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Determination of Variety Reaction to Potato Wart Disease (*Synchytrium endobioticum*) in Potato Planting Areas of Nevsehir Province, Turkey

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ABSTRACT

Potato wart disease is caused by the soil borne fungus *Synchytrium endobioticum* (Schilberszky) Percival belong to *Chytridiomycetes* class as an obligate fungus. In order to determine the varietal reactions against the pathogen, an experiment was conducted in Derinkuyu district in Nevşehir, in 2008. Thirty varieties including industrial and table ones, were used in the trial. The lowest disease intensity ratio (11.1%) was recorded on Jelly variety. In addition, 15 varieties showing much tolerant reaction than Jelly variety were placed in the same group, statistically. Binella was found as the most susceptible variety with the disease intensity in rate of 26.2 %. In general, the most resistant variety was Jelly (11.1 %) and the most susceptible variety was Binella (26.2 %). Nearly half of the varieties showed disease intensity ratios between 11.1–15.4 %, and the rest showed 16.0-26.2 % disease reaction.

Key Words: Potato, *Synchytrium endobioticum*, susceptibility, resistance

INTRODUCTION

Potato (*Solanum tuberosum* L.) as a member of *Solanaceae* family, originated Peru and the Andean region of Bolivia. Potato was introduced to our country at the end of 19th Century, first of all in Eastern Black Sea region, and then the west of Thrace (Simsek, 2002).

According to 2009 data, potatoes had 18.326.242 hectares of plantation area, 329.556.911 tons of production and 1798,3 kg of yield around the world. According to 2009 data, the planting area was 142.684 hectares, production 4.397.711 tons and the yield 3082,1 kg in Turkey (FAO, 2009). Turkey ranked number seven after China, Russia, India, Poland, USA and Germany in terms of the amount of planting area and production (Anonymus, 2002).

The potato wart disease spread at the end of the nineteenth century from its original range in the Andes in South America to parts of North America and Europe and then other potato growing countries like in Asia, Africa, and Oceania continents (EPPO/CABI, 1997). Potato Wart Disease is caused by the soil borne fungus *Synchytrium endobioticum* (Schilberszky) Percival belong to *Chytridiomycetes* class as an obligate fungus (Langerfeld, 1984). Resting spores of the fungus in soil are extremely long lived, in the range of 10-40 years or more (Langerfeld, 1984; Laidlaw, 1985; Hampson, 1996; EPPO/CABI, 1997; Strachewicz ve Langerfeld, 1998).

The pathogen usually preferring cool climates is known to exist in 43 countries today (Baayen et al. 2006). Losses due to the disease have been changing between 50 and 100 percent worldwide (Hampson, 1993; Melnik, 1998). The first determination of disease was taken place in 1992 in Ordu (Aybastı), Niğde (Ağcaşar) and Nevşehir (Kaymaklı, Derinkuyu) in Turkey.

A typical symptom of the disease occurring on tubers is cauliflower-like warts or tumors of different sizes. Initially the size of warts changes from pea size to hand punch size with white to green color. Above-ground warts are green but later become black and subterranean warts are white to brown, becoming black on decayed area (Hampson, 1981). The disease can cause symptoms to the underground components of potato plants including crown, stolons and tubers except roots (Hampson ve Haard, 1980).

Phytosanitary regulations, national and international, have been applied throughout the world for nearly a century to prevent spread of the fungus. The time that infected fields are identified, strict phytosanitary control and prohibition of cultivation of susceptible cultivars have been the main components of official control. Because the serious nature of the disease and the fact that spores can remain viable in the soil for many years it has to be controlled in the European Union by a Wart Disease Directive (EU, 1969). According to the legislation, potatoes cultivation does not allowed on the area which an outbreak has occurred. Therefore, only the resistant cultivars may be grown in a safety zone around the infected sites.

The purpose of this study was to find out the efficacy of some applications to provide a base for Potato Wart Disease control, since there is any control measures exist, apart from quarantine legislations in Turkey. For this purpose, susceptibility of potato varieties was tested to the pathogen in the soil.

MATERIALS AND METHODS

In this study, 30 potato varieties were used which are commercially grown in Turkey, named as; Agata, Agria, Almera, Ambition, Anuckha, Armada, Binella, Cosmos, Elfe, Elodi, Esprit, Faluca, Floris, Hermes, Jelly, Consul, Latona, Madeleine, Marabel, Maranca, Marfona, Markies, Matador, Milva, Presto, Provento, Safran, Sante, Van Gogh, Zafira.

