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THE ASSESSMENT OF *PHLEBIOPSIS GIGANTEA* (FR.) JÜLICH PINE STUMPS TREATMENT IN STAND GROWING IN THE FIRST GENERATION ON THE POST ARABLE SOIL

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Abstract. The aim of this study was the analysis of *H. annosum* s. s. stand infection and also the stumps colonization by *P. gigantea* and *H. annosum* a year after stumps inoculation with biopreparation. The study was conducted in 40-year-old Scots pine stand growing on the post arable soil, where two plots had been established. After commercial thinning the stumps treatment with *P. gigantea* was done. There were no sporocarps or mycelium of both *H. annosum* and *P. gigantea* on investigated stumps. The mycological analysis of wood showed that 64-72% stumps were colonized by *P. gigantea* and 14-17% by *H. annosum*. The mycelium of both fungi was also isolated from roots (34-42% colonized by *H. annosum* and 21-31% by *P. gigantea*). This study confirmed that stumps treatment in pine stands growing on the post arable soil plays the important role in avoiding the risk of *Heterobasidion* disease.

Key words: *Phlebiopsis gigantea*, *Heterobasidion annosum* sensu stricto, stumps treatment, Scots pine

INTRODUCTION

Heterobasidion root and butt rot is one of the most important diseases of forest trees in Poland and also in the world [Mańka 2005]. The pathogens cause the white pocket rot of butt and roots. *Heterobasidion annosum* (Fr.) Bref sensu stricto due to the most important damages in Scots pine stands growing on the post arable soil. The risk of infection and damages occurs during the whole stands rotation [Mańka 2005, Sierota 1995].

The studies of effective stumps treatment after stands thinning have been undertaken for many years. Hitherto the best results were obtained for preparations based on *Phlebiopsis gigantea* isolates [Pratt et al. 2000]. In Poland the first use of stumps treatment was done in 1971, on the area of the Gdańsk Regional Directorate of Forest State [Sie-

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rota 1984]. Nowadays the treatment is done prophylactic mostly in Scots pine stands growing on the post arable soil [Sierota 1996, Pratt et al. 2000].

The aim of this study was the analysis of *H. annosum* s. s. stand infection and also the stumps colonization by *P. gigantea* and *H. annosum* a year after stumps inoculation with biopreparation.

MATERIAL AND METHODS

The study was done in the Człopa Forest District, Przelewice Range, compartment 292c.

Stand characteristic. 40-year-old Scots pine stand growing on the mixed coniferous-deciduous site, on the post arable soil. The forest floor was covered by moss, clubmoss and grass. The stand was damaged by *H. annosum* in 35%. The stand type was beech-pine, stock density 0.7, dbh 14 cm, height 14, site quality Ia, 5.

The wood volume in this stand was calculated on 1350 m^3 and 147 m^3 per ha. The current wood increment in the whole area was estimated on 83.7 m^3 and 9.1 m^3 per ha. In this stand the gaps, appeared after remove the trees killed by pathogen, were planted with Scots pine, Norway spruce, European larch and Beech in 1995. In 1998 the thinning was carried out and 98 m^3 of logs and 98 m^3 of small size wood was harvested. Another thinning was done in 2002, when 174 m^3 of logs and 12 m^3 of small size wood was harvested and the stumps were treated with *P. gigantea.* In addition the dead trees have been removed every year. Since 1995 there was harvested 454 m^3 of dead wood.

Field and laboratory studies. In this stand two experimental plots (A and B) were establish, each in size 20 m × 20 m. On the plot A 29 stumps and on plot B 50 stumps after the last thinning were marked. The disc about 5 cm thin was cut from each stump's surface and was discarded. The second disc and two root from each stump were collected and carried to the laboratory of Department of Forest Pathology in Poznań University of Life Sciences. The small pieces of wood from each sample were put on 1% malt extract agar (Merck, Germany) in Petri dishes. After 4-5 days of incubation in the dark and temperature 22°C the identification of *Heterobasidion* and *Phlebiopsis* was done on the base of appeared conidial sporulation in 250 × magnification (Zeiss, Jeneval).

