Table 2. Tree height (m) 'Valencia' orange trees on sour orange rootstock after 4 years infection with 4 different citrus tristeza virus (CTV) isolates.

Isolate	Original host	Tree ht. (m)
DPI	Temple	2.01 a[z]
DPI	'Valencia'	1.94 ab
DD	Temple	1.98 ab
DD	'Valencia'	1.96 ab
GHS	Temple	1.85 b
GHS	'Valencia'	1.88 ab
T-3	'Valencia'	.81 c
Uninoculated Control	—	1.96 ab

[z]Mean separation by Duncan's multiple range test, 5% level.

treatments. Trees inoculated with DPI and GHS passed through Temple differed in tree height (Table 2).

Tree condition observations were recorded annually, on a scale of 0 representing healthy, to 3.0 indicating a tree in severe decline. Trees inoculated with T-3 were rated as being in moderate to severe decline from early in the experiment. These trees showed typical CTV symptoms: honeycombing and bud union overgrowths, and were stunted and unthrifty (5).

The absence of differences in the effect of CTV strains passed through and not passed through Temple indicates that virulence was not magnified by a single passage through Temple orange. Although more exhastive passage of CTV through Temple on CTV-tolerant rootstocks may be required to determine if increased CTV virulence can occur, our results indicate that increased virulence in not a common phenomenon. There is a more likely reason for the observation that Temple on CTV-tolerant rootstocks serves as a focal point of local CTV epidemics. Temple has more frequent leaf flushes than other scion varieties, and therefore, aphids that serve as CTV vectors are attracted to these flushes (R. Yokomi, personal communication). Large populations of aphids can build up on these flushes. Because of the high density of aphids on Temple trees, transmission of CTV from infected Temple trees to healthy citrus trees will be more likely to occur.

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INCIDENCE OF CITRUS BLIGHT IN FLORIDA'S CITRUS BUDWOOD FOUNDATION GROVE

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Abstract. **Florida's citrus budwood foundation grove was established in its present location at Dundee, FL, during the period 1973-76. Most popular cultivars are represented on a large number of rootstocks growing in a deep, sandy soil typical of the ridge of Central Florida. The first incidence of blight in the planting was noted in 'Hamlin' oranges (*Citrus sinensis sinensis* (L.) Osb.) on rough lemon (*C. limon* (L.) Burm. f.) rootstock at 5 years of age. High incidence of blight symptoms have been subsequently noted on rough lemon, Volkamer lemon (*C. limon*), Rangpur lime (*C. limonia* Osb.), and 'Carrizo' citrange (*Poncirus trifoliata* (L.) Raf. X *C. sinensis*). Low incidence has occurred on 'Milam' lemon (*C. limon*), sweet lime (*C. aurantiifolia* (Christm.), and citrumelos 'F-80-3', 'F-80-8' and 'Swingle' (*P. trifoliata* X *C. paradisi* Macf.). Rangpur lime X 'Troyer' citrange (*C. limonia* X *P. trifoliata* X *C. sinensis*) had a significant incidence of blight as a rootstock for certain varieties. No visible symptoms have been observed on 'Cleopatra' mandarin (*C. reticulata* Blanco), and 'Smooth Flat Seville' (*Citrus* sp.).**

Citrus blight is a term used to describe a decline condition of unknown etiology causing major losses in Florida citrus plantings (3). Preliminary experiments have shown that the disease is transmitted through root grafts (4). Citrus blight has been reported to affect nearly all citrus varieties and rootstocks commercially grown in Florida (6). The Florida Department of Agriculture and Consumer Services, through the Bureau of Citrus Budwood Registration, maintains in Dundee, FL (Polk, Co.), a citrus planting of the best selected budlines, and distributes propagation material to interested growers and nurserymen.

This paper reports the incidence of citrus blight in this 11-year-old planting of registered foundation citrus trees consisting of 7 varieties growing on 12 rootstocks in a deep, sandy soil typical of central Florida.

Appreciation is expressed to Dr. Heinz K. Wutscher, U. S. Department of Agriculture, Orlando, FL, for the zinc analysis.

Materials and Methods

Trees used in this planting were propagated from selections in the 14-year old foundation grove located north of Haines City, FL, at Highways I-4 and US-27. Trees were free of psorosis virus, and xyloporosis and exocortis viroids with no visible symptoms of citrus blight. Some trees were infected with what was thought to be mild strains of citrus tristeza virus. All trees were propagated in February 1974, and planted in February 1975, except those on rough lemon and Rangpur X 'Troyer' rootstocks, which were budded in March 1975, and planted in February 1976. Trees were grown in a field nursery and planted bare-root. The land was previously planted to citrus which was removed and the planting sites fumigated with ethylene dibromide several months prior to replanting.

