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THE PROTECTIVE EFFECT OF BIOPREPARATIONS APPLIED AS THE DRESSING FOR COMMON BEAN (*Phaseolus vulgaris* L.) AND PEA (*Pisum sativum* L.)

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Abstract. The studies conducted in a growth chamber observed the protective effect of biopreparations such as Biosept 33 SL, Biochikol 020 PC and Polyversum, used as seed dressing for common bean and pea. The fungicide Zaprawa Oxafun T was used as a comparison, while the seeds that were not dressed constituted the control. The studied plants grew in the medium grown over with different species of fungi pathogenic towards pea and common bean. Irrespective of the species, the fewest plants, with the greatest proportion of infected ones, were obtained in control combinations. The application of biopreparations and the fungicide turned out to be an effective protection of pea and common bean from the infection by the examined phytopathogens. Biosept 33 SL in the concentration of 0.2% showed to have the best effect among the tested biopreparations.

Key words: pea, common bean, biopreparations, fungicide, pathogenic fungi

INTRODUCTION

The last decade has witnessed a considerable advance in the research on the application of antagonistic microorganisms and organic compounds in controlling plant diseases [Orlikowski and Skrzypczak 2001, Pięta et al. 1998]. The expenses on biopreparations applied in plant protection constituted more than 3% of the amount intended for pesticides [Lisansky and Coombs 1994, Stetter 1998]. Introducing biopreparations in plant protection can contribute to a reduced use of fungicides, and – as a result – less contamination of the natural environment.

At present Biospept 33 SL and Biochikol 020 PC (biopreparations based on organic compounds) as well as Polyversum (based on antagonistic fungus) are registered in Poland and introduced in production. Biospept 33 SL contains extract from the stones and flesh of grapefruit rich in endogenous flavonoids with antibacterial and antifungal properties [Saniewska 2002a].

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Besides, geranoxycumarin contained in grapefruit contributes to the induction of plants' resistance to infectious factors [Angioni et al. 1998, Woedtke et al. 1999]. According to Orlikowski [2001], Saniewska [2002b] and Solarska and Jończyk [2003], the biopreparation discussed here is effective in protecting the ornamental and grain plants.

Biochikol 020 PC is recommended in the protection of different species of cultivated plants before they are infected by viruses, bacteria and fungi [Pospieszny et al. 1995, Pięta et al. 2001a]. The active substance in this preparation is chitosan [Pospieszny and Struszczyk 1994].

Another biopreparation is Polyversum, which is most frequently used in the cultivations under covers. This biopreparation contains oospores of *Pythium oligandrum* and it is effective in limiting the growth and developmet of different species of pathogenic soil-borne fungi [Orlikowski et al. 2002, Orlikowski and Skrzypczak 2003].

The literature has no information on the protective effect of the above – mentioned biopreparations on the germinating seeds of common bean and peas. Hence, the studies cited in the title were undertaken.

MATERIAL AND METHODS

The studies were conducted in a growth chamber, where the air temperature, relative humidity of the air, the length and intensity of illumination were described in an earlier paper [Pięta et al. 2001b]. The object of the studies were the seeds of common bean ('Narew' cv.) and pea ('Sześciotygodniowy TOR' cv.), which were well formed and without any spots on the cover. The seeds were sown into the soil infected by pathogenic fungi. Seven fungi species were considered for common bean (*Alternaria alternata* 7, *Botrytis cinerea* 47, *Fusarium culmorum* 39, *F. oxysporum* f. sp. *phaseoli* 51, *F. solani* 3, *Rhizoctonia solani* 57 i *Sclerotinia sclerotiorum* 69*)*, while eight were considered for pea (*A. alternata* 14, *Ascochyta pisi* 31, *B. cinerea* 9, *F. culmorum* 17, *F. oxysporum* f. sp. *pisi* 9*, F. solani* 16, *R. solani* 19 i *S. sclerotiorum* 93). The fungi were isolated from infected plants. The infection mixture was prepared according to the method described by Noll [Łacicowa 1970]. The soil overgrown with particular pathogenic fungi was sown with the seeds dressed with 0.2% Biosept 33 SL, 2.5% Biochikol 020 PC and Polyversum in the dose of 1 $g \cdot 100^{-1}$ seeds. The experiment also considered the dressing of seeds with Zaprawa Oxafun T (in the dose 2 $g \cdot kg^{-1}$ seeds) and the control (without any dressing). Four pots, where 100 seeds were sown into each, were considered for each species of the examined plants and the tested biopreparations, the chemical preparation and the control. Five weeks after the experiment was established the number of plants and their healthiness were determined. The healthiness was evaluated according to a five-grade scale according to Pięta [1992], while the disease index was calculated according to the formula used by Sadowski and Rzekanowski [1989].