RESULTS

There were no sporocarps of *H. annosum* s. s. or the *P. gigantea* mycelium on the stumps localized in both experimental plots. Only on a few stumps the decay process of a wood was visible. *Heterobasidion annosum* s. s. mycelium was isolated from 33.3% of wood samples collected from stumps and roots from plot A, and in 32.7% of wood samples collected from plot B. *Phlebiopsis gigantea* mycelium was isolated from 42.5% wood samples (from stumps and roots) from plot A and from 35.3% from wood samples collected from plot B.

Wood of twelve stumps on plot A was visibly decayed (41.4% of all stumps on this plot). *Heterobasidion annosum* s. s. mycelium was isolated from wood derived from 5 stumps and 20 roots (respectively 17.2% of stumps and 34.5% of roots), however the *P. gigantea* mycelium was present in wood of 21 stumps and 18 roots (respectively 72.4% of stumps and 31% roots).

Table 1. Stumps and roots colonization by *H. annosum* and *P. gigantea* on plot A and B
Tabela 1. Zasiedlenie pniaków i korzeni przez *H. annosum* i *P. gigantea* na powierzchni A i B

Plot Powierzchnia	Number of stumps/ number of roots Liczba pniaków/ liczba korzeni	Stumps infected by: Pniaki zasiedlone przez:				Roots infected by: Korzenie zasiedlone przez:				Stumps or roots infected by: Pniaki bądź korzenie zasiedlone przez:			
		H. annosum		*P. gigantea*		*H. annosum*		*P. gigantea*		*H. annosum*		*P. gigantea*	
		number liczba	%	number liczba	%	number liczba	%	number liczba	%	number liczba	%	number liczba	%
A	29/58	5	17.2	21	72.4	20	34.5	18	31	29	33.3	37	42.5
B	50/100	7	14	32	64	42	42	21	21	49	32.7	53	35.3

On plot B wood of 18 stumps was decayed (36% of stumps). Mycelium of *H. annosum* s. s. colonized wood of 7 stumps and 42 roots (respectively 14% of stumps and 42% of roots), however the mycelium of *P. gigantea* was isolated from 32 stumps and 21 roots (respectively 64% of stumps and 21% of roots). 24.1% stumps were colonized only by *H. annosum* s. s. on plot A and 36% on plot B. Both fungi occurred together in 20.7% stumps and their roots on plot A and 14% on plot B (Table 1).

DISCUSSION AND CONCLUSIONS

Sierota [1996] found that in 41-year-old Scots pine stands growing in second generation on the post arable soil *H. annosum* occupied 29-39% stumps and 52.9-77.2% of their roots. Two years after *P. gigantea* stumps inoculation the number of stump occupation by pathogen decreased to 14.4%, although that in wood of all stumps the mycelium of saprotroph was present. In this study, after the stumps inoculation with *P. gigantea* pathogen's mycelium was found in 14% stumps on plot A and 17.2% on plot B, however the saprotroph colonized wood of 72.4% stumps on plot A and of 64% on plot B. Scots pine stands infested by *H. annosum* s. s. have to be protected with the aim of suitable methods. Precommercial and commercial thinning, the routine silviculture operation open the infection way through the fresh stumps in the stand especially growing on the post arable soil [Sierota 1987, 1996]. That is why the only method protected these stands against root rot pathogens is the biological control method using the *P. gigantea* [Sierota 1995, Mańka and Łakomy 1997]. The use of *P. gigantea* guarantee the high effectiveness of Scots pine protection against *H. annosum* s. s. especially these growing on the post arable soil. The stump preparation, consist in cutting a deep hole in the stump surface, before the treatment plays the important role for wood colonization by mycelium [Sierota 1995]. In this study the effectiveness of stump colonization was not so high as noted in other studies [Sierota 1995, Pratt et al. 2000] but this situation might be resulted with a not proper treatment done by workers (probably too late after cutting) or usage a bed quality preparation (e.g. old preparation or stored in unfovourable conditions). The spores infection of *H. annosum* s. s. was not high (17.2% on plot A and 14% on plot B), although the common pathogen's presence in these

stands (34% colonized roots on plot A and 42% on plot B), but it was resulted by a lack of pathogen's sporocarps on stumps or trees.

