

THE OCCURRENCE OF *ARMILLARIA* SPECIES IN SIEMIANICE EXPERIMENTAL FOREST DISTRICT

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Abstract. The objective of the presented studies was the determination of *Armillaria* species causing root rot in stands growing in habitats of a higher fertility in the Siemianice Experimental Forest District. With the application of the mycelium intersterility test, the occurrence of *A. gallica* and *A. ostoyae* was found on the area of the mentioned Forest District, while in the nearby situated Mansion Park, *Armillaria cepistipes* was identified.

Key words: *Armillaria* species, *Armillaria* root rot, Siemianice

INTRODUCTION

Armillaria root rot belongs to the most dangerous diseases of tree root systems in the moderate and subtropical climatic zones [Kile et al. 1991, Mańka 2005, Rykowski 1990]. So far, in the subject-related world literature, over 40 species of *Armillaria* have been described [Żółciak 2005]. Seven species from this number occur in Europe including the following ones: *Armillaria borealis* Marxm. Et Korhonen, *Armillaria cepistipes* Velen, *Armillaria gallica* Marxm., *Armillaria mellea* (Vahl: Fr.) Kumm., *Armillaria ostoyae* (Romagn.) Hering, *Armillaria tabescens* (Scop.: Fr.) Emel. and *A. ectypa* (Fr.) Lamoure [Korhonen 1995]. *Armillaria borealis* defined as a weakness pathogen occurs in the northern part of the European continent [Korhonen 1998, Marxmüller 1978, Marxmüller and Prinz 1982], in coniferous and deciduous tree stands [Roll-Hansen 1985]. *Armillaria cepistipes* is the least dangerous weakness pathogen among all European species. It has been described in coniferous tree stands of Finland and Scotland [Korhonen 1978]. *A. gallica* is also defined as weakness pathogen [Guillaumin et al. 1985]. According to Rishbeth [1985], this species causes tree root rot of coniferous trees. *A. mellea* is a pathogen of deciduous trees [Rishbeth 1985]. This species is more frequent in countries with a warmer and more moist climate and it causes an infestation of young beech and oak tree stands [Sicoli et al. 1994, Szanto 1998, Tsopelas 1999]. In Poland, the occurrence of *A. mellea* was recorded on logs of poplar and apple trees and grapevine [Żółciak 1999]. In forest ecosystem, *A. mellea* was found by Łakomy

[2000, 2006] in two oak tree stand and a birch stump. *Armillaria ostoyae* is the most dangerous pathogen of coniferous tree stands both in Europe and on the North-American continent [Korhonen 1978, Risbeth 1985, Hood et al. 1991, Morrison et al. 1991]. In Poland, this species has a high economic importance and the area of its occurrence is estimated to cover 144 thous. ha [Sierota et al. 2000]. This pathogen occurs in the majority of habitats, but it dominates particularly in the BMśw and LMśw [Żółciak 1999] and it infests particularly frequently the coniferous tree stands of younger age classes [Risbeth 1985, Łakomy 1998, Szewczyk and Mańka 2002] and young tree cultivations [Żółciak 1999].

Fungi of *Armillaria* genus cause infections by rhyzomorphs. Their possible infections depend, among others, on the environment in which they exist and on the susceptibility degree to infection of the given tree. Among the environmental factors, the following ones must be mentioned: accessibility of a nutritional base, soil reaction, soil moisture, oxygen and carbon dioxide content in the soil temperature and the accompanying microorganisms. The objective of the present study was to determine the occurrence of *Armillaria* genus species in tree stands in the more fertile habitats of the Experimental Forest District Siemianice.

