

Cachexia and Other Diseases of Citrus in the Jordan Valley

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ABSTRACT. A survey of the major virus and virus-like diseases of citrus in Jordan was done between 1985 and 1987. Cachexia was found the most important virus disease problem. Psorosis, exocortis, and stubborn were also found to be present there. No evidence for the presence of tristeza was found based on symptomatology, indexing, and ELISA. Two blocks of citrus orchards were planted in 1987 with trees originating from virus-free buds imported from California. Virus indexing and establishment of a virus-free buddwood program is necessary with priority for cachexia-free local mandarins.

Index words. tristeza, stubborn, exocortis, psorosis, variegation, leaf rugose, ELISA.

Citrus, the number one tree fruit crop in the Jordan Valley, is planted on 13,000 acres, which is 23% of the agricultural land of the valley. The documentation of citrus diseases in the Jordan Valley is limited to some reports and abstracts only (9). We surveyed 1,816 acres of private citrus orchards owned by 190 owners, and recorded the major diseases and management problems. The results of this survey are reported here.

MATERIALS AND METHODS

Survey. Field survey and laboratory identification of the major diseases on citrus was done between 1985-87. The methodology used is summarized in Table 1. Apart from the general survey, four orchards at Baqura, El Yabis, Deir Alla, and Wadi Shueib that belong to the Ministry of Agriculture were indexed to identify some potential virus-free

TABLE 1
METHODS USED IN THE IDENTIFICATION OF VIRUS AND VIRUS LIKE DISEASES OF CITRUS IN THE JORDAN VALLEY

Disease	Symptomatology	Identification Methods		
		Serological	Cultural	Bait/Indicator Plants
Cachexia	Wood distortion and pitting	None	None	Inoculation onto Orlando tangelo.
Psorosis	Bark scales and ring spots/oak Leaf pattern on young leaves.	None	None	Inoculation onto Washington navel.
Exocortis	Leaf drooping, vein necrosis and corking bark splitting, &	None	None	Inoculation onto Etrog citron 861 S-1, tomato cv. Claudia Raf & Rutgers
Stubborn	Bunchy upright twigs, lopsided fruits with aborted seed	ELISA	On ME-1 & C-3G media	Periwinkle
Citrus vein variegation	Mosaic leaves	Double diffusion	None	Not done
Citrus leaf rugose	Leaf puckering	Double diffusion	None	Not done
Tristeza	Tree decline and stem pitting	ELISA	None	Inoculation onto Mexican lime

mother trees. The field survey included checking for diseases like greening and canker, however, no laboratory tests were done for the detection of these two diseases.

Indicator plants. All citrus indicator plants were brought in from university sources in California, Florida and Texas. Inoculated plants were kept in a greenhouse and/or screen house.

Tristeza ELISA. Special emphasis was given to identifying citrus tristeza virus (CTV). Initial field surveys for tristeza disease showed no symptomatic trees. Three hundred and fifty samples consisting of young leaf and bark tissue were collected and stored in a refrigerator or in a -80C freezer until they were tested by enzyme linked immunosorbent assay (ELISA) for CTV (1, 4).

Stubborn disease agent. The presence of stubborn disease was suspected, especially in some orange trees with symptoms of bunchy top and lopsided fruits. Stubborn has been reported by Bove, *et al.* (2) from neighboring countries of Iraq and Syria. For baiting the disease agent, 1,864 periwinkle seedlings were planted at four different locations in the Jordan Valley. Healthy plants were maintained in a greenhouse at the Dier Alla experiment station. Plants were periodically checked for bunchy twigs, small flowers with virescence, wilting, and death. Field infected plants were tested by ELISA and an attempt was made to culture (6) the pathogen on ME-1 and/or C-3G media.

RESULTS AND DISCUSSION

Table 2 contains the major diseases, varieties affected and a description of symptoms observed on field trees and/or indicator plants.

