Poznań University of Life Sciences, Poznań, Poland

THE EFFECT OF SOIL FUNGI COMMUNITIES ON *RHIZOCTONIA* SPP., CAUSING AGENTS OF SCOTS PINE SEEDLING DAMPING-OFF IN GARNCARSKIBRÓD FOREST NURSERY

M. Bełka and M. Mańka

Abstract

In Garncarskibród forest nursery *Rhizoctonia* spp. caused damping-off of Scots pine seedlings in 2004 and 2005. The biotic relations between isolates of the pathogens and communities of saprotrophic soil fungi isolated in June 2004 and 2005 were investigated.

Every year two binucleate and two multinucleate *Rhizoctonia* spp. were tested *versus* the soil fungi communities of the year. Both soil fungi communities supported the growth of all the *Rhizoctonia* spp. isolates. The support was bigger in 2004, and in both years *R. solani* (multinucleate) isolates were supported more that the binucleate ones.

Key words: *Rhizoctonia*, *Pinus sylvestris,* damping-off, seedlings, soil fungi community

Introduction

Damping-off fungi every year cause serious damage in forest nurseries. The range of pathogen species is very wide but usually the disease is caused by the species most favoured by the environment. Scots pine (*Pinus sylvestris*) seedling damping-off in the Garncarskibród forest nursery is caused mainly by *Rhizoctonia* spp., to a smaller extent by *Cylindrocarpon destructans* and *Fusarium* spp. The representatives of *Rhizoctonia* genus are considered the most severe pathogens of seedlings in many forest nurseries in Wielkopolska region (central-west Poland; Gierczak 1963, Mańka et al. 2001, Stępniewska and Mańka 2003).

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The aim of the work was examining biotic relations between saprotrophic soil fungi and *Rhizoctonia* spp. that occurred in forest nursery Garncarskibród in the years 2004 and 2005.

Materials and methods

Forest nursery Garncarskibród (Regional Directorate of State Forest Poznań, Forest District Oborniki) is situated on fresh mixed coniferous forest site (according to Polish forest site typology). In the first decade of June in 2004 and 2005 Scots pine seedlings with damping-off symptoms and soil samples were collected from the nursery. The pathogens were isolated from the seedlings on Martin-Johnson agar medium, after disinfecting them with 10% sodium hypochlorite. Most of the isolates were, however, obtained with the bait method, after sowing Scots pine seeds into the nursery soil and isolating pathogenic fungi from the emerging diseased seedlings.

From the soil samples, collected according to Mańka (1964) and Mańka and Salmanowicz (1987), communities of saprotrophic soil fungi were isolated with the soil plate method by Warcup (1950) modified by Mańka (Johnson and Mańka 1961, Mańka 1964, Mańka and Salmanowicz 1987).

Isolates of *Rhizoctonia* spp. from the nursery from 2004 and 2005 had diversified colony morphology on potato dextrose agar (PDA). They were examined for number of nuclei in cell, according to Bandoni (1979). Next, the effect of soil fungi communities on the growth of the isolates was examined with the biotic series method by Mańka (Mańka 1974, Mańka and Mańka 1992, 1993). In the method individual biotic effect (IBE) is evaluated, basing on the situation in a dual fungal culture on PDA after 10 days of incubation. The IBE is the effect of one isolate of a soil fungus species (community component) on the pathogen growth. After multiplication of the IBE value by the soil fungus species frequency in the community, the general biotic effect (GBE) is obtained which is the effect of all the isolates of the soil fungus species on the pathogen growth. Summarizing all the GBEs results in the summary biotic effect (SBE), i.e. the effect of the entire soil fungi community on the pathogen – this describes the phytopathological function of the community. The biotic effects mentioned can be positive (suppressive effect on the pathogen's growth), negative (supporting effect on the pathogen's growth) or neutral ("0"). The impact of the supporting or suppressing effect is described by the absolute value of the effect.

In both representations of soil fungi communities 12 fungal species were identified, of which nine were common for both communities. Basing on Marczewski-Steinhaus formula (Kowalski 1996, Tyszkiewicz 2001), the similarity of both communities was calculated.

