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SUITABILITY OF TEST TREE METHOD IN ASSESSMENT OF THREAT TO PINE STANDS POSED BY *ARMILLARIA* SPP.

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Abstract. In the Złotów Forest District 5 pine stands were selected and in each of which 4 observation plots were established each, consisting of 50 trees growing in clusters. The study consisted in one count of dead trees per year conducted in observation plots and in the whole experimental area. Results of the 3-year study showed the applied test tree method is not suitable in the assessment of threat to age class I pine stands posed by *Armillaria* fungi.

Key words: *Pinus sylvestris*, *Armillaria*, threat, forest stand

INTRODUCTION

Among the known root diseases root rot caused by *Armillaria* fungi belongs to those diseases which are difficult to control. It results in the biggest damage in pure spruce or pine stands at the stage of sapling and pole stage forest. Starting from the times of Hartig, who was the first to discover a relationship between *Armillaria* fungi and dying out of trees, repeated attempts have been made to develop a method of control of this disease, so far with no success. Since the early 1990's studies have been carried out at the Department of Forest Phytopathology, the Agricultural University of Poznań, connected with the monitoring of infectious root diseases in age class I (up to 20 years) pine stands. For observation purposes in experimental areas smaller areas were established [Łakomy and Mańka 1998, Szewczyk 2005], which consisted of a specific number of trees and constituting sample plots. This study is an attempt to evaluate observation plots in pine stands in terms of their suitability in the assessment of threat posed by fungi of genus *Armillaria*.

In the Złotów Forest Districts 5 tree stands of similar area were selected (Table 1), in each of which 4 observation plots were established, denoted here as a, b, c and d and each consisting of 50 trees growing in clusters. The investigations in the experimental plots consisted in the count of dead trees, performed in observation plots and in the whole

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Table 1. A characteristic of observation plots
Tabela 1. Charakterystyka powierzchni obserwacyjnych

Division Wydzielenie	Forest site type Typ siedliskowy lasu	Area Powierzchnia ha	Forest age in 2005 Wiek (drzewostanu w 2005) w latach
13b	LMśw	3.08	7
14f	BMśw	4.65	8
15c	BMśw	3.42	8
16i	BMśw	3.09	5
17g	BMśw	3.58	5

experimental area once a year and the determination of the cause of trees dying out after the end of the vegetation season. The study was carried out in the years 2003-2005. The methodology of observations had been previously developed at the Department of Forest Phytopathology, the Agricultural University of Poznań [Mańka 1953 a, b, 1954, Łakomy and Mańka 1998, Mańka and Jańczyk 1999].

RESULTS

Dying out of trees caused by infestation with *Armillaria ostoyae* was found in each selected experimental plot. In the three years of observations in all the experimental plots a total of 399 trees died, while for the observation plots it was 70 trees. The incidence of infestation with fungi of genus *Armillaria* was found to decrease markedly with the age of stands. Thus in most cases no statistically significant differences were observed between observation plots and the whole experimental areas in 2005 (Table 3). Graph 1 presents the percentage of dead trees in individual experimental areas, while graph 2 presents the same parameter for observation plots. Table 2 gives detailed data

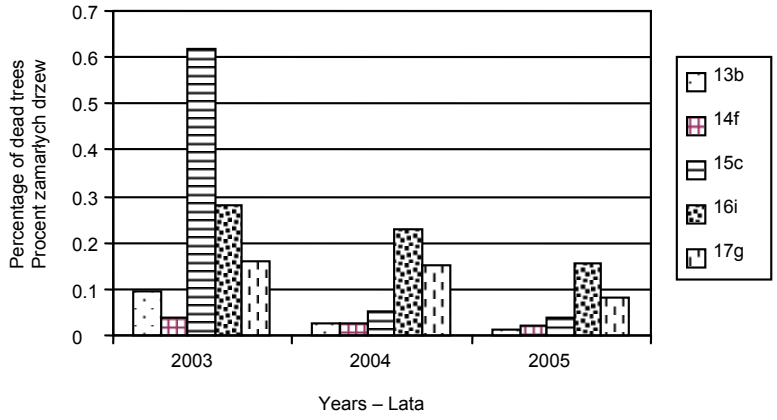

Fig. 1. Percentage of dead trees in division in individual years
Rys. 1. Procent zamarłych drzew w wydzieleniach w poszczególnych latach

