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OCCURRENCE OF WHITE POCKET ROT IN PINE STANDS OF OLDER AGE CLASSES IN NORTH-WESTERN POLAND

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Abstract. The study analysed the occurrence of white pocket rot in older pine stands. Analyses were conducted during cutting operations, which provided an opportunity to examine each felled tree in terms of the occurrence of heartwood rot. Based on observations it was found that the actual share of trees infested by *Porodaedalea pini* considerably exceeds the number of trees with external symptoms. Most frequently the range of rot caused by *P. pini* covered sections from the root swelling to a heightof 5 m.

Key words: white pocket rot, *Porodaedalea pini*, Scots pine

INTRODUCTION

White pocket rot of pine is caused by a fungus *Porodaedalea pini* (Brot.) Murrill (formerly *Phellinuspini* (Brot.) Bondartsev & Singer), which is found in its natural range throughout Europe, northern Asia and North America. Mycelium of *P. pini* actively overgrows infested xylem. The fungus activity is manifested in the formation of numerous pockets, visible with the naked eye, filled with white cellulose, conspicuous against the dark brownish-red background (Wiertelak, 1933; Ważny, 1968; Krzysik, 1978). Losses are extensive, since the parasite is a common species (Mańka, 2011). *Porodaedalea pini* constitutes a permanent threat and causes great losses of timber; already before WWII rot caused by *P. pini* was found in 80% stands in Poland (Filipowski, 1937, after Sierota 1998). The parasite affects the functioning of the forest ecosystem and its stability from the economic point of view (Sierota, 1998). The aim of the study was to determine the share and progression of white pocket rot in heartwood of pines in pine stands of older age classes.

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MATERIAL AND METHODS

Analyses were conducted in randomly selected pine stands of older age classes. In the Zielonka Experimental Forest District (N52°32'27 E17°6'5) three experimental sites were selected. Site I is a pine stand aged 155 years in the fresh broadleaved forest site (Lśw), in which 93 pines were felled in the cutting operation. Site II with pines aged 130 years in the fresh mixed broadleaved forest (LMśw) 143 trees were cut. In site III with pine aged 130 years in the fresh mixed broadleaved forest (LMśw) 80 trees were felled during cutting operations. Sites IV and V were located in the Świerczyna Forest District (N53°26'36 E16°16'50). A total of 90 pines aged 169 years were removed from site IV (BMśw), while in site V (BMśw) it was 157 trees aged 124 years. The first stage in the study consisted in the assessment of external symptoms of *P. pini* occurrence in the form of fruiting bodies and hollows in pines before tree felling. Next after felling and splitting in the course of timber harvesting the incidence of external symptoms of white pocket rot in heartwood was analysed. In this way information was collected concerning the number of trees infected with external symptoms and those with no external symptoms. The next stage was to separate each infected pine into 1-m sections. On this basis the range of rot was assessed, while at cross stem sections the degree of wood decomposition was recorded in a 4-point scale. In determination of rot progression a modified scale proposed by Zaleski and Mańka (1939) was applied. This classification is as follows:

- Stage I – early rot – pale pink coloured xylem. No structural or strength changes.
- Stage II – medium rot – more intensive xylem colouring: from pink to pale cocoa brown. The pale cocoa brown colouring is associated with certain brittleness and occasionally also the presence of the first pockets.
- Stage III – late rot – reddish or cocoa brown coloured xylem. Visible cracking along rings and towards pith rays, as well as pockets filled with white cellulose. When pressed with the finger nail wood breaks into pieces, it may be powderised.
- Stage IV – empty spaces inside the stem. They are internal and external hollows. Generally they are found at the location of primary infection (Mańka and Żebrowska, 1997).

RESULTS

In the course of observations external symptoms of *P. pini* were observed at all the selected locations. Trees with white pocket rot accounted for 7 up to 28% total number of trees harvested in the cutting area, with the share of trees with external symptoms ranging from 1.3 to 7.8% (Fig. 1). Analysis of rot incidence in stems showed that in all cases rot was found starting from the butt end, i.e. infection occurred already at younger stand development stages, in sections where the lowest branches were self-pruned the earliest. The maximal range of rot in individual experimental sites varied; in site V it was found only up to 5 m, while in site I it was up to 20 m (Fig. 2). The greatest share in