In order to determine the variety reactions against the pathogen, a study was conducted in Derinkuyu district in Nevşehir, in 2008. A total of 30 varieties including industrial and table ones were used in the trials. The experiment was established according to completely randomized design with three replications. The study was conducted on infested soil in the pots (25 cm) in the open air. The pots were filled with *S. endobioticum* infected soil from Derinkuyu and two potatoes from each potato varieties were planted. And then, 150g of inoculum from the pathogen compost was prepared like the method of Spieckermann and Kothoff (1924) added in the pots and covered with infected soil. At the end of the vegetation period of 120 days, the plants were pulled out and all the underground plant parts, root, underground housing, stolons and tubers were evaluated (Figure 1). After harvest, the tubers' wart development was evaluated for the stem base, stolons and tubers by rating on the scale of 1-9 (EPPO, 2004) where 1=Not affected, 2=Single proliferation (<5 mm), 3= 2 or 3 proliferations (<5 mm) or a single larger one (5-10 mm), 4=Several small warts (5-10 mm), 5=Several medium-sized warts (>10mm), 6=Several large warts, at last one of these being > 10 mm, and beginning deformation of the tuber, 7=Large warts with a diameter of > 10 mm and disruption of tuber formation, 8=Very large warts, but individual tubers still recognizable, 9=Very large warts, no normal tubers present.

Preparation of *Synchytrium endobioticum* Inoculum and Compost Production

S. endobioticum inoculum and compost production were prepared using the fresh warts on potato tubers according to the method of Spieckermann and Kothoff, (1924). Compost inoculums were obtained from the Nevşehir province. The warts were cut approx. 1cm. in size and added to sand by one portion of wart in three portions of sand (1W:3S). The mixture was incubated at 18-25°C in dark for six months and the experiments were conducted with two replicates. The production of compost was completed in three steps:1) one-third of the wart and sand mixture in the clean trays were wetted with tap water and stirred every day during a period of two months. 2) wetting and stirring processes were carried out in weekly intervals for two months 3) the compost left to dry without any wetting and stirring process and kept at +4°C for further use.

Figure 1. Wart on potato stolons, stem base and tuber

Disease severity scale of values was calculated and variance analysis was applied to these values. Later, by LSD multiple comparison tests with the varieties of *S. endobioticum* been in their sensitivity showed differences between (Karman, 1971).

RESULTS AND DISCUSSION

In this work, 30 potato varieties which grown commercially in Turkey were tested for the variety reactions against the pathogen. Sensitivity tests were carried out in the field on all the varieties. In the pot tests, all plants were removed from the soil at the end of the ripening period, and then evaluated according to the scale of 1-9 in terms of formation of the potato wart.

The cultivars were classified into resistance categories as given in Table 1. The lowest disease development was recorded from Jelly variety as 11.1 %. In addition, 15 varieties showing much tolerant reaction than the Jelly were placed in the same group, statistically. Binella was found as the most susceptible variety with the disease development in a rate of 26.2 %.

In general, the most resistant and most susceptible varieties were Jelly (11.1 %) and Binella (26.2 %), respectively. However, the average disease incidence was resulted in between the range of 11.1–15.4 % in the half of the varieties and 16.0-26.2 % in the rest (Figure 2).

Table 1. Sensivity of Potato varieties to *Synchytrium endobioticum*

Variete	Disease severity(%)		Variete	Disease severity(%)		Variete	Disease severity(%)	
Jelly	11,1	a*	Floris	14,2	ab	Cosmos	18,7	b
Matador	11,4	ab	Marabel	14,2	ab	Marfona	18,3	b
Madeleine	11,7	ab	Sante	14,3	ab	Agria	19,8	bc
Almera	12,0	ab	Maranca	15,4	ab	Esprit	20,0	bcd
Van Gogh	12,6	ab	Zafira	15,4	ab	Armada	20,2	bcd
Safran	13,1	ab	Hermes	16,0	ab	Presto	20,7	bcd
Ambition	13,2	ab	Agata	17,3	ab	Provento	22,2	bcd
Anuckha	13,3	ab	Milva	17,3	ab	Consult	23,5	bcd
Elfe	14,0	ab	Markies	17,4	b	Elodi	25,1	cd
Faluka	14,1	ab	Latona	17,4	b	Binella	26,2	d

