Performance of Selections of Trifoliate Orange and Trifoliate Orange Hybrids as Rootstocks for Citrus in the Presence of Tristeza Virus

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TRIFOLIATE ORANGE and certain of its hybrids have many characteristics that make them desirable rootstocks for citrus (1, 4). Therefore, there is an increasing tendency to use these rootstocks in the areas where tristeza virus has become endemic. In Brazil, for example, trifoliate orange is fast becoming the second most largely used rootstock for citrus, now that its limitations are better known (2, 3). Nearly 1 million citrus trees were propagated on trifoliate orange during the last 5 years in the state of São Paulo.

The genus *Poncirus* is considered to be monotypic (6), but in recent years a number of different selections of trifoliate orange have been reported (2, 5). Thirty-three of these selections were tested as rootstocks for nucellar Hamlin sweet orange in the presence of a severe strain of tristeza virus. The results are summarized in this paper.

Materials and Methods

Seed of the 33 selections—obtained from California through the courtesy of Mr. E. F. Frolich—were sown at the Limeira Citrus Experiment Station in October 1959. The resulting seedlings were budded in December 1961 with buds from a nucellar line Hamlin orange tree known to be infected with a severe strain of tristeza virus. The nursery trees made poor growth because of

a serious drought and were not transferred to the field until January 1965. Trees propagated from the same Hamlin line on Morton, Troyer, Rusk, and Carrizo citrange rootstock were included for general comparison but they were 2 years younger.

Yearly observations were made of the general aspect of the trees, drought tolerance, and coloring of the fruit. Yearly measurements included height of trees and their circumference 10 cm above the bud union and 10 cm below.

Another experiment, started in 1961, included Carrizo, Citruvel, Cunningham, I-150,917, I-86,498, Morton, Rusk, Saunders, Savage, and Troyer citrange; Thompson and EEL-154 citremon; San Jacinto, EEL-203, and Sacaton citrumelo; and a Limeira selection of trifoliate orange. When 2 years old, the seedlings were budded with buds from the same Hamlin orange tree and were transplanted to the field in December 1966. Seed for this experiment were obtained from trees of the citrus collection at the Limeira Experiment Station; they had been propagated on Caipira sweet orange stocks about 20 years ago from material introduced from the United States. The results of a survey made in March 1968 to determine the occurrence of wood pitting in the hybrid tops also appear in this paper.

Results

The data from the first experiment suggest that the 33 trifoliate orange selections may be grouped into 4 classes as follows: 1. Superior—including Davis A, Davis B, Rich 16-6, Rich 21-3, Kryder 8-5, Jacobsen, Ronnse, English Large, and Rich 22-2; 2. Good—including English Small, Kryder 28-3, Towne F, Towne G, Limeira, Kryder 60-2, Rubidoux, Kryder 55-1, Benecke, Rich 5-2, and San Jacinto; 3. Fair—including Rich 12-2, Kryder 5-5, Taylor 23, Kryder 25-4, Christian, Rich 7-5, Argentina, and Tucuman (Arg.); and 4. Poor—including Yamagouchi, Constriction, Frost tetraploid-1, Tetraploid-2, and Tetraploid-3. Trees classed as superior had an excellent general aspect, medium or good drought tolerance, trunk circumference 14–15 cm above the union, 18–20 cm below, and a height of 185–215 cm. Those classed as good had a good-to-medium general aspect, good-to-medium drought tolerance, trunk circumference 11–13 cm above the union and 15–22 cm below, and a height of 155–205 cm. Those classed as fair had a medium general appearance, good-to-medium drought tolerance, trunk circumference 9–12 cm above the union and 14–19 cm below, and a height of 175–200 cm. Those classed as poor had a poor general aspect, poor-to-medium drought tolerance, trunk circumference 9–12 cm above the union and 12–17 cm below, and a height of 145–60 cm.

The data suggest that seed of the selections rated superior should be used instead of seed of Limeira for future propagations. Trees on the 4 selections of citrange made excellent growth.

Differences in fruit production are not considered to be significant because the trees are still young. There was, however, a remarkable difference in rind color of the mature fruit produced by the trees on the various rootstocks. Fruit from trees on English Small, Limeira, and San Jacinto developed a deep orange color (rated 10, 8, and 10, respectively), whereas those from trees on the other rootstocks were much paler (rated 6 or less).

All trees budded on the 33 trifoliate orange selections proved to be resistant to the tristeza virus strain present in the Hamlin sweet orange tops. None of the trees have thus far shown symptoms of Phytophthora root rot; they seem to be free of this disease.

In the second experiment, differences appeared within a few months after the seedlings were budded. All plants on citremon EEL-203 turned yellow and died within 4–6 months. Those on Thompson and EEL-154 citrangequat, on Saunders and Savage citrange, and on San Jacinto citremon developed leaves with a mottling pattern suggestive of zinc and manganese deficiencies; apparently they are intolerant of the tristeza virus strain present in the tops. They made very poor growth, despite the fact that they were sprayed with solutions of various microelements.

Trees on the other rootstocks made fairly good growth and may be classified according to their vigor in the following decreasing order: Morton citrange, Carrizo citrange, I-150,917 citrange, I-86,498 citrange, Troyer citrange, Rusk citrange, Cunningham citrange, Citruvel citrange, trifoliate orange, and Sacaton citrumelo. An examination of the trunks and branches of the trifoliate orange hybrids in the citrus collection revealed the presence of various degrees of wood pitting. They were rated from 1 (slightly pitted) to 10 (severely pitted) as follows: Savage citrange (10), I-150, 917 (7), Saunders (6), EEL-150 citrangequat (6), EEL-203 citremon (6), Morton citrange (5), Thompson citrangequat (5), and Rusk citrange (5). The other trifoliate orange hybrid trees in the citrus collection had no wood pitting. Inspection of the rootstock portion of the Hamlin orange trees budded on these hybrids confirmed the observations of wood pitting.

Seedlings of San Jacinto citremon about 20 years old are among the largest trees at the Limeira Citrus Experiment Station, whereas those of Savage citrange are in very poor condition, showing conspicuous symptoms of decline due to the effects of tristeza virus. Both of these hybrids are intolerant of tristeza virus when used as rootstocks.

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