The obtained data were statistically analyzed and the significance of differences was determined according to Tukey's confidence intervals [Oktaba 1987].

RESULTS AND DISCUSSION

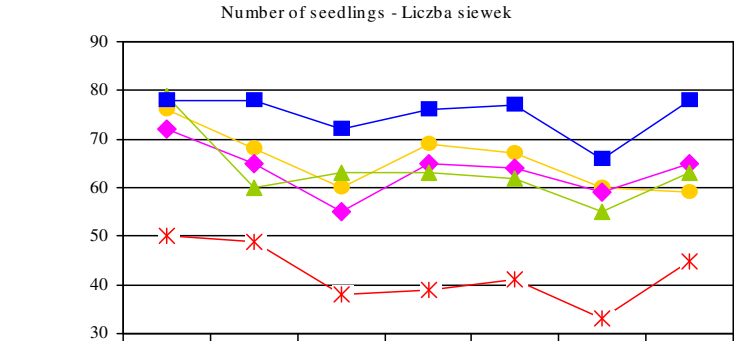
Five weeks after the seed sowing it was established that the number of plants, both pea and common bean, varied in particular experimental combinations (fig. 1, 2). The smallest number of plants, irrespectively of the species, grew in the control combination. In the case of common bean the number of seedlings in this combination ranged from 33 to 50 (fig. 1), while in the case of pea it ranged from 41 to 56 (fig. 2). Depending on the species of the pathogenic fungus present in the medium, but with the exception of *Alternaria alternata* 7, *Fusarium culmorum* 39 i *Sclerotinia sclerotiorum* 69, the greatest number of common bean seedlings grew from the seeds dressed with Biosept 33 SL or Zaprawa Oxafun T (fig. 1). The situation was similar in the case of pea, when the greatest number of seedlings grew from those combinations, only with the exception of the combination with *A. alternata* 14 (fig. 2).

The application of biopreparations and Zaprawa Oxafun T to the seed dressing proved to be effective protection from the infection of the studied plant species by phytopathogens. The smallest number of infected plants of common bean was obtained after dressing the seeds with Biosept 33 SL or Zaprawa Oxafun T. Their proportion was, respectively, from 8.7% to 16.2% and from 7.2% to 14.7% (fig. 1). A similar protective effect of the enumerated preparations was observed for pea. The proportion of the infected plants in the combination with Biosept 33 SL ranged from 5.4% to 15.8%, and in the combination with Zaprawa Oxafun T from 6.8% to 11.2% (fig. 2). The worst healthiness was characteristic of control plants, since the proportion of the infected bean plants ranged from 20.3% to 38.9% (fig. 1). On the other hand, the proportion of the infected plants of pea in the combination without any seed dressing ranged from 23.4% to 47.8% (fig. 2).

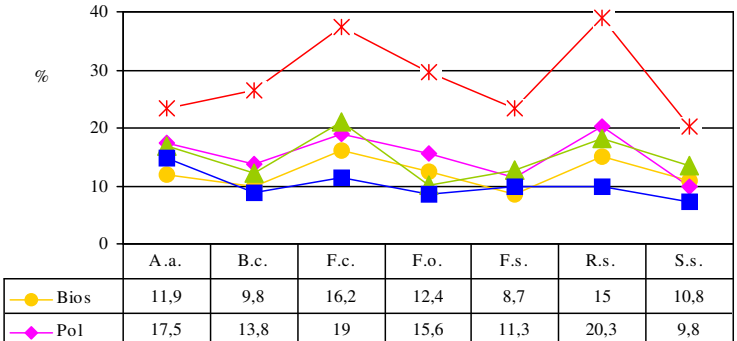
The results showed that the seeds of pea and common bean dressed with the tested biopreparations effectively improved the emergencies, number and healthiness of plants. A similar protective effect was observed in the case of dressing the seeds of *Phaseolus coccineus* with biopreparations Polyversum or Biosept 33 SL [Patkowska and Pięta 2004].

