

GREENHOUSE TOMATO CROPS AFFECTED BY VIRUSES IN THE WEST MEDITERRANEAN REGION OF TURKEY

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Abstract

A large number of viruses cause economically important diseases on tomato plants worldwide. The viruses causing serious damage to tomatoes in the greenhouses of West Mediterranean Region in Turkey were identified. For this purpose, three viruses were investigated. A total of 186 tomato leaf samples were collected from 6 locations. Leaf samples were serologically tested by DAS-ELISA technique for 3 viruses: *Tomato spotted wilt virus* (TSWV), *Tomato yellow leaf curl virus* (TYLCV) and *Pepino mosaic virus* (PepMV). It was found that 63.44% (118 samples) of the tested samples were infected with one or more viruses. ELISA tests showed that among 186 samples, 53 were infected with TSWV (28.48%), 43 were TYLCV (23.12%) and 22 were infected with PepMV (11.83%). Various combinations of mixed infections were also observed in different samples. DAS-ELISA positive leaf samples were further confirmed through mechanical transmission of pathogen to herbaceous indicator plants.

Western flower thrips, (*Frankliniella occidentalis*) and whitefly (*Bemisia tabaci*) were found in tomato greenhouses in this region to transmit the TSWV and TYLCV, respectively. It was also observed that bumble bees have been used for pollination in the tomato greenhouses in this region.

Tomato is economically the most important vegetable crop worldwide. Turkey's tomato production has been increasing year by year, which enables the country to keep its position as one of the top 5 tomato producing countries in the world.

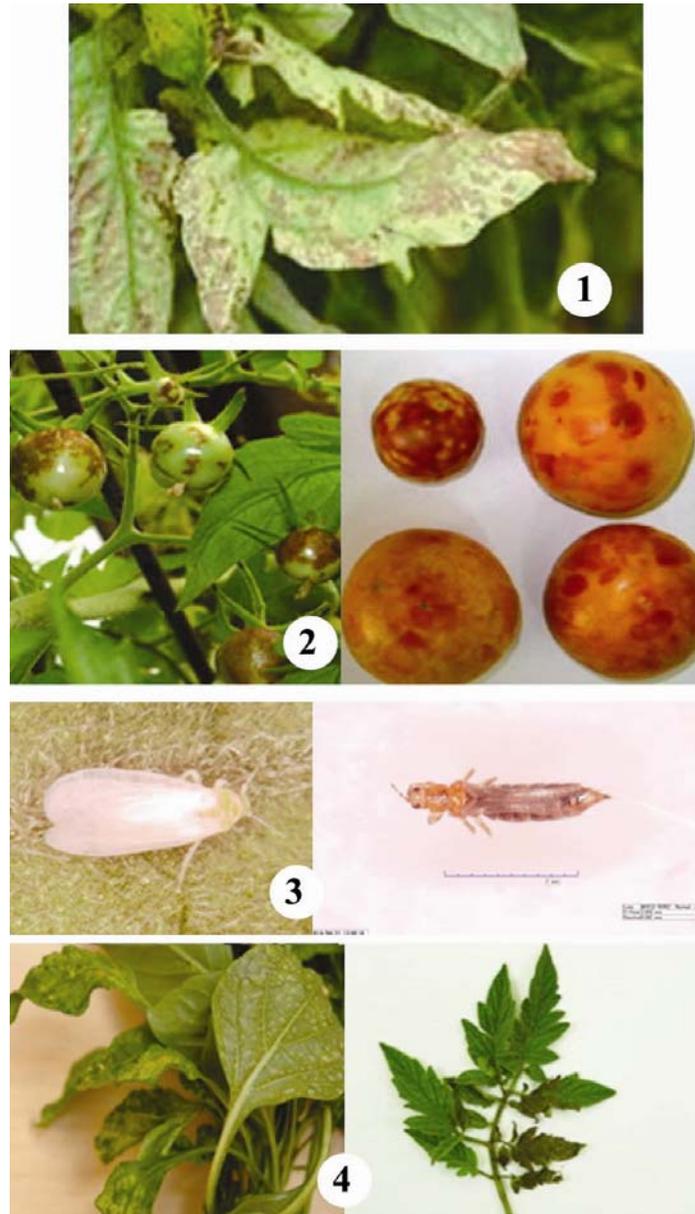
Although tomato production is being carried out in almost all the provinces of Turkey, production under greenhouse conditions is generally carried out in the Mediterranean, Aegean and Marmara regions (Keskin *et al.* 2010).

