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OCCURRENCE OF *HETEROBASIDION ANNOSUM* (FR.) BREF. IN THE ROOTS OF BLOWN DOWN TREES IN SCOTS PINE STANDS GROWING ON POST-AGRICULTURAL SOIL OF THE EXPERIMENTAL FOREST DISTRICT ZIELONKA

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Abstract. Trees infected by *Heterobasidion* root rot are more exposed to the results of strong winds. In January 2007, a strong wind which passed among others over the Experimental Forest District Zielonka caused significant losses in the stands. The objective of this work was to verify whether the roots of the wind-fallen trees were settled by *Heterobasidion annosum.* The presence of root rot was found in 83% of roots, and the presence of the pathogen was identified in 53% of the studied trees.

Key words: *Heterobasidion annosum*, blown down, post-agricultural soil

INTRODUCTION

Infections diseases of roots are caused by fungi of *Armillaria* and *Heterobasidion* genera and they are the most important ones regarding the economic reasons of damages occurring in stands. In Poland, as reported by Sierota [2001], in 1960, root diseases were found on a total area of about 60 000 ha. In the successive decades, the acreage of the damaged stands was respectively: 194.100 ha; 200.300 ha and 346 000 ha in 1999. According to the Annual Reports of 2005, the occurrence of infectious diseases was found on a total area of 463.500 ha of stands. The area threatened by *Armillaria* root rot decreased by 21% in the structure of the total endangerment of forest by infections diseases, diseases of root rot which for many years invariably have occupied the leading position (58% in total area of 269 000 ha). Next to biotic factors threatening forests, there can also occur damages caused by flood, wind, frost etc. There is no doubt that windfalls are closely related with weak condition of roots caused by pathogens. In January of 2007, in many forest districts, there occurred damages caused by winds; thousands of trees were blown down. One of the affected areas was the Experimental Forest

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District Zielonka where on the 18th of January 2007, the main attack of wind blew down about 2800 m^3 of compact wood.

The main objective of this work was the analysis of the occurrence of *Heterobasidion annosum* (Fr.) Bref. in the roots of the blown down trees in pine stands of the first generation growing on post-agricultural soil in Experimental Forest District Zielonka.

MATERIAL AND METHODS

Studies were carried out on a Scots pine stand growing as a first generation on post-agricultural soil. Division 24Aa, 15.91 ha, Scots pine 37 age, in some place Scots pine 50 age, breast height 15, height 15 (status on 1.01.2003). During field works, root samples were taken, 10 samples from each tree, the position of wind fallen trees was recorded using GPS instruments. In the laboratory, roots were washed under running water, then they were disinfected in 70% ethyl alcohol for one minute and afterwards they were dried in sterile blotting paper.

The successive stage of the analysis included the separation of roots into 1 cm sections which were placed on a maltose nutrient in Petri dishes. After incubation at room temperature for 72 hours, the occurrence of conidiophores of *Heterobasidion annosum* s.l. assessed. Those analyses were carried out in March 2007.

RESULTS

As a result of the wind action in the stand division, 5 target areas of the wind's attack creating gaps in the stand were found. Four of these gaps were for analyses and trees within those areas were marked making a total of 132 trees (Fig. 1-4). Figure 5 shows the localization of the gaps, the wind direction and the reason of damages. The total number of blown down trees included windbreaks (10 trees) and 13 pines from which it was impossible to take roots for analyses (91, 99, 102, 103, 120, 121, 129, 131, 138, 139, 162, 178). Totally, 109 trees were examined. The obtained results are shown in Table 1.

