THE EFFECTS OF BIOLOGICAL CONTROL ON FUNGAL COMMUNITIES COLONIZING EGGPLANT (*Solanum melongena* L.) ORGANS AND THE SUBSTRATE USED FOR EGGPLANT CULTIVATION

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Abstract

Eggplants, cv. Black Beauty, were grown in the greenhouse of the University of Warmia and Mazury in Olsztyn. During the growing season, the plants were sprayed three times with Asahi SL, Biochikol 020 PC and Bravo 500 SC, they were watered with Polyversum, and a mycorrhizal inoculum was applied to the roots of seedlings. Unprotected plants, treated with distilled water, served as control. After fruit harvest, samples of the substrate used for eggplant cultivation, eggplant stems and roots were collected, and fungi were isolated in the laboratory.

The fungal soil community was more abundant and diverse than the communities colonizing the stems and roots of eggplants. The applied biological and chemical control agents effectively reduced the abundance of fungi, including pathogenic species, in the organs of eggplants and the substrate used for eggplant cultivation. Potential pathogens (*Alternaria alternata*, *Botrytis cinerea* and *Fusarium* species) were isolated in high numbers from eggplant stems in the control treatment and in the Polyversum treatment (67%). The lowest number of potential pathogenic species were isolated from plants treated with the biostimulator Asahi SL, the fungicide Bravo 500 SC and the mycorrhizal inoculum. The population size of pathogenic fungi (*Colletotrichum coccodes* and *Fusarium*) isolated from eggplant roots was smaller, compared with stems, particularly in the treatments with the fungicide Bravo 500 SC and the biostimulator Biochikol 020 PC. The soil fungal community was dominated by yeast-like fungi (over 60% of all isolates). Fungi known as potential causal agents of diseases were found in low abundance, and they were not detected in substrate samples collected from under fungicide-treated eggplant plants.

Key words: eggplant, stems, roots, soil, biological control, pathogenic fungi

INTRODUCTION

The eggplant (*Solanum melongena* L.) is grown in many countries of the world due to its high content of bioactive components, including phenolic compounds, macro- and micronutrients (Luthria, 2009). The yield and quality of eggplant fruit are determined, among others, by cultivation form, organic and mineral fertilization, soil moisture content and pathogen infection rates (Bletsos et al. 1999; Raigon et al. 2010). During the growing season, eggplant organs are attacked by viruses (Sadeghi et al. 2008), bacteria (Arsenijevic et al. 1997; Yerchyk, 2008), fungus-like organisms such as *Phytophthora capsici* (Sholberg et al. 2007), and soil-borne fungal pathogens including *Sclerotinia sclerotiorum*, *Verticillium* spp. and *Rhizoctonia solani* (Lewis et al. 1998; Janas et al. 2002). Cases of eggplant infection by the tomato powdery mildew fungus *Oidium lycopersici* have been reported from The Netherlands (Huang et al. 2000).

Developing new cultivars with improved resistance is an important consideration in disease control (Panthee and Chen, 2010). There has been a growing interest in the use of biological control methods and practices. In a study by Elmer and Ferrandino (2009), an increase in the size of snail populations improved the biological state of soil, thus stimulating the growth of eggplant and reducing the symptoms of verticillium wilt. Strains of *Bacillus* spp., applied to soil or root surface, provided good control of pathogens, such as *Verticillium albo-atrum*, *V. dahliae* and *V. tricornutum* (Tjamos et al. 2004). Biocontrol agents (Polyversum), biotechnological control agents

(Biosept 33 SL, Biochikol 020 PC) and mycorrhizal inoculum (Karagiannidis et al. 2002) have been increasingly applied in the production of vegetable crops (Janas et al. 2002).

The aim of this study was to determine the effects of biological and chemical control agents on the composition of fungal communities colonizing eggplant stems, roots and the substrate used for eggplant cultivation.