Sierota [1984] found in stands growing on the post arable soils more alive trees (uninfected) in treated stands with *Phlebiopsis gigantea* than in control stands, where the treatment had been not done. In addition half number of stumps were colonized by *P. gigantea* mycelium. Twelve years after treatment *P. gigantea* was still active in those stands.

The treatment correctly done and weather conditions, which allows the *P. gigantea* mycelium growth, stimulate the stumps decay [Sierota 1997]. Sierota [1995] showed that *P. gigantea* mycelium could overgrow a wood of roots up to 1.4 m from inoculated stump, which diameter was 40 cm. In this study the mycelium of *P. gigantea* was found on distance at least 50 cm from stumps.

Rykowski and Sierota [1984 a] emphasized that losses caused by *H. annosum* in stands growing on the post arable soils were difficult to calculate. However, it was possible to define the losses caused by pathogen: timber losses – decrease of harvested timber volume and decrease of its quality; losses of volume (decrease of yearly wood increment), losses connected with decrease of site capacity (weed development), losses connected with too early stand removal (not full usage of site productiveness), losses connected with decrease of stand resistance to other stress factors, losses connected with periodic decrease of productive and nonproductive stands values.

In the untreated stands with biopreparation pathogen could cause the decrease of trees' density, wood increment (in 40-year-old stand about 50-60%) and wood volume from 27.6 to 69.5 m^3/ha, dependently on thinning intensity [Sierota 1997].

Plebiopsis gigantea could cause an intensive wood decay even 6 months after inoculation and protected the stump and roots against *H. annosum* colonization. The stumps treatment during even precommercial thinning limited the losses which consist in decrease of alive trees number about 36-43% and decrease of timber volume about 32-110 m^3/ha (depends on disease intensity) in comparison to treated stands [Sierota 1997]. In studied stands from 1995 to 2002 there were harvested 454 m^3 of timber during occasional cuttings. The *P. gigantea* treatment started after the first commercial thinning in 1998. During the second commercial thinning in 2002 the treatment was also done, but after precommercial thinning all stumps were exposed to spore infections. At the other hand the mycelium of *P. gigantea* could be still active in stumps even six years after treatment [Łakomy et al. 2008].

Rykowski and Sierota [1984 b] showed that pathogen could decrease trees density by about 10% and the volume loss amounted to 11% of stand value in a 30-35 year-old stand. Because of an earlier stand removal the loss of timber volume could reach 44.5% of the value of a healthy stand.

Sierota [1995] found that in a 21-year-old pine stand with untreated stumps timber volume decreased from 53.6% to 62% in comparison to table timber volume, however in treated stand the timber volume reached from 73.8% to 100% of table timber volume.

To conclude the stumps treatment with biopreparation based on *P. gigantea* could substantially limit infestation by *H. annosum* in stands growing on the post arable soils and in addition decreased the losses in these stands. This study confirmed that stumps treatment in pine stands growing on the post arable soil, plays an important role in avoiding the risk of *Heterobasidion* disease.

REFERENCES

Łakomy P., Wojtczak K., Frański H., 2008. *Phlebiopsis gigantea* survival after treatment and its natural stump colonization. In: Proceedings of the 12th International Conference on Root and Butt Rot of Forest Trees. IUFRO Working Party 7.02.01. Eds M. Garbelotto, P. Gonthier. 12th-19th August 2007. Berkeley, California, Medford, Oregon (USA), 240-242.

Mańka K., 2005. Fitopatologia leśna [Forest pathology]. PWRiL Warszawa [in Polish].

Mańka M., Łakomy P., 1997. Preparat „PG" skutecznym środkiem zapobiegającym [Preparation "PG" a protection effective tool]. Las Pol. 3, 20 [in Polish].

Pratt J.E., Niemi M., Sierota Z.H., 2000. Comparison of three products based on *Phlebiopsis gigantea* for the control of *Heterobasidion annosum* in Europe. Biocontrol Sci. Techn. 10, 467-477.

Rykowski K., Sierota Z., 1984 a. Aspekt ekonomiczny występowania huby korzeni w drzewostanach sosnowych na gruntach porolnych [Economic aspect of the occurrence of *Fomes annosus* root rot and butt rot in pine stands on post-agricultural land]. Sylwan 1, 11-21 [in Polish].