Table 1. List of studied trees on the research area
Tabela 1. Wykaz drzew poddanych badaniom na powierzchni badawczej

Trees with visible root rot Drzewa z widoczną zgnilizną korzeni	Trees infected by *Heterobasidion annosum* s.l. Drzewa z zasiedlonymi korzeniami przez *Heterobasidion annosum* s.l.	Wind-fallen tree Wiatrołomy
17, 23, 26, 30, 36, 37, 38, 39, 40, 41, 42, 44, 45, 46, 47, 49, 50, 51, 53, 54, 55, 56, 57, 58, 59, 60, 62, 63, 65, 66, 67, 69, 74, 76, 78, 80, 81, 82, 83, 92, 94, 95, 104, 105, 106, 107, 108, 109, 110, 113, 115, 118, 119, 122, 123, 124, 125, 126, 128, 130, 132, 134, 135, 136, 137, 140, 141, 142, 143, 144, 145, 146, 147, 148, 152, 153, 154, 155, 157, 158, 159, 160, 161, 163, 164, 166, 167, 173, 174, 177, 179	17, 18, 21, 25, 26, 30, 36, 39, 40, 42, 44, 47, 51, 52, 53, 54, 57, 63, 64, 66, 67, 68, 69, 70, 71, 72, 73, 74, 76, 89, 90, 92, 93, 94, 97, 98, 100, 114, 122, 127, 130, 148, 149, 152, 153, 154, 155, 156, 157, 159, 160, 162, 166, 167, 173, 174, 175	22, 75, 77, 79, 84, 101, 111, 112, 168, 171

In the studied roots, 52% were settled by *H. annosum* s.l. On the other hand, as many as 83% of trees had roots with a visible root rot at a very advanced stage. In the majority of cases, it was not possible to isolate *H. annosum* s.l. from these roots. Certainly, these symptoms suggest the action of other fungi species which could be inferred from the type of root rot, only 38% were infected by root rot fungus, 38% of roots infected by *H. annosum* did not have any visible rot, it indicates that it was an early phase of infection by that pathogen. On the whole of the studied surface, no presence of root rot fungus fruit bodies were found. However, judging according to the creased gaps in the stand and the dead trees occurring on the area, one can guess that the disease process had been continued for a long time. All blown down trees had a living crown and did not show any external disease symptoms.

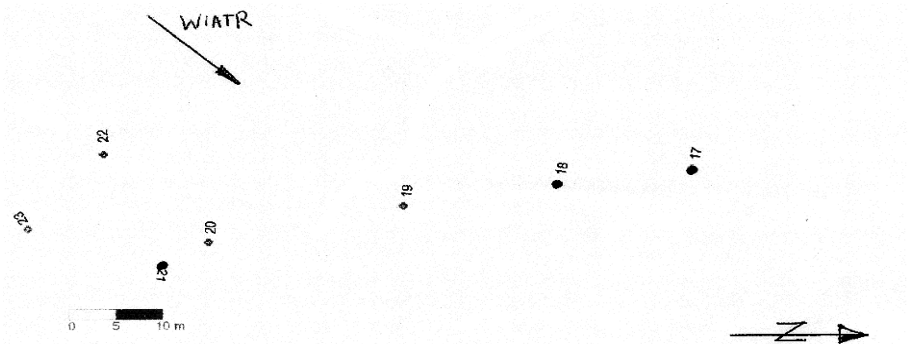

Fig. 1. Scheme of wind-fallen trees in gap no. 1: black point – tree with root rot
Rys. 1. Schemat wywrotów w gnieździe nr 1: czarny punkt – drzewo ze zgnilizną korzeni

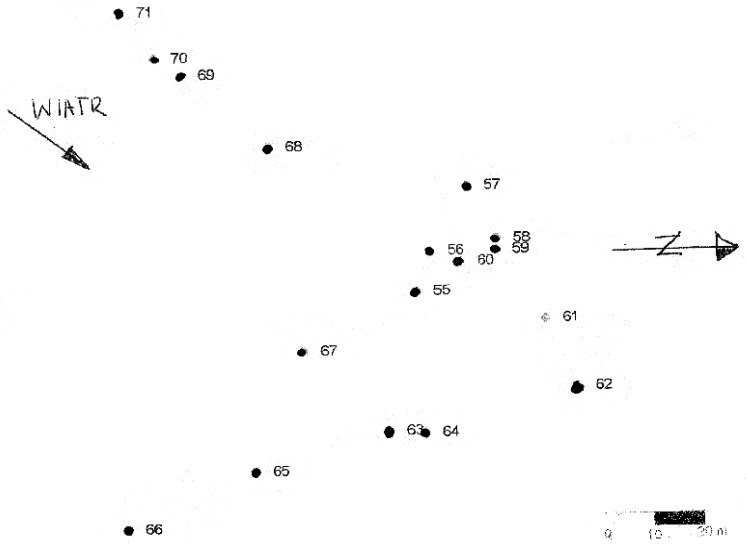

Fig. 2. Scheme of wind-fallen trees in gap no. 2: black point – tree with root rot
Rys. 2. Schemat wywrotów w gnieździe nr 2: czarny punkt – drzewo ze zgnilizną korzeni

