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Citrus Virus Diseases in Argentina

Tristeza

THIS SERIOUS DISEASE was observed for the first time in South America in the region of Bella Vista (Corrientes province, Argentina) in 1931. Since then approximately 10 million trees on bitter orange (*Citrus aurantium* L.) rootstock have been destroyed (3). In the extensive Argentine littoral (Misiones, Corrientes, and Entre Ríos provinces and the Paraná Delta), it destroyed all mature trees on bitter orange rootstock (10). It appeared in 1947 in Northwest Argentina (Salta and Jujuy) and its destructive action is at present in Tucumán where 50 per cent of the trees growing there have begun to decline. Wherever tristeza appears the destruction of trees on bitter orange rootstocks is complete.

Trees in a few isolated zones in the provinces of San Luis, Córdoba, Santiago del Estero, and Catamarca have not yet been infected, judging by the normal look of the plantations.

The uneven behavior of the disease indicates that in Argentina there exist strains of the virus as in other parts of the world (12).

In Argentina, *Toxoptera citricidus* (Kirk.) proved to be an efficient vector and, in certain periods of the year, is very abundant in all citrus-growing areas of the country. Both the virus and the vector were introduced from South Africa in the late twenties or early thirties (7, 10).

The major tristeza tolerant rootstocks used in Argentina are: trifoliate orange [*Poncirus trifoliata* (L.) Raf.], Cleopatra mandarin (*Citrus reshni* hort. Tanaka), rough lemon (*Citrus jambhiri* Lush.), and sweet orange [*Citrus sinensis* (L.) Osbeck]. Rangpur lime (*Citrus limonia* Osbeck) is used less extensively (11).

Despite the great losses caused by tristeza and the lack of experimen-

tal data about the regional behavior of rootstocks to be substituted for bitter orange, Argentina has rebuilt a large and vigorous industry, which is already satisfying all local demands.

Stem Pitting

Based on the differences in symptoms, differences in the behavior of grapefruit trees in relation to stem pitting have been noticed in different citrus growing regions of Argentina. It is difficult to assert whether this is due to mild strains that protect these trees from injury, whether trees become naturally infected with more virulent strains, or whether virus strains which cause stem pitting on grapefruit (*Citrus paradisi* Macf.) are not yet generally distributed.

Stem pitting on grapefruit is more extended in the Argentine littoral than in the north central and northwest provinces.

Knorr and DuCharme (14) have determined that infections in groves in the littoral varied between 39 and 93 per cent, and said that on the basis of observations alone they did not report any outstanding differences in the yield or in the size of the fruit between gnarled trees and neighbouring healthy-looking ones, and that it would seem that the grapefruit industry in Argentina will continue on a profitable basis.

Oberholzer, Mathews, and Stieme (15) indicate that in South Africa the grapefruit is severely damaged by stem pitting. In the Argentine, grapefruit on rough lemon that were obtained 30 years ago from South Africa have behaved variously. In the Santiago del Estero province, which is still free from tristeza, trees are very vigorous without internal symptoms of stem pitting. On the other hand, in San Pedro, province of Buenos Aires, where tristeza passed more than 15 years ago, some trees have pronounced symptoms of stem pitting and are in complete decline whereas others are in good condition even though internal symptoms of stem pitting are present.

While stem pitting seems to have more severe effects when the grapefruit trees are grafted on rough lemon than on other stocks, in the Delta Experiment Station 31 Marsh grapefruit trees grafted on trifoliate orange show stem pitting and many of them are in decline.

In the Experiment Station at Bella Vista (Corrientes), stem pitting has appeared in the Pera sweet orange budded on seedling sweet orange. Stem pitting occurs only on the scion, although the stock is also sweet orange. None of the Pera sweet orange plants developed satisfactorily. Stem pitting was also found there in seedlings of Persian sweet lime.

Stem pitting at present is not considered to be an important problem in Argentina's grapefruit industry. However, research should be done to determine whether or not the different behavior is caused by the protection of mild strains or whether these virulent strains are not yet widespread.

Exocortis

In Argentina, two commercially used rootstocks affected by exocortis are trifoliate orange and Rangpur lime. Trifoliate orange is used exclusively in the Delta of Paraná and San Pedro areas and frequently in Concordia (Entre Ríos province). Rangpur lime is used to some extent in the northeast and northwest provinces of the country.