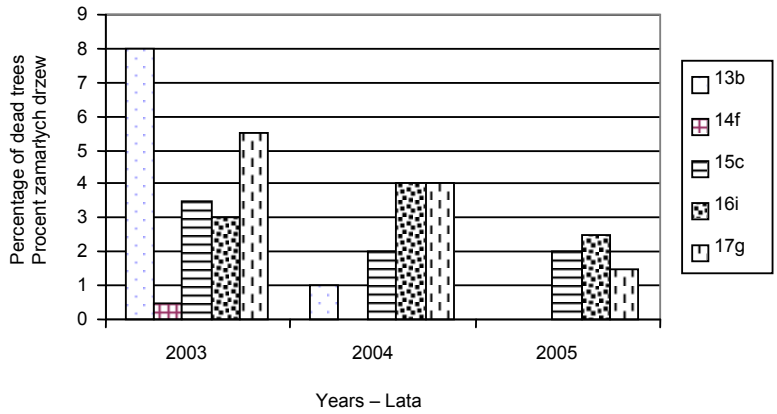

Fig. 2. Percentage of dead trees in observation plots jointly in individual experimental areas
Rys. 2. Procent zamarłych drzew na powierzchniach obserwacyjnych łącznie w poszczególnych wydzieleniach

on the percentage of dead trees in individual observation plots. In order to compare the two structure indexes the test was applied at the level of significance $\alpha = 0.05$.

Testing results for each observation plot are presented in Table 3. Moreover, an analysis was also conducted in which losses were calculated for individual observation plots (a, b, ...), and this number for always referred to the total of the analysed trees, i.e. 200 trees with the percentage of losses in the large plots (Table 4). For this system a test was conducted to compare the two structure indexes at the level of significance $\alpha = 0.05$. In such cases no differences are found only in those situations when the number of dead trees in small plots is zero.

Where *n* denotes a lack of significant differences between the percentage of dead trees in a given observation plot and the percentage of dead trees in the whole experimental area (i.e. the variation in losses in a small plot is statistically similar to the losses found in the large area), *r* denotes the occurrence of differences

Table 2. Percentage of dead trees in individual observation plots
Tabela 2. Procent zamarłych drzew na poszczególnych powierzchniach obserwacyjnych

Years Lata	Division – Wydzielenie																			
	13b				14f				15c				16i				17g			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
2003	12	1	2	14	0	0	2	0	4	2	4	4	8	2	2	0	10	8	4	0
2004	0	2	0	2	0	0	0	0	2	4	0	2	2	2	8	4	10	2	2	2
2005	0	0	0	0	0	0	0	0	0	0	0	2	4	0	4	1	4	0	2	0

Table 3. Testing results for each observation plot
Tabela 3. Wynik testu dla każdej powierzchni obserwacyjnej

Years Lata	Division – Wydzielenie																			
	13b				14f				15c				16i				17g			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
2003	*r*	*r*	*r*	*r*	*n*	*n*	*r*	*n*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*n*	*r*	*r*	*r*	*n*
2004	*n*	*r*	*n*	*r*	*n*	*n*	*n*	*n*	*r*	*r*	*n*	*n*	*r*	*r*	*n*	*r*	*r*	*r*	*r*	*r*
2005	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*r*	*r*	*n*	*r*	*r*	*r*	*n*	*r*	*n*

Table 4. Testing results for observation plots jointly within experimental areas
Tabela 4. Wynik testu dla powierzchni obserwacyjnych zebranych łącznie w ramach wydzieleń

Years Lata	Division – Wydzielenie																			
	13b				14f				15c				16i				17g			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
2003			*r*				*r*				*r*				*r*				*r*	
2004			*r*				*r*				*r*				*n*				*r*	
2005			*r*				*r*				*r*				*n*				*n*	

DISCUSSION AND CONCLUSION

Forecasting infestation caused by *Armillaria* fungi is especially difficult due to the way they cause infection and propagation. Rhizomorphs growing in the soil and absorbing nutrients from colonized stumps, in which they may live for 40, or even 70 years [Show and Roth 1978, Kile et al. 1991], pose a threat for a very long time. Age class I tree stand is characterized by the most dynamic processes of tree growth. Competition between specimens results in their natural elimination. Stress factors such as e.g. drought, high temperatures and air pollution play an important role, making trees susceptible to *Armillaria* infestation. All these aspects result in a situation when within the first 20 years after planting the biggest number of trees dies out and the dynamics of the disease is the biggest [Mańka 1998]. The use of observation plots, selected in terms of the number of trees, randomly distributed in the tree stand, does not always reflect the situation found in the whole experimental area. It happens sometimes that randomly selected observation plots are located next to intensively dying trees and do not show any disease symptoms.