MATERIALS AND METHODS

Eggplants *Solanum melongena* L., cv. Black Beauty, were grown in the greenhouse of the University of Warmia and Mazury in Olsztyn in 2006-2007. Four-week-old eggplant seedlings were planted in pots filled with peat substrate and garden soil at a ratio of 1:3 (total 9 dm³ of the substrate). The experiment involved the following treatments: eggplant sprayed three times with 0.2% Asahi SL (20 ml/plant), plants sprayed three times with 2% Biochikol (40 ml/plant), plants watered three times with 0.1% Polyversum (40 ml/plant), mycorrhizal inoculum (*Glomus* spp. – Mycoflor®) applied to the roots of seedlings prior to planting, eggplant sprayed three times with Bravo 500 SC (according to the recommendations of the Institute of Plant Protection-National Research Institute in Poznań). Every treatment comprised six plants (six pots). Pots with unprotected plants served as control. After fruit harvest, samples of substrate from the rhizosphere, stems and roots were collected from each pot. Following disinfection with 50% ethanol and 1% sodium hypochlorite, 0.5 cm pieces of stems and roots were treated with distilled water and placed on PDA medium, in five replications (five Petri dishes x 6 pieces of stems/ roots). After seven days of incubation, fungal colonies were inoculated onto agar slants for later microscopic identification according to standard keys and monographs (Arx, 1970; Booth, 1971; Ellis, 1971; Skirgiełło et al. 1979; Domsch et al. 1980; Nelson et al. 1983). Substrate samples collected at a depth of up to 5 cm under each plant were placed in dishes and mixed with a rotary motion. 1 g of the resultant fraction was mixed thoroughly with 149 g fine sand in a flask with a rotary motion for 10 minutes. 300 mm³ of the mixture was poured with Martin medium (50°C) (Máňka, 1974). Fungal colonies were transferred on agar slants for later microscopic identification.

RESULTS AND DISCUSSION

The results of the greenhouse experiment show that fungal communities colonizing the stems and roots of eggplants were characterized by low diversity (Tables 1 and 2). The isolated communities comprised

filamentous fungi, yeast-like fungi and non-sporulating fungi. The applied biological and chemical control agents reduced the abundance of fungi, including potential pathogenic species (*Alternaria alternata*, *Botrytis cinerea* and five species of the genus *Fusarium*), compared with the control treatment. Differences in the abundance of these fungi between particular control treatments were significant, except for pathogens isolated from substrate samples (Table 4).

In India, *Alternaria tenuissima* was found to cause leaf spot and fruit rot on eggplant (Reddy and Allam, 2006). Wu et al. (2008) detected symptoms of grey mold on eggplant leaves. *Fusarium* wilt caused by *F. oxysporum* f. sp. *melongenae* poses a serious problem in many countries (Altinok and Can, 2010). Rombert and Davis (2007) reported that *F. solani* isolates obtained from tomatoes and potatoes caused root rot in *S. melongena*. In another experiment (Panteadidos et al. 2009), non-pathogenic strains of *F. oxysporum* colonizing the roots of eggplants lowered the severity of infection caused by *V. dahliae*. In the present study, the above mentioned pathogenic fungi colonized the stems of eggplants from all treatments, except for *B. cinerea* in plants sprayed with Asahi SL. Pathogens had a high share (over 65%) of the fungal community colonizing the stems of unprotected plants and plants watered with Polyversum (Fig. 1b). Pathogenic species were isolated in lower numbers (30% of all isolates) from eggplant organs in other experimental treatments. The lowest number of *Fusarium* species were isolated from the stems of plants sprayed with Biochikol 020 PC and Bravo 500 SC. As demonstrated by Hijwegen and Termorshuizen (2000), the synthetic growth inducer Bion (R) had no inhibitory effect on the development of *Verticillium* wilt caused by the soil-borne pathogen *V. dahliae* in eggplants. In the present experiment, the species *Cladosporium cladosporioides* and *Penicillium* had a share of ca. 10% each in saprotrophic fungi (Fig. 1a). They were isolated from eggplant stems in all treatments. *Sporotrichum olivaceum* and the species order *Mucorales* (*Mucor circinelloides*, *M. hiemalis*, *Rhizopus nigricans* and *Zygorhynchus nigricans*) accounted for less than 6% of all isolates in this fungal community.

Pathogenic fungi were less frequently (40.6%) isolated from the roots of eggplants than from the stems (47.6%) (Fig. 2a). Pathogens were present in the lowest numbers on the roots of plants sprayed with the fungicide Bravo 500 SC, and they were represented only by *Fusarium* species. They colonized the roots of eggplants from all treatments, and were isolated in greatest abundance from plants sprayed with the growth regulator Asahi SL (Fig. 2b). The species *Colletotrichum coccodes* was present in the largest numbers in control plants.

