Severity of Young Tree Decline of Citrus Independent of Incidence of Xyloporosis

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ABSTRACT

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Xyloporosis was found in 46 of 110 healthy and 55 of 113 citrus trees affected by young tree decline (YTD) in 21 groves in the major citrus-producing areas of Florida. Annual rate of tree loss from YTD varied considerably among groves, and there was no evidence that additional stresses induced by xyloporosis either increased the rate of tree loss or accelerated the development of symptoms in YTD-affected trees.

Additional key words: blight, sandhill decline

Young tree decline (YTD), also referred to as sandhill decline or blight, is a serious disease of citrus trees in Florida, particularly on rough lemon (*Citrus jambhiri* Lush.) rootstock. Etiology of YTD is unknown, and the complete syndrome has not been reproduced by either transmission (6) or propagation (2). Extensive indexing was initiated in 1972 (4,5) to determine the virus content of healthy and YTD-affected trees on rough lemon rootstock from affected groves throughout the state's major citrus areas. Data on xyloporosis, however, have been pending because 3–5 yr are required for onset of symptoms in indicators. Except for tristeza virus, no known transmissible factor was consistently present in the YTD-affected trees (6).

Xyloporosis, a bud-transmissible disease causing gumming and stem pitting of certain susceptible citrus cultivars, is widespread in Florida, particularly in old-line cultivars (1). Although no external symptoms are obvious in sweet orange (*C. sinensis* Osbeck) and grapefruit (*C. paradisi* Macf.) on tolerant rough lemon rootstock, the virus can cause stress because it reduces fruit production and tree size and interferes with minor element nutrition in the foliage (10). Early in the indexing program, we realized that xyloporosis does not cause YTD (5), but its importance as a supplemental stress factor enhancing tree loss needed to be ascertained. We report results of xyloporosis indexing and the average annual rate of tree loss from YTD in 21 groves.

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MATERIALS AND METHODS

Source trees. Two-hundred twenty-three donor trees on rough lemon rootstock were selected for xyloporosis indexing from 10 groves in the flatwoods of east, west, and south Florida and from 11 groves in the central ridge area (Table 1). Scion varieties of donor trees were Valencia, Pineapple, Hamlin, Queen, and Lue Gim Gong sweet orange and Marsh white and Thompson pink grapefruit. Four to 10 apparently healthy and usually an equal number of YTD-affected donor trees in early stages of decline (0.5 rating on a scale of 0–3) were selected from each grove for xyloporosis indexing. Altogether, 110 of the 223 donors were presumed healthy; the remaining 113 were affected with young tree decline. Donor trees were rated every 3 mo for YTD severity. Tree loss (mid-decline, 1.5 rating of YTD) was determined annually from 1972 through 1975 in each grove from a preselected group of 100 presumed healthy trees. Data on the number of donor trees with xyloporosis and the average annual rate of tree loss from YTD in each grove are given in Table 1.

Xyloporosis indexing. One-year-old Orlando tangelo (*C. reticulata* × *C. paradisi*) seedlings, propagated from seed in the greenhouse, were used. Inoculations were made using two donor buds per seedling and three seedlings for each donor tree. Controls consisted of 15 seedlings budded with virus-free Valencia sweet orange, 15 budded with a moderate-reacting isolate of tristeza virus (T_1M), and 15 budded with a moderate-reacting isolate of xyloporosis from a Valencia sweet orange tree that also

