EFFECTIVENESS OF BIOFUNGICIDES BIOCZOS S AND POLYVERSUM USED TO SOAK STRAWBERRY CUTTINGS IN VERTICILLIUM WILT DISEASE CONTROL

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Abstract: The objective of the work was to assess the effectiveness of biofungicides Bioczos S and Polyversum applied by soaking cuttings prior to planting to control Verticillium wilt in strawberry. Studies included two strawberry cultivars (Honeoye and Elvira) with different resistance to Verticillium wilt. An experiment was established in a Verticillium wilt infected field.

Strawberry cv. Elvira was more resistant to Verticillium wilt than Honeoye. It was found that the preparations applied in the experiment did not provide sufficient protection of both strawberry cultivars tested against Verticillium wilt. For Honeoye all the fungicides, in particular Previcur 607 SL and Bioczos S supplemented with humic acids, assured better survival of mother plants compared with the control. This cultivar was also characterized by higher yields obtained following application of fungicide Previcur 607 SL. No impact of either preparation on the number of runner plants was found.

Key words: strawberry, Verticillium wilt, biological control, runner cuttings, yield

INTRODUCTION

In recent years an increased interest of producers in dessert strawberry cultivars was observed in Poland. Associated intensification of production was followed by an increased incidence of a number of diseases, including root system diseases. An example of these is Verticillium wilt to which most dessert cultivars are susceptible (Łabanowska and Bielenin 2002; Meszka and Bielenin 2004). The disease is caused by fungus *Verticillium dahliae* Kleb. which is a soilborne pathogen widely distributed in Poland. Once established, the fungus causes considerable losses in fields where cultivars susceptible to infection, like Honeoye and Elsanta, are cultivated. The losses may amount to as much as 80% (Łabanowska *et al.* 2004; Meszka and Bielenin 2005; Bielenin 2007). Marked losses are also observed for cultivars Syriusz, Gerida, Camarosa, Kent or Onda (Meszka and Bielenin 2005; Masny and Żurawicz 2008). However infection is sometimes acquired by cultivars which are assumed to be tolerant to Verticillium wilt, especially when the amount of fungus propagation units in soil is high.

In order to prevent the occurrence of the disease it is crucial to choose a pathogen-free field and healthy material from nurseries, and to grow resistant cultivars. It is troublesome or sometimes impossible to assess whether the pathogen is present in the soil before strawberry plantation establishment. Moreover, it is not possible to control the disease when the strawberry field has been infected. As a result, prophylaxis is the best way to prevent the occurrence of the disease. Partial protection against Verticillium wilt can be obtained when a synthetic fungicide Topsin M 500 SC or Benlate are used to soak plants prior to planting or to water seedlings following their planting (Profic-Alwasiak *et al.* 1977/1978; Meszka and Bielenin 2004; Meszka *et al.* 2006). Also attempts are made to use biological preparations to protect strawberry against Verticillium wilt (Meszka and Bielenin 2005; Meszka *et al.* 2006).

The objective of this work was to evaluate the effectiveness of biofungicides Bioczos S and Polyversum in Verticillium wilt control of strawberry.

MATERIALS AND METHODS

An experiment was carried out in the years 2005–2006 on a farm owned by the University of Podlasie in Siedlce.

Two strawberry cultivars with different tolerance to Verticillium wilt were selected for examination: Honeoye and Elvira. The experiment was set up for each cultivar separately. The experimental design was randomized blocks with four replicates for each treatment. Plants of

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each cultivar were planted in separate rows. One plot consisted of 10 plants of each cultivar planted at the spacing of 0.35x0.5 m. The experiment was located on a Verticillium wilt infected soil originating form heavy loamy sand. Prior to planting, seedlings were soaked for 30 minutes in suspensions of the following preparations:

– Polyversum (oospores of fungus *Pythium oligandrum*) – 0.05%
– Bioczos S (extract from garlic) – 2%+hiumic acids – 0.4%
– Previcur 607 SL (propamocarb) – 0.25%.

A control treatment consisted of plots with non-treated plants.

In the first year of strawberry cultivation plant survival rate and numbers of runner plants produced by mother plants were recorded. In the next year, apart from survival rate, plant yield was also assessed.

The obtained results were statistically analysed by the analysis of variance and means were compared by Tukey's test at the significance level of 0.05 and 0.01.

RESULTS AND DISCUSSION

The performed studies revealed that, in general, survival of Elvira seedlings was better than that of Honeoye (Table 1).

