Behaviour of Rough Lemon as Rootstock in the Presence of Tristeza Virus

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ABSTRACT. Trees budded on rough lemon grew and yielded less than those on most other rootstocks used in Brazil. Four types of rough lemon were known in the country, namely: Deodoro (intolerant to tristeza), Brazilian, Florida and South African. Controlled experiments and field observations indicated that Florida rough lemon while considered commercially tolerant to tristeza is somewhat affected by the virus and may exhibit wood pitting in the presence of severe strains. South African rough lemon having been selected in the presence of tristeza is probably more tolerant to the virus and should be considered a superior type to be used in tristeza infected areas.
Index words. Florida rough lemon, sweet orange tristeza stem pitting.

Rough lemon ranks among the most widely used rootstocks in citrus orchards around the world. In Brazil, Florida rough lemon was indicated as a valuable rootstock type, before the invasion of tristeza virus (1), however, trees budded on rough lemon nearly always grew and yielded poorly and rough lemon never became popular in Brazil (6, 9, 11, 12).

Over 100 rootstock experiments were conducted in São Paulo, Brazil, since 1930. Florida rough lemon was included in practically all of them, with different scion varieties and only rarely appeared among those showing the best performances (5, 6, 13). In one exception, it ranked in first place with Pineapple orange scion in an experiment conducted at the Tiete Experiment Station from 1949-1958 (7). In several instances, trees of orange and grapefruit budded on rough lemon developed an abnormality resembling "dry root rot", declined and died within 15 years of planting (5).

A statistical study made by the authors indicated that from 1930-1983, 101 rootstock experiments were conducted in São Paulo, Brazil. Numbers of experiments with the following scion varieties were: oranges 64, lemons 12, tangerines 11, grapefruits 6, limes 5, and tangors 3. The number of experiments with rootstocks ranking top position were: Rangpur lime 48, sweet orange 5, sour orange 2, Brazilian rough lemon 2, Palestine sweet lime 2, Morton citrange 1, Florida rough lemon 1 and Volkamer lemon 1. Other experiments are still underway and those results were not included here.

Four types of rough lemon are known in Brazil, namely Deodoro, Brazilian, Florida and South African. All trees budded on Deodoro rough lemon died following tristeza infection indicating intolerance or hypersensitivity of this rootstock to this virus. The behaviour of these rough lemon selections when used as rootstock in the presence of tristeza virus was studied and results are reported here.

MATERIALS AND METHODS

Seedlings of Florida and South African rough lemon and Brazilian rough lemon (possibly a lemon hybrid) and also of Rangpur lime, 20 months old in the nursery were budded with nucellar Baianinha navel orange taken from a single mother tree. This mother tree was known to be free from psorosis, exocortis and xyloporosis but infected with a severe strain of tristeza virus. Budding was conducted in January 1956 and the buddlings

transferred to the field (Bebedouro county), in February 1957. The experiment was set out in a randomized block design with four replications and three trees per plot. Planting distance was 7x7. The soil was very sandy, with a pH around 5.0 raised to 6.0-6.5 by yearly applications of dolomitic limestone. The experiment was conducted without irrigation.

Trees bloomed for the first time in 1960 and fruit production was recorded from 1961 to 1968. Trunk circumference was measured 10 cm above the budunion, in 1968, as a comparative index of tree growth. At the same time, a piece of bark was removed at budunion and the amount of wood pitting was rated, on a scale from zero (no pits) to four (severe pitting).

RESULTS

The various rootstocks affected tree vigour and fruit production considerably (table 1). Trees on Florida rough lemon were the smallest and exhibited the largest average amount of wood pitting in the trunk below the budunion. Those budded on South African rough lemon were significantly superior to those on other rough lemon types, and were larger and more productive and less affected by tristeza wood pitting. Rangpur lime, while not considered a rough lemon type was included in the experiment for comparative purposes and showed excellent performance, superior to all other rootstocks tested.

DISCUSSION AND CONCLUSIONS

Rough lemon, because of its vigour and productivity is a popular rootstock for sandy soils in many citrus growing areas of the world. However, in the presence of tristeza virus, under growing conditions of the State of São Paulo, trees on Florida rough lemon have frequently shown poor growth and lower yields when compared with those budded on Rangpur lime (5, 6, 8, 11). Results of the experiment reported here confirmed that the rough lemon selections tested were inferior to Rangpur lime as rootstocks. Moreover, trees on Florida rough lemon made the least growth and ranked in third position in productivity.

