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COMPARISON OF MYCELIUM GROWTH OF SELECTED SPECIES OF CULTIVATED MUSHROOMS ON TEXTILE INDUSTRY WASTES

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Abstract. Mushrooms are cultivated on a wide range of materials of organic origin. Textile industry wastes seem to be interesting in this regard. In experiment, mycelium growth of the following eight mushroom species: *Pholiota nameko* (Ito) Ito et Imai, *Flammulina velutipes* (Curt. ex Fr.) Sing., *Lyophyllum ulmarium* (Bull. ex Fr.) Kumm., *Marasmius oreades* (Bolt.: Fr.) Fr., *Hericium erinaceus* (Bull: Fr.) Pers., *Agrocybe aegerita* (Brig.) Sing., *Lentinula edodes* (Berk.) Pegl. and *Ganoderma lucidum* (Curt: Fr.) Karst. cultivated on alder sawdust, rye straw, hemp and flax shive substrates was investigated. Significant variability in mycelium growth was observed depending on the mushroom species and the type of the applied substrate. The best mycelium growth of the examined mushroom species was recorded on flax shive and alder sawdust. In the majority of the experimental mushroom species, the worst growth of mycelia was recorded on the hemp shive substrate.

Key words: hemp shive, flax shive, edible fungi, mycelium

INTRODUCTION

Mushrooms are cultivated on a wide range of materials of organic origin. Among the most frequent materials used for this purpose are: sawdust and cereal straw as the most common and easily available raw materials [Stamets 2000]. However, there are possibilities of utilisation of many other materials containing cellulose and lignin as confirmed by research results of many researchers [Poppe and Hofte 1995, Zervakis et al. 2001, Ozcelik and Peksen 2007, Rani et al. 2008, Akevia et al. 2009, Dundar et al. 2009]. These materials comprise, among others, cotton wastes [Danai et al. 1989, Oei 2003]. Frequently, mycelium growth rate is used as an indicator of the substrate useful-

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ness for mushroom cultivation. Rapid mycelium growth in the substrate makes its intensive decomposition possible and guarantees sufficient quantities of nutrients for carpophore development [Chang and Miles 2004].

The aim of the presented investigations was to assess the usefulness of the substrate made from flax and hemp shive for the cultivation of several species of cultivated mushrooms. Bearing in mind the crucial importance for mushroom cultivation of the mycelium development in the substrate, the authors compared mycelium growth in the above-mentioned substrates as well as in the most commonly applied substrates, namely straw and sawdust.

MATERIAL AND METHODS

Experiments were carried out at the Department of Vegetable Crops of the Poznań University of Life Sciences in 2009 using four substrates, i.e. alder sawdust, rye straw, hemp and flax shive. The mycelium growth of eight species of mushroom was tested. The experimental mushroom species derived from the collection of the Department of Vegetable Crops. The following mushroom species were applied: *Pholiota nameko* (Ito) Ito et Imai, *Flammulina velutipes* (Curt. ex Fr.) Sing., *Lyophyllum ulmarium* (Bull. ex Fr.) Kumm., *Marasmius oreades* (Bolt.: Fr.) Fr., *Hericium erinaceus* (Bull: Fr.) Pers., *Agrocybe aegerita* (Brig.) Sing., *Lentinula edodes* (Berk.) Pegl. and *Ganoderma lucidum* (Curt: Fr.) Karst. Experiments were performed in two series in ten replicates.

The experiment was carried out in glass test-tubes 4 cm in diameter and 16 cm long. Prior to placing it in test-tubes, the substrate was moistened with tap water to the moisture content of 65%. After filling the test-tubes with the substrate to the height of 12 cm, they were sealed with cotton stoppers and sterilised in an autoclave for 45 minutes at the temperature of 121°C. When the substrates cooled down to the temperature of about 25°C, they were inoculated with the mycelium (on wheat grain) of the examined mushroom species. Mycelium growth was determined following 10 days of incubation at the temperature of 25°C. Mycelium growth rate was assessed on the basis of the thickness of the substrate layer overgrown with mycelium.