Table 1. Average survival rate of maternal seedlings (number per plot)

Fungicides	Cultivars	
	Elvira	Honeoye
1. Polyversum	5.50 A	4.25 A
2. Bioczos S+humid acids	5.75 A	4.62 A
3. Previcur 607 SL	5.12 A	5.25 A
4. Control	6.88 B	3.50 A
Mean	5.81 b	4.41 a

LSD for cultivar x combination = 1.60
A, B – means followed by same letters are not significantly different at p = 0.05
LSD for cultivars = 0.79
a,b – means followed by same letters are not significantly different at p = 0.01

The number of control plants of cv. Elvira which remained alive was significantly higher compared with cv. Honeoye (Table 1), this indicates that the latter cultivar is more susceptible to Verticillium wilt (Meszka and Bielenin 2004; Bielenin 2007). As far as cv. Elvira was concerned, none of the preparations examined significantly influenced the plant survival rate compared with the control (Table 1). Despite the lack of significant differences, in Honeoye a tendency was observed for all the preparations to affect positively the number of surviving plants compared with the control (Table 1). The most effective preparation was Previcur 607 SL, for which the average survival rate of seedlings amounted to 17.5% compared with the control plots (Table 1). Many studies indicate a possibility of controlling Verticillium wilt in strawberry as a result of the application of synthetic fungicides, such as Topsin M 500 SC or Benlate (Profic-Alwasiak *et al.* 1977/1978; Rebandel 1993; Meszka *et al.* 2006). Partial protection of Honeoye cuttings against Verticillium wilt was also obtained when, prior to planting, the plants were soaked in solutions of Polyversum and Bioczos S supplemented with hiumic acids, the application of Bioczos being followed by higher for cutting survival rate than Polyversum (Table 1).

In the first year of the study average survival rate of Elvira and Honeoye seedlings was 62.5 and under 50%, respectively (Table 2).

Table 2. Number of maternal seedlings per plot which survived in first year of the experiment (until 11 November 2005)

Fungicides	Cultivars			
	Elvira		Honeoye	
	number	[%]	number	[%]
1. Polyversum	5.75	57.50	4.50	45.00
2. Bioczos S+hiumic acids	6.50	65.00	5.00	50.00
3. Previcur 607 SL	5.75	57.50	6.00	60.00
4. Control	7.00	70.00	4.25	42.50
Mean	6.25	62.50	4.94	49.40

Not significant differences

Verticillium wilt symptoms i.e. drooping, wilting of the oldest leaves and then of whole plants which finally turned dry, were particularly visible during dry and hot weather. Initially, the first disease symptoms could be noticed on individual seedlings, then patches of dead plants were observed over the whole area of strawberry cultivation. There was a sudden development of the disease in the first year. Meszka and Bielenin (2005) claimed that young plants are more affected by the disease, which is enhanced by poor seedling rooting. Statistical analysis of results for both Elvira and Honeoye did not show a significant effect of examined preparations on the seedling survival rate in the first year of the experiment. Only for Honeoye a tendency was observed for the increase in survival rate of seedlings in all treatments, compared with the control (Table 2).

In the second year, plant mortality for both cultivars was even higher. The average numbers of Elvira and Honeoye plants which survived were by 8.5 and 10.4% lover, respectively than in the first year (Table 3). However, much less severe symptoms of the disease developed.

As in the case of Elvira cultivated in the first year, none of the preparations stimulated the growth of the seedlings that had survived, the tendency observed for Honeoye in the first years being the same in the next year of study. Synthetic Previcur 607 SL best protected Honeoye seedlings against the disease. In the group of biofungicides studied a tendency was observed which indicated that Bioczos S with an addition of hiumic acids was more effective in protecting seedlings against Verticillium wilt

compared with Polyversum. For Bioczos S and Polyversum the average plant survival rate was respectively by 15 and 12% higher compared with the control, the difference being non-significant (Table 3). Meszka *et al.* (2006) applied a *Trichoderma* fungus-based biological preparation and observed a markedly limited occurrence of Verticillium wilt. When applied prior to planting, the preparation inhibited Verticillium wilt incidence by 40–60%.

Table 3. Number of maternal seedlings per plot which survived to end of the experiment (29 June 2006)

Fungicides	Cultivars			
	Elvira		Honeoye	
	number	[%]	number	[%]
1. Polyversum	5.30	53.00	4.00	40.00
2. Bioczos S+hiumic acids	5.00	50.00	4.30	43.00
3. Previcur 607 SL	4.50	45.00	4.50	45.00
4. Control	6.80	68.00	2.80	28.00
Mean	5.40	54.00	3.90	39.00

Not significant differences

The number of runner plants obtained form mother plants varied and depended on the cultivar (Tables 4, 5). In general, Elvira produced more runner plants than Honeoye. For both cultivars, the applied fungicides did not significantly influence the number of runner plants produced by mother plants from both quality groups, in comparison with the control (Tables 4, 5).

Table 4. Average number per plant of strong and well-rooted seedlings obtained from one maternal plant depending on the treatment

