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SCREENING SOME TOMATO SEEDLINGS FOR *FUSARIUM OXYSPORUM* F.SP. *LYCOPERSICI* (FOL)

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ABSTRACT

Fusarium oxysporum f.sp. *lycopersici* (FOL) Snyd. et Hans. (FOL) is a pathogenic form that causes soilborne vascular wilt disease in the tomato (*Solanum lycopersicum* L.). Resistant tomato varieties are mostly used against FOL. In this study, it was investigated to the efficacy of 15 commercial tomato varieties reported to be resistant to FOL and 3 suscebtible tomato variaties (Mercury, Polaris, Tayfun, Alsancak, 112, Dort, 535, Northköy, Alaturka, Tory, Yakup, Seval, Arzum, Kahraman, Asil, H2274, SC2121, Soil). Tomato varieties were inoculated with FOL and were assessed according to the scale of 0-4 after 4 weeks. The disease severity was evaluated using the Townsend-Heuberger's formula. As a result, the most resistance variaties were obtained from Merkür, Polaris, Alsancak, Kuzeyköy and Tory to FOL disease and no symptom of diseases was observed. These varieties were followed by Kahraman and Tayfun varieties and low disease symptoms (7%) were observed. FOL was most commonly seen in Toprak, SC2121 and H2274 tomato varieties, known as susceptible to disease.

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INTRODUCTION

Tomato (*Solanum lycopersicum* Mill.) is systematically found in the Solanaceae family. It is one of the most important produced and consumed agricultural products in the world and Turkey. Tomato is a vegetable that grows in almost every region of our country, and is

produced continuously in recent years, especially in greenhouse conditions. The tomato which is one of the most consumed vegetables in the country is the first among the fresh vegetables we export [1]. Tomato is in 3rd place after China and America with 10.985.400 tons in terms of production amount in 2010, while it is in the 4th place after China, India and USA with 300.000 ha area in terms of breeding area. Indeed, as of 2010, 7.7% of world production of fresh tomatoes was carried out by Turkey [2].. According to the data of 2016, the production of tomato was 8,181,247 tons in 1.248.324 decare area, and the production of tomato (tomato paste) 558.549 decare was 4,018,753 tons in area. [3].

Fungal diseases are the most important factors limiting tomato cultivation, Fusarium species caused plant dseases are the most common fungal disease pathogens in nature. This fungus, which can live in different forms on organic materials and in all kinds of soil, is one of the most soil-borne diseases causing significant yield losses in tomato cultivation [4]. In this respect, loss of yield in economic terms is mostly caused by soil-borne pathogens such as seedling blight disease, rot root diesease and wilt disease [5]. *Fusarium oxysporum* f.sp. *lycopersici* (Sacc.) W.C. Snyder and H.N. Hans, a soilborne plant pathogen in the class Hyphomycetes, causes Fusarium wilt specifically in tomato. The pathogen is soilborne and remains in infested soils for up to ten years. Soil and air temperatures of 28°C are optimum for disease. Three physiological races of this pathogen have been reported. Race 1 is the most widely distributed and has been reported from most geographical areas. Although race 2 was first reported in Ohio in 1940, it did not become widespread or of economic concern until its discovery in Florida in 1961. Since then, it was rapidly reported in several of the states and in several other countries, including Australia, Brazil, Great Britain, Israel, Mexico, Morocco, the Netherlands, and Iraq. Race 3 was reported in 1966 in Brazil [6-8]. Control measure is mainly through the use of resistant cultivars. The control of races 1 and 2 utilizes both

polygenic and monogenic resistance while monogenic resistance to race 3 has been developed.

There are a large number of tomato plants on the market that are resistant to FOL diseases, however, FOL disease is observed. In this study, 18 commercial tomato varieties (Merkür, Polaris, Tayfun, Sancak, 112, Dorit, 535, Kuzeyköy, Alaturka, Tory, Yakup, Seval, Arzum, Kahraman, Asil, H2274, SC2121, Toprak) were investigated to determine whether these tomato strains were resistant to the disease.

MATERIAL AND METHOD

This work was carried out in the Laboratory of Plant Protection Department of the Faculty of Agricultural Engineering of Süleyman Demirel University and in the climate chamber. 18 tomatoes were used as the material in the study (Merkür, Polaris,Tayfun, Sancak, 112, Dorit, 535, Kuzeyköy, Alaturka, Tory, Yakup, Seval, Arzum, Kahraman, Asil, H2274, SC2121 and Toprak) (Fig 1).