Besides, the enumerated biopreparations, used as seed dressing for soybean, were most effective in protecting the germinating seeds as well as the roots and the stem base of soybean from the infection by phytopathogens [Patkowska 2005]. On the other hand, Biochikol 020 PC matched Zaprawa Oxafun T in its efficiency in the case of dressing the seeds of runner bean growing in the medium infected with pathogenic fungi. A similar effect of the studied biopreparations in protecting ornamental plants and vegetables was shown in the studies by Orlikowski [2001], Orlikowski and Skrzypczak [2001, 2003], Orlikowski et al. [2001, 2002], Saniewska [2002b], Wojdyła [2001] and Picard et al. [2000].

The mean value of the disease index of the examined plant species was the highest in the control combination, since for common bean the disease index ranged from 11.7 to 28.7, while for the plants of pea it ranged from 13.8 to 30.6 (fig. 3). The infection index for the plants of common bean or pea in the combinations with biopreparations was significantly lower and it was from 6.7 to 19.3 and from 8.3 to 18.7, respectively (fig. 3). Disease symptoms of the smallest size, which was testified to by the smallest



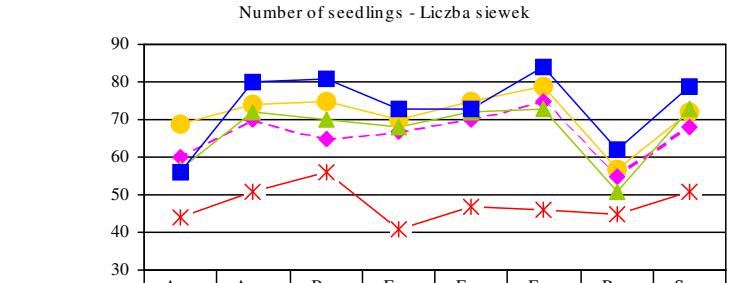
	A.a.	B.c.	F.c.	F.o.	F.s.	R.s.	S.s.
Bios	76	68	60	69	67	60	59
Pol	72	65	55	65	64	59	65
Bioch	79	60	63	63	62	55	63
Z.Ox. T	78	78	72	76	77	66	78
C	50	49	38	39	41	33	45
LSD, L = 0.05	13.5	12.9	15.4	14.6	14.1	15.9	10.7



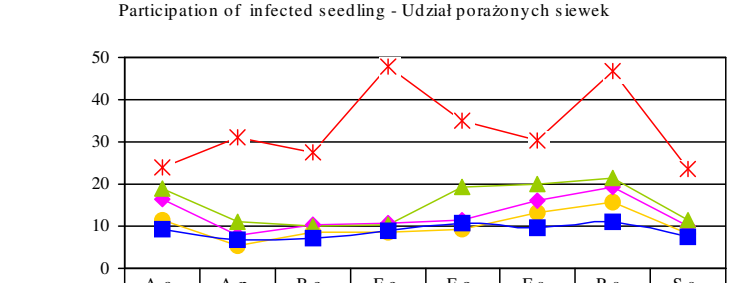
	A.a.	B.c.	F.c.	F.o.	F.s.	R.s.	S.s.
Bios	11,9	9,8	16,2	12,4	8,7	15	10,8
Pol	17,5	13,8	19	15,6	11,3	20,3	9,8
Bioch	16,9	12,1	21,1	10,2	12,8	18,3	13,6
Z.Ox. T	14,7	8,8	11,4	8,6	9,9	9,8	7,2
C	23,5	26,5	37,5	29,5	23,4	38,9	20,3
LSD, L = 0.05	6.6	7.1	8.9	7.2	6.5	8.8	5.6

Bios. – Biosept 33 SL, Pol. – Polyversum, Bioch. – Biochikol 020 PC, Z.Ox.T – Zaprawa Oxafun T, C – control, kontrola, A.a. – *A. alternata*, B.c. – *B. cinerea*, F.c. – *F. culmorum*, F.o. – *F. oxysporum* f. sp. *phaseoli*, F.s. – *F. solani*, R.s. – *R. solani*, S.s. – *S. sclerotiorum*

Fig. 1. Number and healthiness of common bean seedlings in individual experimental combinations
Rys. 1. Liczebność i zdrowotność siewek fasoli w poszczególnych kombinacjach doświadczenia