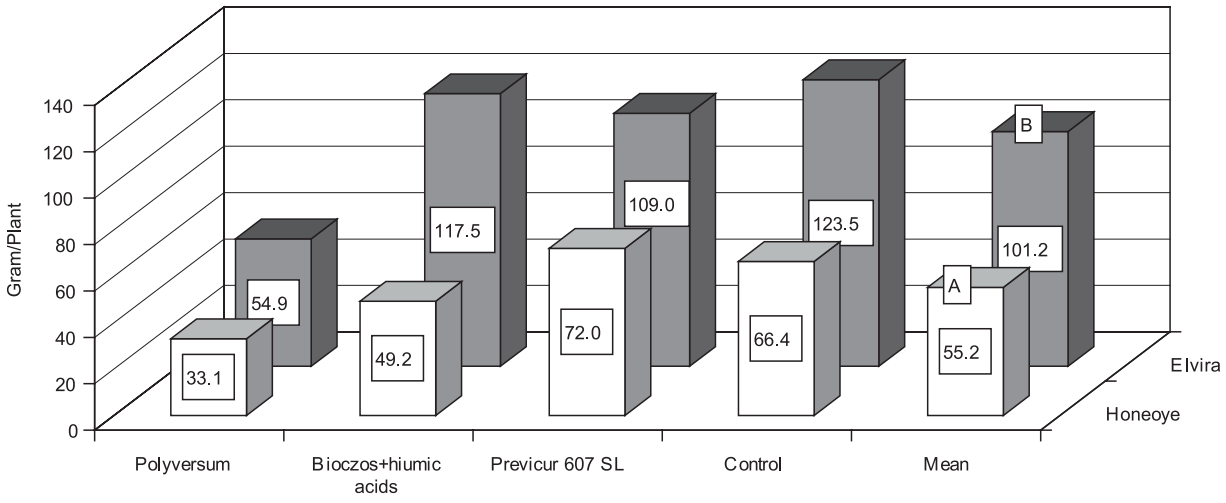
Fungicides	Cultivars	
	Elvira	Honeoye
1. Polyversum	6.45	5.74
2. Bioczos S+hiumic acids	8.87	6.33
3. Previcur 607 SL	9.27	4.43
4. Control	11.01	7.24
Mean	8.90 B	5.93 A

LSD for cultivars = 1.78
A, B – means followed by same letters are not significant different at p = 0.01
Not significant means for cultivar x treatment

Table 5. Average number of remainder seedlings obtained from one maternal plant depending on the treatment (number per plant)

Fungicides	Cultivars	
	Elvira	Honeoye
1. Polyversum	24.88	11.81
2. Bioczos S+hiumic acids	32.87	16.40
3. Previcur 607 SL	26.13	9.75
4. Control	36.66	19.28
Mean	30.14 B	14.31 A

LSD for cultivars = 5.23
A, B – means followed by same letters are not significantly different at p = 0.01
Not significant means for cultivar x treatment



LSD for cultivrs = 38.6
A,B – means followed by same letters are not significantly different at p = 0.05
Not significant means for cultivar x combination

Fig. 1. Average commercial yield of cv. Honeoye and Elvira after fungicide application (gram/plant)

In the second year, the effect of the preparations on strawberry yield of Honeoye and Elvira was examined. Although none of the fungicides significantly influenced yield of both cultivars, Elvira produced higher yield than Honeoye (Fig. 1).

Only for Honeoye a small increase (of about 9.5%) of strawberry marketable yield was obtained compared with the control when Previcur 607 SL was applied, however the difference was not statistically significant.

CONCLUSIONS

1. Strawberry cv. Elvira was more resistant to Verticillium wilt than Honeoye. It was reflected by increased yield and a significantly higher seedling survival rate as well as a higher average number of runner cuttings produced by one mother plant.
2. Fungicides used in the experiment did not provide sufficient protection of either strawberry cultivar tested against Verticillium wilt.
3. Despite a lack of significant differences, all the preparations applied in the experiment, in particular Previcur 607 SL and Bioczos S with the addition of hiumic acids, made it possible to produce higher survival rates of mother plants of Honeoye.
4. A tendency for Honeoye plants to produce higher yield following the application of Previcur 607 SL was observed.
5. The preparations applied did not influence the number of runner plants produced by both cultivars.

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POLISH SUMMARY

SKUTECZNOŚĆ BIOPREPARATÓW BIOCZOS S I POLYVERSUM ZASTOSOWANYCH DO MOCZENIA SADZONEK W OCHRONIE TRUSKAWKI PRZED WERTICILIOZĄ

Celem pracy była ocena skuteczności biopreparatów Bioczos S i Polyversum w ochronie truskawki przed werticiliozą, które zastosowano do moczenia roślin przed ich posadzeniem. Do badań wytypowano 2 odmiany truskawki (Elvira i Honeoye), o zróżnicowanej podatności na werticiliozę. Doświadczenie założono na polu, gdzie gleba była naturalnie zakażona *Verticillium dahliae* Kleb.

Odmiana Elvira, w porównaniu z Honeoye, okazała się bardziej odporna na chorobę. Stwierdzono, że zastosowane w doświadczeniu preparaty nie były dostatecznie skuteczne w ochronie obu testowanych odmian truskawki przed werticiliozą. Jednak w przypadku odmiany Honeoye wszystkie preparaty zapewniły lepszą niż w kontroli przeżywalność sadzonek matecznych, dotyczyło to zwłaszcza preparatu Previcur 607 SL oraz Bioczos S z dodatkiem kwasów humowych. Natomiast po zastosowaniu preparatu Previcur 607 SL rośliny tej odmiany lepiej plonowały. W przypadku obu odmian nie stwierdzono wpływu badanych preparatów na liczbę uzyskiwanych sadzonek rozłogowych.