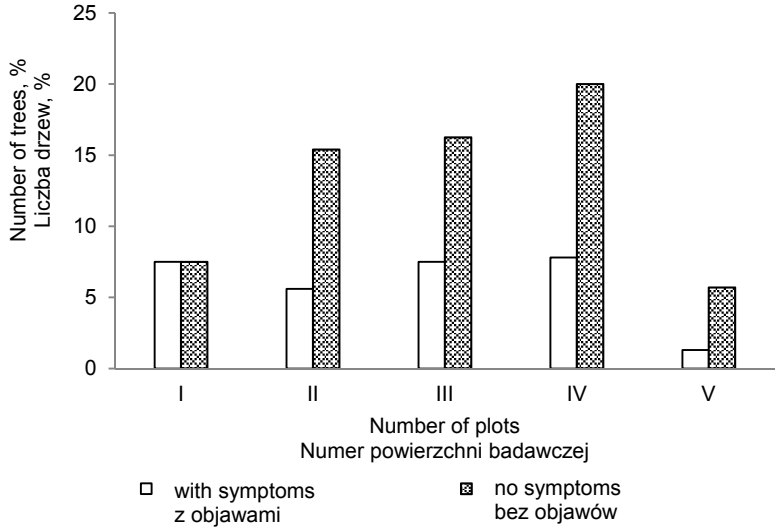

Fig. 1. Share of trees infected by *P. pini* in analysed stands
Rys. 1. Udział drzew zainfekowanych przez *P. pini* w analizowanych drzewostanach

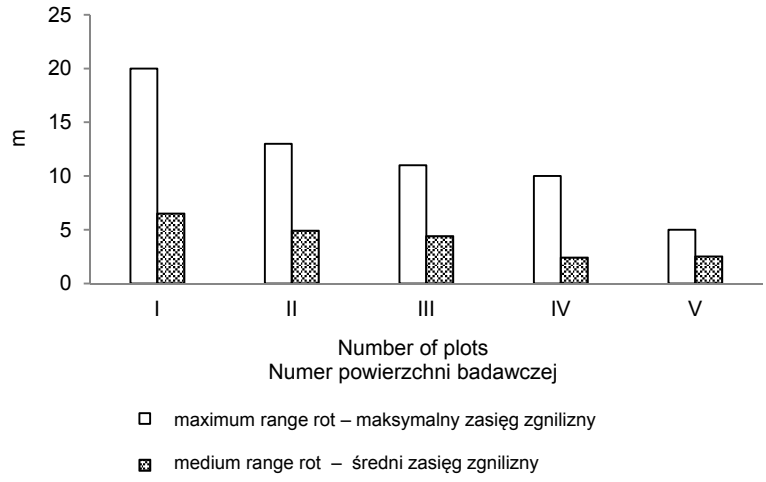

Fig. 2. Range of white pocket rot in heartwood of stems in analysed stands
Rys. 2. Zasięg zgnilizny białej jamkowatej w drewnie twardzielowym strzały w analizowanych drzewostanach

the examined stands was found for stages II and III of rot progression (Fig. 3). In site V no empty spaces were found inside the stem, while stage I of rot progression accounted for only 1%. In the other stands stage IV was observed in the range of 2 to 5%.

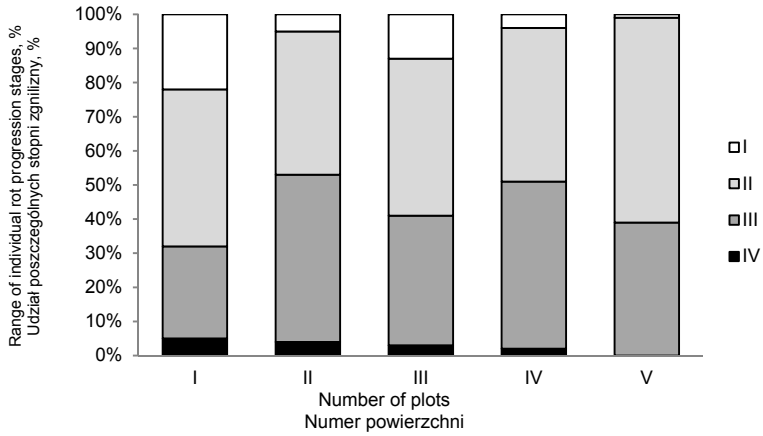

Fig. 3. Range of individual rot progression stages in individual experimental sites

Rys. 3. Udział poszczególnych stopni zaawansowania zgnilizny na poszczególnych powierzchniach badawczych

DISCUSSION AND RESULTS

The conducted observations showed a high share of trees containing white pocket rot caused by *P. pini*, amounting to as much as 28%. In the study on the occurrence of *P. pini* fruiting bodies in northern Poland was observed on up to 18% trees (Szewczyk, 2008a); however, on this basis the actual share of trees with rot caused by this fungus may not be determined. Results of this study indicate that the percentage of trees with external symptoms may account for as few as 23% total number of trees with rot. Obviously the age of stand had the greatest effect on the number of infected trees and the size of rot. The specific nature of fungus infestation consists in the fact that it develops for decades in a living tree, frequently showing no symptoms. Among analysed stands two were over 150 years of age. However, in site I only 15% trees with rot symptoms were recorded. In the case of site IV this share was 28%, at the age of trees of 169 years. The share of trees with white pocket rot falls within the range given by Mańka (2005), who stated that after 100 years stand infestation reaches considerable values of 15–35%. This regularity was also observed by Hubert (1931), Burkot-Klonowa (1974) and Mańka and Mańka (1992). According to Bernadzki (2003), the share of trees infested with rot, aged over 160 years, may be as high as 100% (Bernadzki, 2003); however, in that study the species of fungi causing rot was not taken into consideration. Potentially