Table 1
Fungi isolated from eggplant stems during the investigation period (% of isolates)

Fungi	C ¹	A	B	P	MI	Br
<i>Alternaria alternata</i> (Fr.) Keissler*	20.7	25.0	3.4	32.4	13.1	12.5
<i>Botrytis cinerea</i> Pers*	20.7		13.8	20.7	7.9	12.5
<i>Chaetomium spirale</i> Zopf	1.7	12.4			7.9	
<i>Cladosporium cladosporioides</i> (Fres.) de Vries	13.8	18.7	3.4	8.8	10.5	5.0
<i>Coniothyrium minitans</i> Campbell	5.2		3.4	8.8	5.3	5.0
<i>Epicoccum purpurascens</i> Ehrenb. ex Schlecht			3.4		5.3	2.5
<i>Fusarium culmorum</i> (W.G.Sm.) Sacc.*	3.4		7.0			2.5
<i>Fusarium equiseti</i> (Corda) Sacc. *	12.2		13.8	11.8	5.3	
<i>Fusarium oxysporum</i> Schlecht *	5.2		3.4	2.9	5.3	5.0
<i>Fusarium poae</i> (Peck.) Wollenweber *		6.3	7.0			
<i>Fusarium semitectum</i> Berk. & Rav.*	3.4					
<i>Glomastix murorum</i> (Corda) Hughes	1.7	6.3			5.3	5.0
<i>Mucor circinelloides</i> von Tieghem		6.3				
<i>Mucor hiemalis</i> Wehmer	1.7			5.9		
<i>Penicillium</i> spp.	1.7	18.7	13.8	2.9	2.6	17.5
<i>Rhizopus nigricans</i> Ehrenberg					7.9	5.0
<i>Sporotrichum olivaceum</i> Fries	5.2	6.3	13.8	2.9		5.0
<i>Ulocladium botrytis</i> Preuss					2.6	7.5
<i>Zygorhynchus</i> spp.					5.3	5.0
Non-sporulating fungi	3.4		13.8	2.9	15.7	10.0
Total number of isolates	58	32	29	34	38	40

¹C – control, A – Asahi, B – Biochikol 020 PC, P – Polyversum, MI – mycorrhizal inoculum, Br – Bravo 500 SC, * – pathogenic fungi

Table 2
Fungi isolated from eggplant roots during the investigation period (% of isolates)

Fungi	C	A	B	P	MI	Br
<i>Acremonium strictum</i> W. Gams					5.9	
<i>Chaetomium globosum</i> Hughes			12.5	2.9		
<i>Chaetomium pulliliferum</i> Kunze ex Fr.	2.3			5.9	5.9	
<i>Cladosporium cladosporioides</i> (Fres.)	4.5					8.3
<i>Colletotrichum coccodes</i> (Wallr.) Hughes*	29.6	15.4	17.5	17.7	23.5	
<i>Coniothyrium minitans</i> Campbell		7.7				4.2
<i>Fusarium culmorum</i> (W.G.Sm.) Sacc.*	6.8	7.7				8.3
<i>Fusarium equiseti</i> (Corda) Sacc.*	4.5	15.4			8.8	
<i>Fusarium fusarioides</i> (Frag. et Cif.)*	2.3					
<i>Fusarium oxysporum</i> Schlecht*	6.8	7.7	17.5	20.6	5.9	16.7
<i>Fusarium solani</i> (Mart.) Sacc.*	2.3			2.9		
<i>Glomastix murorum</i> (Corda) Hughes		7.7				
<i>Mortierella alpina</i> Peyronel	15.9		5.0	14.7	14.7	33.4
<i>Mortierella isabelina</i> Oudemans	4.5	7.7		5.9	20.6	12.5
<i>Mortierella lignicola</i> (Martin) Gams, Moreau			2.5			
<i>Penicillium</i> spp.		15.4	5.0			
<i>Rhizopus nigricans</i> Ehrenberg			12.5	2.9		
<i>Sporotrichum olivaceum</i> Fries		15.4		5.9		
<i>Zygorhynchus</i> spp.	9.1				14.7	8.3
Yeast-like fungi	9.1		25.0	14.7		
Non-sporulating fungi	2.3		2.5	5.9		8.3
Total number of isolates	44	26	40	34	34	24