Results

Among 10 isolates of *Rhizoctonia* spp. obtained in 2004 there were six binucleate ones and four multinucleate ones, and among 17 isolates of 2005 – 10 binucleate and multinucleate isolates. The latter represented *R. solani*. For further work two binucleate and two multinucleate isolates from each year were chosen and tested against the soil fungi communities of the year.

The soil fungi community of June 2004 consisted of 307 isolates. Out of the number 274 isolates (representing 10 most frequently occurring species; 89% of all the isolates) were used in the biotic test (Table 1). The soil fungi community of June 2005 consisted of 116 isolates, of which 94 (representing 11 most frequently occurring species; 81% of all the isolates) were considered in the biotic tests (Table 2).

The majority of soil fungi from both communities supported the growth of *Rhizoctonia* spp. isolates. This resulted in negative values of SBE, depicting supporting effect of both communities on the growth of all the pathogenic isolates. The only two fast growing soil fungi species, *Rhizopus* sp. and *Trichoderma harzianum*, suppressed the growth of all pathogens in question.

The soil fungi community effect on the *Rhizoctonia* spp. isolates' growth was much more supporting in 2004 than in 2005. In 2004 the SBE values were –1150 to –1559, while in 2005 they were only –372 to –630 (Tables 1 and 2). In both years the community effect was more supporting to the growth of *R. solani* isolates than to the growth of the binuclear ones.

Table 1

Biotic effect of soil fungi community from forest nursery in 2004 on the growth of *Rhizoctonia* spp. isolates

Species of fungus	Frequency	Biotic effect on							
		multinucleate				binucleate			
		R. 3		*R* . 4		*R.* 7		*R.* 2	
		IBE	GBE	IBE	GBE	IBE	GBE	IBE	GBE
Penicillium janczewskii	65	–5	–325	–5	–325	–3	–195	–2	–130
Chaetomium globosum	58	–7	–406	–6	–348	–5	–290	–7	–406
Umbelopsis vinacea	42	–7	–294	–5	–210	–6	–252	–5	–210
Penicillium roseum	33	–7	–231	–5	–165	–4	–132	–6	–198
Haematonectria haematococca	27	–8	–216	–7	–189	–7	–189	–4	–108
Penicillium daleae	22	–4	–88	–7	–154	–6	–132	–7	–154
Gliocladium viride	8	–5	–40	–5	–40	–5	–40	–5	–40
Rhizopus sp.	7	+5	+35	+6	+42	+8	+56	+7	+49
Truncatella hartigii	6	–4	–24	–2	–12	–3	–18	–5	–30
Trichoderma harzianum	6	+5	+30	+6	+36	+7	+42	+6	+36
Summary biotic effect		**–1559**		**–1365**		**–1150**		**–1191**	

IBE – individual biotic effect, GBE – general biotic effect.

Table 2

Biotic effect of soil fungi community from forest nursery in 2005 on the growth of *Rhizoctonia* spp. isolates

Species of fungus	Frequency	Biotic effect on							
		multinucleate				binucleate			
		R. 19		*R* . 20		*R.* 71		*R.* 21	
		IBE	GBE	IBE	GBE	IBE	GBE	IBE	GBE
Aspergillus clavatus	18	–8	–144	–8	–144	–7	–126	–7	–126
Penicillium janczewskii	16	–8	–128	–7	–112	–4	–64	–4	–64
Penicillium roseum	15	–8	–120	–7	–105	–4	–60	–5	–75
Gliocladium viride	10	–8	–80	–6	–60	–5	–50	–4	–40
Penicillium daleae	9	–8	–72	–8	–72	–3	–27	–4	–36
Umbelopsis vinacea	6	–8	–48	–8	–48	–6	–36	–6	–36
Haematonectria haematococca	5	–2	–10	–2	–10	–2	–10	–7	–35
Chaetomium globosum	5	–8	–40	–8	–40	–6	–30	–6	–30
Rhizopus sp.	4	+6	+24	+7	+28	+7	+28	+7	+28
Truncatella truncata	3	–8	–24	–7	–21	–4	–12	–5	–15
Trichoderma harzianum	3	+4	+12	+5	+15	+5	+15	+7	+21
Summary biotic effect		**–630**		**–569**		**–372**		**–408**	

Explanation – see Table 1.

