

Distribution of Tristeza Virus in Philippine Citrus

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THE TRISTEZA VIRUS was first reported in the Philippines in 1961 (2). However, in 1921 Atherton Lee (1) described various disorders of mandarins on pummelo rootstocks with symptoms now considered typical of tristeza. Furthermore, the Batangas mandarin introduced from the Philippines into California in 1914 was found (3) to be carrying the tristeza virus. Most Philippine citrus varieties were introduced after 1900 from China, India, Indo-China, Thailand, Java, British North Borneo, the United States, Hong Kong, Australia, and other places. Tristeza virus is known to have been in some of these countries for many years and could have been brought into the Philippines with the first introductions.

The efficient insect vector *Toxoptera citricida* Kirk. is present in the Philippines and no doubt has spread tristeza virus to practically all areas of the country. Citrus culture in the Philippines has consequently grown in the presence of tristeza. Nevertheless, a lucrative industry flourished for several decades mainly because tolerant combinations of top and rootstock were used by the growers.

Propagative materials used in the citrus areas not covered in this study came originally from Batangas and Laguna Provinces. Thus, the virus diseases occurring in those two provinces doubtless occur at similar levels in the other areas.

Materials and Methods

One hundred and five citrus orchards, chosen at random in the main citrus areas of the country were examined in this study. Fifty-eight orchards are in Batangas and Laguna Provinces, 20 in the Bicol region, 12 in Mindanao, 10 in Mountain Province, and 5 in Oriental Mindoro. Together, they constitute approximately 5 per cent of the total population of 8 million citrus trees estimated to exist in the Philippines.

Trees were examined for tristeza stem pitting by removing the bark of young branches. For each citrus tree examined, a strip of bark 10 to 12 cm long was removed from each of 5 branches. Severity of pitting was rated on a scale of 1 (slightly pitted) to 6 (severely pitted) and recorded.

All field trees that showed stem pitting were indexed on Key lime [*Citrus aurantifolia* (Christm.) Swing.] for tristeza virus and on Eureka

lemon [*C. limon* (L.) Burm. f.] seedlings for seedling yellows. Those causing severe symptoms on these indicators were inoculated into healthy seedlings of sweet orange [*C. sinensis* (L.) Osb.], Orlando tangelo (*C. reticulata* Blanco x *C. paradisi* Macf.), and Rangpur lime (*C. reticulata* var. *austera* hyb.).

Sources that caused symptoms on sweet orange, Orlando tangelo, and Rangpur lime test plants were used to inoculate healthy seedlings of trifoliolate orange [*Poncirus trifoliata* (L.) Raf.] to determine whether the latter is able to filter out the apparently severe tristeza virus.

Three healthy seedlings of trifoliolate orange were each inoculated with 5 blind buds of Orlando tangelo that previously had been inoculated and had shown severe symptoms of tristeza stem pitting. Twenty days after inoculation, the trifoliolate seedlings were cut off about 2 inches above the last inoculating bud. One hundred and twenty days after inoculation, new sprouts of the trifoliolate seedling were used to inoculate Key lime and Eureka lemon seedlings. Duplicate healthy control plants were maintained for all treatments.

Results and Discussion

Tristeza stem pitting was found in practically all areas visited. According to the average amount of pitting observed, the varieties inspected were classified as follows: Rate 5-6 as severely pitted; 3-4 as moderately pitted; 1-2 as slightly pitted; and 0 as not pitted. The results are shown in Table 1.

Great variation in the amount of stem pitting was observed among trees of a same variety. Trees with severely pitted branches were usually stunted, bushy, and had a high percentage of small fruits. In all trees inspected, pitting stopped at the bud-union and did not progress into the mandarin rootstock.

Two types of orange trees were generally found in mixed plantings in Mindanao. One type produces very sweet fruits, having few seeds and a smooth skin. This type was frequently stunted and severely affected by stem pitting. The other type bears more acid and seedy fruits, produces vigorous growth, and shows only slight pitting on the trunk and branches.

Stem pitting was found on certain mandarin trees, as follows: on one tree each of Szinkom, Szwuikom, Kishiu, King, Ponkan, and Oneco; on two trees of Ladu; and on four trees of Batangas mandarin (*C. reticulata* Blanco).

