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A Six-Year Fight Against Citrus Tristeza Virus in Cyprus

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ABSTRACT. A program for the control of citrus tristeza virus (CTV) was implemented in Cyprus in 1992. It involves surveying citrus for CTV, and removing of infected trees wherever feasible. Of the 41,762 trees of five districts indexed by ELISA, 2,337 (5.6%) trees were found to be infected; 13.8% of the 538 groves had infected trees. Nearly all infected trees in four of the five districts were eradicated and growers were compensated. However, in the fifth district CTV infection incidence was high (18.3%), thus, eradication was not considered possible. Field symptoms ranged from inconspicuous to stunting, chlorosis, pitting and dieback. However, no seedling yellows isolates have been found.

After citrus tristeza virus (CTV) was detected in Cyprus in the late 1980's (2), a 5-yr project was undertaken in 1992 for the control of the disease (3). This project, which was renewed for a second 5-yr period, involves mainly the systematic survey of all citrus and the removal of infected trees and/or groves where feasible. Results obtained during the first 6-yr of the project are presented here.

The survey was conducted by indexing 10 to 20% of the trees of each grove in the five citrus-producing districts of Cyprus. Trees were individually indexed by ELISA and samples were collected and processed as previously described (1, 3) using polyclonal antisera obtained from the Tolkowsky Laboratory, Bet Dagan, Israel. Several CTV isolates were grafted onto Mexican lime, sour orange, Washington Navel sweet orange and grapefruit in a glasshouse with temperatures 14° to 32°C. The first two citrus indicator species were used as seedlings, whereas the others were grafted on sour orange.

Results of the survey from the five districts of the island showed an average CTV incidence of 5.6% (Table 1). From 41,762 trees indexed and obtained from 538 groves with approximately 180,000 trees, 2,337

trees were found to be CTV-infected. Seventy four of the 538 groves surveyed had CTV-infected trees.

Disease incidence and prevalence ranged in the different districts from 1.5% to 18.3% and from 7% to 72%, respectively. The highest proportion of infected trees and groves was noted in the district of Famagusta (Table 1) where it was decided that eradication was not possible. The practice of removal of infected trees was applied, however, in the other areas. In those cases where the percentage of infected trees was 15% or higher, it was recommended that the whole grove be destroyed, but where CTV incidence was lower, it was suggested that only infected trees be removed. Compensation given to growers was based on a prescribed formula (3) with an average value of US\$24.00 per tree. Approximately 3,500 trees have been uprooted, including six entire groves, and compensation of US\$110,000 has been paid.

Field symptoms of CTV-positive trees varied from inconspicuous to severe. The most intense symptoms were noted on Marsh seedless or Star Ruby grapefruit and Valencia oranges and included tree stunting, chlorosis, fragility and dieback of twigs, pitting of branches and general thriftiness. Tristeza caused

TABLE 1
SURVEY FOR CITRUS TRISTEZA VIRUS IN FIVE DISTRICTS OF CYPRUS, 1992-1998

Description	District*					Total
	Nicosia	Famagusta	Limassol	Larnaca	Paphos	
No. groves indexed	296	29	128	35	50	538
No. groves infected	33	21	9	4	7	74
% groves infected	11.2	72.4	7.0	11.4	14.0	13.8
No. trees indexed	20,186	1,514	12,422	2,683	4,957	41,762
No. trees infected	1,061	277	184	254	561	2,337
% trees infected	5.3	18.3	1.5	9.5	11.3	5.6
No. trees in groves indexed	86,839	6,374	59,171	8,983	17,262	178,629

*Indexing was by enzyme-linked immunosorbent assay (ELISA).

severe decline and eventual death of 40 to 50-yr-old grapefruit and Valencia orange trees in certain groves in the eastern district of Famagusta and the southern district of Limassol where some of the oldest citrus plantings are situated.

In indexing tests in the glasshouse, 85 CTV isolates from different locations and 10 citrus species and/or varieties produced a variety of symptoms on Mexican lime, ranging from mild vein clearing and light stem pitting without stunting, to leaf cupping, intense vein clearing or vein corking and severe pitting and stunting. Isolates which expressed severe symptoms on Mexican lime showed also pitting on grapefruit and occasionally on sweet orange indicators. Usually the intensity of symptoms on citrus indicators in the glasshouse related well to the severity of field symptoms. No seedling yellows symptoms on sour orange or grapefruit seedlings were observed.

From the history of infected groves, where this was available, as well as from preliminary epidemiological work (Kyriakou and Kapari, unpublished data), it is decided that CTV has been spread in Cyprus mainly through infected material which possibly originated from more than one source. A major source of CTV was infected material which was introduced from South Africa and established in a citrus nursery in the Famagusta district in 1928. This would explain the higher incidence of the virus in this district. The proportion of infection in the other areas shows that control of CTV is still possible by removal of infected material and use of virus-free planting material for the establishment of new groves through a mandatory certification program which was recently initiated (3). Efforts will be made in the future to clear the heavily infected area of Famagusta from trees and/or

TABLE 2
SURVEY FOR CITRUS TRISTEZA VIRUS BY ELISA IN CYPRUS, 1992-98

District	No. groves infected/ no. tested (%)		No. trees infected/ no. tested (%)		Total no. trees indexed
Nicosia	33/296	(11.2)	1,061/20,186	(5.3)	86,839
Famagusta	21/29	(72.4)	277/1,514	(18.3)	6,374
Limassol	9/128	(7.0)	184/12,422	(1.5)	59,171
Larnaca	4/35	(11.4)	254/2,683	(9.5)	8,983
Paphos	7/50	(14.0)	561/4,957	(11.3)	17,262
Totals	74/538	(13.8)	2,337/41,762	(5.6)	178,629

groves with severe CTV isolates. This measure will minimize the danger of spread of severe disease

isolates in case *Toxoptera citricida*, the efficient aphid vector of CTV, invades the Mediterranean basin.

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