Citrus Tristeza Virus Causes Stem Pitting in Rangpur Lime Rootstock Grafted with Some Mandarin Cultivars in Capão Bonito, Brazil

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ABSTRACT. Trees of 11 cultivars of late maturing mandarins, tangerines and hybrids from nucellar clones were budded to Rangpur lime and Cleopatra mandarin in a field nursery where common tristeza is endemic. In 1976, these combinations were established in a planting where the Capão Bonito CTV complex was prevalent. By 1993, most combinations on Rangpur lime were in an advanced stage of decline and a stem pitting evaluation was carried out on the rootstock of the grafted combinations. Almost all of the Rangpur lime rootstocks showed stem pitting, with the exception of those grafted with the scions Harris, Murcott and King; whereas none of the scions or Cleopatra mandarin rootstocks showed stem pitting and had significantly higher yields. These reactions were considered to be the result of differential interaction of Capão Bonito CTV strains among different Mandarin or Tangerine/ Rangpur combinations that developed over the 17-yr-period of field exposure. Furthermore, significant tolerance to the same Capão Bonito CTV complex was demonstrated with the same scion on Cleopatra rootstock. Several hypothesis are advanced to explain these differences.

Field observations indicate that mandarins and certain mandarin hybrids are tolerant to the Capão Bonito complex of CTV. However it was observed that some Mexerica do Rio (Willow leaf type) mandarins growing in the Southern coastal areas, and some Ponkan tangerines growing in the Southern plateau of the State of São Paulo, Brazil, were smaller in size than other trees in the same orchard. Stem pitting (SP) was observed in the rootstocks of either Rangpur lime or Caipira sweet orange, but not in the scion (3, 6). These observations suggested that the Capão Bonito CTV complex could be symptomless in mandarin scions. Evidence for this suggestion was obtained by graft and aphid-inoculation of CTV from Mexerica do Rio, Cravo and Dancy mandarins growing in the Capão Bonito area to healthy sweet orange plants. The inoculated plants showed stunting and SP similar to control plants inoculated from sweet orange trees showing typical Capão Bonito CTV symptoms (4). In another experiment, several scions and rootstocks combinations including mandarins, Mexerica do Rio and Dancy were aphid-inoculated with the Capão Bonito isolate. The Oneco tangerine rootstock showed more severe SP symptoms when the top was Mexerica do Rio than Dancy mandarin (5). These results show that Capão Bonito CTV reaction is different in the Rangpur lime rootstock of one mandarins variety or the other.

In 1993, an evaluation was conducted of an experiment initiated in 1976 at the Capão Bonito Experiment Station, Capão Bonito County, Sao Paulo, Brazil, which compared late maturing mandarin, tangerine and hybrids budded on Rangpur lime and Cleopatra mandarin (1). During this evaluation, it was noticed that a great number of plants on Rangpur lime rootstock were in an advanced stage of decline whereas the plot on Cleopatra was growing well. Since the Rangpur lime rootstock is known for its intolerance to the Capão Bonito CTV complex, it was thought that this strain of CTV might be responsible for the damage. Therefore, a stem pitting evaluation was carried out on those experimental trees. In this paper we present the results of this evaluation.

Buds from nucellar clones of nine late maturing mandarines and tangerines (Harry, Dancy, Kara, Loose Jacket, Szinkon, Ladu, King, Mexerica Tardia A and Oneco) and two tangors (Murcott and Ortanique) were propagated on Rangpur lime and Cleopatra mandarin. Trees of each combination were prepared in a field nursery at the Sylvio Moreira Citrus Center, Cordeirópolis County, where common tristeza is endemic, and later (1976) established in the Capão Bonito Experiment Station in close proximity to trees with typical symptoms of the Capão Bonito CTV complex. The statistical design was randomized blocks, with one plant per parcel repeated five times, for each rootstock, amounting to 120 useful trees. The experiment had only an outer border row (1).