Explanations as in Table 1

Table 3
Fungi isolated from the substrate used for eggplant cultivation during the investigation period (% of isolates)

Fungi	C	A	B	P	MI	Br
<i>Acremonium strictum</i> W. Gams	0.8	0.7		0.5		1.7
<i>Arthrinium sphaeospermum</i> Fuckel		0.7				
<i>Aureobasidium pullulans</i> (de Bary) Arnaud	0.4				0.4	
<i>Cladosporium cladosporioides</i> (Fres.)	0.4		1.1	0.9	1.1	2.2
<i>Colletotrichum coccodes</i> (Wallr.) Hughes *	0.8	0.7	1.1			
<i>Coniothyrium minitans</i> Campbell		0.7				0.6
<i>Cordana</i> sp.						0.6
<i>Fusarium avenaceum</i> (Fr.) Sacc.*	0.4					
<i>Fusarium culmorum</i> (W.G.Sm.) Sacc. *		0.7			0.4	
<i>Fusarium equiseti</i> (Corda) Sacc. *					0.8	
<i>Fusarium fusarioides</i> (Frag. & Cif.) Booth*				0.5		
<i>Fusarium oxysporum</i> Schlecht *	1.3				0.4	
<i>Gilmaniella humicola</i> Barron					0.4	0.6
<i>Gliomastix murorum</i> (Corda) Hughes		2.2	0.4	0.9	2.3	2.2
<i>Mortierella alpina</i> Peyronel	0.8					2.2
<i>Mortierella isabelina</i> Oudemans	0.4			2.3		1.1
<i>Mucor hiemalis</i> Wehmer	1.3	3.5	2.9	0.5	1.1	
<i>Paecilomyces niveus</i> Stolk et Samson **	9.2			8.0	2.7	9.6
<i>Paecilomyces lilacinus</i> (Thom) Samson **	10.2	2.8	17.3	9.8	10.7	2.8
<i>Paecilomyces variotti</i> Bainier**		0.8		3.6	7.2	
<i>Papulaspora irregularis</i> Hotson		2.2				
<i>Penicillium</i> spp.	1.7	4.9	6.1	3.6	2.1	5.1
<i>Rhizopus nigricans</i> Ehrenberg			2.2			
<i>Sporotrichum carnis</i> Books and Hansford	0.4			1.4	4.2	
<i>Sporotrichum olivaceum</i> Fries.	10.8	0.7	7.9	5.0	1.1	10.7
<i>Trichoderma aureoviride</i> Rafii**			0.4	0.5	0.4	0.6
<i>Trichoderma hamatum</i> (Bon) Bain **			1.1		0.8	0.6
<i>Trichoderma harzianum</i> Rifai**	0.8	2.8	1.1			
<i>Trichoderma koningii</i> Oudemans **			1.8		2.7	
<i>Trichoderma polysporum</i> (Link ex Pers.) Rifai**			0.4			
Yeast-like fungi	60.3	76.6	56.2	62.5	61.2	59.4
Total number of isolates	240	282	278	222	263	178

Explanations as in Table 1

Table 4
Fungi isolated most frequently from eggplant organs and substrate (mean number of isolates in years)

Treatments	Stems				Roots			Substrate				
	Path	Cl.cl	Muc	Pen	Path	Muc	Yeast	Path	Antag	Muc	Yeast	Pen
Control	19.0a**	4.0a	0.5a	0.5a	11.5a	6.5ab	2.0a	3.0a	25.0a	1.5a	73.0a	2.0a
Asahi SL	5.0b	3.0a	1.0a	3.0a	6.0b	2.0b	1.0a	2.0a	9.0a	5.0a	108.0a	7.0a
Biochikol 020PC	7.0b	1.0a	0a	2.,0a	7.0ab	4.0ab	5.0a	1.5a	30.5a	8.0a	78.0a	8.5a
Polyversum	11.5ab	1.5a	1.0a	0.5a	7.0ab	4.0ab	2.,5a	0.5a	24.5a	3.0a	69.5a	4.0a
MI*	5.0b	2.,0a	2.5a	0a	6.5ab	8.5ab	0a	2.0a	32.0a	1.5a	80.5a	3.0a
Bravo 500 SC	6.5b	1.0a	2.0a	3.5a	6.0b	6.5ab	0a	0a	12,0a	3.0a	53.0a	4.5a