Trifoliate orange provides to the different citrus varieties grafted on it resistance to brown-rot gummosis, good cold tolerance, good quality of fruit, and resistance to humidity. Plants on this rootstock were flooded in 1959 in the Delta for more than 50 days with very little loss of trees, whereas the majority of lemons grafted on sour orange perished.

Surveys in the Delta and San Pedro areas revealed that 18 per cent and 24 per cent respectively of trees on trifoliate orange had exocortis. In Concordia, it is estimated that of four million plants budded on trifoliate orange, about a half million have exocortis.

Further north, trifoliate orange has not been used much, except for experimental purposes and the few commercial plantations started after tristeza swept by have been abandoned or replanted. Strains of kumquat (*Fortunella* sp.) free of exocortis grow well on trifoliate orange rootstock in all the citrus regions of the country.

In Santiago del Estero, where trifoliate orange is unadapted, the writer has seen trees of common mandarin, apparently free of exocortis, well developed and very productive, and in the Experiment Station of Tucumán, McCarty grapefruit and Ruby blood orange trees have their best result upon the trifoliate orange (11).

The existence of exocortis in Argentina goes back at least to the first grafts that were made in this country about 1930. There are trees about 25-30 years old affected by exocortis in the Delta.

Psorosis

This disease is spread over almost all the country. It has been observed mostly in the regions of Delta del Paraná, San Pedro, and Concordia but

is not common in the littoral, north central, and northwest regions of the country.

Until the coming of tristeza, references to psorosis in the different species budded on bitter orange rootstock were few. The steady increase of psorosis in Argentina since then is due to indiscriminate use of buds from psorosis-infected trees.

The most serious effects of psorosis are in the Delta del Paraná, San Pedro, and Concordia regions. The percentage of plants with trunk scaling is estimated, judging by scaling symptoms, to be 5 per cent and 8 per cent in the Delta and San Pedro areas. In Concordia the percentage is equally high.

This disease exists in other Mesopotamian provinces and in the provinces of the north central and northwest regions, but in less degree, if the scaling of the trunk is considered.

Some growers have selected buds from trees 20 years old, or older, that did not have bark symptoms of psorosis. Many of the plants derived from these buds showed symptoms of scaling in the trunk in the eighth year, while the mother plant remained normal.

Sweet orange seedling trees have, although rarely, been observed with advanced bark lesions of psorosis "A" (9, 18). Wallace (18) suggested that these plants could have been budded in the nursery with psorosis-infected buds, which later died or failed to grow.

It is the general impression that plants with psorosis develop and produce fairly well until appearance of symptoms in the trunk; then they begin to decline, though in plantings presumably with a high incidence of psorosis, but without symptoms on the trunk, the growth is not equal, such as less foliage in the branches, smaller leaves, and irregular growing habit.

Xyloporosis

According to Reichert (16), xyloporosis was reported in 1937 by Fawcett and Moreira from Argentina and Brazil and it is believed that this is the first reference to it in this country. In 1947, Condado (5) noted the bad condition of several plantations in the district of Bella Vista (Corrientes province) of different varieties of sweet orange, mandarin, and lemon trees budded on sweet lime stock (*C. limettioides* Tanaka) and the same author in 1950 (6) published a detail of the behavior of these varieties upon sweet lime and Rangpur lime, pointing out that all those plants budded on the first showed a marked decline while those

grafted on Rangpur lime developed normally.

In 1952 Knorr and Benatena (13) reported existence of xyloporosis in the district of Concordia (Entre Ríos province) on common mandarin budded on sweet orange, but showing symptoms only in the mandarin scion and nothing on the sweet orange stock. Similar symptoms have been found by the writer in the common mandarin, but on bitter orange stock affecting only the scion, in the Catamarca province, accompanied or not by a type of blind pocket. In Catamarca, a plant of sweet orange of a local variety budded on bitter orange, showed xyloporosis on the scion sweet orange, small leaves, and bushy twig growth, symptoms similar to those described by Carpenter (2), Chapot (4), and Fawcett and Klotz (8) for stubborn disease.