After 17 years of field exposure, the incidence of SP on Rangpur lime and Cleopatra mandarin rootstocks was evaluated removing a 15 × 5 cm rectangle of bark immediately below the budunion to expose the wood on each of six trees per selection. SP intensity was rated as the number of pits on the inner face of a 5 cm^2 piece of bark on a scale of 0 to 5 where 0 = no pits; 1 = 1 to 15 pits; 2 = 16 to 30 pits; 3 = 31 to 50 pits; 4 = 51 to 80 pits; and 5 = entire surface covered with pits. Fruit yield was measured biannually from 1989 through 1994 due to the alternate year production characteristic of mandarins.

SP ratings are presented in Table 1. Generally, some of the plants on Rangpur lime rootstocks were pitted; whereas others with the same scion were not. For example, only 60% of the plants topped with Kara or Loose Jacket, and only 40% of those topped with Ortanique or Szinkon, showed SP. Oneco was an exception than 100% of the plants had SP in their Rangpur lime rootstock. Maximum SP intensity was observed on Rangpur lime grafted with Kara, Loose Jacket, Szinkon, Oneco and Ortanique scions (Fig. 1d). No SP was found on Rangpur lime rootstock grafted with Harris, King or Murcott scions neither on any of the Cleopatra mandarin rootstocks. Sometimes trees showing SP were smaller than those of the same scion/rootstock combination without SP (Fig. 1a, b).

TABLE 1
INCIDENCE OF STEM PITTING AND MEAN YIELD OF SEVERAL MANDARINS AND HYBRIDS GRAFTED ON RANGPUR LIME OR CLEOPATRA MANDARIN ROOTSTOCKS AND EXPOSED TO NATURAL INFECTION BY THE CAPÃO BONITO CTV COMPLEX

	Stem pitting on Rangpur lime[z]						Yield per rootstock[y]	
Scion	0	1	2	3	4	5	Rangpur lime	Cleopatra mandarin
Loose Jacket	3	0	2	0	0	1	39.89	218.03*
Dancy	0	0	0	1	0	0	157.37	200.21
Ladu	2	2	0	2	0	0	138.35	176.39
Kara	1	0	1	0	1	3	36.34	156.50*
Ortanique	3	0	1	1	0	1	58.10	127.50*
Mexerica Tardia A	2	2	0	0	2	0	45.82	123.29*
Oneco	0	0	0	2	2	2	94.85	118.76
Murcott	0	0	0	0	0	0	45.76	78.32
King	0	0	0	0	0	0	20.93	58.27
Harris	0	0	0	0	0	0	40.64	48.11
Szinkon	0	1	0	0	1	1	70.63	32.70
Mean							68.06	121.64*

[z]Number of trees in each score. Details in text.
[y]Mean biannual yield (kg fruit/tree) measured along 6-yr-period. Yields denoted by * are significantly different ($P < 0.05$) from the corresponding yield in the other rootstock per scion selection. Means were compared by Tukey's multiple range test.

