

"Marchitamiento Repentino," An Infectious Disease of Citrus Trees

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"Marchitamiento repentino" is a serious destructive disease affecting sweet orange and mandarin trees and, less frequently, lemon trees on trifoliate orange rootstock. It was first observed around 1960 on citrus trees in the Paysandu area in Uruguay; since then it has spread slowly to other citrus areas of the country (Mousques, 1970). Soil problems and nutritional disorders were first suggested as possible causes of the abnormality (Andrews, 1971; Blondel and Vogel, 1967; Dommergues and Weinhard, 1970;

Larue, 1970). However, all efforts in these areas of research failed to promote the recovery of declining trees or prevent spread of the disease. Diseased trees die within 1 to 2 years following the appearance of first symptoms. All trees found diseased are on trifoliate orange, which is practically the only rootstock used in Uruguay. Transmission experiments conducted at the Salto Citrus Experiment Station have shown the infectious nature of the "Marchitamiento repentino" disease.

SYMPTOMS

On vigorous, productive and apparently healthy trees, the leaves of one branch or sector of the tree begin to show mottling, suggesting deficiencies of various minor elements, mainly zinc and manganese. New leaves in affected twigs are small, frequently malformed, and narrowed (fig. 1). The disorder progresses slowly to involve the entire tree, so that trees with variable amounts of diseased tops are seen in affected orchards. The leaves of large affected sectors wilt suddenly and die (fig. 2) at any time of the year, but most frequently during dry periods in summer; death of the diseased branches follows. Blossoming is abundant in diseased portions of the tree but fruits are small, sometimes lopsided, and most seeds are aborted (fig. 3). Fertile seeds from diseased fruits produced normal seedlings in various trials. Death of the entire tree usually occurs within one to two years after the first symptoms appear. Rarely, sudden wilt followed by death of the tree within a few days was

observed in the Salto area.

Removing the bark of main branches and trunks of diseased trees frequently reveals longitudinal necrotic lines in the cambial area, sometimes with gum impregnation in the xylem. Affected trees are commonly over 10 years old but a few trees as young as five years were found diseased. In affected young trees 5 to 10 years old, and less frequently in older trees, other symptoms related to "marchitamiento repentino" are small pegs and pits, cachexia-like, in the trifoliate portion of the trunk. They occur more frequently on the side of the trunk corresponding to the affected sector of the scion and they develop in trees with the less severe form of the disease. These pegs and pits occurred in trees of Valencia orange and Malaquina mandarin in various orchards, most frequently in diseased trees in the southern citrus area where the climate is more humid than further north.

HOST RANGE

Field observations indicate that the disease affects trees of most citrus varieties grown in the country. Valencia orange and Common (Willowleaf) mandarin, the two varieties most extensively grown, are very susceptible. Other varieties found diseased include Washington navel and Common seedy sweet oranges, Malaquina mandarin, and Lisbon lemon. Malvasio and Ellendale mandarins, grapefruit, and other citrus grown on a small scale were not found affected.

All trees with "marchitamiento repentino" were budded on a local selection of trifoliate orange. Experimental work underway will certainly show if the disease is related to this rootstock or will affect trees on other rootstocks.



Fig. 2. Six-year-old Valencia orange tree partially affected by marchitamiento repentino disease.

EXPERIMENTAL WORK

Bud transmission. A number of transmission experiments were established to determine the infectious nature of the disease. In a bud transmission trial, initiated November 1973, young seedlings of trifoliate orange grown in pots were budded with nucellar Valencia orange and

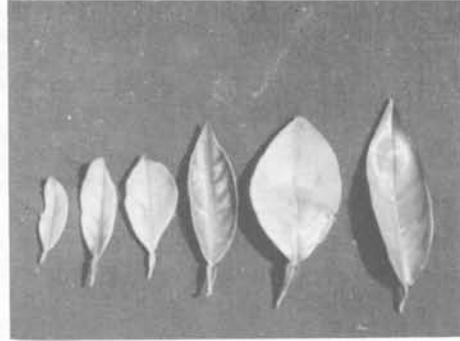


Fig. 1. Small, malformed and mottled leaves from a diseased Valencia tree.