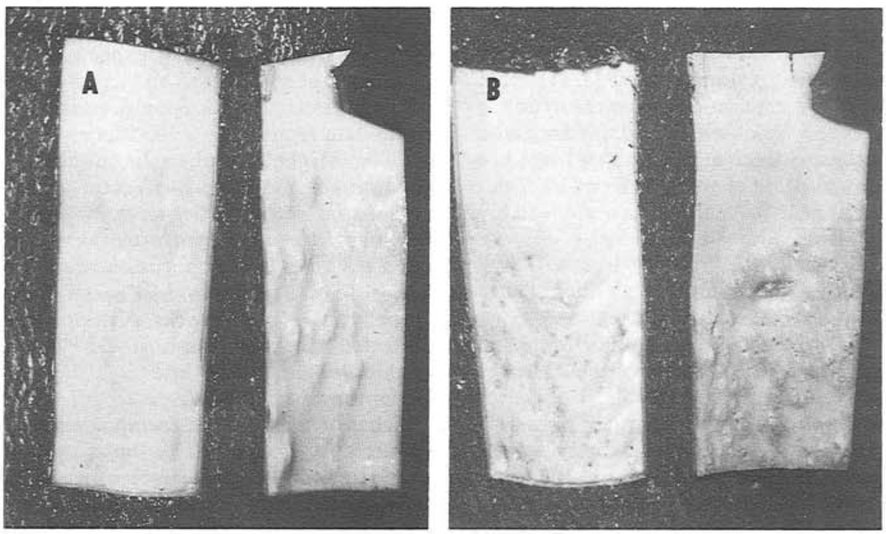

Fig. 1. Moderate (**A**) and severe (**B**) symptoms of xyloporosis in wood and inner bark of Orlando tangelo stock.

Table 1. Incidence of xyloporosis and average annual rate of citrus tree loss from young tree decline (YTD) in affected groves

Grove no.	Location[a]	Cultivar[b]	Age	No. trees with xyloporosis	Total donors	Tree loss from YTD[c] (%) 1972	1973	1974	1975	Average annual tree loss
1	Flatwoods (E)	Pink grapefruit	25	9	13	8	12	10	6	9.0
2	Ridge	Pink grapefruit	30	0	8	8	10	10	6	8.5
3	Ridge	Pink grapefruit	30	6	8	10	8	10	8	9.0
4	Flatwoods (C)	Marsh grapefruit	28	8	8	5	10	8	4	6.8
5	Flatwoods (E)	Valencia	10	10	19	7	11	9	11	9.5
6	Ridge	Valencia	40	6	11	9	7	12	5	8.3
7	Ridge	Valencia	25	5	12	5	8	4	3	5.0
8	Ridge	Valencia	22	8	8	9	6	15	12	10.5
9	Ridge	Valencia	26	4	8	8	4	10	5	6.8
10	Ridge	Valencia	24	6	8	5	8	6	10	7.3
11	Ridge	Valencia	23	4	8	3	5	8	6	5.5
12	Ridge	Valencia	20	6	8	5	6	6	4	5.3
13	Flatwoods (S)	Valencia	12	1	10	8	12	10	5	8.7
14	Flatwoods (S)	Valencia	11	0	10	4	5	7	11	4.8
15	Flatwoods (S)	Pineapple	12	0	20	10	15	8	14	11.8
16	Flatwoods (S)	Pineapple	10	2	10	6	4	4	7	5.3
17	Ridge	Hamlin	18	7	16	10	5	4	4	5.7
18	Flatwoods (C)	Hamlin	14	6	8	12	9	15	12	12.0
19	Flatwoods (C)	Queen	16	8	8	9	13	16	15	13.0
20	Flatwoods (E)	Queen	13	0	14	8	10	5	10	8.3
21	Ridge	Lue Gim Gong	22	5	8	5	8	3	3	4.8
Total				101	223					

[a] E, C, and S indicate east, central, and south Florida, respectively.
[b] All cultivars on rough lemon rootstock.
[c] Based on ratings of 100 initially healthy trees in each grove.

carried a mild strain of exocortis viroid.

