

Viral Diseases Affecting Open Field Tomato in Jordan

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ABSTRACT

This study reports the incidence of tomato viruses in open field tomato in Jordan. A total of 1647 tomato samples were collected from Southern Jordan Valley, Central Jordan Valley, Northern Jordan Valley and Badia. Double-antibody sandwich enzyme linked immunosorbent assay (DAS-ELISA) tests indicated that about 39.6% of the collected samples were infected with one virus or more. The survey results revealed the presence of *Tomato spotted wilt virus* (TSWV), *Potato virus Y* (PVY), *Tomato ring spot virus* (ToRSV), *Tomato yellow leaf curl virus* (TYLCV), *Tomato bushy stunt virus* (TBSV), *Tomato aspermy virus* (TAV), *Tobacco etch virus* (TEV) and *Tobacco rattle virus* (TRV). Interestingly, TSWV was the dominant viral disease in tomato fields since about 17.7% of the samples collected were found to be infected with TSWV either in a single or mixed infection. The second greatest number of samples were infected with PVY at 8.7% infection, followed by ToRSV with 7.8% infection. However, *Tomato mosaic virus* (ToMV), *Alfalfa mosaic virus* (AMV), *Potato virus X* (PVX), *Tobacco ring spot virus* (TRSV) and *Cucumber mosaic virus* (CMV) were not detected in any tomato sample.

Keywords: Tomato, ELISA, TSWV, PVY, TYLCV.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill syn. *Solanum lycopersicum* L.) is one of the most economically important vegetable crops grown in Jordan. Approximately, 117,523 ha are planted to tomato annually (Anonymous, 2008). Several factors limit tomato production, including a large number of viral diseases (Sutic *et al.*, 1999). About 18 viruses are known to infect tomato crops in the Mediterranean

region. These are *Tomato yellow leaf curl virus* (TYLCV), genus (*Begomovirus*; *Geminiviridae*), *Tomato spotted wilt virus* (TSWV), genus (*Tospovirus*; *Bunyaviridae*), *Tomato mosaic virus* (ToMV), genus (*Tobamovirus*), *Alfalfa mosaic virus* (AMV), genus (*Alfamovirus*; *Bromoviridae*), *Potato virus Y* (PVY), genus (*Potyvirus*; *Potyviridae*), *Potato virus X* (PVX), genus (*Potexvirus*; *Flexiviridae*), *Tomato ring spot virus* (ToRSV), genus (*Nepovirus*; *Comoviridae*) and *Tomato bushy stunt virus* (TBSV), genus (*Tombusvirus*; *Tomoviridae*) (Cohen and Nitzany, 1966; Fischer and Luckhart, 1977; Makkouk *et al.*, 1979; Al-Musa and Mansour, 1982; Abdul Sattar and Haithami, 1986; Ouf *et al.*, 1991; Walkey, 1992; Mazyad *et al.*, 1994; Fegla *et al.*, 1997; Peterschmitt *et al.*, 1999; Ben Moussa *et al.*, 2000; Monci *et al.*, 2000; El-Afifi *et al.*, 2004; Elshafie *et al.*, 2005; Abou-Jawdah *et al.*, 2006).

In the early 1980's Al-Musa and Mansour (1982)

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reported the presence of four viruses infecting open field tomato, including TYLCV, *Tobacco mosaic virus* (TMV), genus (*Tobamovirus*), PVY and *Cucumber mosaic virus* (CMV), genus (*Cucumovirus*; *Bromoviridae*). TYLCV was the predominant virus causing major yield losses to tomato farmers in the Jordan Valley, particularly in the fall growing season. Recently, TSWV was reported to infect tomato in Jordan (Anfoka *et al.*, 2007). Only a limited number of samples and conventional diagnostic techniques used in the first survey, so far, no comprehensive work has been done on tomato. Therefore, this project was conducted to determine the status of tomato viruses in Jordan by identifying viruses affecting tomato in Jordan, especially in light of the introduction of a large number of new varieties

and advancement of virus diagnostic technique.

Materials and Methods

Field Survey

A field survey was conducted in Jordan in October of 2008 and during the entire year of 2009 (Table 1). A total of 1647 samples were collected at two weeks intervals from tomato fields grown in the main tomato growing areas including Jordan Valley (3 sites) and Badia (1 site) (Fig. 1). Young shoots in the newest growth were collected from plants showing representative virus-like symptoms and some that were symptomless (negative controls), and placed individually in plastic bags, transported to the lab, and held at 4 °C until processed for virus identification.

Table 1: Detection of 13 tomato viruses in tomato crops grown in different four locations in Jordan during the tomato growing periods of 2008-2009 using ELISA test.

