Response of *Citrus amblycarpa* Ochse Rootstock to Citrus Virus Diseases

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THE REPORT (5) that many old sweet orange [*Citrus sinensis* (L.) Osb.] trees in Spain were infected with tristeza virus disease and of possible spread of the disease by an insect vector changed the generally accepted idea that tristeza does not spread by insect vectors in the Mediterranean countries. The present status of tristeza makes urgent the need to replace the tristeza non-tolerant sour orange (*C. aurantium* L.) with a suitable tristeza-tolerant rootstock. The present study constitutes a preliminary report of an experiment on the evaluation of rootstocks tolerant to tristeza and certain other virus diseases.

Materials and Methods

Buds from 1-year-old nucellar navel sweet orange trees were grafted on 15 different rootstocks and inoculated with buds from 2 trees infected with psorosis and one of the following virus diseases: cachexia-xyloporosis, exocortis, and gummy bark disease (3) of sweet orange. The sweet orange trees were inoculated with a single tristeza virus. In all inoculations, 2 navel trees were inoculated from both infected sources. At least 5 trees on each rootstock were left uninoculated as checks.

Trees inoculated with tristeza virus disease were indexed on baladi lime [*C. aurantifolia* (Christm.) Swing.] seedlings to detect the presence of this virus. All trees were planted on light silt soil at the Barrage Experiment Station in the Nile River delta. Beginning 3 years after planting, all trees were examined periodically over a 3-year period.

Results

At the end of 6 years, all uninoculated trees were free of symptoms of tristeza, psorosis, cachexia-xyloporosis, exocortis, gummy bark of sweet orange, and bud-union constriction of sweet orange on Rough lemon (*C. jambhiri* Lush.) rootstock.

Transmission of the above-mentioned diseases was confirmed by symptoms exhibited on the inoculated trees as follows: cachexia-xyloporosis virus disease caused gum deposits in the bark of Orlando tangelo (*C. reticulata* Blanco x *C. paradisi* Macf.) and baladi mandarin (*C. reticulata* Blanco) rootstocks. Also, severe pitting was exhibited on the cambial surface of the wood of these rootstocks. Trees on trifoliate orange [*Poncirus trifoliata* (L.) Raf.], citrange (*P. trifoliata* x *C. sinensis*), citron (*C. medica* L.), and Rangpur lime (*C. reticulata* var. *austera* hyb.) that were inoculated with exocortis virus exhibited severe cracking and shelling of the outer layers of the bark of the rootstocks. The shelling of the bark commenced at the soil surface or below and progressed upward to the bud-union, but not into the scion bark.

Sweet orange tops on all rootstocks in this experiment reacted to inoculation with the gummy bark virus as follows: After scraping away the corky surface of the bark, a brownish-red circumferential line was observed which later turned to dark brown. These symptoms could be seen in various degrees of severity as the trees reached 6 years of age.

All trees inoculated with the above viruses and grafted on indicator rootstocks were stunted and in a state of slow decline. Also, all inoculated trees on sour orange, grapefruit (*C. paradisi* Macf.), baladi lime, shaddock (*C. grandis* L. Osbeck), and calamondin (*C. mitis* Blanco) were severely stunted. However, the effect of tristeza virus on trees grafted on citron and Palestine sweet lime (*C. limettioides* Tanaka) was moderate, and the infected trees grew very slowly with severe leaf symptoms of mineral deficiencies.

Nasnaran (*C. amblycarpa* Ochse) was the only rootstock that did not react with any of the above-mentioned virus diseases. Except for trees infected with gummy bark disease of sweet orange, all trees infected with the other viruses grew satisfactorily and almost as vigorously as their healthy uninoculated sister trees. Moreover, uninoculated trees grafted on this particular rootstock were more vigorous than the healthy sister trees grafted on the other rootstocks.

During the flood period of the River Nile, when the orchard was flooded for a height of at least 10 cms for 3 months, *C. amblycarpa* rootstock proved one of the most resistant rootstocks to brown rot gummosis (*Phytophthora* sp.) and can be placed in the category of trifoliate orange, citrange, and sour orange as regards resistance to that disease. When brown rot gummosis occurred on the scion it usually progressed downward to the bud-union, but never caused gummosis of the bark of the *C. amblycarpa* rootstock. On the other hand, sweet orange, baladi mandarin, baladi lime, shaddock, and grapefruit were the rootstocks most susceptible to brown rot gummosis. Sweet lime, Rough lemon, Rangpur lime, Orlando tangelo, citron, and calamondin were moderately susceptible.

Discussion

A number of rootstocks including trifoliate orange and its hybrids, mandarins, Rangpur lime, and Rough lemon have been found suitable and safe to replace sour orange rootstock as long as they are grafted with certified virus-free budwood. On the other hand, these rootstocks proved to be failures when grafted with old-line varieties which usually harbor many virus diseases.

In this study, *C. amblycarpa*, which is tolerant to tristeza (1), was also found to be unaffected to any appreciable extent by exocortis, cachexia, and xyloporosis viruses. These results suggest that *C. amblycarpa* can be used safely for propagating old lines of sweet orange trees in regions where virus-free lines are not available. Furthermore, trees grafted on this rootstock grow satisfactorily on light soils and tolerate wet soils without being affected by foot rot.

It was observed that trees infected with gummy bark disease always induced bud-union constriction of sweet orange on Rough lemon rootstock in the absence of cachexia disease. This suggests that gummy bark of sweet orange on sour orange stock (3) and bud-union constriction of sweet orange on Rough lemon rootstock (2, 4) are caused by the same agent.

Literature Cited

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