Explanations: Path – pathogens, Cl.cl – *Cladosporium cladosporioides*, Muc – Mucorales, Pen – *Penicillium* spp. Yeast – yeast-like fungi, Antag – antagonists

*MI – mycorrhizal inoculum, ** means with the same letter do not differ significantly (Duncan's test, p=0.01)

Fig. 1. Fungal species groups isolated from eggplant stems

Fig. 2. Fungal species groups isolated from eggplant roots

Fig. 3. Fungal species groups isolated from substrate

According to Janas et al. (2002), Biosept 33 SL, Polyversum and Amistar 250 SC offer effective control of soil pathogens, in particular *S. sclerotiorum* and *V. dahliae*, and they also stimulate the growth of eggplants and improve the yield. Freeman (2008) reported that *C. acutatum* may asymptotically colonize eggplants, tomatoes and peppers. In the present study, saprotrophic fungi of the order Mucorales accounted for over 30% of all isolates, and the dominant species were *Mortierella alpina* and *M. isabellina*. Yeast-like fungi had a three-fold lower share of the community. They developed primarily on the roots of plants treated with Polyversum and Biochikol 020 PC.

The soil fungal community was most diverse, and it consisted of as many as 30 species (Table 3). Yeast-like fungi occurred in greatest abundance – over 60% of all isolates (Fig. 3a). Pathogenic fungi were seldom isolated from the substrate, and they accounted for only 2.5% of all isolates in the control treatment (Fig. 3b). Pathogenic species were much more frequently found on the roots and stems of eggplants, and they were not present in substrate samples

collected from under fungicide-treated plants. Fungi showing antagonistic activity against pathogens were more commonly isolated (18.2% of all isolates, five *Paecilomyces* species and five *Trichoderma* species). Nagtzam et al. (1998) reported that a combination of *Gliocladium roseum* and *Talaromyces flavus* incorporated in soil reduced colonization of roots and infection of eggplants by *V. dahliae*. In a study by Lewis et al. (1998), *T. hamatum* and *G. virens* applied to soil reduced damping-off of eggplant seedlings caused by *Rhizoctonia solani*. Wu et al. (2008) described hyperparasitic potential of *T. harzianum* over *S. sclerotiorum*, a dangerous pathogen of eggplant seedlings, which was manifested as inhibition of mycelial growth and sclerotia production. The above mentioned antagonistic fungi colonized the substrate from all treatments, and the applied mycorrhizal inoculum supported their growth. Karagianidis et al. (2002) observed a beneficial influence of the arbuscular mycorrhizal fungus (AMF) *Glomus mosseae* which increased the macronutrient and micronutrient uptake by plants and reduced *V. dahliae* infection rates.

CONCLUSIONS

Potential pathogenic fungi (*A. alternata*, *B. cinerea*, *C. coccodes* and *Fusarium* species) more frequently colonized the stems and roots of *Solanum melongena* in particular treatments with biological and chemical control than the substrate used for eggplant cultivation.

The applied biological and chemical control agents effectively reduced the populations of pathogenic fungi colonizing eggplant stems, compared with the control treatment.

The lowest number of potential pathogenic species were isolated from the stems of eggplants treated with the biostimulator Asahi SL and the fungicide Bravo 500 SC, and from the roots of fungicide-treated plants.

The fungal community isolated from the substrate used for eggplant cultivation was dominated by yeast-like fungi.