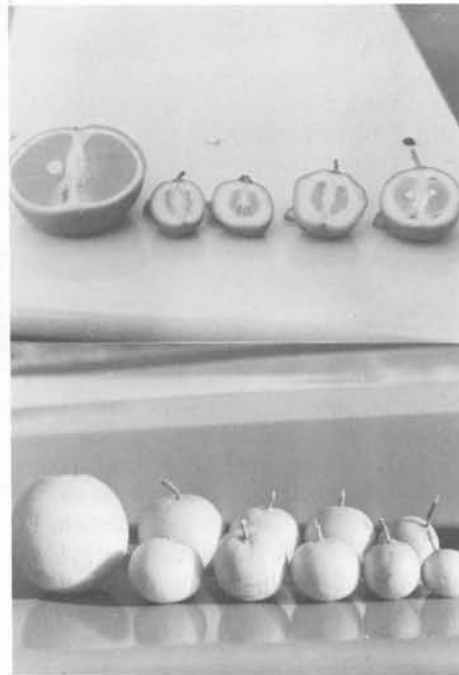


Fig. 3. Upper and lower, Valencia orange fruits from normal (left) and diseased branches.

Common mandarin. At the same time each seedling was inoculated with three blind buds from diseased trees selected in various orchards. Twenty days later the seedlings were cut back and the nucellar buds allowed to sprout. Three test plants were inoculated with buds from each diseased source. Control plants were inoculated with nucellar Valencia orange known to be carrying only tristeza virus, which is endemic in Uruguay. Symptoms

TABLE 1
TRANSMISSION OF "MARCHITAMIENTO REPENTINO" DISEASE TO YOUNG VALENCIA
ORANGE PLANTS ON TRIFOLIATE ORANGE ROOTSTOCK,
USING BUD-GRAFT INOCULATION

Inoculum source	Total trees inoculated	No. diseased trees after incubation	
		8 months	12 months
Lisbon lemon			
Tree 1	3	1	2
Tree 2	3	0	0
Valencia orange			
Tree 1	2	0	2
Tree 2	3	2	2
Tree 3	3	0	0
Tree 4	3	0	0
Tree 5	3	1	2
Tree 6	3	0	0
Tree 7	3	0	0
Tree 8	3	0	0
Washington navel			
Tree 1	3	0	1
Tree 2	3	0	0
Common mandarin			
Tree 1	3	1	1
Tree 2	3	0	1
Tree 3	3	0	0

of poor growth, severe zinc deficiency, and narrowed and distorted leaves were evident in a number of infected plants eight months after inoculation, as shown in table 1. One year after inoculation, 11 out of 44 Valencia orange test plants were diseased while only 2 out of 10 mandarin test plants showed symptoms. All control plants grew normally.

In another series of transmission trials, various scion-rootstock combinations were used as test plants. Symptoms appeared only in two out of three Ponkan mandarin and two out of three Lisbon lemon plants budded on trifoliolate orange rootstock and not in 18 other test plants budded on Florida rough lemon, Rangpur lime, and Cleopatra mandarin.

The low rate of transmission suggested the use of side-graft inoculation in new experiments, in which a large number of scion-rootstock combinations are being tested.

Mechanical transmission. Attempts were made to transmit mechanically the

pathogen responsible for "marchitamiento repentino," from citrus to citrus and to various herbaceous plants. Techniques used were those described by Grant and Corbett (1961) and Garnsey and Jones (1967) but, to date, all results are negative.

Insect transmission. It is believed that an inefficient insect vector of this disease must exist. This could explain the slow spread of the disease in commercial orchards. All attempts to transmit the disease using aphids and leafhoppers failed.

