36: 675-677.