the occurrence of white pocket rot may indicate a local bracket fungus infestation of trees in a given area (Bernadzki, 2003). This would confirm earlier studies conducted in the Narol, Czarne Człuchowskie or Tuchola Forest Districts, where the presence of external symptoms was recorded in a small number of trees (Szewczyk, 2008b, 2013; Szewczyk et al., 2014). The greatest number of trees affected by rot was reported in the fresh mixed coniferous forest site (BMśw) (site IV); however, it may be explained by the age of the stand (169 years). In site V, with the smallest number of rot-affected trees, the share of oak in the stand probably contributed to a lesser infestation of pines by spores of *P. pini*. In the other locations the number of infested trees corresponded to the earlier reports on the effect of forest site type on the number of infested trees (Szewczyk, 2008a). This is probably connected in these sites with the availability of larger branches, and thus a greater share of heartwood, in which mycelium of *P. pini* may readily develop. Greater diameters of available heartwood promote infestation by spores of Basidiomycetes. At this stage of the study it was difficult to definitely determine the period at which infection started and thus identify the weather conditions prevalent then. However, it is known that adequate humidity is required for spore germination in *P. pini*. It may have been the reason why the greatest number of stands infested by *P. pini* is located in the area administered by the Regional Directorate of State Forests in Olsztyn (Baranowska-Wasilewska et al., 2013), where high precipitation levels are recorded. The average range of rot within the stem observed in the Zielonka Experimental Forest District was greater than that in the Świerczyna Forest District. Most frequently the range of rot caused by *P. pini* covered sections from the root swelling to a height of 5 m. Already in 1939 Mańka and Zaleski stated the predominance of rot in the lower parts of the stem, i.e. up to 5 m in height. Also in later studies conducted in that area in 1961 Mańka and Chwaliński in examined 110-year old pines reported 65% red ring rot caused by *Phellinus pini* covering buttress, 32% rot in the central stem section and 3% in the upper stem section (above 10 m). The range of rot suggests that infection starts in lower parts of the stem, which is determined by the earliest self-pruning of branches located the lowest, occurring at an early age. The mycelium develops for many years towards the pith even if heartwood has not been formed. Results recorded in this study in the Zielonka Experimental Forest District in comparison to those reported in 1939 and 1961 indicate that the incidence and development of rot caused by *P. pini* are determined by local conditions. The share of individual degrees of decomposition indicates that in the Zielonka Experimental Forest District infection most probably occurred at a younger age of the stand or, which is less probable, the mycelium spread faster. The range of rot also increases with time. For this reason after 120 years the lower part is sometimes empty, decomposed and the fungus reaches several meters upwards the stem. In old stands the development of rot may exceed the rate of increment in volume of the uninfested tissue of the tree (Mańka and Mańka, 1993). The amount of infested wood and the degree of wood decomposition depend mainly on the time, which has passed since the moment of infection. Szewczyk (2015) showed differences in the potential for heartwood decomposition in selected isolates of *P. pini*, coming from different regions of Poland, with no effect of isolate provenance on wood decomposition. This is consistent with the theory of genetic structure of pathogen populations, which typically comprise many different biotypes with several dominants (Burdon, 1993).

CONCLUDING REMARKS

Based on the recorded results it may be stated that white pocket rot constitutes a serious economic problem. The occurrence of external symptoms does not fully reflect the actual share of trees affected by rot. Depending on local conditions infection may develop only at an older age of the stand. In order to reduce economic losses it would be advisable to perform branch clearing operations before heartwood forms inside them.

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WYSTĘPOWANIE ZGNILIZNY BIAŁEJ JAMKOWATEJ W DRZEWOSTANACH SOSNOWYCH STARSZYCH KLAS WIEKU NA TERENIE PÓŁNOCNO-ZACHODNIEJ POLSKI

Streszczenie. W pracy analizowano występowanie zgnilizny białej jamkowatej w starszych drzewostanach sosnowych. Analizę przeprowadzono w czasie wykonywania zrębu i możliwości sprawdzenia każdego ściętego drzewa pod kątem występowania zgnilizny drewna twardzielowego. Na podstawie obserwacji stwierdzono, że rzeczywisty udział drzew zainfekowanych *Porodaedalea pini* jest znacznie wyższy niż liczba drzew z objawami zewnętrznymi. Najczęściej zasięg zgnilizny powodowanej przez *P. pini* obejmował sekcje od szyi korzeniowej do 5 m wysokości.

Słowa kluczowe: zgnilizna biała jamkowata sosny, huba sosny, sosna zwyczajna

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