The obtained research results were subjected to the analysis of variance for factorial experiments using Duncan's test at $\alpha = 0.05$. The results were described as average values of the two series.

RESULTS AND DISCUSSION

The type of the employed substrate was found to impact the mycelium growth of the examined mushroom species (fig. 1). On average, the best mycelium growth was observed on the flax shive and weaker, consecutively, on substrates from sawdust, straw with the poorest growth on hemp shive.

The examined mushroom species differed from one another in mycelium growth (fig. 1). The best growth was recorded in the case of *G. lucidum* mycelium. Weaker mycelium growth was observed in *F. velutipes* and *H. erinaceus* which did not differ

from each other in this respect. Even weaker mycelium growth was determined successively in the case of *L. edodes*, *A. aegerita* and then in *P. nameko* and *M. oreades* which did not differ from each other. The weakest mycelium growth was observed in *L. ulmarium*. Differences in the mycelium growth of different mushroom species were also reported by Poppe and Hofte [1995].

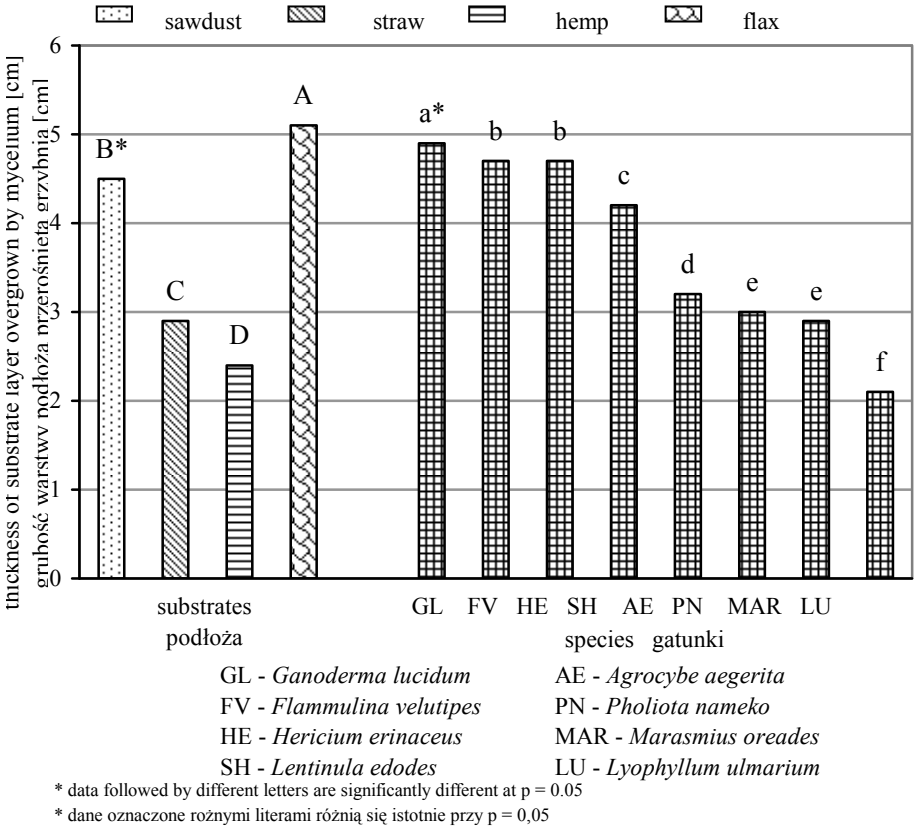

Fig. 1. Comparison of mycelium growth in relation to substrate type and fungi species
Ryc. 1. Porównanie wzrostu grzybni w zależności od rodzaju podłoża i gatunku grzyba

