

Growing Citrus in the Presence of Tristeza

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TRISTEZA DISEASE is considered the most serious threat to the world citrus industry and is still a problem in countries like Brazil where it has become endemic. Nearly 20 million citrus trees were destroyed by tristeza in Brazil, but approximately three times that many new trees have been replanted on tolerant rootstocks, and citrus fruits are being produced economically in spite of tristeza. New plantings are being made with trees budded on the tristeza tolerant rootstocks, Rangpur lime (*Citrus reticulata* var. *austera* hyb.), sweet orange [*C. sinensis* (L.) Osb.], Cleopatra mandarin (*C. reticulata* Blanco), Florida Rough lemon [*C. limon* (L.) Burm. f.], and trifoliolate orange [*Poncirus trifoliata* (L.) Raf.]. Over 400 different citrus rootstocks were tested for their reaction to the tristeza virus; only 77 were found tolerant (2). Among other rootstocks

more recently tested *C. volkameriana* and Estes and Milam Rough lemons were found tolerant; *C. macrophylla* was found intolerant. However, replacing sour orange (*C. aurantium* L.) by rootstocks tolerant to tristeza virus has not proved to be a satisfactory solution in many cases.

Results

Observations made at the Experiment Station and in commercial citrus orchards in the State of São Paulo show that growth and productivity of many trees is reduced because of tristeza virus infection. The degree of damage is proportional to the intolerance of the tissues and the severity of virus strains with which they are infected.

REACTION OF SCION VARIETIES TO TRISTEZA.—Investigations conducted under Brazilian conditions show that citrus varieties can be divided into four groups on the basis of their reaction to tristeza virus, as follows: 1. Varieties with good tolerance, such as Hamlin, Valencia, and Natal sweet oranges; Ponkan, Dancy, Cravo, and Mexerica tangerines (*C. reticulata* Blanco); Murcott and Temple tangors (*C. sinensis* Osb. x *C. reticulata* Blanco). 2. Varieties with a certain degree of intolerance and which develop mild symptoms, but are not seriously affected in their growth and productivity, such as Baianinha, Shamouti, and Barão sweet oranges; Tahiti lime (*C. latifolia* Tanaka); Piña, and Orlando tangelo (*C. reticulata* Blanco x *C. paradisi* Macf.). 3. Varieties seriously affected by severe strains of the virus. In this group are Mexican, Key, Marfin, and most limes [*C. aurantifolia* (Christm.) Swing.]; Marsh, Duncan, Foster, and most grapefruit (*C. paradisi* Macf.); Pera, Lamb Summer, Mediterranean sweet, and some other sweet orange varieties; Docinho, S. Joao del Rei, and some other tangors. 4. Varieties extremely intolerant to the virus such as Eureka, Lisboa, Genoa, Villafranca, and other true lemons [*C. limon* (L.) Burm. f.].

Normally, lemons are not affected by tristeza virus even when grown on sour orange rootstock. However, problems arise when lemons are grown on rootstock varieties such as Rangpur lime, sweet orange, Rough lemon, Cleopatra tangerine, and others that allow the multiplication of the tristeza virus if the rootstock seedling becomes infected before budding.

LEMON AND LIME GROWING IN TRISTEZA AREAS.—At the Limeira Citrus Experiment Station, buds of nucellar Eureka lemon were propagated on 30 plants each of Florida and Brazilian Rough lemon, sour orange, and Caipira sweet orange. The seedling rootstocks were infected with the tristeza virus by means of aphids before budding. All 30 lemon plants on

sour orange rootstock grew vigorously and appeared healthy. Over 50 per cent of the lemon tops on the other rootstocks grew poorly and remained stunted (18 on Florida Rough lemon, 20 on Brazilian Rough lemon, and 16 on Caipira sweet orange). The more severely affected plants had symptoms resembling those reported for seedling yellows.

In a similar experiment, Tahiti lime tops were propagated on 50 seedlings each of 10 different rootstocks. The tristeza virus was inoculated by means of *Toxoptera citricida* Kirk. before budding the various rootstocks. The number of plants with abnormal scion behavior (stunted, bushy, with short internodes and small, yellowish, cupped leaves) were as follows: Brazilian Rough lemon, 44; Palestine sweet lime, 41; Orlando tangelo, 27; Florida Rough lemon, 14; Rangpur lime, 10; Sunki mandarin, 10; Caipira sweet orange, 9; and Cleopatra mandarin, 6. On trifoliolate orange and Troyer citrange [*C. sinensis* (L.) Osb. x *P. trifoliata* (L.) Raf.], all Tahiti lime tops grew well. The tissues of these two varieties are resistant to the tristeza virus (1). The different reaction of the Eureka lemon scions was very possibly directly related to the severity of the tristeza virus strain infecting the rootstock.

West Indian lime, known as Galego lemon in Brazil, is very sensitive to tristeza virus. Soon after infection with strong strains of the virus the trees develop severe stem pitting, turn yellow, and decline. Consequently, this variety is being replaced in the new commercial plantings by Tahiti lime which is more tolerant to the tristeza virus.

Discussion and Conclusions

When the tristeza virus and its efficient insect vector, *T. citricida* Kirk., are both present, the development of new, more virulent strains of tristeza virus constitutes a continuous and serious problem. Hope of solving the problem of stronger strains or of strains having specificity for certain citrus varieties rests on the selection of varieties with tissues more tolerant to the virus, and on cross-protection.

Experience with tristeza in Brazil suggests that different varieties of the same citrus species react differently to the infection with the same strain of the virus. Consequently, some varieties of sweet orange, mandarin, tangelo, and grapefruit grow poorly because of tristeza, even on tolerant rootstocks.

On the other hand, certain highly intolerant lemon varieties grow satisfactorily on intolerant sour orange rootstock, but grow poorly on tolerant stocks if the latter are infected with tristeza virus before budding. This situation seems similar to that occurring with tolerant tops on

intolerant stocks, except that the top and the rootstock have exchanged roles. Tahiti lime reacted in much the same manner as the lemon varieties on tolerant rootstocks, but it grew well on trifoliate orange and Troyer citrange because these varieties are resistant to the tristeza virus (1). The performance of lemons and limes on the various rootstocks suggests that their growth is directly related to the capacity of the virus to multiply in the rootstock and to affect the top.

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