

TOMATO LEAF MOLD IN GREENHOUSES OF BARTIN AND ZONGULDAK PROVINCES OF TURKEY

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Original scientific paper

Summary

Tomato leaf mold caused by *Passalora fulva* is an important disease of tomatoes that grow especially in greenhouse conditions. In 2019, 27 and 29 greenhouses from different areas were inspected for the presence of tomato leaf mold in Bartın and Zonguldak provinces of Turkey. Tomato leaf mold was present in 20 greenhouses in Bartın (74.1%) and 10 greenhouses in Zonguldak (34.5%). Disease percentages ranged between 5 and 100 in Bartın and 15 and 100 in Zonguldak. Severe disease symptoms occurred in some greenhouses and drying of the leaves were observed. Precautionary measures should be taken in order to control of the disease in Bartın and Zonguldak greenhouses.

Keywords: Passalora fulva, tomato, greenhouse, Bartın, Zonguldak, Turkey

INTRODUCTION

Tomato (*Solanum lycopersicum* L. = *Lycopersicon esculentum* Mill.) is an important plant in the world. Today, tomato is considered to be indispensable in food culture of the world and it is also an important raw material for many industrial products. The native land of tomato is the Andes region of South America. Tomato plant was first cultivated in Mexico (Costa and Heuvelink, 2005). Today tomato is spread to different geographical regions and it is grown and consumed widely in Turkey and in the whole world.

Global tomato production is about 170 million tons. Seventy-five percent of this production is marketed as fresh tomatoes (Costa and Heuvelink, 2018). Turkey is one of the important countries that export fresh tomatoes. The greenhouse cultivation enables the production and export of tomato even when it is not the season. Tomato is very popular in Turkey and in the rest of the world, and people consume it during the whole year and for that reason greenhouse production of tomato is common.

Bartın and Zonguldak provinces are located in the Western Black Sea Region of Turkey (Figure 1). Undercover tomato production is common in Bartın province (Anonymous 2019). In this province, 5615 tons of tomatoes are grown on 0.53 hectares of land in greenhouse cultivation. Ninety percent of this production is carried out in the central district of Bartın. Apart from the central district, tomato production

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in Amasra, Kurucaşile and Ulus districts constitute 10% of the total tomato production. In terms of surface area of the greenhouses in Bartın province, 74% is composed of high tunnels. In Zonguldak province, 2273 tons of tomatoes were grown on 0.21 hectares of land in greenhouse cultivation. Most of undercover tomato production in Zonguldak province is carried out in Gökçeşey and Çaycuma districts. Fifty-eight percent of the surface area of the greenhouses in Zonguldak province is composed of high tunnels (TUIK, 2018).

Diseases and pests in undercover production cause decreases in tomato yield and quality. In greenhouses, inadequate ventilation and frequent planting increase plant losses caused by diseases. One of the fungal diseases that can lead to a decrease in yield and quality in undercover production is tomato-specific leaf mold disease caused by *Passalora fulva* (*Cladosporium fulvum*). This disease is a problem especially in greenhouse grown tomatoes (Babadoost, 2011b) and hydroponics production (Novak and Miličević, 2010).

As the native land of cultured tomatoes and wild tomatoes is South America, it is assumed that the origin of *Passalora fulva* is also South America (De Wit *et al.*, 2009). Today, this disease can be found almost everywhere in the world where tomatoes are grown. In China, Japan, Netherlands and Poland, it has been reported that the pathogen broke down the Cf resistance genes in tomato and formed new races (Lindhout *et al.*, 1989; Satou *et al.*, 2005; Kubota *et al.*, 2015; Iida *et al.*, 2015; Li *et al.*, 2015).

The disease usually begins on the lower leaves and proceeds further to the upper leaves. First infections are observed on older leaves and later symptoms develop on younger leaves (Babadoost, 2011a; Babadoost, 2011b). On the upper surface of the leaf, pale green, then yellow spots with uncertain edges appear. Dark olive green and velvety fungal cover is formed on the lower surface of the leaves. Infected leaves become yellowish brown, curl, wither and shed (Babadoost, 2011a). If the disease is not controlled, most of the leaves may die and cause significant yield losses (Babadoost, 1989, 2011b).