It is believed that Florida rough lemon, while having tissues tolerant to tristeza virus, must be affected to a certain degree by this virus. Salibe (10) reported that

TABLE 1
EFFECT OF ROOTSTOCK IN THE GROWTH AND PRODUCTIVITY OF NUCELLAR BAIANINHA NAVEL ORANGE TREES IN THE PRESENCE OF SEVERE TRISTEZA VIRUS, PLUS RATE OF WOOD PITTING IN THE TRUNK OF ROOTSTOCKS

Rootstock	Wood Pitting*	Average trunk circumference in 1968	Total number of fruits (1961-68)
		(cm)	
Rangpur lime	0.1	51.50	3 665
South African rough lemon	0.3	43.83	2 383
Florida rough lemon	1.4	36.25	1 916
Brazilian rough lemon	1.1	40.08	1 124

* wood pitting rated on a scale of 0 = none to 4 = severe.

tristeza virus reduced the growth of young mandarin plants up to 50%, on 17 different tristeza tolerant rootstocks. Reductions were: trifoliata 50.0%, Morton citrange 48.9%, Rough lemon 32.3%, sweet orange 21.1%, Orlando tangelo 16.0%, Cleopatra mandarin 11.6%, Carrizo citrange 2.3% and Rangpur lime 0.0. On the other hand, several authors (2, 3, 4) as early as 1922 reported the superiority of trees on Florida rough lemon rootstock, but their studies were made with trees free from tristeza virus.

South African rough lemon having been selected in the presence of tristeza probably is more tolerant to the virus and this would explain its superiority in the present work. For this reason it should be considered a superior type for tristeza infected areas.

Tristeza is spreading in the citrus areas around the world. On the basis of the results here reported it is recommended that the behaviour of commercial citrus types and stionic combinations should be re-evaluated in areas invaded by this virus.

LITERATURE CITED

1. ANDRADE, E. N.
1930. Rootstocks for citrus budding. Boletim de Agricultura, São Paulo. No. 9-10.
2. COOK, J. A., G. E. HORANIC, and F. E. GARDNER
1952. Citrus rootstock trials. Proc. Fla. State Hort. Soc. 65: 69-77.
3. EVANS, W. E.
1922. Citrus root stocks. Proc. Fla. State Hort. Soc. 35: 134-138.
4. MENDEL, K.
1956. Rootstock-scion relationships in Shamouti trees on light soil. Ktavim, Rehovot 6: 35-60.
5. MOREIRA, S.
1957. Rootstocks and diseases of citrus in Brazil. Revista de Agricultura, Piracicaba 32(2): 127-136.
6. MOREIRA, S. and A. A. SALIBE
1969. The contribution of research for the progressive changes in citrus rootstocks for South America. p. 351-357. *In* H. D. Chapman (ed.) Proc. First Intern. Citrus Symp. Vol. 1.
7. MOREIRA, S., V. G. OLIVEIRA and E. ABRAMIDES
1960. Experimentos de cavalos para citros III. Bragantia, Campinas 19(59): 961-995.
8. MOREIRA, S., C. ROESSING, and E. ABRAMIDES
1962. Experimentos de cavalos para citros IV. Bragantia, Campinas 21: 63-76.
9. MOREIRA, S., T. J. GRANT, A. A. SALIBE and C. ROESSING
1965. Tristeza tolerant rootstocks—their behavior after twelve years in orchard. p. 18-24. *In* W. C. Price (ed.) Proc. 3rd Conf. IOCV. Univ. Florida Press, Gainesville.
10. SALIBE, A. A.
1966. Citrus virus diseases, a report to the government of the Philippines. Food and Agricultural Organization. Report No. TA 2237. 31 p.
11. SALIBE, A. A.
1974. Effect of rootstock and locality in the vigour and productivity of sweet orange trees. Thesis. Faculty of Agricultural Sciences, Botucatu. 226 p.
12. SALIBE, A. A. and V. ROSSETTI
1960. Variedades citricas e seus porta-enxertos nos laranjais paulistas. Arquivos Instituto Biológico 27: 161-168.
13. VASCONCELLOS, P. W. C.
1939. Estudo comparativo de laranjeira Bahia comum sobre cinco diferentes porta-enxertos. Boletim de Agricultura, número único. 37 p.