Indexing on Key lime revealed that all field trees showing stem pitting were infected with tristeza. Variation was observed in the degree of vein

TABLE 1. TRISTEZA STEM PITTING OF VARIOUS CITRUS VARIETIES IN THE PHILIPPINES

Variety	Rate of stem pitting in different areas ^a				
	Batangas and Laguna	Bicol	Mindanao	Mindoro	Mountain Province
Mandarins					
Szinkom	0 to 1	0	0	0	0
Ladu	0 to 1	0 to 1	0	0	0
Szruikom	0	0	0	0 to 1	0
Sunwuiikom	0	0		0	0
Kishiu	0 to 3	0	0		
King	0 to 1	0	0	0	
Taikat	0	0	0	0	
Santa Cruz	0	0	0	0	
Ponkan	0	0	0 to 1	0	0
Batangas	0 to 1	0	0	0	0
Kalinga					0 to 3
Oneco	0	0 to 1		0 to 1	
Unshiu			0		
Oranges					
Common Valencia	1 to 5	1 to 5	1 to 6	1 to 3	1 to 5
Campbell Valencia			1 to 2		
Sweet	1 to 4		1 to 3		2 to 4
On Lau Chiang	2 to 3				2 to 3
Pineapple	1 to 4		0 to 2		
Wash. navel			1 to 5		
Pummelos					
Fortich	3 to 5		1 to 2		
Pink Marsh	1 to 2				
Pink La Union	3				
Tai Tau	2 to 4				
Amoy Mantan	2 to 5		2 to 6		
Native pummelo	1 to 2	0 to 1	0 to 4	0 to 5	
Lemons and limes					
Eureka lemon	0		0		0
Meyer lemon			1 to 3		
Seville lemon					1 to 6
Rangpur lime	0 to 4				
Tahiti lime	2 to 3		1 to 3		
Misc. varieties					
Calamondin	2 to 5	2 to 6	2 to 4	1 to 3	3 to 5
<i>C. macrophylla</i>	1 to 3				
Sour orange	1 to 2				
Calamandarin	0	0	0	0	0
M. S. grapefruit	2 to 3		3 to 4		6
Igorot orange	5				
Biyason			1 to 2		
Citron	1 to 2		0 to 1		

a. 0 = not pitted, 1-2 = slightly pitted, 3-4 = moderately pitted, and 5-6 = severely pitted.

clearing in the leaves, stunting, and stem pitting of inoculated Key lime indicators. This situation suggests the existence of different strains of the tristeza virus in field trees. Inoculum from most trees induced seedling yellows on Eureka lemon indicator plants. Bud inoculations from certain severely pitted trees induced stunting, yellowing of the leaves, and stem pitting on seedlings of sweet orange, Rangpur lime, and Orlando tangelo. This suggests that a severe strain of tristeza virus is infecting those trees. However, these severe sources failed to pass through trifoliolate orange as evidenced by the fact that inoculum taken from new sprouts of trifoliolate seedlings failed to induce tristeza symptoms on the inoculated Key lime and Eureka lemon seedlings.

Conclusions

The results of the field survey and the indexing program strongly suggest that all field orchard trees in the Philippines are infected with the tristeza virus. The high population of aphids everywhere, especially the efficient vector *T. citricida* Kirk., probably accounts for the wide spread of the disease. Similarly, these results indicate the occurrence of especially severe strains of tristeza in the Philippines as shown by the severe symptoms induced on citrus types considered tolerant to the strains of the tristeza virus occurring in North and South America.

Literature Cited

1. ATHERTON LEE, H. 1921. The relation of stocks to mottled leaf of citrus trees. *Philippine J. Sci.* 18: 85-95, 3 pls.
 2. BICORNIA, A. E., and CALICA, C. A. 1961. Tristeza in the Philippines, p. 101-106. In W. C. Price [ed.], *Proc. 2nd Conf. Intern. Organization Citrus Virol.* Univ. Florida Press, Gainesville.
 3. NORA, D. M. 1961. Initial evidence of the presence of tristeza disease of citrus in the Philippines. Paper read in a seminar held in the Bureau of Plant Industry, Manila on September 29, 1961. Unpublished.
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