Title
Influence of Ecological and Genetic Conditions on Damage and Symptom Expressions of Tristeza in Brazil

Journal
International Organization of Citrus Virologists Conference Proceedings (1957-2010), 8(8)

ISSN
2313-5123

Authors
Rodriguez, O.
Pompeu, J.
Figueiredo, J. O.
et al.

Publication Date
1980

Peer reviewed

Influence of Ecological and Genetic Conditions on Damage and Symptom Expressions of Tristeza in Brazil

O. Rodriguez, J. Pompeu, J. O. Figueiredo, A. A. Caetano, and J. Teofilo Sob.

Different genetic and climatological influences on symptom expression of the tristeza disease and on general performance of citrus trees (Cox *et al.*, 1976; Dornelles, 1976; Grant *et al.*, 1961; Salibe and Mischan, 1976) have been observed. Poor growth of the trees and/or small size of the fruit together with stem pitting and mineral deficiencies were found to be markedly influenced by the strain of tristeza virus, climate, and clonal origin of the scions and rootstocks. Virus strain or mixtures may complicate the interpretation of tristeza symptoms. Rootstocks absorb nutrients differently from the soil (Gallo *et al.*, 1960) and this influences the vigor of the trees and the availability of nutrients to the scion. This can interfere with the expression of tristeza symptoms, such as stem pitting, or the development of the tree and fruit. Such knowledge is of great importance to a better interpretation of the behavior of the trees in a given situation.

OBSERVATIONS AND DISCUSSION

A — In Taquari, Rio Grande do Sul, a southern Brazilian state with a humid, temperate climate (table 1), some sweet orange varieties such as Hamlin, Valencia, Natal, and others showed a certain degree of intolerance to tristeza and developed mild stem pitting symptoms (Dornelles, 1976). On the other hand, the same clones of such varieties were considered tolerant to tristeza in Sao Paulo (Moreira, 1968) in a less humid and warmer climate. The average fruit size of these commercial varieties as well as Baianinha, Pera, and others is smaller than at Sao Paulo.

B — In different climatological situations in the state of Sao Paulo, citrus clones and rootstocks present different reactions to tristeza as follows:

B1 — One trial of 15 rootstocks for Mexican lime preimunized with a mild isolate of tristeza virus, was planted in 1976 at Ubatuba Experiment Station on the coast of Sao Paulo. The climate is warm and humid with an average annual rainfall of 276 cm. The size of the trees varied and the stem pitting severity was not correlated with the rootstocks. Even on trifoliate orange rootstock, which is immune to tristeza, the degree of stem pitting on the scion was variable. This demonstrates that this protective isolate of tristeza is not appropriate here, in contrast with the good performance of similar material in the Bebedouro area which is warmer and less humid.

At the Limeira Experiment Station and at Campinas, some mild isolates used as preimmunizing agents efficiently protected Mexican lime for more than 10 years (Müller, 1972).

B2 — Campos do Jordao Experiment Station, Sao Paulo, is at 1600 m altitude and has a temperate and humid climate (table 1). The symtoms of tristeza are much more pronounced here than at the Limeira Station in Cordeiropolis for the sweet orange varieties Hamlin, Baianinha, Westin, Sanguinelli, Ruby Blood, Blood Oval, Pera, Barao, Sanguinia, Moro and Natal.

The Cravo, Ponkan and Willowleaf tangerines, sour orange and Eureka lemon did not show pitting. For that reason growers are encouraged to plant only lemons and some tangerines in this area.