Area	Number of tested samples	Tomato viruses												
		TSWV	PVY	ToRSV	TAV	TYLCV	TBSV	TEV	TRV	CMV	AMV	ToMV	PVX	TRSV
Southern Jordan Valley	476	78	4	80	27	21	-	-	3	-	-	-	-	-
Central Jordan Valley	793	124	130	49	25	-	10	4	-	-	-	-	-	-
Northern Jordan Valley	22	-	9	-	-	-	-	-	-	-	-	-	-	-
Badia	356	89	-	-	-	-	-	-	-	-	-	-	-	-
Total	1647	291*(17.7%)	143(8.7%)	129(7.8%)	52(3.2%)	21(1.3%)	10(0.6%)	4(0.2%)	3(0.2%)	-	-	-	-	-

* Percentage of infection.

Serological Test

Each sample was tested for the presence of the following 13 viruses: CMV, TYLCV, TSWV, ToMV, AMV, PVY, PVX, ToRSV, TBSV, *Tobacco ring spot virus* (TRSV),

genus (*Nepovirus*; *Comoviridae*), *Tomato aspermy virus* (TAV) genus (*Cucumovirus*; *Bromoviridae*), *Tobacco etch virus* (TEV), genus (*Potyvirus*; *Potyviridae*) and *Tobacco rattle virus* (TRV) genus (*Tobravirus*; *Togaviridae*), by using

commercially available kits specific for each virus (Bioreba, AG, Reinach, Switzerland). Double-antibody sandwich enzyme linked immunosorbent assay (DAS-ELISA) was used as described by Clark and Adams (1977) and as recommended by the manufacturer's company. Two wells were used per sample. ELISA readings were considered positive when the absorption (OD = 405 nm) of the sample well was at least 3 times greater than the mean absorption of healthy control samples.

Results

A total of 1647 tomato samples were collected from Southern Jordan Valley, Central Jordan Valley, Northern Jordan Valley and Badia. The DAS-ELISA tests indicated that about 39.6% of the collected samples (653/1647) were found to be infected with one or more virus, and revealed the presence of TSWV, PVY, ToRSV, TYLCV, TBSV, TAV, TEV and TRV. However, the following viruses were not detected in tomato samples: ToMV, AMV, PVX, TRSV and CMV (Table 1). The results clearly indicated that TSWV was the dominant virus, causing disease in tomato fields based on its detection in 17.7% of samples (291/1647),

either in a single or mixed infection (Table 1). PVY was found to be the second most prevalent virus at 8.7% infection, followed by ToRSV at 7.8%.

Tomato viruses were widespread in all tomato growing regions surveyed. The infection rate ranged from a low of 25% in the Badia region to a high of 44.7% in Southern Jordan Valley (Table 1). Remarkable differences in prevalence was observed between the four sampled areas. TSWV was detected at three of four sites but not in Northern Jordan Valley (Table 1), whereas, TSWV was not detected in. TYLCV and TRV were identified only from the Southern Jordan Valley, while both TBSV and TEV were detected from Central Jordan Valley (Table 1). Single TSWV infections were detected in 76.3%, PVY infection was 55.2% and ToRSV in 63.6% of infected samples. Double infections were the most common comprising 88.3% of the samples. The combination of the three viruses (PVY, TSWV and ToRV or TYLCV, TSWV and ToRSV) was detected in 13 of 111 samples. However, all viruses except TRV were found to be associated with one or more virus (Table 2).

Table 2: Mixed infection with tomato viruses recorded during the survey study fall 2008-2009.

Mixed viruses	No. of infected samples
TSWV + ToRSV	14
PVY + ToRSV	8
TAS + ToRSV	6
TYLCV + ToRSV	6
PVY + TSWV	34
TAV + TSWV	7
TYLCV + TSWV	8
PVY + TBSV	6
PVY + TEV	2
PVY + TYLCV	7
PVY + TSWV + ToRSV	7
TYLCV + TSWV + ToRSV	6
Total	111

Discussion

Although certain diseases caused by TSWV and TYLCV at times can be identified based on the field symptoms, the associating a field symptom with a specific suite of viruses was generally difficult. This might be due to mixed infection and/or to the poor conditions of plants. The survey revealed the presence of many viruses reported for the first time in Jordan, of these viruses TBSV, TAV, TEV and TRV. All of these viruses have been reported in the region (Cohen and Nitzany, 1966; Fischer and Luckhart, 1977; Nakhla *et al.*, 1978; Makkouk *et al.*, 1979; Mazyad *et al.*, 1979; Abdul Sattar and Haithami, 1986; Ouf *et al.*, 1991; Walkey, 1992; Peterschmitt *et al.*, 1999; Ben Moussa *et al.*, 2000; Abdelkader *et al.*, 2004; El- Afifi *et al.*, 2004;

Elshafie *et al.*, 2005; Abou-Jawdah *et al.*, 2006).