Passalora fulva is usually seen in greenhouses with high humidity. This pathogen cannot grow below 85% relative humidity and 22-24°C is the optimum temperature at which the disease can develop (Csizinszky *et al.*, 2005; Babadoost, 2011b). It is stated that this disease is widespread in the Western Black Sea Region in late July and early August (Cengiz Bostancı and İbrahim Yıldırım, Ministry of Agriculture and Forestry, Bartın Directorate of Provincial Agriculture and Forestry, Turkey, *personal communication*).

This study was carried out to determine the prevalence of leaf mold in undercover areas in Bartın and Zonguldak provinces of Turkey where intensive tomato cultivation was carried out.

MATERIALS AND METHODS

Surveys were conducted on July 31, 2019 and on August 1, 2019 in Bartın and Zonguldak provinces (Figure 1). Twenty-seven greenhouses in Bartın and 29 greenhouses in Zonguldak were included in the survey. In central district of Bartın province, greenhouses in the villages of Old Hamidiye, Bayıryüzü, Derbent and Gerişkatırcı were investigated. In Zonguldak, greenhouses in the Çaycuma district-Hacılar and Kayıkçılar villages and Gökçebey district-Bakacakkadı region were included in the survey.

Climate is influenced by Black Sea in Bartın and Zonguldak provinces. In the region, high humidity is present with hot summers and cool winters.

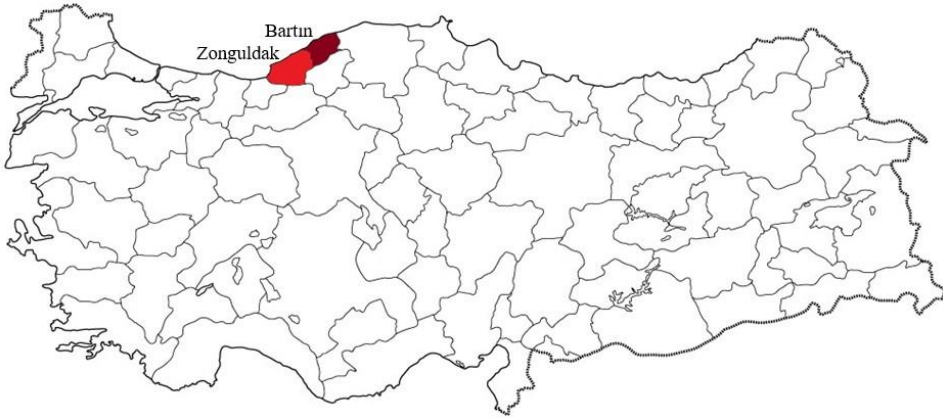


Figure 1. The location of Bartın and Zonguldak provinces in the Western Black Sea Region of Turkey where the surveys were conducted

All plants in these greenhouses were examined for the presence of the disease. The percentage of the disease was determined by observing at least two rows in each greenhouse. All aboveground plant parts were examined. At least three leaf samples were selected from each greenhouse. Single spores were taken under the stereo microscope from the fungal covers on the lower surfaces of the leaves and they were transferred to Potato Dextrose Agar (PDA) medium. The isolates were stored on PDA slants at + 4°C.

RESULTS AND DISCUSSION

In the survey conducted on July 31, 2019 in Bartın province, the greenhouses in the villages of Old Hamidiye, Bayıryüzü, Derbent and Gerişkatırcı were investigated. In Zonguldak province, the survey was conducted in Hacılar and Kayıkçılar villages of Çaycuma district and Bakacakkadı region of Gökçebey district on August 1, 2019. Percentages of leaf mold disease in greenhouses of Old Hamidiye, Bayıryüzü, Derbent and Gerişkatırcı villages of Bartın province ranged between 5 and 100 (Figure 1,

Table 1). It was observed that leaves of the tomatoes grown in some high tunnel greenhouses in Old Hamidiye village of Bartın were completely dried out due to leaf mold disease (Figure 3A). Also in some Bartın greenhouses, fungal cover on tomato adaxial leaf surfaces was observed (Figure 3B).

Percentages of leaf mold disease in greenhouses of Hacılar and Kayıkçılar villages of Çaycuma district and Bakacakkadı region of Gökçeşey district ranged between 15 and 100 (Figure 2, Table 2).