Bud inoculations were made during the summer of 1972 and the spring and fall of 1973. All knives and pruning shears were disinfected before budwood was collected from each donor and before seedlings were inoculated (7). Seedlings were later cut back to allow the bud to develop and were transferred to field plots during the fall of 1973 and the spring of 1974 in 1 × 6 m plantings. Xyloporosis determinations were made in the 4th through the 6th yr after inoculation by removing a 1 × 5 cm bark patch in the stock at the bud union. Gum deposits in the inner bark and pitting of the wood (Fig. 1) were considered indications of xyloporosis transmission.

RESULTS

Tree loss. Annual rate of tree loss from YTD varied considerably among groves (Table 1) and showed no correlation with incidence of xyloporosis ($r = .211$). Rate of YTD symptom development in donor trees also varied widely and was unrelated to the incidence of xyloporosis (data not shown). Rate of tree loss from YTD did not appear to be influenced appreciably by scion variety or tree age (Table 1). Average annual rate of tree loss was slightly greater in the flatwoods (8.9%) than in the central ridge area (6.9%).

Xyloporosis indexing. Xyloporosis was found in 101 (45%) of the 223 trees indexed and was present in 17 of the 21 groves (Table 1). Percentage of trees with xyloporosis varied considerably among groves, but at least half of the trees carried xyloporosis in approximately two-thirds of the groves (Table 1). Of the 110 presumably healthy trees, 46 (42%) carried xyloporosis, compared with 55 (49%) of the 113 YTD-affected trees. Of the 110 "healthy" trees, 78 succumbed to YTD during the 4 yr that ratings were taken; of the 32 that remained healthy, 12 carried xyloporosis.

Most of the xyloporosis isolates were mild or moderate reacting in Orlando tangelo indicators; less than 12% were considered severe (Fig. 1). Xyloporosis symptoms were produced in 13 of the 15 indicators budded with a known source of xyloporosis. No symptoms of xyloporosis were observed in indicators budded with virus-free Valencia or with T_1M tristeza virus, indicating that natural spread of the disease did not occur.

DISCUSSION

Average annual rate of tree loss observed in these investigations agrees in general with previous reports (3,8,9) and indicates that a highly variable pattern of tree loss from YTD can be expected. The incidence of xyloporosis and its extensive distribution in Florida are also consistent with data reported in a 1955 survey (1).

The slightly higher incidence of xyloporosis in YTD-affected trees compared with healthy trees may be a consequence of the inadvertent selection of a few trees on xyloporosis-susceptible sweet lime (*C. limettioides* Tan.) or "off-type" rough lemon stocks. Xyloporosis-infected trees on these stocks would exhibit some foliage and twig dieback symptoms similar to early stages of YTD. Such stocks, produced from mixed seed sources, are occasionally found among various scion varieties in some groves.

Rate of decline (about 18%/yr) among the 110 presumably healthy trees selected for indexing was more than double the average annual rate (about 8%) noted in the 21 groups of preselected healthy trees used to assess rate of tree loss. Such differences may be due to the wide variation in sample size (110 vs. 2,100) or to the inadvertent selection of presumably "healthy" trees in the immediate area of declining trees that may have been in a generally more adversely affected area of the grove. Many donor trees rated "healthy" began to exhibit decline symptoms within 3–12 mo of their selection, indicating that some of the "healthy" trees were presymptomatic diseased.

Smith et al (10) noted that although the exocortis viroid is considered to be symptomless in Valencia scions on rough lemon rootstock, growth rate, fruit quality, and mineral nutrition were modified and stress effects were frequently additive when xyloporosis and exocortis were combined. In our studies, a high incidence of exocortis was also present in all groves except 14 and 20 (4,5, and *unpublished data*). However, neither exocortis nor xyloporosis with exocortis appeared to function as a stress factor to hasten decline or increase the rate of tree loss from YTD.

Such variable responses are typical of YTD and indicate that rate of tree loss and rate of symptom development in each grove depend on a number of undefined factors. We found no evidence that additional stresses induced by the presence of xyloporosis either increased rate of tree loss from YTD or accelerated symptom development in YTD-affected trees.

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