Results of this study revealed that the prevalence of viruses in tomato fields in Jordan has changed since the early 1980's. The early eighties survey showed the presence of four viruses on open field tomato, including TYLCV, ToMV, PVY and CMV. At the time TYLCV was the most prevalent virus, and ToMV and CMV were negligible (Al-Musa and Mansour, 1982). On the other hand a low incidence of TYLCV was anticipated because most tomato farmers in Jordan Valley plant TYLCV- resistant cultivars, however, no explanation is available for the absence of ToMV and CMV particularly, although both viruses are known to have wide host range.

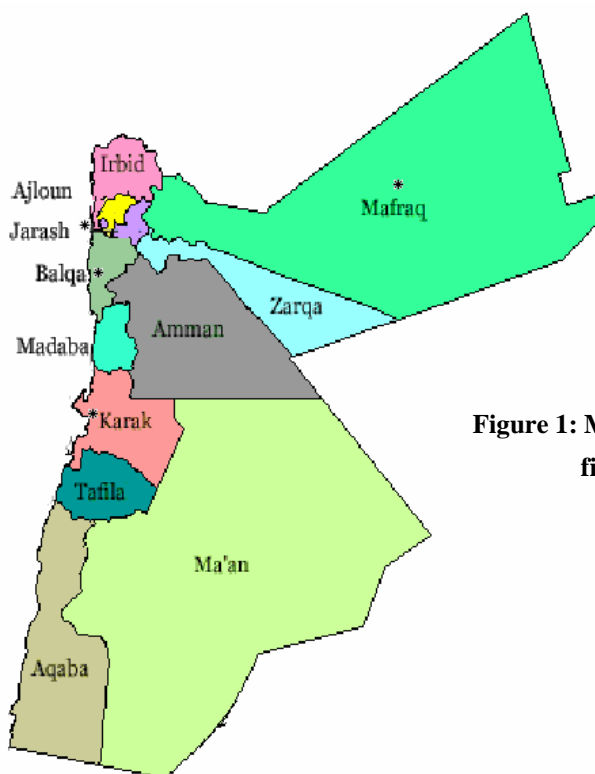


Figure 1: Map of Jordan showing the location of tomato fields surveyed during 2008-2009.

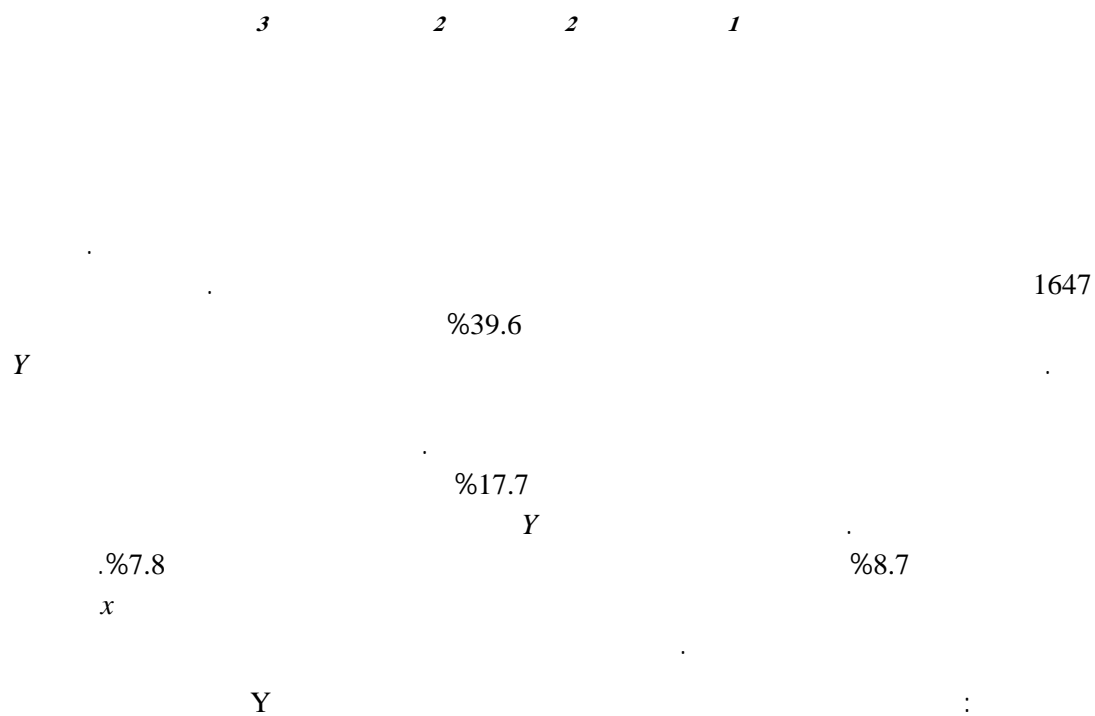
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