Tomato leaf mold was present in 20 Bartın greenhouses (74.1%) and 10 Zonguldak greenhouses (34.5%). Leaf mold was more common in Bartın greenhouses.

In a previous study, Ozan and Aşkın (2006) surveyed 2 greenhouses in Bakacakkadı region, 2 in Kayıkçılar village of Zonguldak province and 2 greenhouses in Bartın province of Turkey. In their research, the prevalence of leaf mold in Zonguldak and Bartın provinces was found as 95% and 51%, respectively. In our current study, disease prevalence values in these provinces reached up to 100% depending on the greenhouse conditions and the cultivar grown.

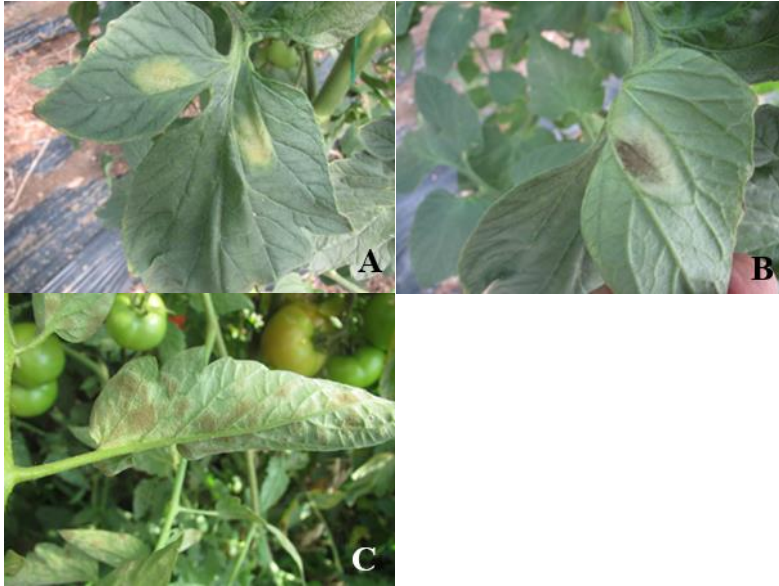


Figure 2. Symptoms of tomato leaf mold caused by *Passalora fulva* observed in Bartın and Zonguldak provinces of Turkey (A: adaxial surface of the diseased leaf, B-C: abaxial surfaces of the diseased leaves, C: curling of infected leaf)



Figure 3. A: Leaves of the tomatoes grown in a high tunnel greenhouse in the Old Hamidiye village of Bartın were completely dry due to leaf mold caused by *Passalora fulva*. B: Fungal cover on tomato leaf surface observed in Bartın province.

Table 1. Tomato leaf mold occurrence and prevalence in greenhouses of Bartın province of Turkey

Bartın				
Greenhouse No	District	Location	Disease prevalence (%)	Variety
1	Central	Old Hamidiye village	100	Calypso and Tayfun
2	Central	Bayiryüzü village	5	Unknown
3	Central	Bayiryüzü village	Absent	Unknown
4	Central	Derbent village	Absent	Unknown
5	Central	Derbent village	Absent	Unknown
6	Central	Derbent village	Absent	Unknown
7	Central	Derbent village	30	Tayfun
8	Central	Derbent village	Absent	Sandoline
9	Central	Derbent village	Absent	Calypso
10	Central	Derbent village	60	Tayfun
11	Central	Derbent village	Absent	Unknown
12	Central	Derbent village	50	Unknown
13	Central	Derbent village	50	Unknown
14	Central	Derbent village	35	Unknown
15	Central	Derbent village	20	Unknown
16	Central	Derbent village	40	Torry
17	Central	Gerişkatırcı village	60	Unknown
18	Central	Gerişkatırcı village	70	Unknown
19	Central	Gerişkatırcı village	80	Unknown
20	Central	Gerişkatırcı village	80	Unknown
21	Central	Gerişkatırcı village	30	Unknown
22	Central	Gerişkatırcı village	60	Unknown
23	Central	Gerişkatırcı village	90	Unknown
24	Central	Gerişkatırcı village	70	Unknown
25	Central	Gerişkatırcı village	90	Unknown
26	Central	Gerişkatırcı village	60	Ömür
27	Central	Gerişkatırcı village	70	Ömür

Table 2. Tomato leaf mold occurrence and prevalence in greenhouses of Zonguldak province of Turkey