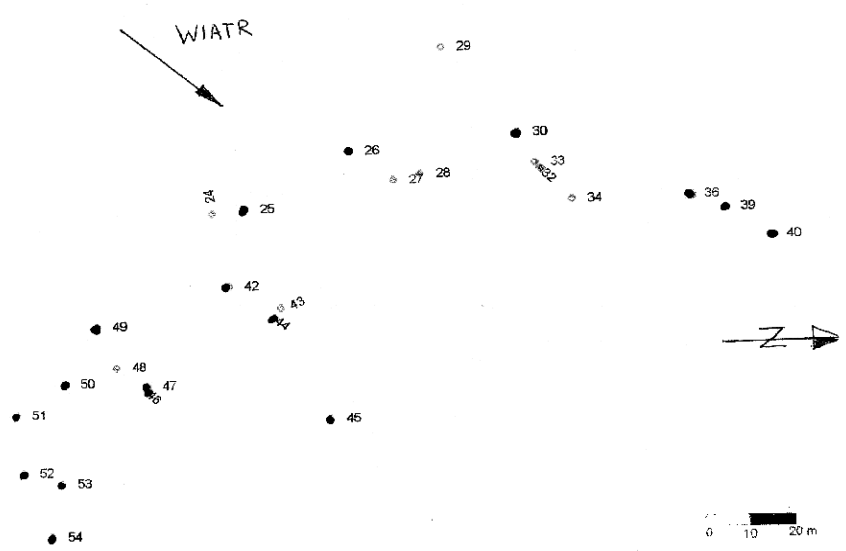

Fig. 3. Scheme of wind-fallen trees in gap no. 3: black point – tree with root rot
Rys. 3. Schemat wywrotów w gnieździe nr 3: czarny punkt – drzewo ze zgnilizną korzeni

DISCUSSION

The studies were carried out in the stand of the first generation on a post-agricultural soil. The analysis of wind direction indicated that the size of damages increased with the depth inside the stand. First, there developed a gap in the stand affecting only seven trees, but only three of them were infected by root rot fungus. A successive gap included more than 10 blown down trees, which in 95% were weakened because they were settled by fungi. The last gap in the stand was created because of several tens of blown down trees and a rather high percentage of them consisted of healthy trees. Root rot caused by *H. annosum* makes the trees more endangered by windfall in case of a strong wind [Vollbrecht et al. 1995]. In our conditions, *Heterobasidion* root rot causes the greatest damages in Scots pine stand growing on post-agricultural soil, particularly those of the first generation. As a result of the infection of these stands by *H. annosum*, there develop gaps in the stand, the predisposition of trees to other disease increases and the resistance of trees to abiotic damages decreases [Sierota 1995]. The infection of trees by *Heterobasidion* root rot on post-agricultural soil can reach from 30% (III age class) to 67% (VI age class) [Greig 1995]. The first infection by *H. annosum* on post--agricultural soil of the first generation was observed at the age of 13 years. Cultivation treatments significantly contribute to the increase of the infection extend [Greig 1984]. The problem of damages from wind was investigated on post-agricultural soil by Rykowski and Sierota [1984]. They showed that as many as 80% of trees had strongly reduced roots because of an infection by *H. annosum*. On the studied area, a similar result was obtained, although not only because of the infection by *H. annosum*. Łakomy

et al. [2001], in their studies on the effect of infection by settled by the pathogen in 58.7% to 80.4%. The weakening of roots will always expose tree stands to damages by windfalls, however, abiotic factors only accelerate in time the unavoidable result of infection by root pathogen. Therefore, prophylaxis is absolutely necessary to limit the damages caused by root rot pathogens. On the areas of the Experimental Forest District Zielonka, no preparations based on *Phlebiopsis gigantea* (Fr.Fr.) Jülich are applied.

