ACTA SCIENTIARUM POLONORUM *Acta Sci. Pol., Hortorum Cultus 5(2) 2006, 35-41*

THE USE OF BIOSEPT 33 SL, BIOCHIKOL 020 PC AND POLYVERSUM TO CONTROL SOYBEAN (*Glycine max* (L.) Merrill) DISEASES AGAINST PATHOGENS. PART I. HEALTHINESS AND YIELDING OF SOYBEAN AFTER USING BIOPREPARATIONS

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Abstract. The object of the studies were soybean plants grown of the seeds dressed with Polyversum, Biochikol 020 PC and Biosept 33 SL. At anthesis those plants were sprayed with the same biopreparations. The experiment considered a combination with the chemical preparation Zaprawa Oxafun T for seed dressing, and Bravo Plus SC for spraying plants at anthesis. It can be stated on the basis of the obtained results that the application of biopreparations for seed dressing and spraying plants at anthesis was similar to that of chemical preparations. Among the studied biopreparations, Biosept 33 SL turned out to be the most effective in protecting plants from soil-borne pathogenic fungi.

Key words: biopreparations, biological control, soybean

INTRODUCTION

Soybean seeds are a valuable raw material for the production of oil and they contain full-value protein. Despite big nutritional properties only a small area of soybean cultivation is still observed in Poland. One of the reasons for the lack of profitability in the cultivation is an increasing and unlimited import of cheap soybean ground grain and whole seeds from the USA and Brazil [Szyrmer and Boros 1997]. According to the FAO data, soybean production in the world is 209.5 million tons of seeds, while in Europe it is 2.7 million tons. There are no complete data concerning the production in Poland. From 1.5 to 2.5 tons of seeds are obtained from 1 ha, on average [Szyrmer and Boros 1996]. One of the main reasons for such differentiated yielding of soybean are the soil-borne fungi.

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The size and quality of the yield of soybean seeds are decreased by the diseases of roots and above-ground parts of plants caused by such fungi as *Rhizoctonia solani* Kühn., *Colletotrichum truncatum* Andrus, Moore, *Septoria glycines* Hemi, *Phomopsis sojae* Lehman, *Phoma exigua* Desm. var. *exigua, Altenaria alternata* (Fr.) Keissler, *Botrytis cinerea* Pers., *Sclerotinia sclerotiorum* (Lib.) de Bary and *Fusarium* spp. [Lori and Sarando 1989, Sinclair and Backman 1989, Nickel et al. 1992, Pięta and Pastucha 1993, Nelson et al. 1996]. Pre-sowing seed dressing is a commonly applied treatment improving the emergencies and healthiness of plants. It is most frequently performed by means of chemical preparations. Nowadays attempts are made to use biopreparations on the basis of organic compounds or antagonistic microorganisms.

The purpose of the present studies was to establish the protective effect of Polyversum, Biochikol 020 PC and Biosept 33 SL before soybean is infected by soil-borne pathogenic fungi.

MATERIALS AND METHODS

The studies were conducted in the years 2005-2006 at the Experimental Station at Czesławice near Nałęczów on a field of an 11-year-old monoculture of soybean with naturally accumulated infection material in the soil. The experiment was set according to the method described by Patkowska [2006]. The seeds of soybean 'Mazowia' cv. were dressed, and the plants at anthesis were sprayed with such biopreparations as Polyversum (1 g·100 g^{-1} seeds), 0.2% Biosept 33 SL and 2.5% Biochikol 020 PC. The experiment considered the combination with a chemical preparation Zaprawa Oxafun T for seed dressing, and Bravo Plus SC for spraying plants at anthesis. Plants without any protective treatment constituted the control.

The number of seedlings and plants at anthesis as well as their healthiness were established in the period of vegetation. Infected seedlings and plants at anthesis were sampled from each plot and taken for a mycological analysis, which was conducted according to the method described by Pięta [1988]. After the harvest the weight of the yield and the proportion of the seeds with spots were determined in particular experimental combinations. The results were statistically analyzed and the significance of differences was established on the basis of Tukey's confidence intervals [Elandt 1964].