Zonguldak				
Greenhouse No	District	Location	Disease prevalence (%)	Variety
1	Çaycuma	Hacılar village	Absent	Unknown
2	Çaycuma	Hacılar village	Absent	Unknown
3	Çaycuma	Hacılar village	Absent	Unknown
4	Çaycuma	Hacılar village	Absent	Unknown
5	Çaycuma	Kayıkçılar village	Absent	Namlı
6	Çaycuma	Kayıkçılar village	Absent	Grando
7	Çaycuma	Kayıkçılar village	Absent	Unknown
8	Çaycuma	Kayıkçılar village	90	Nazal
9	Çaycuma	Kayıkçılar village	Absent	Unknown
10	Çaycuma	Kayıkçılar village	25	Unknown
11	Çaycuma	Kayıkçılar village	30	Şahmat and Kocaman
12	Çaycuma	Kayıkçılar village	Absent	Unknown
13	Çaycuma	Kayıkçılar village	Absent	Namlı
14	Gökçebey	Bakacakkadı	Absent	Nurdan and Calypso
15	Gökçebey	Bakacakkadı	Absent	Unknown
16	Gökçebey	Bakacakkadı	Absent	Unknown
17	Gökçebey	Bakacakkadı	Absent	Unknown
18	Gökçebey	Bakacakkadı	Absent	Unknown
19	Gökçebey	Bakacakkadı	Absent	Unknown
20	Gökçebey	Bakacakkadı	Absent	Unknown
21	Gökçebey	Bakacakkadı	Absent	Unknown
22	Gökçebey	Bakacakkadı	100	Unknown
23	Gökçebey	Bakacakkadı	60	Unknown
24	Gökçebey	Bakacakkadı	50	Unknown
25	Gökçebey	Bakacakkadı	60	Unknown
26	Gökçebey	Bakacakkadı	15	Unknown
27	Gökçebey	Bakacakkadı	60	Unknown
28	Gökçebey	Bakacakkadı	Absent	Unknown
29	Gökçebey	Bakacakkadı	20	Unknown

During the production season, carrying out integrated control activities against disease will reduce the use of chemical pesticides. Also, pesticide resistance problems and farmer production costs will be lower.

The first step of integrated control is to grow resistant varieties to disease (Csizinszky *et al.*, 2005). In our survey, it was observed that Tayfun and Ömür

cultivars grown in Bartın province and Nazal cultivar grown in Zonguldak province were very susceptible to the leaf mold. These varieties do not contain Cf genes that provide resistance to leaf mold. Leaf mold was not observed on Namlı cultivar grown in greenhouses in Zonguldak province. This cultivar contains Cf-5 resistance gene. Namlı cultivar can be recommended for greenhouses in the provinces of Zonguldak and Bartın.

There are no studies related to determination of the races of leaf mold in Bartın and Zonguldak provinces of Turkey. The identification of races in these provinces will be helpful for recommending varieties containing the Cf gene(s) for control of the disease.

In the integrated control of the disease, it is very important to reduce the relative humidity below 85% in the greenhouse by providing ventilation (Babadoost, 2011). In addition, it is advised to remove infected plant residues from the greenhouses, application of hot water to seeds and pruning to increase ventilation (Csizinszky *et al.*, 2005). Leaf mold control precautions will reduce the yield losses caused by the disease at Bartın and Zonguldak provinces of Turkey.

CONCLUSIONS

Tomato leaf mold was present in 20 Bartın greenhouses (74.1%) and 10 Zonguldak greenhouses (34.5%). Leaf mold was more common in Bartın greenhouses. Percentages of leaf mold disease in greenhouses of Old Hamidiye, Bayıryüzü, Derbent and Geriřkatırcı villages of Bartın province ranged between 5 and 100. Percentages of leaf mold disease in greenhouses of Hacılar and Kayıkçılar villages of Çaycuma district and Bakacakkadı region of Gökçebey district ranged between 15 and 100. It was observed that leaves of the tomatoes grown in some high tunnel greenhouses in Old Hamidiye village of Bartın were completely dried out due to leaf mold disease. It appears that tomato leaf mold disease is common in the region. Precautionary measures should be implemented in order to control leaf mold in Bartın and Zonguldak provinces of Turkey.

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