The analyzed observation plots indicate a much higher threat than it is actually found and the obtained results show the application of observation plots (test trees) to obtain reliable information on dying out of *Armillaria* infested trees is not advisable. To analyze the dynamics of this disease it is necessary to study the whole experimental areas or, as it was suggested by Łakomy (unpublished data), areas of at least 1 ha. The lethality of trees caused by fungi of genus *Armillaria* was decreasing with age, as it was previously observed by e.g. Morrison et al. [1991] and Szewczyk [2005].

REFERENCES

Kile G.A., Mc Donald G.I., Byler J.W., 1991. Ecology and disease in natural forests. In: *Armillaria* Root Diseases. Eds C.G. Show III, G.A. Kile. U.S.D.A., Forest Service. Agricultural Handbook 691. Washington 102-121.

Łakomy P., Mańka M., 1998. Monitoring root rot disease development in two Scots pine (*Pinus sylvestris* L.) stands in Krucz Forest District. Phytopathol. Pol. 15, 41-48.

Mańka K., 1953 a. Badania terenowe i laboratoryjne nad opieńką miodową *Armillaria mellea* (Vahl.) Quel. [Forest and laboratory investigations on *Armillaria mellea* (Vahl.) Quel.]. Pr. Inst. Bad. Leśn. 94, 1-96 [in Polish].

Mańka K., 1953 b. O przebiegu holenderskiej choroby wiązów (*Ceratostomella ulmi* (Schw.) Buisman) na terenie miasta Poznania [The progress of Dutch elm disease (*Ceratostomella ulmi* (Schw.) Buisman) on the area of Poznań (Poland)]. Acta Soc. Bot. Pol. 22, 355-378 [in Polish].

Mańka K., 1954. Dalsze badania nad przebiegiem holenderskiej choroby wiązów (*Ceratostomella ulmi* (Schw.) Buisman) na terenie miasta Poznania (w latach 1946-1953) [Further investigation on the progress of Dutch elm disease (*Ceratostomella ulmi* (Schw.) Buisman) on the area of Poznań in 1946-1953]. Acta Soc. Bot. Pol. 23, 783-805 [in Polish].

Mańka K., 1998. Fitopatologia leśna [Forest pathology]. PWRiL Warszawa [in Polish].

Mańka M., Jańczyk J., 1999. Spread of *Armillaria* disease in young Scots pine (*Pinus silvestris* L.) plantations established by artificial sowing or by planting. Rocz. AR Pozn. 310, Melior. Inż. Środ. 20, cz. 2, 419-428.

Morrison D.J., Williams R.E., Whitney R.D., 1991. Infection, disease development, diagnosis, and detection. In: Armillaria root disease. Eds C.G. Shaw III, G.A. Kile. U.S.D.A., Forest Service. Agricultural Handbook 691, Washington 62-75.

Show C.G. III, Roth L.F., 1978. Control of Armillaria root rot in managed coniferous forests. A literature review. Eur. J. For. Pathol, 163-174.

Szewczyk W., 2005. Monitoring *Armillaria* root rot in young (up to 20 yrs) Scots pine plantation in Zielonka Forest District. Acta Sci. Pol. Silv. Colendar. Rat. Ind. Lignar. 4(2), 91-100.

PRZYDATNOŚĆ METODY DRZEW PRÓBNYCH W OCENIE ZAGROŻENIA DRZEWOSTANÓW SOSNOWYCH PRZEZ OPIEŃKĘ

Streszczenie. Na terenie Nadleśnictwa Złotów wybrano pięć drzewostanów sosnowych, w których założono po cztery powierzchnie obserwacyjne składające się z 50 drzew rosnących w grupie. Prace polegały na jednokrotnym w ciągu roku liczeniu zamarłych drzew na powierzchniach obserwacyjnych oraz w całym wydzieleniu. Uzyskane wyniki prac prowadzonych w ciągu 3 lat wykazały nieprzydatność stosowania metody drzew próbnych w ocenie zagrożenia drzewostanów sosnowych I klasy wieku przez grzyby rodzaju *Armillaria.*

Słowa kluczowe: *Pinus sylvestris*, *Armillaria*, zagrożenie, drzewostan

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