B3 — A commercial plantation of 80,000 Marsh Seedless grapefruit trees was established in 1974-75 in the Barretos area. These trees originated from a

TABLE 1
AVERAGE °C TEMPERATURES IN RIO GRANDE DO SUL, SÃO PAULO AND PIAUI STATES

Experiment Station district and state	Minimum			Maximum			Annual rainfall (cm)
	Jan.	Jul.	Annual	Jan.	Jul.	Annual	
Taquari, RS*	19.0	8.9	14.1	31.8	19.6	25.6	154
Campos do Jordão, SP	12.4	2.5	7.7	22.6	17.2	20.6	170
Limeira, SP	17.9	10.4	14.5	29.2	24.7	27.5	139
Ubatuba, SP	19.8	12.2	16.4	29.5	24.2	26.6	276
Campinas, SP	18.7	11.7	15.6	29.6	17.3	27.6	139
Mococa, SP	18.3	11.3	15.4	30.0	26.3	28.8	141
Barretos, SP	19.3	11.9	—	30.1	27.5	—	120
Teresina, PI	22.7	20.2	22.1	33.0	33.7	33.8	130†

* Abbreviations of the States Rio Grande do Sul — RS; São Paulo — SP and Piaui — PI.
† The rainfall in Teresina is 90 per cent from October to March and only 10 per cent from April to September.

TABLE 2
PERFORMANCE OF MARSH SEEDLESS GRAPEFRUIT ON 3 ROOTSTOCKS IN THE BARRETOS AREA

Rootstock	Per cent plants with stem pitting				Average tree height (m)	Average fruit diameter (cm)
	very mild	mild	medium	severe		
Rangpur lime	0	20	20	60	3.0	8.0
Sweet orange	30	20	10	40	2.5	9.5
Trifoliate	30	20	30	20	2.0	9.0

single clone provided by the Limeira Experiment Station and carried a weak strain of tristeza virus. Three rootstocks were used: Rangpur lime (50 per cent), Caipira sweet orange (25 per cent) and trifoliate orange (25 per cent). The trees show many differences in pitting, average tree height and fruit size, depending on their rootstocks (table 2). Trees on Rangpur lime were larger, had more severe stem pitting, and showed some zinc deficiency, and produced smaller fruits, in contrast to trees on sweet orange and trifoliate rootstocks, which were less vigorous, showed no mineral deficiencies, had less pitting and produced larger fruits. We can assume that the more vigorous the tree, the better the development of tristeza virus in its tissues. However, in the near future, the severity of stem pitting in the scions of Rangpur lime-rooted trees may reduce vigor and consequently these trees will be surpassed by those on other rootstocks. In Dobrada County, Sao Paulo, another orchard having the same Marsh Seedless grapefruit clone on Rangpur lime rootstocks grew so poorly and produced such small, non-marketable fruits that it was eliminated.

B4— In a preimmunization trial at Campinas, Sao Paulo, Pera sweet orange infected with a mild isolate and grafted on Rangpur lime, Caipira sweet orange and Cleopatra mandarin rootstocks showed different reactions when challenge inoculated with a severe strain of the same virus. Trees on Rangpur lime showed more severe reduction in development after the challenge inoculation than trees on other rootstocks. It is presumed that the initial vigor of the trees on this rootstock facilitates the development of the virus (G.W. Müller, personal communication).

B5 — In 1969 a group of virologists and citriculturists selected 10 of the best clones of Pera orange based on development of trees, production, and quality of fruit in the Bebedouro area of northern Sao Paulo. These clones when tested at the Limeira Experiment Station (Teofilo Sob. *et al.*, 1978) performed differently with regard to development and productivity than when tested in other ecological conditions. The symptoms of stem pitting increased markedly, except for one clone (Bianchi). In the Limeira area, the nine remaining clones had so many tristeza problems that many were unsuitable for commercial orchards. One clone, preimmunized with a mild isolate selected at Campinas, was the best in productivity, fruit weight and tree size in comparison with the other ten. The trial demonstrated that good Pera orange clones selected for the Bebedouro area in the northern part of the state, which has a warmer and drier climate, are not appropriate for southern conditions, unless they have been tested for tristeza reaction. In other words, it is necessary to select proper isolates of the virus for each area in the State.

B6 — At Casa Branca County, Sao Paulo, in a climate similar to that of the Mococa Experiment Station, the Pera preimmunized clone mentioned above has been tested since 1974 on seven rootstocks. Trees showed decreasing severity of pitting on sampled branches, according to rootstock, in the following order: Volkameriana lemon, trifoliate orange, Morton citrange, Rangpur lime, Troyer citrange, Sunki mandarin and Cleopatra mandarin. In the future, Sunki and Cleopatra mandarins will probably be the best of these rootstocks for Pera in these conditions.