The quality similarity of the 2004 and 2005 communities, calculated with Marczewski-Steinhaus formula, was 69%.

Discussion

The support of a community to *Rhizoctonia* spp. isolates happens often as the species are fast growing ones, including the isolates in question (Mańka et al. 2001). Neither *Rhizopus* sp. nor *T. harzianum* isolates, due to their small frequency in both communities, were able to play a considerable role and to contribute to the summary biotic effect in either year. The results of the work do not confirm the opinion of Gierczak (1963), who claimed that abundance of *Penicillium* spp. in soil inhibited the occurrence and intensity of seedling damping-off, due to the antibiotic compounds the fungi of the genus produced. In the community of 2004 *Penicillium* spp. amounted up to 44%, while in the 2005 community – 43% of the total isolate number, and yet none of them inhibited the growth of the *Rhizoctonia* isolates.

Also greater support of both communities to the *R. solani* isolates than to the binucleate isolates (occurring every year) seems to confirm results obtained by Mańka et al. (2001) in 1999 in forest nursery Wronczyn by Poznań. Damping-off of seedlings in the nursery was mainly caused by *R. solani*, who was most supported

by the local soil fungal community. Other pathogens were much less numerous in the diseased seedlings and were less supported by the soil fungi community (several *F. oxysporum* isolates and one binuclear *Rhizoctonia* isolate) or even suppressed (the single isolate of *Cylindrocarpon destructans*).

The similarity of 2004 and 2005 communities is high (69%) which seems natural as the communities were isolated from the same bed.

It is worth noticing that Sen (2001) claims that binuclear isolates do not inhibit the growth of coniferous seedlings (in Finland and Norway), and Herr (1995) describes even several binuclear isolates that he considers promising for biocontrol against *R. solani* on some horticultural plants. The role and share of binuclear isolates in the *Rhizoctonia* population in forest nurseries do demand further investigation.

Streszczenie

WPŁYW ZBIOROWISK GRZYBÓW GLEBOWYCH NA *RHIZOCTONIA* SPP., SPRAWCÓW ZGORZELI SIEWEK SOSNY ZWYCZAJNEJ W SZKÓŁCE LEŚNEJ GARNCARSKIBRÓD

Na terenie szkółki leśnej Garncarskibród (RDLP Poznań, Nadleśnictwo Oborniki) co roku występuje zgorzel siewek sosny zwyczajnej, powodowana w głównej mierze przez patogeny rodzaju *Rhizoctonia*. Zbadano zależności biotyczne pomiędzy saprotroficznymi grzybami glebowymi a grzybami rodzaju *Rhizoctonia* występującymi w tej szkółce, w dwóch następujących po sobie latach, 2004 i 2005.

Izolaty *Rhizoctonia* spp. pozyskano z siewek chorujących w szkółce oraz metodą pułapkową, z siewek rosnących w pobranej ze szkółki glebie. Spośród nich cztery izolaty *Rhizoctonia* dwujądrowe oraz cztery izolaty wielojądrowe (odpowiednio po dwa z każdego roku badań) zestawiono w testach szeregów biotycznych ze zbiorowiskami grzybów glebowych uzyskanymi w tym samym roku.

Oba zbiorowiska grzybów sprzyjały wzrostowi badanych izolatów *Rhizoctonia* spp. Nasilenie sprzyjającego wpływu zbiorowiska grzybów glebowych było większe w 2004 roku, a w obu latach także większe w odniesieniu do *R. solani*.

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Authors' address:
Marta Bełka M.Sc., Prof. Dr. hab. Małgorzata Mańka, Department of Forest Pathology, Poznań University of Life Sciences, ul. Wojska Polskiego 71 C, 60-625 Poznań, Poland, e-mail: marta.belka@up.poznan.pl

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