Fig 1. Tomato varieties used in the experiment

Isolation of *Fusarium oxyporum* f.sp *lycopersici* (FOL)

Fusarium oxysporum f.sp. *lycopersici* (FOL) were isolated from tomato plants showing symptoms of wilt, crown and root. Sample were collected from greenhouse in Antalya. The roots, crown sand stems were first cut into small pieces, rinsed with distilled water, disinfected with sodium hypochlorite (3%) for 3 min and rinsed again with sterile distilled water to remove traces of bleach water and then dried using sterile filter papers. The fragments were then cut lengthwise and placed in Petri dishes containing Potato Dextrose Agar (PDA) with 200 mg/L of Streptomycin (Sigma). The plates were incubated at 24°C for 4 to 5 days. Strain purification was carried out by single spores culture. The morphological identification of strains was performe based on the characteristics of microconidia, macroconidia, phialides and chlamydospores **[9-11].** A pathogenicity test was performed on the variety SC2121 to *F. oxysporum* f.sp. *lycopersici* and the pathogen re- isolated from infected roots. A molecular analysis of the isolate with a high pathogenicity was carried out and it was determined as race FOL 1.

Growth of Tomatoes seedlings

Tomato seedlings were planted to the mixture of sterilized 1: 1 peat: perlite in plastic cups 5x5 cm in size. These plants were cultured at 24 °C, relative humidity 60±5%, 16 photoperiod. When seedling reached 3-5 were used in the trials. Tomato culture list for FOL was also given in the table 1.

Table 1. Tomato variety list for FOL

Variety name	FOL resistances	Variety name	FOL resistances
Merkür	FOL 0-1	Tory	FOL 1-2
Polaris	FOL 1-2	Yakup	FOL 0-1
Tayfun	Fusarium spp	Seval	FOL tolerant
Alsancak	FOL 0-1	Arzum	FOL 0-1
112	FOL tolerant	Kahraman	FOL 0-1
DORİT	FOL 0-1	Asil	FOL 0-1-2
535	FOL 0-1	H2274	FOL susceptible
Kuzeyköy	FOL	SC2121	FOL susceptible
Alaturka	FOL 0-1	Toprak	FOL susceptible

Inoculation of tomato plants with FOL

FOL was grown on potato dextrose agar (PDA) in petri dishes and incubated at 24 ^{o}C for 10 days. Conidial suspension was prepared with sterile distilled water and filtering through five layers of cheesecloth. The concentration of the conidial suspension of FOL was adjusted to approximately 10^6 spores/mL by hemacytometer. The inoculum was poured around the roots of each of the plants. Tomato plants were inoculated with 10 ml of FOL per plant. Seven plants from each tomato varieties were used for experiment. Three weeks after inoculation, average disease index of plants was scored. The disease index was scored on a 0–4 scale, (0 = asymptomatic, 1 = yellowing, 2 = vascular discoloration, 3 = wilting, 4 = plant dead)

The disease severity was valuated using Townsend-Heuberger's formula **[12].**

Statistic Analyses

Data were analyzed by analysis of varience (ANNOVA) to detect differences between tomato varieties. Mean comparisons were made using TUKEY tests; all statistical tests were conducted at a probability level of $P \leq 0.05$. All analyses were performed using the SPSS 21 software.

RESULTS AND DISCUSSION

As a result, Mercury, Polaris, Alsancak, Kuzeyköy, Tory varieties were determined to the most resistant against FOL. The rate of FOL were observed 7% in Kahraman and Tayfun varieties. According to the results FOL disease was detected in Asil, Alaturka, Arzum, Dorit and Seval varieties more than other tomato varieties (Fig. 2). In the experiment, the highest disease severity was found in varieties Toprak, SC2121 and H2274d, which were also known susceptible to FOL (Table 2).

Fig 2. Tomato plantless inoculated with FOL

Table 2. FOL disease severity in tomato varieties (%)

Variety	Disease severity (%)	Variety	Disease severity (%)
Merkür	0a	Tory+Arazi	0 a
Polaris	0 a	Yakup	17 abc
Tayfun	7 a	Seval	38 c
Alsancak	0 a	Arzum	14 ab
112	10 a	Kahraman	7 a
Dorit	32 bc	Asil	10 a
535	14 ab	H2274	95 d
Kuzeyköy	0 a	SC2121	92 d
Alaturka	14 ab	Toprak	80 d

With ever increasing tomato production shifting to high tunnels and greenhouses, the importance of identifying tomato varieties with a good disease resistance package takes center stage. Plants and plant disease pathogens have led to complex mechanisms of attack and defence Plant defence system is the ability to perceive pathogens and to activate effective defence responses [14]. Resistance plant involves plant resistance (R) proteins which detect specific effec-tor (Avr) proteins produced by the pathogen. Three R genes have been reported in tomato for FOL: the I and I-2genes from S. pimpinellifolium, which confer resistance against Fol races 1 and 2, respectively, and the I-3 gene from S. pennellii, which confers resistance to Fol race 3 [15, 16]. Until now, some of disease resistance genes to FOL have been used successfully in plant breeding. The use of resistance tomatoe varieties obtained from breeding programs has created a good alternative to applications such as pesticides.

