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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

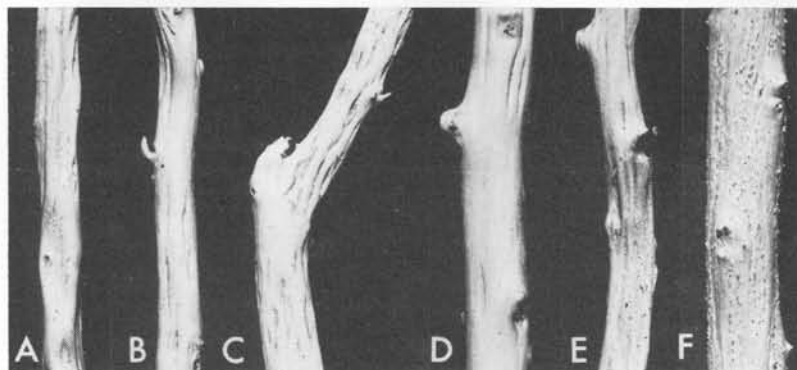


FIGURE 1. Stem pitting in stems of A. Lamb Summer, B. Dulce del Mediterraneo, C. Shamouti sweet orange, D. U.S. sour orange, E. *Citrus taiwanica*, and F. honeycombing in Nakorn shaddock.

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* × *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
	<i>Orange</i>	<i>Orange</i>	<i>Orange</i>	<i>Orange</i>
	Dulce del Mediterraneo	Barão	Baianinha	D.A.C.
	Lamb Summer	Blood Oval	Buckeye Navel	Thompson Navel
	Navelencia	Jaffa	Cadenera	
	Pera do Rio	Mortera	Enterprise	<i>Tangerine</i>
	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
42	<i>Tangor</i>	<i>Lemon</i>	Piralima	
	Docinho S.J.R.	Acido	Rehovot	<i>Tangelo</i>
		Camargo	Robertson Navel	Orlando
	<i>Grapefruit</i>	Kulu	Sanguinea	Sampson
	Duncan	Perrine	São Miguel	Thornton
	Foster		Seleta Amarela	Williams
	Indian Red	<i>Shaddock</i>	Vale del Cauca	
	MacCarthy	Cuban	Valencia late	<i>Lemon</i>
	Marsh seedless	Melancia	Washington Navel	Amber
	Pernambuco	Ogami		Cowgill
	Red Blush	Vermelha	<i>Tangerine</i>	Eureka
	Retiro		Kara	Lisboa
	Royal		Mexirica do Rio	Vilafranca
	Ruby		Wilking	Woglum
	Triumph			
	Viçosa			

TABLE 1 (Continued)

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

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.

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