C — In the Teresina area of the State of Piaui, in northern Brazil, 14-year-old trees of Malrose sweet orange on sour orange rootstock were producing economically in a commercial orchard. This indicates that tristeza virus in this warm, semiarid area (table 1) either suffers from the ecological conditions or is so mild for unknown reasons, that trees of the sweet/sour orange combination survive surprisingly well and produce good crops for many years.

CONCLUSIONS

The symptom expression of tristeza disease and the performance of sweet oranges, limes and grapefruit under different ecological conditions varies according to the rootstock and the isolate of the virus, and shows many differences from southern to northern Brazil. In Taquari, Rio Grande do Sul and Campos de Jordao, Sao Paulo, sweet orange varieties considered tolerant to tristeza show stem pitting problems, while in Teresina, with a warmer and drier climate, the sweet orange/sour orange combination has survived tristeza for more than 10 years, and produced economically.

In hot, dry climates, a certain degree of control seems to occur from thermotherapy effects on the virus.

Pera oranges, Mexican and Tahiti limes, and grapefruit, the commercial types most sensitive to tristeza, may be selected for agronomic value and preimmunized with recognized effective mild isolates of the virus for each particular ecological condition. Rootstocks should be selected so as not to aggravate the tristeza problems of stem pitting, small fruit size and poor fruit quality, and yet allow normal development and nutrition of the trees.

Among the Rangpur lime, Caipira sweet orange and trifoliate rootstocks, Rangpur is the least suitable for grapefruit in the northern part of the state of Sao Paulo. This rootstock aggravates the stem pitting problem and induces a high proportion of nonmarketable fruits, unless preimmunized scions are used.

More accurate observations and studies are needed to determine the best climate for selecting clonal material of citrus, isolates and tristeza virus, and rootstocks, that alone or together will allow citrus not tolerant of tristeza to perform better in areas where the virus is prevalent.

ACKNOWLEDGMENT

The authors thank Dr. Gerd W. Müller for his information and suggestions.

LITERATURE CITED

COX, J.E., L.R. FRASER, and P. BROADBENT
1976. Stem pitting of grapefruit — field protection by the use of mild strains, an evaluation of trials in two climatic districts, p. 68-70. *In* Proc. 7th Conf. IOCV. IOCV, Riverside.

DORNELLES, C.M.M.
1976. Stem pitting in citrus varieties and nucellar clones in Rio Grande do Sul, Brazil, p. 71-74. *In* Proc. 7th Conf. IOCV. IOCV, Riverside.

GALLO, J.R., S. MOREIRA, O. RODRIGUEZ, and PRAGA JUNIOR
1960. Influencia da variedade e do porta-enxerto na composicao mineral das folhas de citros. Bragantia 19: 307-18.

GRANT, T.J., S. MOREIRA, and A.A. SALIBE
1961. Citrus variety reaction to tristeza virus in Brazil when used in various rootstocks and scion combinations. Plant Dis. Rep. 45: 416-21.

MOREIRA, S.
1968. Growing citrus in the presence of tristeza, p. 41-44. *In* Proc. 4th Conf. IOCV. Univ. Florida Press, Gainesville.

MULLER, G.W.
1972. Estudos sobre a interacao entre isolados do virus da tristeza dos citros e controle da moléstia em limao galego por premunizacao. Doctorate Thesis, ESALQ, Piracicaba, SP., Brasil.

SALIBE, A.A., and M.M. MISCHAN
1976. Rootstock effect on tristeza stem-pitting expression in sweet orange trees, p. 75-78. *In* Proc. 7th Conf. IOCV. IOCV, Riverside.

TEOFILO SOB., J. POMPEU JR., O. RODRIGUEZ, and J.O. FIGUEIREDO
1978. Melhoramento de clones de laranja pera no Estado de Sao Paulo, p. 111-16. Anais IV Congr. Brasileiro Frutic., Soc. Brasileira Frutic., Campinas.