MATERIAL AND METHODS

For the purpose of the studies, different localities were selected on the terrain of the Experimental Forest District Siemianice. The characteristic of the selected tree stands is shown in Table 1. In pine stands, wood samples were taken from dead pines and from

Table 1. Classification features of tree stands
Tabela 1. Cechy taksacyjne drzewostanów

Division Wydziałenie	Tree species Gatunek	Forest age in 2008 Wiek w 2008 r.	Forest site type Typ siedliskowy lasu	Area Powierzchnia ha
15b	oak	95	Lśw	1.3
21c	oak	67	Lśw	4.46
9l	pine	4	BMśw	2.28
116d	pine	8	LMśw	2.95
8k	pine	57	BMśw	0.77
9j	pine	1	BMśw	3.77/2.94
9k	pine	6	BMśw	2.24
9m	pine	6	BMśw	2.19
13gx	–	57	Lł	2.44 (forest nursery) (szkółka leśna)
14f	pine	3	Bśw	1.53
14g	pine	10	Bśw	1.49
14h1	pine	2	Bśw	2.05
17f	pine	8	BMw	2.68
Mansion Park Siemianice Park dworski w Siemianicach	lime	120		

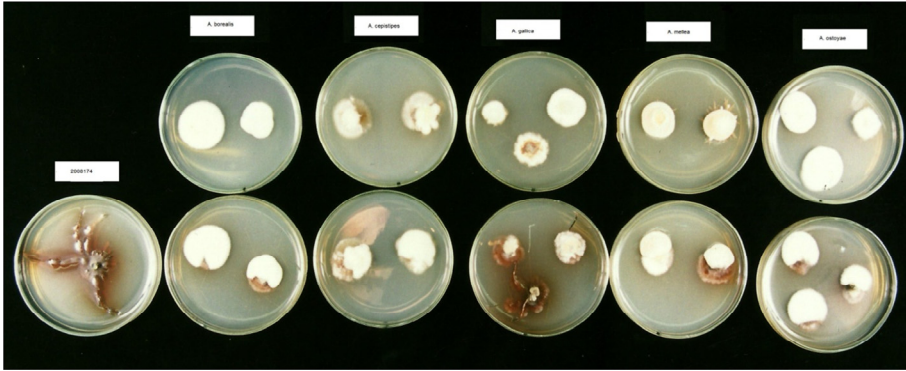


Fig. 1. Results of pairing test with isolate no 2008174

Rys. 1. Wynik testu zgodności grzybnii izolatu 2008174

rhizomorphs which were growing on them. Soil samples from soil outcrops of 50×50 cm dimensions were taken at the depth of 25 cm and they were analysed. In oak division, only soil outcrops were made. They were selected in such a way that they formed a regular network. Wood samples were also taken from stumps. Collected samples of wood and rhizomorphs were taken to the laboratory. There, they were rinsed in tap water, next disinfected in 70% ethyl alcohol (for about 1 minute) and after that, they were dried in a sterile blotting paper. After drying, the samples were divided and placed on Petri dishes with 1% maltose nourishing substance with benomyl and antibiotic (streptomycin and neomycin). The developed mycelium was transferred to test-tubes with 1% maltose nourishing substance. The species of *Armillaria* genus were identified using the mycelium intersterility test elaborated by Korhonen [1978]. The test consisted in the combining of pure fungi cultures. The obtained isolates of *Armillaria* were combined with the test fungi. The test fungi included the following: *A. borealis*, *A. cepistipes*, *A. gallica*, *A. mellea* and *A. ostoyae*. Each isolate obtained from the studied surface was tested with two isolates of the above mentioned five *Armillaria* species (Fig. 1). After three weeks of incubation at 23°C, the reaction of the tested fungi was estimated. After the combining of the haploid mycelium of the tester representing the given species with the identified mycelium, there occurs a fusion in the form of a sclerotium and it indicates that both of them belong to the same species.

RESULTS

On the basis of the mycelium intersterility test, it was found that there occurred the following species: *A. gallica*, *A. ostoyae* and *A. cepistipes*. In the division 21c, rhizomorphs were taken from soil outcrops and in each of them, frizomorphs were found. Then, from the rhizomorphs, mycelium was isolated. On the surface in the division 15b, samples were taken from wood and from soil outcrops. Not from each rhizomorphs sample, a mycelium could be isolated. Some part of the rhizomorphs, particularly those with a wide diameter, seemed to be inactive. All obtained isolates from rhizomorphs originating from soil outcrops were identified as *Armillaria gallica*. On the surfaces, with the participation of pine (in the age of up to 10 years), samples were taken from the