Fig. 4. Scheme of wind-fallen trees in gap no. 4: black point – tree with root rot
Rys. 4. Schemat wywrotów w gnieździe nr 4: czarny punkt – drzewo ze zgnilizną korzeni

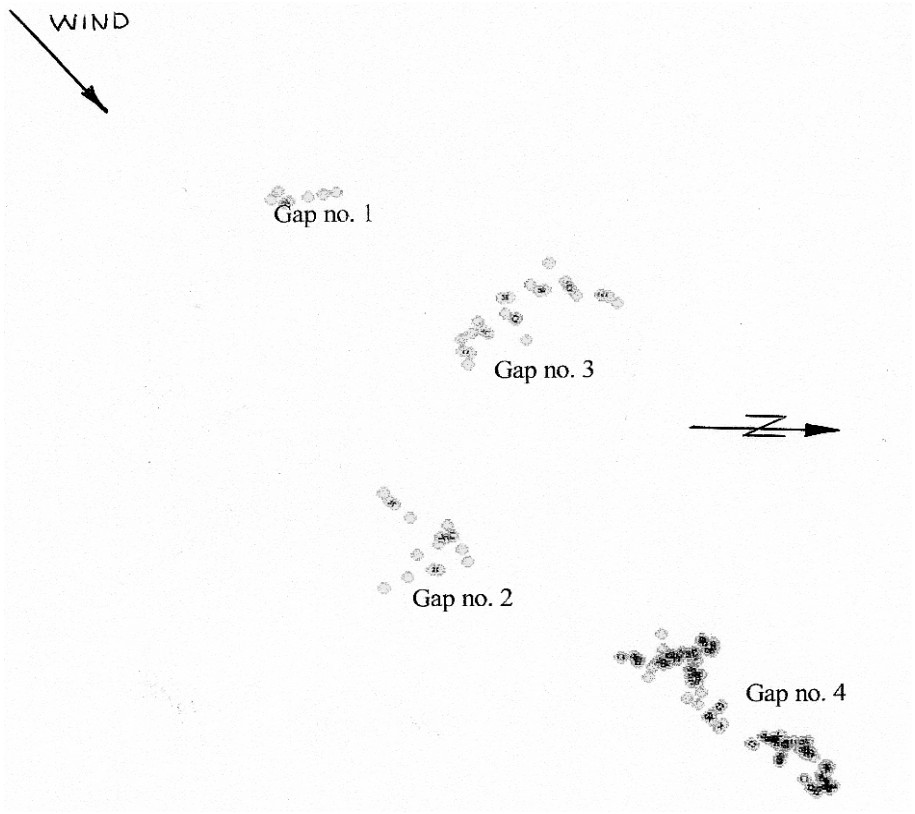

Fig. 5. Scheme of wind-fallen trees in division
Rys. 5. Schemat wywrotów w wydzieleniu

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WYSTĘPOWANIE *HETEROBASIDION ANNOSUM* (FR.) BREF. W KORZENIACH POWALONYCH DRZEW W DRZEWOSTANACH SOSNOWYCH ROSNĄCYCH NA GRUNTACH POROLNYCH NADLEŚNICTWA DOŚWIADCZALNEGO ZIELONKA

Streszczenie. Drzewa porażone przez hubę korzeni są bardziej podatne na skutki silnych wiatrów. W styczniu 2007 roku wichura, która przeszła m.in. nad Nadleśnictwem Doświadczalnym Zielonka wyrządziła spore straty w drzewostanach. W pracy postanowiono sprawdzić czy korzenie wywróconych drzew były zasiedlone przez *Heterobasidion annosum*. Stwierdzono obecność zgnilizny w 83% korzeni, a obecność patogena w 53%.

Słowa kluczowe: *Heterobasidion annosum*, wiatrowały, grunty porolne

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