THE ROLE OF THE STOCK EFFECT IN THE DEVELOPMENT OF HINDERING OF THE PAPRIKA POWDERY MILDEW (*LEVEILLULA TAURICA ARN.*) INFECTION

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Abstract
The powdery mildew is a frequent fungi infection appearing in the intensive paprika growing, which causes rather serious economic loss despite of the integrated plant defense. The leaf necrosis it brings about appears within 20 days as a result of the high humidity (80-90%), and 26-30 °C temperature, mostly in foil-covered growing facilities irrespectively of the forcing periods. Following this, the plants and the development of the fruits cease. In our experiment, we used a cherry shaped pepper as rootstock that was selected from a substance growing wild in Mexico only (*Capsicum annuum var. cerasiforme* L.). It showed a significant resistance against the infection of the paprika powdery mildew (*Leveillula taurica* Arn.). Under the experimental conditions no powdery mildew infection appeared on the leaves of the scion paprika during the whole growing period. The stock's root system had a low AM-type mycorrhiza contact.

Keywords: grafting, powdery mildew, mycorrhizal contact, reactive oxygen species

INTRODUCTION

The pathogen paprika powdery mildew (*Leveillula taurica* Am) is present in Hungary since 1972 primarily causing economic size damages in the paprika growing, but does not appear in open field growing (GLITS & FOLK, 2000). The asexual form of the pathogen is *Oidiopsis taurica*. It is an endophytic parasite. The symptoms appear on the leaves only. The conidiums penetrate through the stomata into the leaf tissues (PALTI, 1988). The resistance capacity is increased by the fact that the stock's adaptational ability brings about better nutrient and water utilisation, increased vigor and a bigger yield in the scion. In this mechanism the activity of the mycorrhiza fungi penetrating into the tissue of the roots then living in symbiosis with them play an important role. The mycorrhiza fungi can grow in the root's risosphera and concerned risoplan (SMITH ET AL., 1994).
The aim of our work was to determine the effect of rootstock on the appearance of powdery mildew infection on the scion compared to the plants of the same variety grown on their own roots.

MATERIAL AND METHOD

Our research was carried out on the Southern Great Plain, Szentes in the summer of 2011 (from May - to August), and in the autumn of 2012 (from September – to February) in the growing period. The peppers were grown in a 25 m long, 9 m wide plastic-covered growing facility. We used cherry shaped pepper as rootstock that was selected from a plant population growing wild only in Mexico and bred in Szentes (*Capsicum annuum var. cerasiforme* L.). The scion was the paprika variety Total. It is bred Szentes. For grafting

the plain matching method was used. Peppers grown on their own roots were planted in a row distance of 40 cm and plant distance of 30 cm. In the growing facility, independently of the growing period, beside 80-90% relative humidity we provided 26-30 °C daytime and 18 °C nighttime. We supported the natural powdery mildew infection by the humidity condensed at night and by the high temperature. Following the symptoms appearing on the substance 30 pieces of Total sweet pepper seedling grafted onto cherry shaped pepper were planted between the infected peppers. The appearing the phases of the development of powdery mildew symptoms on the leaves were surveyed by visual plant diagnosis, and analysed by microscopic examination (*Figure 2*). The photos were taken by Canon DS camera. We did not apply chemical plant protection against the infection. At the end of the growing we examined the root system of 30-30 peppers cultivated on their own roots or concerned from the graft seedlings. At the end of the growing we fixed the roots in 50% ethyl alcohol solution until the beginning of the examinations then purified them again before the painting in 10% KOH solution. We established the mycorrhiza symbiosis on the roots with aniline blue substance (PHILIPS & HAYMAN, 1970). Following the painting we estimated the frequency of the mycorrhiza and its measure by the method of TROUVELOT ET AL. (1986). We carried out the examination of the salicylic acid concentration of the infected leaves and of the ones without symptoms.
The ROS level examinations of the leaves were carried out both on infected plants and on the asymptomatic sweet pepper leaves.

RESULTS

During the examination of the plants it was found that all the root-grown peppers were infected with conidia of powdery mildew in different phases after May 2011 and after October 2012. The appearance of pepper powdery mildew (*Leveillula taurica* Arn.) in the above described forcing conditions was observed in the summer period 2 weeks later after planting in May than it had been experienced during the autumn period. It is likely that in the autumn-winter months, due to the less sunlight, the moisture condensation caused by the difference between day and night temperatures and less ventilation possibility the mildew conidia developed more intensively. The symptom phases set up by visual plant-diagnosis and microscopic examination were ranked by the color and dimension of the spots caused by conidia in both growing periods. Accordingly, on the 5th day, 12th day and 20th day irreversible infection categories were distinguished (*Figures 1* and *2*).

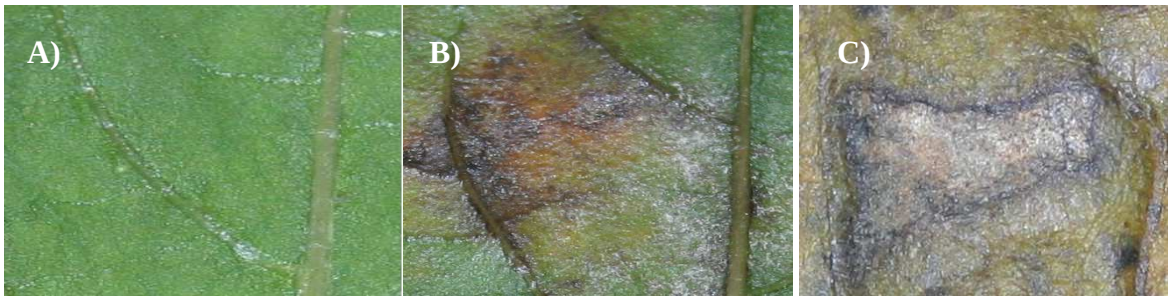

Figure 1. The symptoms of powdery mildew (*Leveillula taurica* Arn.) by via visual plant diagnosis. Symptoms on 5th day A), on 12th day B), on 20th day C)