RESUTLS AND DISCUSSION

It can be stated on the basis of the obtained results concerning the numbers and healthiness of soybean seedlings that the highest mean number of seedlings grew on the plots sown with the seeds dressed with Biosept 33 SL (tab. 1). The healthiness of the seedlings was also the best in this combination of the experiment since here the studies found out the smallest number of seedlings inhibited in their growth and with necrosis on the roots and the stem base. A lot of seeds were found on the plots sown with the seeds dressed with biopreparations (Polyversum, Biochikol 020 PC) and the chemical preparation (Zaprawa Oxafun T) (tab. 1). The smallest number of seedlings with the

greatest share of the diseased ones was found on control plots. Results of the presented studies confirmed the information about effectiveness of the protective effect of biopreparations in controlling plant diseases [Pospieszny and Struszczyk 1994, Wojdyła et al. 1997, Orlikowski et al. 1999, 2001, Borkowski and Nowosielski 2001, Borkowski et al. 2006, Szczeponek et al. 2006]. During the second observation, i.e. 7 days after spraying the plants with biopreparations or a chemical preparation, the number and healthiness of plants at anthesis was similar to the results from the first observation. On the other hand, a further loss of plants and an increase in the number of diseased plants were observed on control plots as compared with the seedlings.

Table 1. Number and healthiness of soybean seedlings
Tabela 1. Liczebność i zdrowotność siewek soi

Experimental combination Kombinacja doświadczenia	Number of seedlings on a plot Liczba siewek na poletku			% infected seedlings % porażonych siewek		
	2005	2006	mean średnia	2005	2006	mean średnia
Polyversum	89^{b*}	90^{c}	89.5^{bc}	3.0^{c}	2^{c}	2.5^{b}
Biochikol 020 PC	85^{b}	87^{b}	86.0^{b}	2.75^{bc}	1.75^{bc}	2.25^{b}
Biosept 33 SL	88^{b}	92^{c}	90.0^{c}	2.25^{a}	0,5^{a}	1.4^{a}
Zaprawa OxafunT	86^{b}	89^{bc}	87.5^{b}	2.5^{ab}	1.5^{b}	2.0^{b}
Control – Kontrola	72^{a}	75^{a}	73.5^{a}	4.5^{d}	3.5^{d}	4.0^{c}

* Means in columns differ significantly ($p \leq 0.05$), if they are not marked with the same letter
Średnie w kolumnach różnią się istotnie ($p \leq 0,05$), jeśli nie są oznaczone tymi samymi literami

Table 2. Number and healthiness of soybean plants at anthesis
Tabela 2. Liczebność i zdrowotność roślin soi w fazie kwitnienia

Experimental combination Kombinacja doświadczenia	Number of plant on plots Liczba roślin na poletku			% infected plants % porażonych roślin		
	2005	2006	mean średnia	2005	2006	mean średnia
Polyversum	87^{b*}	88^{bc}	87.5^{b}	3.25^{a}	2.25^{b}	2.75^{b}
Biochikol 020 PC	84^{b}	85^{b}	84.5^{b}	3.0^{a}	2.0^{ab}	2.5^{b}
Biosept 33 SL	87^{b}	90^{c}	88.5^{b}	2.5^{a}	0.75^{a}	1.63^{a}
Zaprawa OxafunT + Bravo Plus 500 SC	83^{b}	86^{b}	84.5^{b}	3.0^{a}	2.5^{b}	2.75^{b}
Control – Kontrola	66^{a}	70^{a}	68.0^{a}	4.75^{b}	4.0^{c}	4.38^{c}

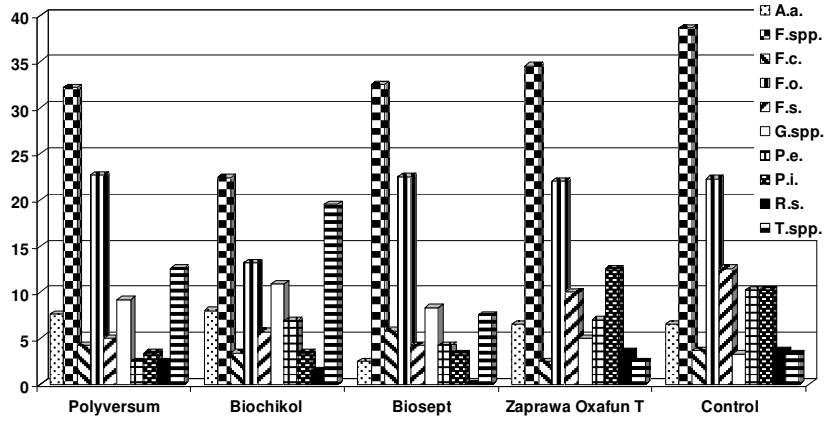
* Means in columns differ significantly ($p \leq 0.05$), if they are not marked with the same letter
Średnie w kolumnach różnią się istotnie ($p \leq 0,05$), jeśli nie są oznaczone tymi samymi literami

The highest yield with the best quality seeds was gathered from the plants in the combination with Biosept 33 SL (tab. 3). A high yield was also collected from the plants from the combination with Polyversum and Biochikol 020 PC and with chemical preparations. The smallest yield with a big proportion of seeds with spots was obtained from control plants (tab. 3).

