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EFFECT OF THE METHOD OF SPAWN STORAGE OF SELECTED STRAINS OF FIELD MUSHROOM *AGARICUS BISPORUS* (LANGE) IMBACH ON YIELDING IN CONDITIONS OF COMMERCIAL CULTIVATION

Summary. The influence of the storage method of *Agaricus* spawn on yielding was tested. Two strains of mushroom were used in the experiments: 'Horst U3' and 'Somycel 516'. The spawn was stored on manure-peat medium, on rye grain, in liquid nitrogen and was also repeatedly passaged. Fourteen spawns stored using different methods were applied. Fresh spawn was treated as a control object. It was observed that the method of spawn refrigeration influenced the *Agaricus* yielding. The yields were the lowest when the spawn was stored for 16 weeks on rye grain at the temperature of 1-3°C and for 8 weeks at 4-6°C and after repeated passaging of the mycelium.

Key words: *Agaricus bisporus*, strain, spawn, method of storage, cultivation

Introduction

The method of spawn storage of the field mushroom is one of the major factors influencing its yields.

LEMKE (1971) as well as GAPIŃSKI and SIWULSKI (1985) demonstrated that long storage of spawn can result in its inadequate aeration causing disturbances in metabolic processes and, consequently, reduced intensity of the growth of mycelium. GAPIŃSKI et AL. (1989) found that the spawn quality was affected first and foremost by its age, duration of storage and variety. On the other hand, physiological changes taking place in the mycelium were influenced most significantly by: the duration of storage, temperature and the presence of bacteria. According to FRITSCHE (1966), KNEEBONE (1967), FRITSCHE (1982), GAPIŃSKI et AL. (1988, 1989, 1992), SIWULSKI and SOBIERALSKI (1994), SOBIERALSKI and SIWULSKI (1996) the simplest method which allows to main-

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tain mushroom strains on a similar level of productivity is passaging pure cultures on fresh substrates. However, spawn passaged on different media can undergo degeneration (FRITSCHE 1966, 1983, LELLEY and SCHMAUS 1976). That is why a number of researchers maintain that the best method of storing mushroom spawn is to keep it at the temperature of liquid nitrogen (KNEEBONE 1967, FRITSCHE 1969, ELLIOTT 1985).

Material and methods

The following two strains of field mushrooms were used in the described experiments: 'Horst U3' and 'Somycel 516'.

The mushroom growing chamber in which the experiments were conducted was a single-zone object. The raw material used to prepare the substrate comprised straw mixed with horse manure and supplemented with mineral and organic additives. The experimental substrate in the amount of 120 kg per one square meter was prepared according to generally accepted guidelines. The cover was prepared from a mixture of highmoor peat and sand. The applied peat was neutralized by lime on the basis of the neutralization curve to pH of about 7.5, then moistened and mixed with sand at the volume ratio of 1:3. The cover layer was 6 cm thick. On day 7 after spreading the cover, the so called combing was performed which consisted in mechanical relocation and fragmentation of the cover.

The growth of mycelium occurred at the substrate temperature of 24-25°C and air relative humidity of 95%. The concentration of carbon dioxide ranged from 0.25-0.27%. Once the mycelium was found to grow into the cover, the temperature was reduced to about 22-23°C and the air relative humidity was maintained at the level of about of 90%. During the period of production, the substrate temperature was maintained at the level of 20-22°C, the air temperature – at the level of 16-19°C, whereas the air relative humidity was kept at the level of 90%.

The mushrooms were grown on shelves of 16.8 m^2 (1.4 × 12 m) area. Experimental plots of 0.84 m^2 (1.4 × 0.6 m) area were selected randomly on shelves with the exception of the top and bottom shelves and outermost plots. The mushrooms were harvested from the first four crops. The yield obtained from the fresh mycelium was treated as the control for all treatments.

The following parameters were determined in cultivation experiments:

1. the total yield,
2. the yield of the 1st and 2nd quality.

Fourteen spawns stored using different methods were selected for cultivation experiments. The selected combinations are presented in Table 1.

The parameters of spawn storage were described by SOBIERALSKI et AL. (1994) while the methods of media preparation by SIWULSKI (1990).

The results of the yield of mushrooms were determined for mean values from four repetitions. All statistical analyses were carried out in accordance with the appropriate one and two factorial experiments with the LSD calculated at the level of $\alpha = 0.05$.