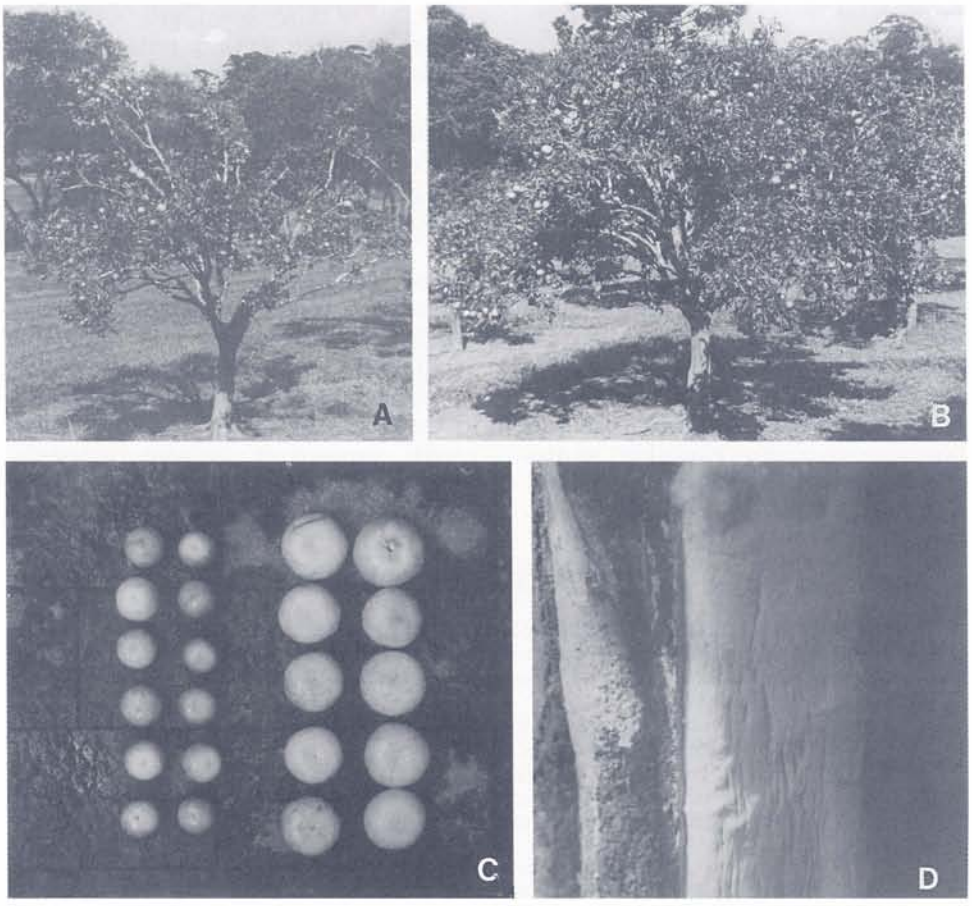

Fig. 1. Symptoms of the Capão Bonito CTV complex on: a) 20-yr-old Szinkon mandarin on Rangpur lime rootstock in advanced stage of decline; b) same combination as (a), but with much better size and probably infected with common CTV; c) fruits: left from tree (a), right from tree (b); d) stem pitting on Rangpur lime rootstock.

Biannual mean yields of trees on Rangpur lime and Cleopatra mandarin rootstocks are compared in Table 1. The yield of Loose Jacket, Kara, Ortanique and Mexerica Tardia A, was higher on Cleopatra mandarin compared to Rangpur lime; whereas the yields of Dancy, Ladu, Oneco, Murcott, King, Harris and Szinkon were not significantly different by rootstocks.

When the yields of scion/rootstock combinations with and without SP were compared, no significant differences were found. However, trees with SP usually produced many small fruit versus trees without SP (Fig. 1c).

After 17 years exposure to Capão Bonito CTV, the Rangpur lime rootstock showed more severe stem pitting when grafted with certain mandarins and hybrids, suggesting that those cultivars might select some strain(s) from the Capão Bonito complex that are especially pathogenic on Rangpur lime. This trend was more evident for Loose Jacket, Kara, Ortanique, Mexerica Tardia A, Szinkon, and especially for Oneco mandarin. All trees of the last variety had their Rangpur lime rootstock severely pitted. A similar effect was noted for Ponkan mandarin, the most planted mandarin variety in São

Paulo, from which the Oneco mandarin is thought to be a selection.

The fact that only some trees of the above scion/rootstock combinations showed SP in the Rangpur lime rootstock might be due to partial protection against the Capão Bonito complex afforded by some strains present in the CTV isolate originally acquired by plants at the nursery stage in Cordeirópolis. We assume that all plants acquired common CTV naturally by aphid vectors at the nursery. However, with the prevalence of the Capão Bonito isolate and *Toxoptera citricida* (Kirkaldy) in the study area over the 17-yr duration of this experiment, the virulent Capão Bonito strain eventually became established in some plants. In most cases, those varieties that showed SP in the Rangpur lime rootstocks yielded much better on Cleopatra mandarin than on Rangpur lime.

Rangpur lime is a popular rootstock among Brazilian citrus growers due to its good adaptability to local conditions. From the data shown, it appears that the presence of the Capão Bonito CTV complex will cause problems on Rangpur lime rootstock for certain mandarins and hybrids. Inoculation of the plants with protecting isolates properly selected (2) might help to avoid the SP and small-sized fruit problem.

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