Survey. Cachexia symptoms (3) were very frequent on mandarin type trees. Though less frequent than cachexia, psorosis symptoms (5) were found on older grapefruit and orange trees. Trees in 171 orchards showed

the symptoms of cachexis, and trees in 27 orchards showed the symptoms of psorosis. Tristeza was not detected in any orchards. Cachexia was found to be the most widespread of all citrus diseases in the Jordan Valley. A popular local cultivar called Yusef Efendi was very susceptible to cachexia. The high incidence of cachexia in the Jordan Valley was attributed to lack of a proper budwood selection program.

Field exposed periwinkles, developed symptoms similar to that caused by *Spiroplasma citri*. The infection percentage increased as the exposure time was increased (Table 3). *Circulifer tenellus*, an efficient vector of *S. citri* was not found in Jordan. Therefore, other insects must be involved in the transmission of the stubborn agent. We have not made any attempt to study the vector relationships of the stubborn disease in the Jordan Valley. Natural transmission of *S. citri* to periwinkle has been reported from the Mediterranean area (7).

A virus-free budwood program is necessary in Jordan with first priority for cachexia-free budwood of mandarins. Of four potential orchards indexed for mother tree selection, only some trees at Wadi Shueib were found suitable as candidate mother trees. Virus-free budwood of different cultivars were imported from California, and budded onto sour orange rootstocks. Two blocks of citrus from these trees were planted, one at Wadi Shueib and another at Dier Alla for future budwood source.

Though CTV is present in neighboring Israel (8), no evidence of CTV was present in the Jordan Valley. This may be because the Jordanian importation of citrus budwood from outside was limited in the past. Most of the budwood importation was from virus-free sources. Therefore, CTV has not been brought into Jordan so far, or if present, the incidence is low. Also, *Toxoptera citricida* Kirk., an efficient vector of CTV is not known to be present in Jordan.

TABLE 2
CITRUS VARIETIES FOUND INFECTED WITH VIRUS DISEASES IN THE
JORDAN VALLEY

Diseases	Varieties infected	Symptoms observed	Confirmation test results
Cachexia	Mandarins Clementines	Severe pitting and wood distortion. Pitting stops sharply at the bud union with sour orange rootstock. Yusef Effendi, a Mediterranean variety showed very severe pitting and wood distortion with scale bark and vertical splits on the scion	Not obtained
Psorosis	Sweet oranges	Scaling of bark tissue and ring spots on young leaves.	Shock reactions on Washington navel
Exocortis	Citrons	Citrons showed leaf epinasty, vine corking, and tree dwarfing and branch die back. Palestine sweet lime rootstocks showed typical splitting. Lemons showed leaf drooping, vein necrosis and corking	Leaf curling on Etrog Citron-861 S-1 and tomato cv. Claudia Raf & Rutgers.
Stubborn	Sweet oranges Mandarins	Bunchy upright twigs, lopsided fruits with aborted seeds.	Culturing of the pathogen from young leaves & seeds on ME-1 & C-3G media were positive. Perwinkle bait plants showed excellent symptoms. Positive ELISA reaction.
Tristeza	None observed		350 samples tested showed no positive ELISA results.
Citrus vein variegation	None observed		
Citrus leaf rugose	None observed		

TABLE 3
INCIDENCE OF SPIROPLASMA-INDUCED SYMPTOMS ON PERWINKLE BAIT PLANTS
EXPOSED AT FOUR LOCATIONS IN THE JORDAN VALLEY

Location	No. of plants exposed	Number of plants showing symptoms			Culture	ELISA
		Small flowers and/or witches' broom	Wilt	Dead		
Baqura	146 (164)	10	1 0	0	Not done	Not done
El Yabis	132 (242)	9 2	5 0	2 0	Not done	Not done
Deir Alla	213 (343)	28 15	8 8	0 1	Positive	Positive
Wadi Shueib	378 (246)	20 6	3 2	1 0	Positive	Positive

Figures without parentheses were exposed for over 3 months and with parentheses were exposed for 1 month.

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