It is very important to identify the dominant resistance genes, to understand the interactions between pathogens and plants. To achieve this aim, it is absolutely necessary to make use of molecular markers in tomato breeding. The effective application of functional genomic information in disease resistance will help not only to understand the signaling system in plant defense but also to understand the interactions between signaling systems and other molecular functions that occur in plants. A good understanding of these functions and the use of intelligent combinations of different applications will provide significant contributions to the development of resistance plant varieties and to the promotion of resistance in plants.

Generally, most commercial tomato varieties carry either one or two of the I-1 and I-2 genes against FOL disease [17]. As a result, it is absolutely necessary to use disease resistant plants against FOL disease.

REFERENCES

[1] Aybak, H.Ç., Kaygısız, H., 2007. Serada ve Tarla alanında Domates Yetiştiriciliği. Hasad yay. 296 s.

[2] FAO, 2010. Food and Agriculture Organization of the United Nations

[3].TÜİK, 2016. Türkiye İstatistik Kurumu. Erişim Tarihi: 03.09.2017, http://www.tuik.gov.tr/Start.do

[4] Özer, N., Soran, H., 1991, *Fusarium* genus and *Fusarium* species isolated from the cultivated plants in Turkey. J. Turk. Phytopath., 20(2-3):69-80.

[5] Yücel S., 1989. Domates *Fusarium* solgunluğuna (*Fusariumoxysporum Schlecht. f.sp. lycopersici*(Sacc.) Snyd. andHans) karşı biyolojik kontrolde antagonistlerin ve toprak solarizasyon uygulamasının karşılıklı etkileşimlerinden yararlanma olanakları üzerinde araştırmalar. Adana Zir. Müc. Araş. Enst. Müd. Araştırma Yayınları Serisi Yayın No: 64, Ankara.

[6] Stevens, M.A., Rick, C.M. 1986. Genetics and breeding. In: J. G. Atherton, and J. Rudich (eds), The Tomato Crop, 35—109. Chapman & Hall Ltd, London.

[7] Beckman, C.H., 1987. The Nature of wilt diseases of plants. APS Press, St Paul, MN, 1—175.

[8] Davet, P., Rouxel, F., 2000. Detection and ısolation of soil fungi. Science Publishers, Inc., Enfield, NH, USA

[9] Booth, C., 1977. *Fusarium*, laboratory guide to the ıdentification of the major species. Commonwelth Mycological Institute, Kew, Surrey, English.

[10] Gerlach, W., Nirenberg, H.I.,1982.The Genus *Fusarium*—a Pictorial Atlas. Mitt Biol Bundesanst Land-u Forstwirsch Berlin-Dahlem 209,1-406.

[11] Nelson, P.E., Toussoun, T.A., Marasas, W.F.O. 1983. *Fusarium* species, An Illustrated Manual for Identification. Pennsylvania State University Press, University Park. 193pp.

[12] Townsend, G.K., Heuberger, J.W. 1943. Methods for estimating losses caused by diseases in fungicide experiments. Plant Dis. Reptr., 27, 340-343.

[13] IBM Corp. Released 2012. IBM SPSS Statistics for windows, version 21.0. Armonk, NY: IBM Corp

[14] Grube, R.C., Radwanski, E.R., Jahn, M. 2000. Comparative genetics of disease resistance within the Solanaceae. Genetics, 155: 873–887.

[15] Parker, J.E., 2000. Signalling in plant disease. Annu. Plant Reviews, Mol. Plant Path., Vol 4., 143-174

[16] Houterman, P.M. Cornelissen, B.J.C. Rep. M., 2008. Suppression of plant resistance gene-based ımmunity by a fungal effector, PLoS Pathogensol 4(5):1-6

[17] El Mohtar, C.A., Atamian, H.S., Dagher, R.B., Abou-Jawdah, Y., Salus, M.S., Maxwell, D.P. 2007. Marker-assisted selection of tomato genotypes with the ı-2 gene for resistance to *Fusarium oxysporum* f.sp. *lycopersici* race 2. Plant Dis., 91:758- 762.