* Different letters of means are statistically different by LSD(0.05) test

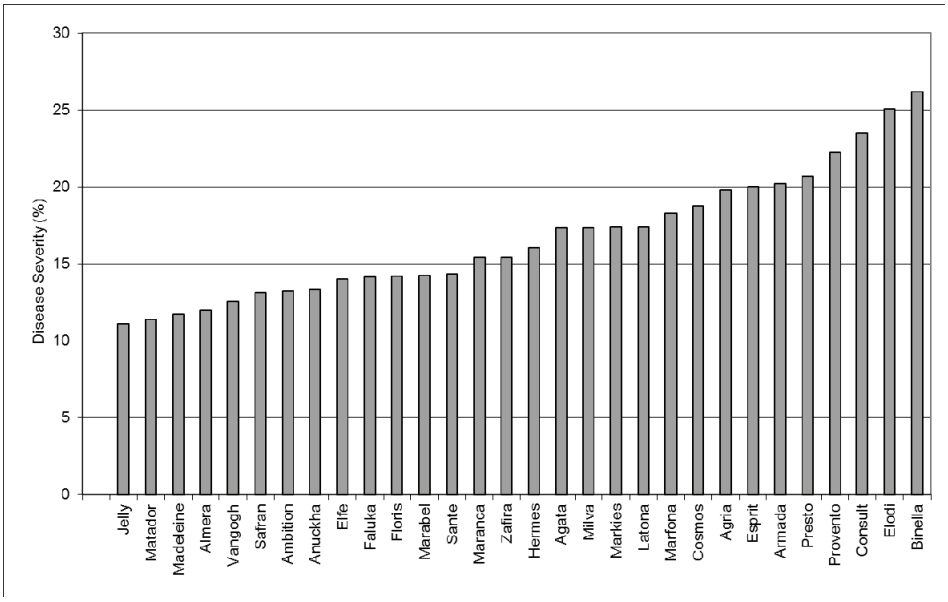

Figure 2. Levels of sensivity potato varieties to *Synchytrium endobioticum*

Agria commonly grown in the region is being referred as susceptible to some sources. In this study it also showed that the severity of disease rate was 19.8% in this variety. The varieties of Van Gogh, Latona and Provento referred as resistant in some literature, however in our study it showed a disease severity of 12.6 %, 17.4 % and 22.2% respectively. The variety Provento is similar to the most susceptible variety Binella. Van Gogh has given similar results like Jelly which is the most resistant.

The study done for determining the resistance and susceptibility reactions of potato varieties against potato wart disease showed that the severity of disease was between 11.1% (in Jelly, the most tolerant) and 26.2% (in Binella, the most susceptible). According to the studies in the region and observations and manufacturers' statements, the varietiy of Van Gogh is resistant to the disease. Van Gogh and 16 potato varieties which were statistically in the same group, they may likely to be tolerant against *S. endobioticum* in the region. However, a comprehensive study may clarify this issue with determining distribution and density of all the races of pathogen in the region.

Because of the intense pressure of inoculum, both the land intensive sporangium and wart compost added to soil in pot trials, the infection was ranged between 11.1-26.2% in some potato varieties. It may not sufficient to say

these cultivars susceptible or resistant under those extreme conditions. There were some studies done in different regions in Turkey, but they were not on isolates of pathogen and their densities in the location. Only one study was carried out on reactions of potato cultivars with 6 isolates of the pathogen collected from Nevsehir and Ordu. They found that the cultivar reactions and isolates of pathogen gave different reactions in 2005 and 2007 years trials. The cultivar Miriam was resistant against Nevşehir 1 isolate in 2005 and susceptible in 2007 (Cakir et al., 2009).

The observations at the harvest time for 3 years and with growers' statements in potato fields in Nigde and Nevsehir provinces showed that the Van Gogh variety is disease resistant one. In this case, the type of Van Gogh and statistically in the same group, which include the 16 potato cultivars in some regions of there may be likely to be tolerant against to *S. endobioticum*. However, the result may be much clear on this issue with a study on the distribution and density of all the isolates of pathogen can reveal by a comprehensive study.

ÖZET

NEVŞEHIR İLI PATATES EKILIŞ ALANLARINDA PATATES SİĞİL HASTALIĞI (*SYNCHYTRIUM ENDOBIOTICUM*)'NA KARŞI ÇEŞİT REAKSİYONLARININ BELİRLENMESİ

Patatesin en önemli yumru hastalığı olan Patates Siğil Hastalığı'na *Synchytrium endobioticum* (Schilb) Percival neden olur. Etmen, *Chytridiomycetes* sınıfına ait, toprak kökenli ve obligat bir fungustur.

Patates çeşitlerinin patojene karşı reaksiyonlarının belirlenmesi amacıyla 2008 yılında Nevşehir ili Derinkuyu ilçesinde bir deneme yürütülmüştür. Denemede 30 adet sanayilik ve sofralık patates çeşidi kullanılmıştır. En düşük hastalık şiddeti %11.1 oranı ile Jelly çeşidinde görülmüştür. Jelly çeşidinin ardından daha yüksek hastalık şiddeti gösteren 15 patates çeşidi de istatiksel olarak aynı gurupta yer almıştır. Binella patates çeşidi %26.2'lik hastalık şiddeti ile en duyarlı çeşit olarak bulunmuştur. Genel olarak değerlendirildiğinde denemedeki çeşitlerin en dayanıklısı Jelly (%11.1) ve en duyarlısı Binella (%26.2) olup, tüm çeşitlerin yaklaşık yarısı %11.1-15.4 arasında, diğer yarısı da %16.0-26.2arasında hastalık şiddeti göstermiştir.

Anahtar Kelimeler: Patates, *Synchytrium endobioticum*, duyarlılık, dayanıklılık

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