Irrigation has been by overhead sprinklers. Standard commercial grove practices have been followed with regards to fertilizers, sprays, and herbicides. Tree spacing is 25 by 25 feet. Rootstocks are planted in single rows, side-by-side, without randomization or replication. Two trees of each scion selection are budded across the rootstock rows in 2 replications (Fig. 1). Observations for bud union compatibility, tree vigor, nutrition, disease symptoms, and individual tree yields have been routinely recorded.

Tree defoliation and wood injury by the severe freeze of December 1983 has been reported (7). The rough lemon and Volkamer lemon rootstock rows in the 'pineapple' and 'Queen' oranges were removed in May 1985 due to blight and additional severe damage by freezing weather received in January 1985. The sweet lime, rough lemon, Volkamer lemon and Rangpur lime rows in the 'Valencia' block, and all of the 'Jaffa' trees were also removed. Blight data for these trees were recorded in 1983 only.

Observations for visual symptoms of citrus blight have been recorded periodically. Visual symptoms have been confirmed by representative sampling of trees using a modification of the water injection method described by Lee, et al. (1), and in selected trees by wood zinc analysis (2, 5).

Canopy ratings were based on observation of zinc deficiency symptoms, sectoring or thinning foliage, trunk sprouts, and wilt, whereas healthy trees (h) exhibited none of the above symptoms. Some healthy trees displayed slight or moderate symptoms of zinc deficiency (h-). Only trees with severe zinc deficiency symptoms and permanent wilt were considered blighted (B) (Fig. 2). Missing trees were not included as part of the calculations of percentage of blight. Cold-damaged trees CD) were separated based on their water-uptake and other visual symptoms.

Results and Discussion

The first symptoms of blight were noticed in the foundation grove when trees were 5 years of age. Leaf symptoms resembling zinc deficiency patterns were noticed on one 'Hamlin' tree budded on rough lemon and one tree on Volkamer lemon rootstock. Additional blight-like symptoms were noted in a number of other trees of 'Hamlin', 'Parson Brown', 'Pineapple' and 'Jaffa' on rough lemon and Volkamer lemon rootstocks in the next 2 years. First symptoms in 'Valencia' scions were noted on 6-year old trees on rough lemon rootstock and 7-year old trees on Volkamer lemon rootstock.

In October 1983, a comprehensive survey was made to record citrus blight symptoms in the foundation grove plantings. Trees on rough lemon and Volkamer lemon rootstocks had the highest incidence of tree decline (Table 1). Rangpur lime with 'Parson Brown' and 'Jaffa' scions, and 'Jaffa' on 'Carrizo' citrange, Rangpur X 'Troyer', sweet

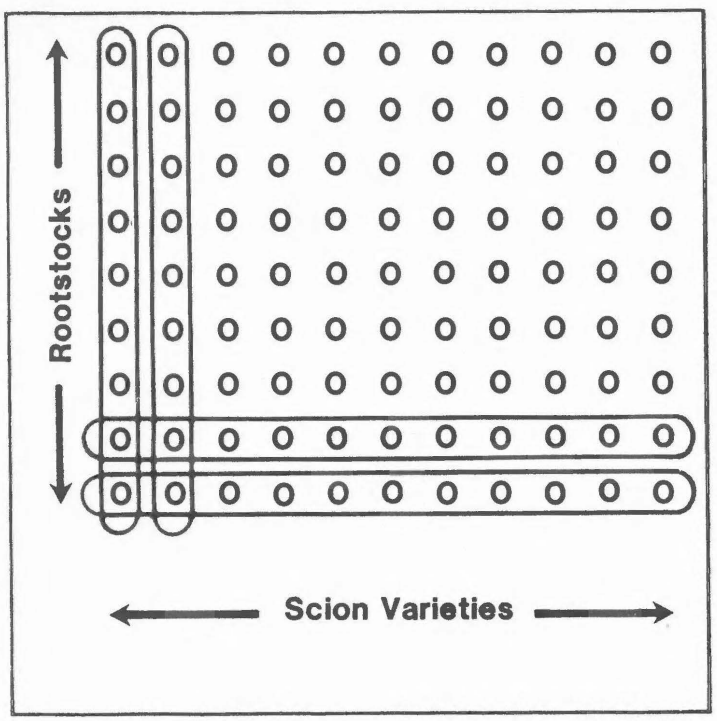

Fig. 1. Planting arrangement.