Rykowski K., Sierota Z., 1984 b. Działalność huby korzeni na gruntach porolnych w związku z różnymi rodzajami cięć pielęgnacyjnych [Activity of *Heterobasidion* (=*Fomes*) annosum on post agricultural land in relation to various kinds of improvement fellings]. Pr. Inst. Bad. Les. 184, 634, 61-80 [in Polish].

Sierota Z., 1984. Ocena przeżywalności grzyba *Phlebia gigantea* (Fr.) Donk w drzewostanach sosnowych po zabiegu biologicznej ochrony pniaków przed hubą korzeni [Evaluation of the survival of the fungus *Phlebia gigantea* (Fr.) Donk in Scots pine stands after biological treatment of stumps against *Heterobasidion annosum*]. Sylwan 128(9), 29-40 [in Polish].

Sierota Z., 1987. Czynniki sprzyjające występowaniu huby korzeni w drzewostanach sosnowych na gruntach porolnych [Factors favouring the occurrence of *Fomes annosus* in pine stands on former agricultural grounds]. Sylwan 11-12, 69-80 [in Polish].

Sierota Z., 1995. Rola grzyba *Phlebiopsis gigantea* (Fr.: Fr.) Jülich w ograniczaniu huby korzeni w drzewostanach sosny zwyczajnej (*Pinus sylvestris* L.) na gruntach porolnych [The role of the fungus *Phlebiopsis gigantea* (Fr.: Fr.) Jülich as a limiting factor of *Heterobasidion annosum* (Fr.) Bref. in the Scots pine (*Pinus sylvestris* L.) stands in post-agricultural lands]. IBL 810, Warszawa [in Polish].

Sierota Z., 1996. Określanie zagrożenia infekcyjnego ze strony *Heterobasidion annosum* (Fr.) Bref. w uprawach sosny zwyczajnej jako 2 generacji lasu na gruncie porolnym [The assesment of infection risk of *Heterobasidion annosum* (Fr.) Bref. in Scots pine plantations as a 2 generation on a post arable lands]. In: Materiały z sympozjum „Nowe kierunki w fitopatologii". Kraków, 147-152 [in Polish].

Sierota Z., 1997. Wpływ zabiegu ochronnego na zmniejszenie strat powstających w drzewostanie sosnowym w wyniku huby korzeni [The influence of a protective treatment of lessening of loss arising in the pine stand as a result of root rot]. Sylwan 11, 17-23 [in Polish].

OCENA SKUTECZNOŚCI INOKULACJI PNIAKÓW SOSNOWYCH GRZYBEM *PHLEBIOPSIS GIGANTEA* (FR.) JÜLICH W DRZEWOSTANIE PIERWSZEJ GENERACJI NA GRUNCIE POROLNYM

Streszczenie. Celem badań była analiza zainfekowania pniaków sosnowych przez *H. annosum* sensu stricto oraz ich zasiedlenia przez *H. annosum* s. s. i *P. gigantea* w roku po inokulacji pniaków biopreparatem. Badania prowadzono w 40-letnim drzewostanie sosnowym rosnącym na gruncie porolnym, w którym założono dwie powierzchnie badaw-

cze. Po trzebieży pniaki traktowano biopreparatem opartym na grzybie *P. gigantea*. Na pniakach nie stwierdzono owocników ani grzybni należących do *H. annosum* i *P. gigantea.* Analiza mikologiczna drewna pniakowego wykazała, że 64-72% pniaków było zasiedlone przez *P. gigantea*, a 14-17% przez *H. annosum* s. s. Grzybnie obu grzybów izolowano także z korzeni (34-42% zasiedlonych przez *H. annosum* s. s. i 21-31% przez *P. gigantea*). Badania potwierdzają zasadność wykonywania zabiegów biologicznej ochrony drzewostanów przez hubą korzeni w celu zmniejszania szkód wyrządzanych przez patogena.

Słowa kluczowe: *Phlebiopsis gigantea*, *Heterobasidion annosum* sensu stricto, zabezpieczanie pniaków, sosna zwyczajna

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