REFERENCES

- Altinok H.H., Can C., 2010. Characterization of *Fusarium oxysporum* f. sp. *melongenae* isolates from eggplant in Turkey by pathogenicity, VCG and RAPD analysis. *Phytoparasitica*, 38 (2): 149-157.
- Arsenijević M., Trkulja V., Obrdović A., 1997. Pathogenic and bacteriological characteristics of Yugoslav *Erwinia* soft rot strains originating from pepper and eggplant fruits. *Zeitsch. Pflanzenkrankh. Pflanzensch.* 104 (4): 394-402.
- Arx von J. A., 1970. The genera of fungi sporulating in pure culture. Verlag von J. Cramer.
- Bletsos F.A., Thanassouloupoulos C.C., Roupakias D.G., 1999. Water stress and verticillium wilt severity on eggplant (*Solanum melongena* L.). *J. Phytopathol.* 147 (4): 243-248.
- Booth T.C., 1971. The genus *Fusarium*. Commonwealth Mycological Institute Kew Surrey, England.
- Domsch K.H., Gams W., Anderson Traute-Heidi, 1980. Compendium of Soil Fungi. Academic Press, A Subsidiary of Harcourt Brace Jovanovich Publishers, London, New York, Toronto, Sydney, San Francisco: 859.
- Ellis M.B., 1971. Dematiaceus hyphomycetes. Commonwealth Mycological Institute Kew Surrey, England.
- Elmer W.H., Ferrandino F.J., 2009. Suppression of *Verticillium* wilt of eggplant by earthworms. *Plant Dis.* 93 (5): 485-489.
- Freeman S., 2008. Management, survival strategies, and host range of *Colletotrichum acutatum* on strawberry. *Hort Sci.* 43 (1): 66-68.
- Hijwegen T., Termorshuizen A.J., 2000. Retarded development of *Verticillium* wilt in eggplant after application of Bion (R) or Oryzalin (R). *Zeitsch. Pflanzenkrankh. Pflanzensch.* 107 (3): 267-273.
- Huang C.C., Biesheuvel J., Lindhout P., Niks R.E., 2000. Host range of *Oidium lycopersici* occurring in the Netherlands. *Europ. J. Plant Pathol.* 106 (5): 465-473.
- Janas R., Szafirowska A., Kołosowski S., 2002. Zastosowanie biopreparatów w biologicznej ochronie oberżyny. / The application of bioagents in biological control of eggplant. *Prog. Plant Protection/Post. Ochr. Roślin*, 42 (2): 417-419. (in Polish).
- Karagiannidis N., Bletsos F., Stavropoulos N., 2002. Effect of *Verticillium* wilt (*Verticillium dahliae* Kleb.) and mycorrhiza (*Glomus mosseae*) on root colonization, growth and nutrient uptake in tomato and eggplant seedlings. *Sci. Horticult.* 94 (1-2): 145-156.
- Lewis J.A., Larkin R.P., Rogers D.L., 1998. A formulation of *Trichoderma* and *Gliocladium* to reduce damping-off caused by *Rhizoctonia solani* and saprophytic growth of the pathogen in soilless mix. *Plant Dis.* 82 (5): 501-506.
- Luthria D.L., 2009. Phenolic compounds analysis in foods and dietary supplements is not the same using different sample preparation procedures. *Acta Horticulturae*, 841: 381-387.
- Mańka K., 1974. Zbiorowiska grzybów jako kryterium oceny wpływu środowiska na choroby roślin. / Fungal communities as a criterion for estimating the effect of the environment on plant diseases. *Zesz. Probl. Post. Nauk Rol.* 160: 9-23. (in Polish)
- Nagtzaam M.P. M., Bollen G.J., Termorshuizen A.J., 1998. Efficacy of *Talaromyces flavus* alone or in combination with other antagonists in controlling *Verticillium dahliae* in growth chamber experiments. *J. Phytopathol.* 146 (4): 165-173.
- Nelson P.E., Toussoun T.A., Marasas W.F.O., 1983. *Fusarium* species. The Pennsylvania State University Press, University Park and London.
- Pantelides L.S., Tjamos S.E., Striglis L.A., Chatzipavlidis L., Paplomatas E.J., 2009. Mode of action of a nonpathogenic *Fusarium oxysporum* strain against *Verticillium dahliae* using Real Time QPCR analysis and biomarker transformation. *Biol. Control*, 50 (1): 30-36.
- Panthee D.R., Chen F., 2010. Genomics of fungal disease resistance in tomato. *Current Genomics*, 11 (1): 30-39.
- Raigon M.D., Rodríguez-Burruezo A., Prohens J., 2010. Effects of organic and conventional cultivation methods on composition of eggplant fruits. *J. Agric. Food Chem.* 58 (11): 6833-6840.
- Reddy A.V.R., Allam U.S., 2006. First report of *Alternaria tenuissima* causing leaf spot and fruit rot on eggplant (*Solanum melongena*) in India. *Plant Pathol.* 55 (4): 579.
- Romberg M.L., Davis R.M., 2007. Host range and phylogeny of *Fusarium solani* f. sp. *eumartii* from