	A.a.	A.p.	B.c.	F.c.	F.o.	F.s.	R.s.	S.s.
Bios	69	74	75	70	75	79	57	72
Pol	60	70	65	67	70	75	55	68
Bioch	57	72	70	68	72	73	51	73
Z.Ox. T	56	80	81	73	73	84	62	79
C	44	51	56	41	47	46	45	51
LSD, L = 0.05	12.1	11.8	14.2	15.1	13.9	14.3	12.8	10.7

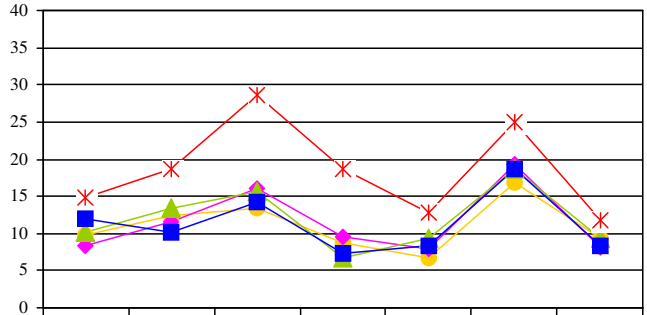


	A.a.	A.p.	B.c.	F.c.	F.o.	F.s.	R.s.	S.s.
Bios	11,6	5,4	8,6	8,6	9,3	13,2	15,8	8,3
Pol	16,4	7,8	10,3	10,7	11,4	16,1	19,4	10
Bioch	19	11	10	10,3	19,4	19,9	21,3	11,3
Z.Ox. T	9,4	6,8	7,3	8,9	10,6	9,5	11,2	7,5
C	23,9	31,1	27,4	47,8	35,1	30,4	46,7	23,4
LSD, L = 0.05	5.6	6.8	4.3	6.9	7.2	6.5	8.7	5.3

Bios. – Biosept 33 SL, Pol. – Polyversum, Bioch. – Biochikol 020 PC, Z.Ox.T – Zaprawa Oxafun T, C – control, kontrola, A.a. – *A. alternata*, A.p. – *A. pisi*, B.c. – *B. cinerea*, F.c. – *F. culmorum*, F.o. – *F. oxysporum* f. sp. *pisi*, F.s. – *F. solani*, R.s. – *R. solani*, S.s. – *S. sclerotiorum*

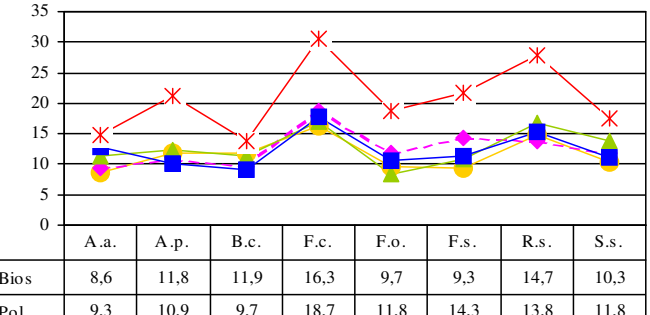
Fig. 2. Number and healthiness of pea seedlings in individual experimental
Rys. 2. Liczebność i zdrowotność siewek grochu w poszczególnych kombinacjach doświadczenia

Disease index of common bean - Indeks porażenia fasoli



	A.a.	B.c.	F.c.	F.o.	F.s.	R.s.	S.s.
Bios	9,8	12,3	13,4	8,8	6,7	16,8	9,3
Pol	8,4	11,6	16,1	9,6	7,9	19,3	8,1
Bioch	10,1	13,3	15,7	6,7	9,4	18,6	9,3
Z.Ox. T	11,9	10,1	14,3	7,3	8,3	18,7	8,4
C	14,9	18,7	28,7	18,7	12,8	24,9	11,7
LSD, L = 0,05	5.6	6..2	8.3	7.4	4.5	6.8	3.5

Disease index of pea - Indeks porażenia grochu



	A.a.	A.p.	B.c.	F.c.	F.o.	F.s.	R.s.	S.s.
Bios	8,6	11,8	11,9	16,3	9,7	9,3	14,7	10,3
Pol	9,3	10,9	9,7	18,7	11,8	14,3	13,8	11,8
Bioch	11,3	12,3	11,3	16,9	8,3	10,8	16,8	13,8
Z.Ox. T	12,7	10,1	9	17,8	10,7	11,3	15,3	11,1
C	14,8	21,1	13,8	30,6	18,7	21,8	27,9	17,6
LSD, L = 0.05	2.8	4.1	2.9	6.1	3.5	2.8	4.6	2.3