Actually this disease is economically important only in the Bella Vista zone, where the sweet lime continues to be the principal rootstock for 70 per cent of the trees of different varieties grown there.

The finding of many declining trees without symptoms of xyloporosis and having observed stem pitting in seedlings of sweet lime would indicate, as has been reported in other countries (1), that the decline of trees budded on sweet lime is due to tristeza virus.

Shell Bark

According to Speroni (17), this disease has been observed in Argentina in plants of Eureka and Lisbon lemon varieties introduced from the United States of America or in their descendants. The same author says that the first information of its existence in Argentina dates from 1939. In the Delta del Paraná, it has been observed in almost all the varieties of lemon trees budded on sour orange, without producing visible damage. It has not been observed on the lemon trees budded on trifoliate orange.

Pittings in Wood of Mediterranean Sweet Orange Budded on Bitter Orange

This abnormality has been observed in a considerable number of plants of the Mediterranean sweet orange variety budded on bitter orange in the provinces of Santiago del Estero, Catamarca, Tucumán, and Jujuy. In all cases, according to the growers, these plants were obtained from nurseries in the Tucumán province. In a planting in Santiago del Estero, the abnormality was observed also in the same variety

budded on bitter orange, which has come from Concordia, without symptoms of pitting at all. Affected plants not only present pittings but also blind pocket in some cases. The pittings (Fig. 1) affected only the sweet scion, not the bitter orange rootstock.

The appearance of the plants varies; some are stunted, but the majority present a good vegetative aspect and produce fruit normally. In plants severely declining, the symptoms are similar to those observed in plants budded on sweet lime with xyloporosis. There is also a swelling of the trunk at the bud union.

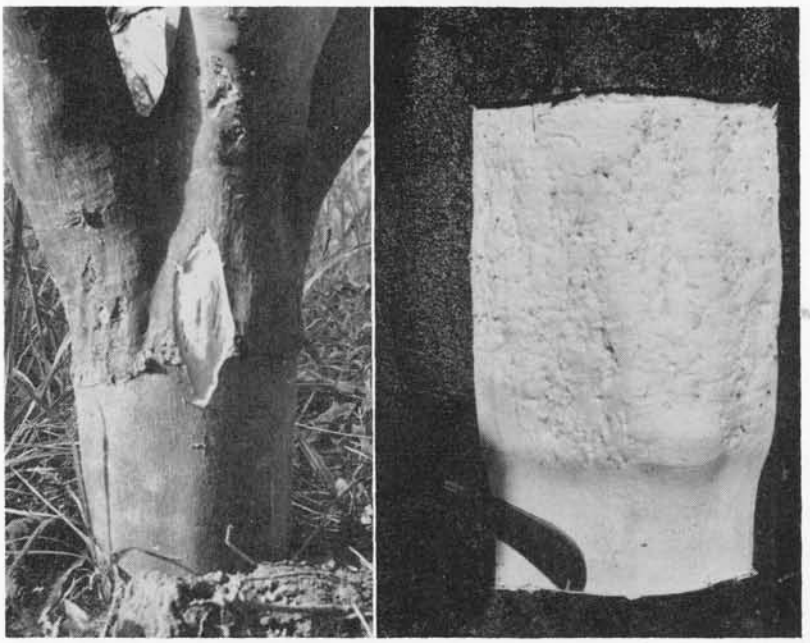

FIGURE 1. *Pittings of the wood on Mediterranean sweet orange budded on bitter orange stocks at Tucumán province.*

Constricted Bud Union of Sweet Orange, Rough Lemon, and Poncirus Trifoliata

Constricted bud union on sweet orange, rough lemon, and trifoliate orange has been observed.

In one grove at Jujuy Province, with 1,500 sweet orange trees about 6 years old of the variety Selecta budded on common sweet orange 8 per cent have a bud disorder. Sometimes instead of a constricted union, in-

verse pitting has been observed. The same disorder has been observed at Tucumán to the extent of 1 per cent in 6-year-old trees of the variety Ruby blood budded on rough lemon. It was frequently seen on several varieties budded on trifoliate orange in the Delta, San Pedro, and Bella Vista areas, seeming to occur whenever this rootstock is employed.

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