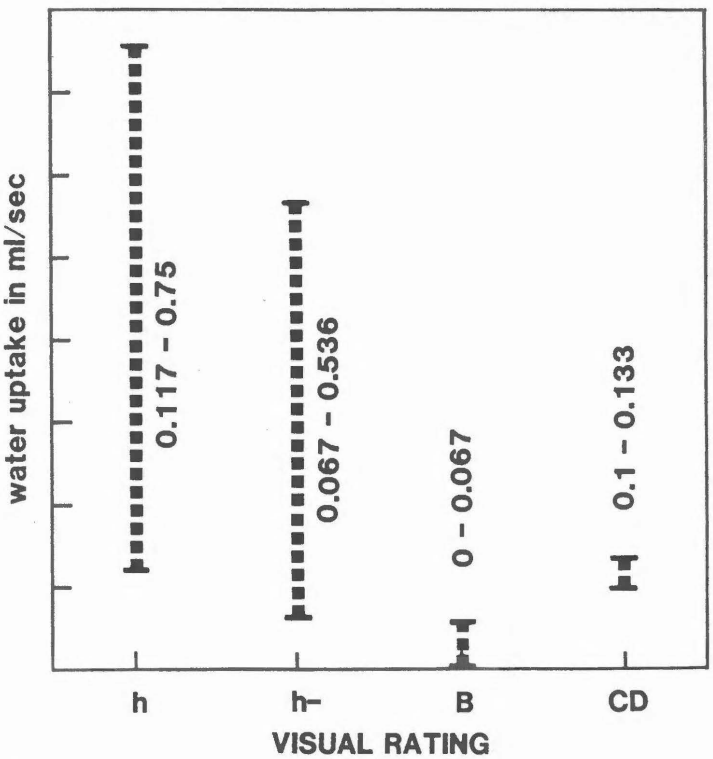

Fig. 2. Relationship between water uptake data and tree canopy visual rating (h = healthy, h- = healthy with foliar symptoms of zinc deficiency), B = blighted, and CD = cold damaged).

Table 1. Comparison of blight incidence (%) for 1983/1986 in 6 varieties on 12 rootstocks.

Rootstock	Blight incidence for 1983/1986 (%)					
	Hamlin	Brown	Jaffa	Pineapple	Queen	Valencia
Milam	0/8	13/38	0/y	0/13	0/0	2/8
Carrizo citrange	0/58	0/50	33/y	6/31	0/6	3/25
Rangpur lime	8/42	25/50	33/y	6/75	0/33	4/54
Rough lemon[z]	50/91	63/88	75/y	83/y	67/y	6/31
Volkamer lemon	33/67	75/88	100/y	67/y	100/y	17/24
Swingle citrumelo	0/0	0/0	0/y	0/0	0/0	0/0
Sweet lime	0/8	0/0	25/y	0/33	0/0	6/8
Smooth Flat Seville	0/0	0/0	0/y	0/0	0/0	0/0
Cleopatra mandarin	0/0	0/0	0/y	0/0	0/0	0/0
Rangpur X Troyer[z]	0/17	0/0	50/y	0/6	0/6	0/9
Citrumelo F-80-3	0/0	0/0	25/y	0/0	0/0	8/19
Citrumelo F-80-8	0/0	0/0	25/y	0/0	0/0	0/0

[z]Planted February 1976, all others March 1975.
[y]Removed May 1985.

lime and citrumelos 'F-80-3' and 'F-80-8' also had a very high incidence of blight. It was encouraging, however, that varieties on other rootstocks growing in close proximity had a low incidence or remained unaffected.

In October 1986, a second survey for symptoms of blight was made, and progressive changes were noted (Table 1). Again, blight was observed most frequently in rough lemon and Volkamer lemon. An increased incidence was noted in 'Carrizo' citrange, Rangpur lime and 'Milam'. The sweet lime with 'pineapple' scions showed a large increase as did 'Hamlin' and 'Valencia' on Rangpur X 'Troyer', and 'Valencia' on citrumelo 'F-80-3'. Trees on 'Smooth Flat Seville' and 'Cleopatra' mandarin were unaffected by blight, and the remaining trees on citrumelo 'F-80-8' were still healthy in appearance. It is interesting to note that only 2 out of 157 trees on 'Swingle', and 2 out of 68 trees on citrumelo 'F-80-3' appear to have blight symptoms that were first observed in the summer of 1986. The only apparent difference in tree decline between scions was in the high number of 'Jaffa' trees that were affected in 1983. Nearly 30% of the 'Jaffas' were affected while 14.5% or less of the other varieties showed decline.

Tree decline appears to be general, not confined to one local area. If citrus blight is an infectious agent, opportunity for infection is certainly present in these plantings. Patterns of spread down the row and between some rows but not between rootstocks, would suggest tolerance, resistance, or at least reduced susceptibility to infection by some rootstocks.

It is encouraging to note that 'Cleopatra' mandarin, 'Smooth Flat Seville', and the citrumelos as a group, appear very promising in their performance in the presence of blight in this particular planting. As we accumulate additional information on tree size and yields, and make further observations in the next few years, more specific recommendations for use of numbered citrumelos will be forthcoming.

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