Bios. – Biosept 33 SL, Pol. – Polyversum, Bioch. – Biochikol 020 PC, Z.Ox.T – Zaprawa Oxafun T, C – control, kontrola, A.a.– *A. alternata*, B.c. – *B. cinerea*, F.c. – *F. culmorum*, F.o. – *F. oxysporum* f. sp. *phaseoli*, F.s. – *F. solani*, R.s. – *R. solani*, S.s. - *S. sclerotiorum*

Fig. 3. Valuex of the disease index of analised seedlings
Rys. 3. Wartość indeksu porażenia badanych siewek

values of the disease index, were found on the seedlings of both common bean and pea in the case of using Biosept 33 SL. This fact is confirmed by the earlier information from literature on the inhibiting effect of endogenous flavonoids and 7-geranoxycumarin on pathogenic fungi [Saniewska 2002a, Angioni et al. 1998]. In earlier studies conducted on runner bean and soybean it was found out that the lowest value of the disease index was characteristic of the bean plants grown from the seeds dressed with Polyversum [Patkowska and Pięta 2004] and the plants of soybean grown from the seeds dressed with Zaprawa Oxafun T or Polyversum [Patkowska 2005]. As stated by Picard et al. [2000], the fungus *Pythium oligandrum,* which is a component of biopreparation Polyversum, creates a protein metabolite – oligandrin, inducing the resistance of plants. Besides, *Pythium oligandrum* settles the root zone of plants, in this way protecting it from the infection by pathogenic fungi [Vesely and Kocova 2001]. It does not cause any disease symptoms although the mycelium of this antagonist develops in intercell spaces of the epidermis [Vesely and Kocova 2001].

CONCLUSIONS

The studies pointed to a possibility of using Biosept 33 SL, Biochikol 020 PC and Polyversum as a dressing to protect the seedlings of bean and pea from soil-borne pathogenic fungi. These biopreparations protected the germinating seeds and next the roots and the stem base of the studied plant species from the infection by phytopathogens. This fact is confirmed in the fact that the tested biopreparations are based on antagonistic microorganisms (*Pythium oligandrum*) or on organic compounds (chitosan, endogenous flavonoids), which directly or indirectly limit the growth and development of pathogenic fungi. In the group of biopreparations, in the conditions of the growth chamber, Biospept 33 SL proved to be the most effective in protecting common bean and beans. Its effectiveness matched that of Zaprawa Oxafun T. All the studied biopreparations were the worst to protect both bean and pea from *Rhizoctonia solani* 57 and 19. Those combinations produced the smallest number of seedlings with a big proportion of infected plants and with the highest disease index. In the case of pea, fungus *Ascochyta pisi* 31, and in the case of common bean the fungi *Botrytis cinerea* 47, *Fusarium solani* 3 and *Sclerotinia sclerotiorum* 69 turned out to be sensitive to the effect of biopreparations.

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EFEKTYWNOŚĆ OCHRONNEGO DZIAŁANIA BIOPREPARATÓW STOSOWANYCH JAKO ZAPRAWY DO FASOLI ZWYKŁEJ (*Phaseolus vulgaris* L.) I GROCHU (*Pisum sativum* L.)

Streszczenie. W badaniach fitotronowych sprawdzano efektywność ochronnego działania biopreparatów, takich jak Biosept 33 SL, Biochikol 020 PC i Polyversum, zastosowanych jako zaprawy nasienne dla fasoli zwykłej i grochu. Dla porównania użyto również fungicydu Zaprawa Oxafun T, a kontrolę stanowiły nasiona niezaprawione. Badane rośliny wzrastały w podłożu przerośniętym różnymi gatunkami grzybów chorobotwórczych dla grochu i fasoli zwykłej. Bez względu na gatunek najmniej roślin, z największym udziałem roślin porażonych, uzyskano w kombinacjach kontrolnych. Użycie biopreparatów oraz fungicydu okazało się skutecznym zabezpieczeniem roślin grochu i fasoli zwykłej przed porażeniem przez badane fitopatogeny. Spośród testowanych biopreparatów najlepszym działaniem ochronnym wykazał się Biosept 33 SL o stężeniu 0,2%.

Słowa kluczowe: groch, fasola zwykła, biopreparaty, fungicyd, grzyby patogeniczne

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