As for all agricultural crops, plant protection problems such as viral diseases are the major factors decreasing tomato production. Over 30 tomato viruses recorded as naturally infecting tomatoes, some of them are restricted to a certain geographical region, while others occur worldwide (Zitter and Tsai 1981).

Because of the suitable climatic conditions, West Mediterranean Region has a great importance in Turkey's tomato production, with 15% share in total production (Türk 2012). Due to common and intensive production, various diseases cause significant yield losses every year. TYLCV, TSWV, PepMV, *Tomato torrado virus*, *Tomato infectious chlorosis virus* and *Tomato chlorosis virus* are the most common and important viruses in terms of distribution and effect on yield in the open field and greenhouse tomato production areas of the region in the world (Hanssen and Lapidot 2012).

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The aim of this study conducted in West Mediterranean region of Turkey was to investigate the presence of PepMV, TYLCV and TSWV known as the most destructive viruses of tomatoes in tomato greenhouses in the world by using ELISA and biological indexing studies. In addition, virus vectors in the greenhouses were collected and identified in this study.



Figs 1-4: 1. Necrosis on tomato leaves. 2. Marbling, uneven ripening, thickening and blackening on tomato fruits. 3. Whitefly and Western flower thrips observed on tomato plants. 4. Chlorotic and necrotic lesions, leaf deformation on pepper and tomato leaves after mechanical inoculations.

Observations during surveys indicated that tomato plants in the greenhouses were possibly infected with TSWV, TYLCV and PepMV or some other viruses. Similar symptoms were previously reported in different studies (German *et al.* 1992, Moriones and Navas-Castillo 2000).

During surveys conducted in the growing seasons in 2012 - 2013, severe virus-like leaf and fruit symptoms were observed in some tomato greenhouses in 6 different locations in the West Mediterranean region. Severe mosaic, chlorotic mottling, necrosis, vein banding, blistering, dwarfing, leaf and fruit malformation were observed on the greenhouse-grown tomato plants (Figs 1, 2, 3). A total of 186 susceptible tomato leaf samples were collected from tomato greenhouses. Symptoms of the plants were recorded and then stored at -20°C until detection tests were performed.

For the determination of PepMV, TYLCV and TSWV, DAS-ELISA and mechanical inoculation tests were carried. Possible vectors that may be related with these viruses feeding on tomato plants were also collected and identified. All leaf samples were tested for the presence of PepMV, TYLCV and TSWV by ELISA using specific detection kits for these viruses (Agdia, Elkhart, USA). Absorbance values were measured at 405 nm with microplate reader (EL X 800 universal Microplate Reader Bio-Tek Instruments, Inc.B-2610, Wilrijk, Belgium). Samples with absorbance values greater than twice the mean absorbance reading of healthy controls were considered as positive.

The results showed that 63.44% (118 samples) of the tested 186 samples were infected with one or more viruses. ELISA tests showed that among 186 samples, 53 were infected with TSWV (28.48%), 43 with TYLCV (23.12%) and 22 with PepMV (11.83%). In addition, various combinations of mixed infections were determined in the samples. ELISA test showed the presence of these virus infections in West Mediterranean region of Turkey. Since ELISA is a routine and reliable test to diagnose plant viruses, several researchers have used this test to reveal the plant viruses (Arlı-Sökmen *et al.* 2005, Köklü 2006).

DAS ELISA positive leaf samples were used for mechanical transmission to herbaceous indicator plants. Test plants inoculated with TSWV showed some symptoms such as; chlorotic local lesion, mosaic, leaf deformation and systemic infection on the leaves (Fig. 4.). However, PepMV inoculation resulted with systemic mosaic, leaf chlorosis and deformation symptoms only on *N. benthamiana*.

Serological and biological assays revealed that TYLCV and TSWV were common and PepMV was present in the region. The presence of this important and destructive viruses in tomato greenhouses in the West Mediterranean region in Turkey were determined. During surveys in tomato and other vegetable greenhouses, intensive aphid and thrips populations were also observed in this region. These aphids were collected and identified as *Bemisia tabaci* and *Trialeurodes vaporariorum*. *Bemisia tabaci* was reported as the most effective vector of TYLCV (Rubinstein and Czosnek 1997). Thrips samples were identified as *Frankiniella occidentalis*, which is known to be the most effective vector of TSWV (Mound and Kibby 1998, Webb *et al.* 1998).

Results demonstrated that presence of PepMV, TYLCV, and TSWV viruses causing serious damage in tomato greenhouses and their possible vectors of West Mediterranean region having great importance in Turkey's tomato production. In addition, possible vectors of these viruses in the survey areas in this region was observed. Probably this is the first report for these virus diseases in this region. The results in this study will provide a source in the control of these diseases in the future.

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