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A Bark Disorder of Grapefruit

IN THE CITRUS collection of the Agricultural Experiment Station of Tucumán, started in 1934, Triumph grapefruit (*Citrus paradisi* Macf.) constitutes the rootstock for a number of varieties. All these plants were observed along with plants of other combinations as part of a study aimed to detect the presence of tristeza virus (1). As a result, a 24-year-old plant of common mandarin (*C. reticulata* Blanco) on Triumph grapefruit was found to be stunted and to have a rootstock showing a type of scaling not identical with that characteristic of any known citrus disease.

Description of Symptoms

The affected mandarin (No. 1945 in the collection) is dwarfed, with dry branches and twigs, and failed to respond to fertilization and pruning. The conical-shaped stock, which is classic for grapefruit used as a rootstock, developed a cracked-bark type of scaling in which separate pieces of bark, of irregular contour, are not raised as plates, as happens in psorosis, but remain attached to the underlying tissue by their central part and are raised at their edges (Fig. 1). The scaling includes the entire surface of the rootstock, reaching the point where the root emerges and stopping at the bud-union line. If a piece of bark is detached at the bud-union, a "bud-union crease" type of disturbance can be noticed. From a total of 152 plants, representing 4 species and 20 varieties grafted on Triumph grapefruit, only the mandarin No. 1945 and one other of the same combination, but 23 years old, were affected. In the second plant, the symptoms were not so conspicuous; the plant seemed to be developed normally.

FIGURE 1. *Crack-like scaling of bark of Triumph grapefruit rootstock under mandarin No. 1945.*

Transmission Tests

Inoculations were carried out using buds of mandarin No. 1945 as inoculum. Five one-year-old plants of Marsh grapefruit grafted on rough lemon that had been derived from an old clone carrying both exocortis and tristeza viruses were budded. Five similar grapefruit trees were kept as controls. Once the buds took, both groups of plants were topped and new shoots were allowed to grow. The controls developed normally whereas the inoculated plants presented a limited growth with tan, boat-shaped, wilted leaves, which fell even when lightly touched (Fig. 2). Later, buds from the same mandarin were budded on nucellar seedlings of Rangpur lime (*C. limonia* Osbeck), without inducing dwarfing or other symptoms of exocortis such as those described by Moreira (4). Foliar symptoms of psorosis, of the oak-leaf pattern type, were observed on the leaves of the grafted plants. In another series of trials, nucellar grapefruit seedlings under greenhouse conditions were budded from mandarin No. 1945. The budding resulted in severe dwarfing of new shoots, thus confirming the results obtained with field tests.

Inoculations with buds containing either exocortis, psorosis, xyloporosis, or tristeza viruses into grapefruit seedlings did not induce reactions such as those induced by buds from mandarin No. 1945. Although it could not be determined whether the combined action of these viruses would produce those symptoms, it was determined that tristeza virus in combination with exocortis, psorosis, or xyloporosis virus would not, since the virus of tristeza is endemic in this area. Neither sweet orange

FIGURE 2. *New shoots produced by a one-year-old Marsh grapefruit tree after inoculation with buds from mandarin No. 1945 and exhibiting boat-shaped leaves.*

nor Key lime seemed to be affected by the suspected agent, although Key lime plants were stunted, which could have been induced by tristeza virus.

Until now, two years after the inoculation, eruptions similar to those observed on mandarin No. 1945 rootstock have not appeared on the first inoculated plants.

It was not experimentally determined whether other citrus species and varieties under trial or in commercial orchards carried the factor existing in mandarin No. 1945; but the field observations suggest that the factor was absent.

Other Viruses Existing in Mandarin No. 1945

Scaling such as that produced by psorosis A was not found on the top of mandarin No. 1945 or in plants of the same clone. Psorosis virus was present in mandarin No. 1945, however, as was shown by foliar symptoms in the original plant and in test plants subinoculated from it.

Concave-gum and blind pocket psorosis are widespread on mandarins of this area; 7-year-old plants were observed with severe deformation of branches.

Xyloporosis (cachexia) was found neither on branches of mandarin

No. 1945 nor in the rootstock portion of plants from the same clone grafted on Rangpur lime.

Discussion

Apparently, scaling symptoms appearing on the Triumph grapefruit rootstock of mandarin No. 1945 are not produced by either exocortis or psorosis A viruses; exocortis virus is known not to be present and typical psorosis A reactions on the bark of the branches of mandarin No. 1945 are absent; the eruptions existing on the bark of the rootstock are different from those described for psorosis A. Moreover, the foliar symptoms that appeared in the inoculated plants were different from those commonly induced by either tristeza or psorosis virus, or a combination of the two. The stunting could possibly have been the result of a severe strain of tristeza virus existing in mandarin No. 1945. If this is correct, however, such strain should be more widespread; since the distribution of the aphid vector is wide, and should have affected many plants grafted on grapefruit that were planted at the same time but which developed normally. In the same way, 24-year-old grapefruit plants on sour orange (*C. aurantium* L.) and on Triumph grapefruit rootstock showing stem pitting on their branches and trunk and growing near mandarin No. 1945, have grown normally until they recently began to decline. In the first series of field inoculations on the old clone of Marsh grapefruit, which carried both exocortis and tristeza viruses, there would have been (supposing theoretically that mandarin No. 1945 carries a severe strain of tristeza) a certain cross-protection, such as that described by several authors (2, 5), from the severe strain of tristeza virus supposedly carried by mandarin No. 1945; but no such cross-protection was evident.

Satsuma dwarf virus produces stunting and boat-shaped leaves on mandarins, but it is not known whether it produces injury on the bark; and it is doubtful that grapefruit is sensitive to it (3).

From the accumulated evidence, it can be assumed that the factor existing in mandarin No. 1945, which is capable of producing scale formation on the grapefruit bark after a non-determined incubation period and stunting effects and malformed leaves when inoculated to the same species, could constitute a new virus entity. If this is not correct, then the symptoms observed could be the result of a new form of psorosis virus or a non-investigated combination of viruses.

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