In one orchard where "marchitamiento repentino" is a serious problem, periodical surveys of affected trees have been made during the last nine years to determine the rate of spread. This plot consisted initially of 1,680 trees of Valencia orange on trifoliolate orange rootstock planted in 1956 in a heavy fertile soil. First symptoms of the disorder are said to have appeared around 1964 and surveys were initiated in 1967 by the technical

personnel of the Salto Citrus Experiment Station. Dates of surveys and total numbers of diseased trees were: May 1967, 314; January 1969, 425; April 1969, 443; October 1969, 463; February 1970, 498; September 1970, 523; June 1971, 555; April 1972, 590; December 1973, 720; December 1974, 801; June 1975, 850. No definite pattern of spread of the disease in this plot was observed. Replants for declining or dead trees were planted periodically and a few young trees developed symptoms of the disease while others grew normally.

Virus indexing. A number of diseased trees and other neighboring healthy trees of Valencia orange and Common mandarin were tested for common viruses by standard indexing methods. All were found to be carrying tristeza and psorosis

viruses, but none carried exocortis virus. Indexing for xyloporosis is incomplete.

Other studies. Electron microscope examinations of sections of young leaves from diseased trees revealed only the presence of thread-like particles typical of tristeza virus. These studies were conducted at the Electron Microscope Laboratory of the University of Brasilia by Dr. Elliot W. Kitajima, to whom the authors are very thankful. Additional examinations are underway.

An albedo fluorescence test and thin layer chromatography studies gave very contradictory results. These studies were conducted according to the methods of Schwarz (1968) at the Faculty of Chemistry, University of Uruguay, Montevideo by Prof. Patrick Moyna whom the authors thank for the cooperation.

DISCUSSION AND CONCLUSIONS

Trees of Valencia orange, Common mandarin and some other citrus varieties on trifoliolate orange rootstock that have grown vigorously and productively for years, many of them being over 20 years old, suddenly develop abnormal leaves, wilt and die within a few months. Evidence was obtained that this disease, named by growers "marchitamiento repentino," meaning sudden wilt, is of an infectious nature. The identity of the pathogen causing the disease has not been determined. The low percentage of transmission suggests that the pathogen has an irregular distribution in diseased trees, similar to that reported for greening disease by McClean (1970) and other authors.

The possibility was considered that the disease may be caused by a severe strain of exocortis virus, for which a vector had appeared, since all diseased trees are on trifoliolate orange which is very sensitive to this virus. Indexing for exocortis yielded negative results.

Declining and healthy trees were found carrying tristeza and psorosis viruses, suggesting that the known strains of these viruses are not responsible for "marchitamiento repentino." However,

"marchitamiento repentino" has many features resembling the "decline of Misiones" or "fruta bolita," a serious disease, reported by Pujol *et al.* (1972), affecting trees on trifoliolate orange rootstock in the area of Misiones, Argentina. Those authors considered this disease to be caused by a new atypical strain of seedling-yellows tristeza virus to which trifoliolate orange, when used as rootstock for certain varieties, is especially susceptible. The proximity of the citrus areas affected by these two diseases and the similarities of symptoms and stionic combinations affected suggest a possible identity of the causal agents. However, there is not enough evidence to support the theory that a new tristeza virus strain is the cause of these diseases.

Symptoms of "marchitamiento repentino" are also similar, in many respects, to those exhibited by young tree decline and sand hill decline in Florida (Feldman and Hanks, 1974; Woods, 1973), leaf mottling in the Philippines (Salibe and Cortez, 1966), and greening disease in South Africa (McClean, 1970; McClean and Schwarz, 1970). Young tree decline and sand hill decline are still of unknown cause, while the other two diseases are

caused by a mycoplasma-like organism. Observations on the field spread of "marchitamiento repentino" suggest the existence of an inefficient insect vector. *Diaphorina citri* Kuway. and *Trioza erytreae* (Del Guercio), two citrus psyllids known to be vectors of greening disease, have not been found in the citrus areas of Uruguay. High populations of several

leafhoppers do occur in many crops grown in the citrus areas and some of these may be the vectors of "marchitamiento repentino." The possibility of non-citrus hosts for the pathogen is being considered. The control of the disease at present is based on the prompt eradication of affected trees to reduce the sources of inoculum.

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