Table 2. List of the obtained species
Tabela 2. Zestawienie uzyskanych gatunków

Armillaria species Gatunek opieńki	Location Lokalizacja	Inoculum Inokulum
<i>Armillaria gallica</i>	15b, 21c, 13gx, 17f	rhizomorphs ryzomorfa
<i>Armillaria ostoyae</i>	8k, 9j, 9h, 9k, 9l, 9m, 14f, 14g, 14hl, 15b, 17f, 116d,	rhizomorphs, wood ryzomorfa, drewno
<i>Armillaria cepistipes</i>	Mansion Park Siemianice Park dworski w Siemianicach	rhizomorphs from alive lime ryzomorfa z żywej lipy

wood of infested trunks. Soil outcrops did not give the expected effect because it was not possible to find rhizomorphs by using the same method. In those division, the rhizomorphs were most frequently found in the close neighbourhood of the infested trees. All isolates originating from these surfaces were identified as *Armillaria ostoyae*. In the separation 13gx mycelium was isolated from a birch stump. The isolate originating from 8k was taken from a pine stump. The obtained species of *Armillaria* genus are shown in Table 2.

DISCUSSION AND CONCLUSION

Armillaria ostoyae is regarded as the main pathogen of coniferous tree stands in Europe. It causes particularly numerous losses in Polish forest [Mańka 2005, Szewczyk and Mańka 2002]. In the studied pine stands, only this species created a high threat and this may be confirmed by the studies of Żółciak [1999], That authoress did not find any distinct preferences of *Armillaria* spp. Towards any specific age of the tree stands, with the exception of *A. ostoyae* which preferred tree stands belonging to the I class age (89.4%). Szewczyk [2005] obtained such results also in the younger age classes of pine tree stands. The occurrence of *A. gallica* rhizomorphs in great numbers in oak stands indicated that there is an abundance of a nutritional base. In older trees, *Armillaria* can infest single roots even of a big root system and it can exist several decades of years [Sierota 2001]. According to Rishbeth [1985], this species causes root rot of deciduous tree roots, but it prefers to colonize deciduous stumps. Morrison et al. [1991] observed *A. gallica* on live and dead deciduous trees. Similarly, Łakomy and Siwecki [2000] isolated *A. gallica* on dead and live oaks in tree stands which were subjected to stresses. This fact was confirmed by Davidson and Rishbeth [1988] who reported that *A. gallica* attacks only stressed trees, but it can also attack live trees of considerable growth causing root rot at the base of the trunks. *A. gallica* is also defined as a weakness pathogen [Guillaumin and Lung 1985]. In Finland and Scotland, it is associated with trunk of spruce [Korhonen 1978]. It also occurs in North-America [Shaw and Roth 1978] and it infests both the deciduous and coniferous trees [Shaw and Roth 1978, Guillaumin and Lung 1985]. The above statements indicate that most probably in the studied oak tree division, a disease process takes place which may be the nearest locality of *A. cepistipes* (inoculum taken in the form of rhizomorphs from a small-leaved lime) in the Mansion Park, localized far from the tree stands.

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WYSTĘPOWANIE GATUNKÓW RODZAJU *ARMILLARIA* W WYBRANYCH DRZEWOSTANACH NADLEŚNICTWA DOŚWIADCZALNEGO SIEMIANICE

Streszczenie. Opieńkowa zgnilizna korzeni drzew jest jedną z najgroźniejszych chorób systemów korzeniowych, głównie w umiarkowanej i podzwrotnikowej strefie klimatycznej. Na świecie dotychczas opisano ponad 40 gatunków rodzaju *Armillaria*, z czego siedem w Europie. Celem pracy było określenie występowania gatunków rodzaju *Armillaria* w drzewostanach na żyzniejszych siedliskach Nadleśnictwa Doświadczalnego Siemianice. Na podstawie testów intersterylności grzybni, w drzewostanach stwierdzono występowanie *A. gallica*, *A. ostoyae* oraz w Parku Pałacowym – *A. cepistipes*.

Słowa kluczowe: opieńka, Siemianice, choroby infekcyjne korzeni

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