The observed response of individual mushroom species to the type of the employed substrate varied (figs. 2 and 3). In the case of three of them, namely: *G. lucidum*, *H. erinaceus* and *L. edodes* mycelium grew distinctly better on the substrate from sawdust than on flax shive as well as on the remaining substrates. In such mushroom species as: *A. aegerita*, *P. nameko* and *F. velutipes*, the best mycelium growth took place on the substrate from flax shive. In majority of the examined mushroom species, mycelium grew better on the substrate from straw than on the hemp shive substrate, however

with three exceptions. In *F. velutipes* and *M. oreades*, no significant differences in mycelium growth on substrates from straw and hemp shive were found. *P. nameko* mycelium was characterised by distinctly better growth on the substrate from hemp shive than of the straw substrate. Differences in the response of mycelium to the applied types of substrates demonstrated in the experiment could have resulted from varying nutritional preferences of the examined mushroom species. In addition, attention should also be drawn to the fact of differences in the amount of enzymes as well as their activity in the substrate degradation of different mushroom species [Martinez et al. 2005, Elisashvili et al. 2008]. Majority of the examined species of mushrooms are cultivated mainly on sawdust from deciduous trees, although wastes derived from farming or food industry were also used successfully. These materials are applied either on their own or are used as components of mixtures with sawdust.

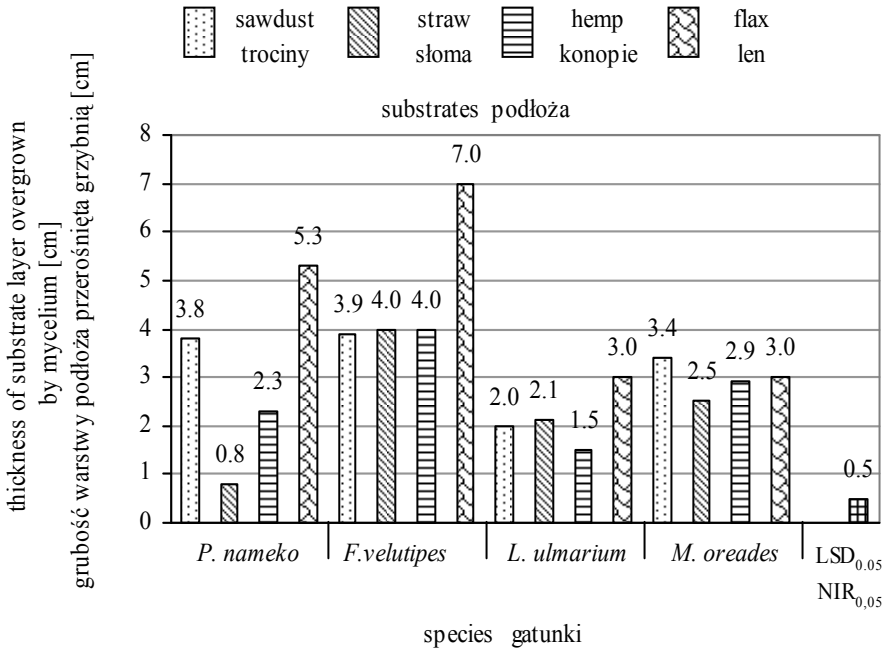

Fig. 2. Effect of substrate type on mycelium growth of some fungi species
Rys. 2. Wpływ rodzaju podłoża na wzrost kilku gatunków grzybów

It can be said on the basis of the performed investigations that, due to good or very good mycelium growth, flax shive could be employed as a substrate for the cultivation of the examined species of mushrooms. Chang [1976] as well as Chang and Hayes [1978] indicated possibilities of utilisation of flax wastes in the cultivation of mushrooms from *Pleurotus*, *Volvariella* and *Auricularia* genera. There may be some doubts as to the feasibility of utilisation of hemp shive for mushroom cultivation although, as demonstrated by Siwulski et al. [2009], it should be remembered that rapid mycelium

