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Occurrence of Stem Pitting in Citrus Types in Brazil

RECENTLY, PERA ORANGE [*Citrus sinensis* (L.) Osbeck] groves in Brazil are declining as a result of stem pitting induced by tristeza virus. Stunting and small fruit are additional symptoms of the virus in infected Pera orange trees. The Pera orange resembles the Lamb Summer orange, the Shamouti orange, the Verna and Verna Peret orange, and the Ovale or Calabresa orange.

This paper reports the results of examinations carried out in the variety collection at the Limeira Citrus Experiment Station to determine the incidence of stem pitting. The paper also summarizes the results of a test made to determine the reaction of certain sweet orange varieties to tristeza stem pitting virus. These varieties—Valencia, Natal, and Lue Gim Gong—have been recommended for replacing the Pera orange in new citrus plantings.

Examination of Trees in the Variety Collection

Each of nearly 400 citrus types is represented in the collection by five trees on Caipira sweet orange rootstock; the collection is now 17 years old. One hundred fifty-seven of the types were examined by removing the bark from some young branches of three trees of each type. As determined by the average amount of stem pitting observed, the types were classified as being severely, moderately, or slightly pitted, or not pitted. The results are in Table 1; some examples of stem pitting are in Fig. 1. The trees that had severely pitted branches were stunted, with a bushy aspect, and produced a high percentage of small fruit. Frequently, stem pitting in these severely affected trees was visible without removing

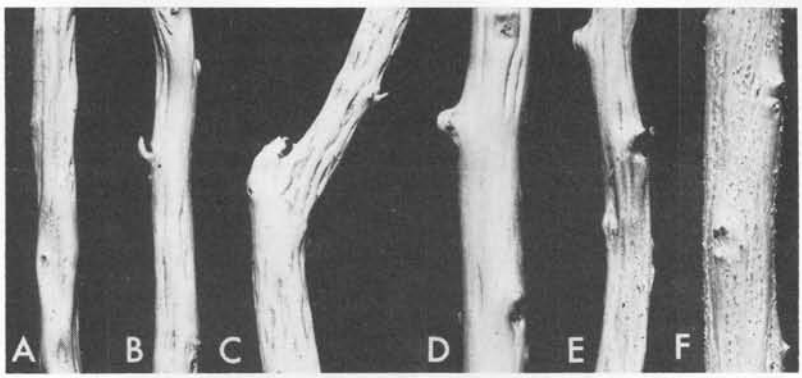

FIGURE 1. *Stem pitting in stems of A. Lamb Summer, B. Dulce del Mediterraneo, C. Shamouti sweet orange, D. U.S. sour orange, E. Citrus taiwanica, and F. honeycombing in Nakorn shaddock.*

the bark. Stunting was noticeable in the trees that developed moderately pitted branches. Growth of trees, such as those of Hamlin and Valencia orange, that had only slightly pitted branches was very good; the growth was apparently little affected by presence of the virus.

Four sour orange (*C. aurantium* L.) selections were examined; some stem pitting was found in trees of the sour orange line introduced from the U.S.D.A. Experiment Station at Orlando, Florida (Fig. 1, D). Trees of almost all shaddock (*C. grandis* Osbeck) types examined displayed inverted pitting (honeycombing) in addition to wood pitting (Fig. 1, F). Honeycombing was also found in branches of Rusk citrange (*C. sinensis* x *Poncirus trifoliata* Raf.), Pernambuco grapefruit (*C. paradisi* Macf.), and Tahiti lime (*C. latifolia* Tanaka).

Trees of Lamb Summer orange were found to be as severely pitted as those of any of the seven selections of Pera orange examined (Fig. 1, A). Trees of Shamouti orange had some branches that were severely pitted and others that were completely healthy (Fig. 1, C). In general, the more vigorous the branches the more severely pitted they were. The Valencia and Lue Gim Gong trees examined had only a few small pits in the stems. Branches from the Natal orange trees were more severely pitted. This variety is probably a selection from Valencia.

Examinations were also made of some trees in the new nucellar collection being established at the Limeira Station; results were similar to those in the old-line collection. Nucellar trees of some types, such as grapefruit and citron (*C. medica* L.), were more severely pitted than in the old-line collection.

TABLE 1. Occurrence of stem pitting in citrus types in the collection at the Limeira Citrus Experiment Station

Severely Pitted	Moderately Pitted	Slightly Pitted	Not Pitted
Orange	*Orange*	*Orange*	*Orange*
Dulce del Mediterraneo	Barão	Baianinha	D.A.C.
Lamb Summer	Blood Oval	Buckeye Navel	Thompson Navel
Navelencia	Jaffa	Cadenera	
Pera do Rio	Mortera	Enterprise	*Tangerine*
Pera Ovo	Parson Brown	Florida sweet sdlg.	Campiona
Pera coroada	Pineapple	Gold Nugget Navel	Cleopatra
Pera comprida	Rubi	Hamlin	Cravo
Pera paulista	Shamouti	Hart's late	Kinnow
Pera Mel	Surprise Navel	Homosassa	Ponkan
Perão	Trovita	Lue Gim Gong	Satsuma Owari
	Westin	Natal	Satsuma Wase
Tangor		Piralima	
Docinho S.J.R.	*Lemon*	Rehovot	*Tangelo*
	Acido	Robertson Navel	Orlando
Grapefruit	Camargo	Sanguinea	Sampson
Duncan	Kulu	São Miguel	Thornton
Foster	Perrine	Seleta Amarela	Williams
Indian Red		Vale del Cauca	
MacCarthy	*Shaddock*	Valencia late	*Lemon*
Marsh seedless	Cuban	Washington Navel	Amber
Pernambuco	Melancia		Cowgill
Red Blush	Ogami	*Tangerine*	Eureka
Retiro	Vermelha	Kara	Lisboa
Royal		Mexirica do Rio	Vilafranca
Ruby		Wilking	Woglum
Triumph			
Viçosa			