- potato and tomato in California. *Plant Dis.* 91 (5): 585-592.
- Sadeghi M.S., Behjatnia S.A.A., Masumi M., Izadpanah K., 2008. Characterisation of a strain of potato virus Y causing eggplant mosaic in southern Iran. *Austral. Plant Pathol.* 37 (1): 79-86.
- Sholberg P.L., Walker M.C., O'Gorman D.T., Jespersen G.D., 2007. First report of *Phytophthora capsici* on cucurbits and peppers in British Columbia. *Can. J. Plant Pathol.* 29 (2): 153-158.
- Skirgiełło A., Zadara M., Ławrynowicz M., 1979. Grzyby (Mycota). 10. Glonowce (Phycomycetes). Pleśniakowce (Mucorales). PAN Instytut Botaniki, Warszawa-Kraków. (in Polish).
- Tjamos E.C., Tsitsigiannis D.I., Tjamos S.E., Antoniou P. P., Katinakis P., 2004. Selection and screening of endorhizosphere bacteria from solarized soils solanaceous hosts. *Eur. J. Plant Pathol.* 110 (1): 35-44.
- Wu D., Feng L., Zhang C., He Y., 2008. Early detection of *Botrytis cinerea* on eggplant leaves based on visible and near-infrared spectroscopy. *Transactions of the American Society of Agricultural and Biological Engineers*, 51 (3): 1133-1139.
- Yerchyk V., 2008. Virulence of strains of *Clavibacter michiganensis* subsp. *sepedonicus*. *Zemdirbyste*, 95 (3): 359-365.

Wpływ ochrony biologicznej na zbiorowisko grzybów zasiedlających łodygi i korzenie oraz podłoże spod uprawy oberżyny (*Solanum melongena* L.)

Streszczenie

Oberżynę odmiany Black Beauty uprawiano w latach 2006-2007 w szklarni Uniwersytetu Warmińsko-Mazurskiego w Olsztynie. W okresie wegetacji zastosowano ochronę w postaci 3-krotnego opryskiwania roślin preparatami: Asahi SL, Biochikol 020 PC, Bravo 500 SC i podlewania roślin Polyversum oraz aplikacji szczepionki mikoryzowej pod korzenie rozsady. Kombinację kontrolną stanowiły rośliny bez ochrony, traktowane wodą destylowaną. Po zbiorach owoców pobierano materiał roślinny (łodygi i korzenie) oraz podłoże spod uprawy oberżyny w celu izolacji grzybów.

Zbiorowisko grzybów glebowych było bardziej liczne i zróżnicowane niż zbiorowisko grzybów zasiedlających łodygi i korzenie oberżyny. Zastosowana ochrona ograniczała liczebność patogenów w analizowanych częściach roślin i w podłożu. Potencjalne patogeny (*A. alternata*, *B. cinerea* i *Fusarium* spp.) licznie zasiedlały łodygi oberżyny w kombinacji kontrolnej i z opryskiwaniem Polyversum (67%). Najmniej potencjalnych patogenów wyizolowano z roślin w kombinacji z użytym stymulatorem wzrostu Asahi SL i fungicydem Bravo 500 SC oraz ze szczepionką mikoryzową. Z korzeni uzyskano mniejszą populację patogenów (*C. coccodes* i *Fusarium* spp.) niż z łodyg, zwłaszcza z roślin opryskiwanych fungicydem i stymulatorem odporności Biochikol 020 PC. W glebie dominowały grzyby drożdżopodobne – ponad 60% izolatów. Potencjalni sprawcy chorób nielicznie zasiedlali podłoże spod uprawy oberżyny, a nie było ich w ogóle w uprawie roślin chronionych chemicznie.