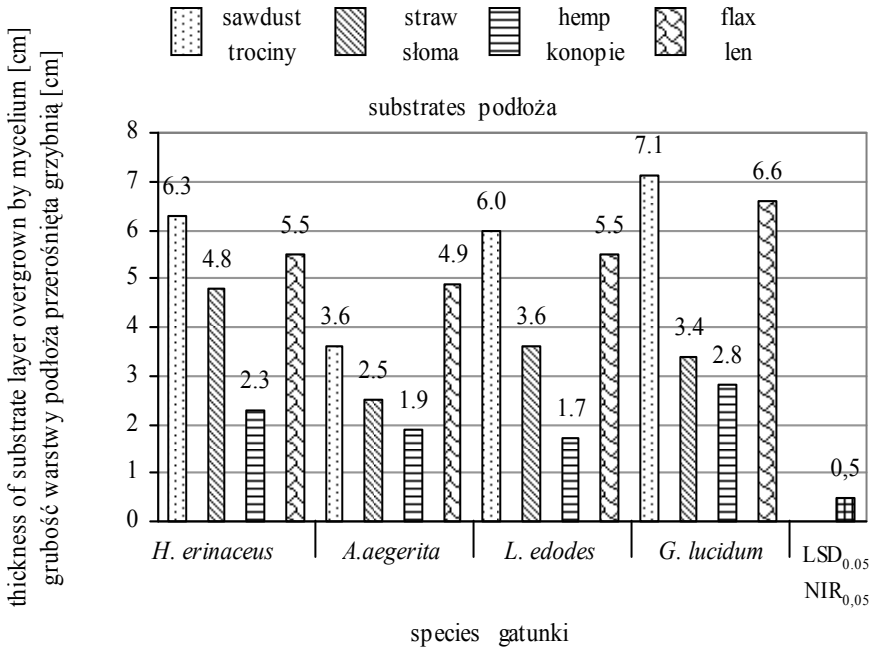

Fig. 3. Effect of substrate type on mycelium growth of some fungi species
Rys. 3. Wpływ rodzaju podłoża na wzrost kilku gatunków grzybów

growth does not always result in obtaining high yields. It is true that rapid mycelium growth is connected with a smaller risk of infection of the substrate with competitive organisms [Stamets 2000], but as indicated by Dorna et al. [2008], hemp shive exhibits antiseptic properties. There is no doubt that further cultivation experiments are essential to assess the usefulness of hemp and flax shive in the cultivation of mushroom species examined in the performed experiments.

CONCLUSIONS

1. The examined mushroom species differed from one another with respect to mycelium growth. *G. lucidum* mycelium was characterised by the fastest rate of growth.

2. The response of the examined mushroom species to the type of the employed substrate varied significantly.

3. For majority of the experimental mushroom species, substrates from flax shive and alder sawdust turned out to be the best ones for mycelium growth.

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PORÓWNANIE WZROSTU GRZYBNI WYBRANYCH GATUNKÓW GRZYBÓW UPRAWNYCH NA ODPADACH PRZEMYSŁU WŁÓKIENNICZEGO

Streszczenie. W uprawie grzybów wykorzystywane są różnego rodzaju materiały pochodzenia organicznego. Odpady przemysłu włókienniczego wydają się pod tym względem interesujące. Badano wzrost grzybni ośmiu gatunków grzybów tj. *Pholiota nameko* (Ito) Ito et Imai, *Flammulina velutipes* (Curt. ex Fr.) Sing., *Lyophyllum ulmarium* (Bull. ex Fr.) Kumm., *Marasmius oreades* (Bolt.: Fr.) Fr., *Hericium erinaceus* (Bull: Fr.) Pers., *Agrocybe aegerita* (Brig.) Sing., *Lentinula edodes* (Berk.) Pegl. i *Ganoderma lucidum* (Curt: Fr.) Karst. na podłożach z trocin olszowych, słomy żytniej oraz paździerzy konopnych i lnianych. Stwierdzono duże zróżnicowanie wzrostu grzybni w zależności od gatunku grzyba i rodzaju podłoża. Najlepszy wzrost grzybni badanych gatunków grzybów zanotowano na podłożu z paździerzy lnianych i trocin olszy. Na podłożu z paździerzy konopnych grzybnia rosła najsłabiej u większości badanych gatunków grzybów.

Słowa kluczowe: paździerze konopne, paździerze lniane, grzyby jadalne, grzybnia

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