TABLE 1 (Continued)

Severely Pitted	Moderately Pitted	Slightly Pitted	Not Pitted
Tangelo	*Citron*	*Tangor*	*Shaddock*
Webber	Comprida	Mó	Tau Yau
	Doce	Murcott Honey	
Lemon	Redonda of Commerce	Reticulata	*Sweet lime*
Harris			Columbia
São Matheus	*Acid lime*	*Tangelo*	Dourada
	Cristal	Pina	Vermelha de Goiás
Shaddock	Marfim	Yalaha	
Chinesa	Selvagem	Watt	*Sour orange*
Shatenyan			Azeda S. Paulo
Singapura	*Citrange*	*Shaddock*	Azeda s/esp.
Zamboa	Morton	Inerme	Paraguaia
	Rusk	Kao Panne	
Acid lime			*Citrange*
Abacaxe	*Miscellaneous*	*Sweet lime*	Carrizzo
Galego	Kumquat Meiwa	Persia	Troyer
Kalpi	*C. celebica*	Teheran	
Key	*C. ichangensis*		*Miscellaneous*
Mexican	*M. tephrocarpa*	*Acid lime*	Faustrimedin
		Tahiti	
Miscellaneous			
C. excelsa		*Sour orange*	
C. taiwanica		Azeda U.S.	
C. Webberii			
Microcitrus sp.		*Miscellaneous*	
		Kumquat Nagami	
		C. histrix	

Inoculation of Sweet Orange Varieties

In May, 1960, five nursery trees each of old-line Valencia, Natal, Lue Gim Gong, and Pera orange and of two different nucellar Pera orange lines were inoculated with tristeza stem pitting virus. These trees were showing at that time very little or no stem pitting. Inoculating buds were taken from a nucellar Pera orange seedling that was severely pitted, having been infected with tristeza virus by means of *Toxoptera citricidus* Kirk. The trees were pruned back and three new sprouts allowed to grow in each one. Eight months later, the sprouts were examined after removal of their bark and the number of pits counted in a length of 10 cm near the base of the sprout. The average numbers of pits were 0.4 for Lue Gim Gong, 3.2 for Valencia, 5.1 for Natal, 59.2 for old-line Pera, 52.4 for nucellar Pera Limeira, and 58.8 for old-line Pera Santa Ernestina lines. The variation in the number of pits among trees of the same variety or line was relatively small. Only one tree of Valencia orange and one of Natal orange were slightly more pitted than the others of the same variety.

Discussion

Almost all citrus varieties have been reported to develop some stem pitting beneath the bark (1, 2, 3, 5). The examinations reported in this paper, however, revealed moderate and severe pitting in several citrus types, many of commercial importance, that previously were considered to be very little affected by tristeza virus. To explain the occurrence of stem pitting in these types, it is postulated that a more severe strain of tristeza virus, or a new mixture of strains, is being disseminated in the citrus groves as was previously suggested (6). Presence of *Toxoptera citricidus,* which is an efficient vector, would account for transmission of any new strain or mixture of strains that may occur in the area.

The stem pitting described here was attributed to tristeza virus, but it is possible that some presently unknown factor is responsible for it. Nour-Eldin and Childs (4) have reported pitting in sweet orange trees apparently free from tristeza virus.

Tests reported here indicate that the Lue Gim Gong, Natal, and Valencia varieties are less sensitive to tristeza virus than the Pera orange. These varieties are therefore recommended for replacing the Pera orange in new plantings.

Literature Cited

1. GRANT, T. J., COSTA, A. S., and MOREIRA, S. 1951. Variations in stem pitting on tristeza-inoculated plants of different citrus groups. Proc. Florida State Hort. Soc. 64: 42-47.
2. GRANT, T. J., MOREIRA, S., and SALIBE, A. A. 1961. Citrus variety reaction to tristeza virus in Brazil when used in various rootstocks and scion combinations. Plant Disease Reptr. 45: 416-421.
3. MCCLEAN, A. P. D. 1963. The tristeza virus complex: its variability in field grown citrus in South Africa. S. African J. Agr. Sci. 6: 303-332.
4. NOUR-ELDIN, F., and CHILDS, J. F. L. 1957. Sweet orange bark pitting, an unreliable symptom of tristeza infection. Plant Disease Reptr. 41: 1011-1013.
5. OBERHOLZER, P. C. J. 1959. Host reactions of citrus to tristeza virus in South Africa, p. 35-43. *In* J. M. Wallace [ed.], Citrus Virus Diseases. Univ. Calif. Div. Agr. Sci., Berkeley.
6. SALIBE, A. A., and ROSSETTI, V. 1963. Stem pitting and decline of Pera sweet orange in the State of São Paulo, p. 52-55. *In* W. C. Price [ed.], Proc. 3d Conf. Intern. Organization Citrus Virol. Univ. Florida Press, Gainesville.