Table 3. Yield and percentage of infected soybean seeds (from the years 2005–2006)
Tabela 3. Plon oraz procent porażenia nasion soi (średni z lat 2005–2006)

Experimental combination Kombinacja doświadczenia	Mean yield of seeds from plot in g Średni plon nasion w g z poletka	% infected seeds % porażonych nasion
Polyversum	425[c*]	2.5[b]
Biochikol 020 PC	375[b]	2.0[b]
Biosept 33 SL	471[c]	0.5[a]
Zaprawa Oxafun T	369[b]	3.5[c]
Control – Kontrola	246[a]	7.5[d]

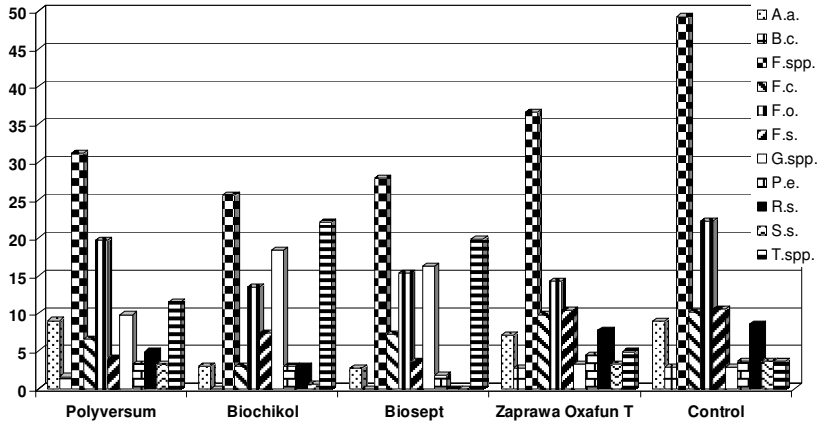
[*] Means in columns differ significantly ($p \leq 0.05$), if they are not marked with the same letter
Średnie w kolumnach różnią się istotnie ($p \leq 0,05$), jeśli nie są oznaczone tymi samymi literami



A.a. – *A. alternata*, B.c. – *B. cinerea*, F.spp. – *Fusarium* total – ogółem, F.c. – *F. culmorum*, F.o. – *F. oxysporum*, F.s. – *F. solani*, G. spp. – *Gliocladium* total – ogółem, P.e. – *P. exigua, P.i. – P. irregulare,* R.s. – *R. solani*, T. spp. – *Trichoderma* total – ogółem

Fig. 1. Fungi isolated from soybean seedlings in individual experimental (mean % from the years 2005–2006)
Rys. 1. Grzyby wyosobnione z siewek soi w poszczególnych kombinacjach doświadczenia (średnie z lat 2005–2006)

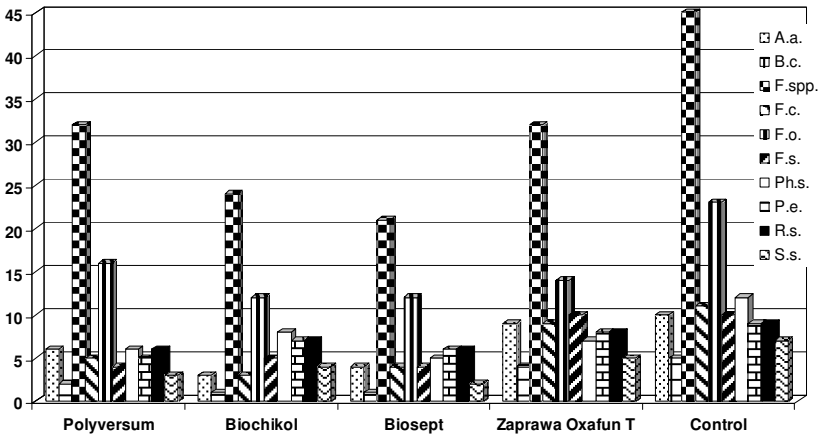
The mycological analysis of both the infected seedlings and plants at anthesis gave the most *Fusarium* spp. represented by *F. culmorum, F. oxysporum* and *F. solani* (fig. 1, 2). Vegetation periods in the years 2005–2006 were favourable to the development of *Fusarium* spp. and plant infection since they were characterized by a high temperature of the air. According to Booth [1971], Sinclair and Backman [1987], these are the fungi requiring the temperature between 22 and 28°C for their growth and development. Besides, *Altenaria alternata, Botrytis cinerea, Phoma exigua,* and *Rhizoctonia solani* were isolated from the studied plants, and their role in plant infection varied. Moreover, *Pythium irregulare* was isolated from the seedlings, while *Sclerotinia sclerotiorum* was isolated from plants at anthesis. Saprobionts were also obtained during the mycological analysis of the seedlings. The colonies of *Gliocladium* spp. and *Trichoderma* spp. were