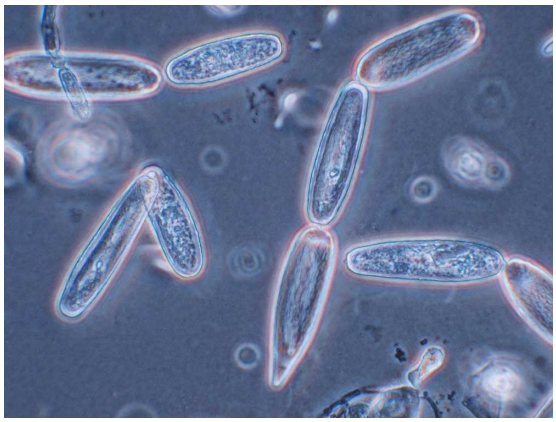

Figure 2. Advanced state of conidia of *Leveillula taurica*

After studying the infected areas it was concluded that under the described forcing conditions the conidia formed continuous conidia bundles on the back of the leaf within 12 days, which caused the complete destruction of chlorophyll in the leaf tissue structure in 20 days. Consequently, the infected area as a whole necrosed. In the control group, however, where plants were grafted onto cherry shaped pepper no powdery mildew fungus infection was found. During the root mass mycorrhizal symbiosis examination it was found that the peppers grown on their own roots as well as on the roots of those grafted there was nearly equal, although insignificant about 30% of AM-scale type of mycorrhizal relationship discovered (*Figure 3*).

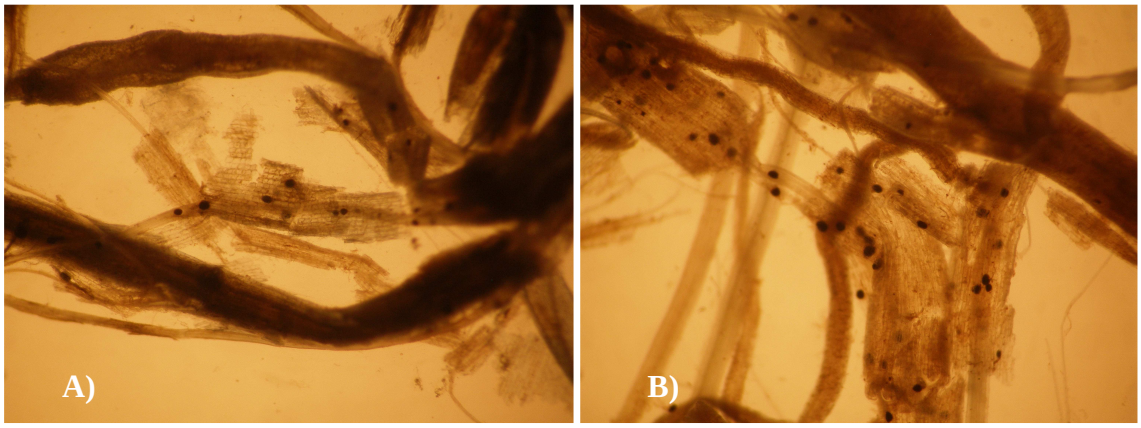

Figure 3. The root mycorrhizal symbiosis of grafted A) and non grafted sweet peppers B)

The grafted, healthy and infected leaves of plants were examined under laboratory conditions at the Hungarian Academy of Sciences Plant Protection Research Institute. During our measurements it was recorded that the reactive oxygen species (ROS), especially hydrogen peroxide (H_2O_2), were extremely concentrated in the leaves of grafted peppers while none of these were found in the infected peppers grown on their own roots (KIRÁLY, personal communication). The large hydrogen peroxide concentration had influenced the inhibition of powdery mildew infection the most. The subjective sensory tests have shown that the cherry shaped pepper stock did not make the peppers lose their characteristic sweet pepper taste or their pleasing shape. The value measuring properties of

non grafted and grafted pepper crop taken from the average of the results of three pickings are shown in *Table 1*.

Table 1. General results of Total sweet pepper in 2011 and 2012

	Total sweet pepper	
Properties of peppers	**protected (Amistar), non grafted**	**grafted**
fruit weight (g)	113,5	105,1
thickness of fruitwall (mm)	7	8,56
root mass (g)	18,8	19,9
powdery mildew infection (%)	**non protected, non grafted** 90	-

CONCLUSIONS

Based on the results of the different forcing periods, it was found that the cherry peppers (*Capsicum annuum var. cerasiforme* L.) as a crop and also as a stock plant is highly resistant to powdery mildew infection. This can be explained by the accumulation of hydrogen peroxide conveyed by the roots. Several studies have demonstrated the fact that mycorrhizal relationship of the root induces better nutrient uptake and resistance in the plants. However, the results of our experiments showed that mycorrhizal symbiosis did not play an important role in the inhibition of powdery mildew infection. The results of the tests of peppers grown under Southern Great Plain conditions suggest that the powdery mildew infection can be prevented well by grafting peppers on cherry shaped pepper rootstock. Plant protection against powdery mildew infection in case of plants grafted on cherry shaped pepper of Szentes will no longer be necessary neither in the summer nor in the autumn growing periods. The grafting had no effect on the pleasing shape of the pepper bells.

The further significance of the application of the cherry shaped pepper of Szentes as rootstock is that the grafted peppers can also be used in organic cultivation.

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