A.a. – *A. alternata*, B.c. – *B. cinerea*, F.spp. – *Fusarium* total – ogółem, F.c. – *F. culmorum*, F.o. – *F. oxysporum*, F.s. – *F. solani*, G. spp. – *Gliocladium* total – ogółem, P.e. – *P. exigua,* R.s. – *R. solani*, S.s. – *S. sclerotiorum*, T. spp. – *Trichoderma* total – ogółem

Fig. 2. Fungi isolated from soybean plants at anthesis in individual experimental (mean % from the years 2005–2006)

Rys. 2. Grzyby wyosobnione z roślin soi w fazie kwitnienia w poszczególnych kombinacjach doświadczenia (średnie z lat 2005–2006)



A.a. – *A. alternata*, B.c. – *B. cinerea*, F.spp. – *Fusarium* total – ogółem, F.c. – *F. culmorum*, F.o. – *F. oxysporum*, F.s. – *F. solani*, G. spp. – *Gliocladium* total – ogółem, P.e. – *P. exigua,* R.s. – *R. solani*, S.s. – *S. sclerotiorum*, T. spp. – *Trichoderma* total – ogółem

Fig. 3. Fungi isolated from soybean seeds in individual experimental (mean % from the years 2005–2006)

Rys. 3. Grzyby wyosobnione z nasion soi z poszczególnych kombinacji doświadczenia (średnie z lat 2005–2006)

obtained most numerously. Those fungi were obtained in especially big numbers from the necrotized plant tissues sampled from the plots from the combination with Biochikol 020 PC. According to Dos Santos and Dhingr [1982], the number of *Fusarium* spp. colonies decreases with abundant occurrence of *Trichoderma* spp. This fact was confirmed by the results of the mycological analysis of both the seedlings and the plants at anthesis. Antagonistic *Gliocladium* spp. and *Trichoderma* spp., colonizing the rhizosphere of soybean, can constitute a protective barrier against pathogens [Papavizas 1985, Weller 1988].

The seeds were infected by the same species of fungi that occurred in the period of vegetation on plants, and by *Phomopsis sojae* (fig. 3).

CONCLUSIONS

1. The application of biopreparations such as Biosept 33 SL, Biochikol 020 PC and Polyversum as seed dressing and for plant spraying protected the seedlings and older plants from infection by phytopathogens in a similar manner as the chemical preparations.

2. Biosept 33 SL proved to be the most effective biopreparation since the greatest number of plants on the plots and the highest seed yield were obtained.

3. Biopreparations such as Biochikol 020 PC and Polyversum matched the protective effect of the chemical preparations such as Zaprawa Oxafun T and Bravo Plus 500 SC hence, their application can be recommended in the integrated protection of plants.

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ZASTOSOWANIE BIOSEPTU 33 SL, BIOCHIKOLU 020 PC I POLYVERSUM DO ZWALCZANIA CHORÓB SOI (*Glycine max* (L.) Merrill). CZĘŚĆ I. ZDROWOTNOŚĆ I PLONOWANIE SOI PO ZASTOSOWANIU BIOPREPARATÓW

Streszczenie. Przedmiotem badań były rośliny soi wyrosłe z nasion zaprawionych Polyversum, Biochikolem 020 PC i Bioseptem 33 SL. W okresie kwitnienia rośliny opryskane były tymi samymi biopreparatami. Ponadto w doświadczeniu uwzględniono kombinację z preparatami chemicznymi: Zaprawa Oxafun T do zaprawiania nasion oraz Bravo Plus SC do oprysku roślin w fazie kwitnienia. Na podstawie uzyskanych wyników można stwierdzić, że stosowanie biopreparatów do zaprawiania nasion oraz oprysku roślin w fazie ich kwitnienia było podobne do preparatów chemicznych. Spośród badanych biopreparatów, Biosept 33 SL okazał się najskuteczniejszym w ochronie roślin przed grzybami patogenicznymi przeżywającymi w glebie.

Słowa kluczowe: biopreparaty, biologiczne zwalczanie, soja

The studies were financed by the Ministry of Science and Information, project No 3P06 034 25

Accepted for print – Zaakceptowano do druku: 20.11.2006