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Table 1. Mycelium selected for yield assessment
Tabela 1. Grzybnia wytypowana do oceny plonowania

Method of spawn storage
Fresh spawn – not stored
On manure-peat medium for 26 weeks at the temperature of 1-3°C
On manure-peat medium for 52 weeks at the temperature of 1-3°C
On manure-peat medium for 16 weeks at the temperature of 4-6°C
On manure-peat medium for 26 weeks at the temperature of 4-6°C
On rye grain for 8 weeks at the temperature of 1-3°C
On rye grain for 12 weeks at the temperature of 1-3°C
On rye grain for 16 weeks at the temperature of 1-3°C
On rye grain for 4 weeks at the temperature of 4-6°C
On rye grain for 8 weeks at the temperature of 4-6°C
Spawn after the 6th passage
Spawn after the 7th passage
Spawn after the 8ht passage
At the temperature of liquid nitrogen for 3 month
At the temperature of liquid nitrogen for 24 month

Results

It was found that the method of spawn storage exerted a significant influence on the yielding of the tested strains of field mushroom.

The total yield of 'Horst U3' strain varied from 14.6 to 19.4 kg per 1 m^2 in relation to the method of spawn storage (Table 2). The biggest yield was obtained with fresh spawn (19.4 $kg \cdot m^{-2}$) and when the spawn was stored on manure-peat medium for 26 weeks at the temperature of 1-3°C (19.2 $kg \cdot m^{-2}$). The lowest total yield gave the spawn of U3 strain stored on manure-peat medium for 16 weeks at the temperature of 1-3°C (14.6 $kg \cdot m^{-2}$) as well as on manure-peat medium for 8 weeks at the temperature of 4--6°C (14.6 $kg \cdot m^{-2}$). The biggest I quality yield was recorded with fresh spawn (18.5 $kg \cdot m^{-2}$) and when the spawn was stored on manure-peat medium for 26 weeks at the temperature of 1-3°C (18.2 $kg \cdot m^{-2}$). The lowest I quality yield gave the spawn of 'Horst U3' strain stored on manure-peat medium for 16 weeks at the temperature of 1-3°C (13.1 $kg \cdot m^{-2}$). The biggest yield of II quality gave the spawn stored on rye grain for 16 weeks at the temperature of 1-3°C (1.5 $kg \cdot m^{-2}$), while the lowest yield gave the fresh spawn and spawn stored on rye grain for 8 and 12 weeks at the temperature of 1-3°C (0.9 $kg \cdot m^{-2}$).

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Table 2. Influence of the selected methods of spawn storage of the 'Horst U3' strain on its yields ($kg \cdot m^{-2}$)
Tabela 2. Wpływ wybranych sposobów przechowywania grzybni odmiany 'Horst U3' na plon ($kg \cdot m^{-2}$)

Method of spawn storage	Yield ($kg \cdot m^{-2}$)		
	total	I quality	II quality
Fresh spawn – not stored	19.4	18.5	0.9
On manure-peat medium for 26 weeks at the temperature of 1-3°C	19.2	18.2	1.0
On manure-peat medium for 52 weeks at the temperature of 1-3°C	19.0	17.8	1.1
On manure-peat medium for 16 weeks at the temperature of 4-6°C	18.2	17.0	1.2
On manure-peat medium for 26 weeks at the temperature of 4-6°C	17.2	16.0	1.2
On rye grain for 8 weeks at the temperature of 1-3°C	18.8	17.8	0.9
On rye grain for 12 weeks at the temperature of 1-3°C	18.0	17.1	0.9
On rye grain for 16 weeks at the temperature of 1-3°C	14.6	13.1	1.5
On rye grain for 4 weeks at the temperature of 4-6°C	18.6	17.5	1.1
On rye grain for 8 weeks at the temperature of 4-6°C	14.6	13.2	1.4
Spawn after the 6th passage	18.4	17.3	1.1
Spawn after the 7th passage	18.1	17.0	1.1
Spawn after the 8th passage	17.6	16.4	1.2
At the temperature of liquid nitrogen for 3 months	19.1	17.7	1.4
At the temperature of liquid nitrogen for 24 months	18.9	17.5	1.4
$LSD_{0.05}$	1.5	1.0	0.3

The biggest total yield of 'Somycel 516' was recorded with fresh spawn (20.2 $kg \cdot m^{-2}$) and when the spawn was stored on manure-peat medium for 26 weeks at the temperature of 1-3°C (20.0 $kg \cdot m^{-2}$) (Table 3). The lowest total yield gave the spawn of 'Somycel 516' strain stored on rye grain for 16 weeks at the temperature of 1-3°C (13.9 $kg \cdot m^{-2}$). Similar trends were observed in the case of I quality yield. The highest yield gave fresh spawn (19.2 $kg \cdot m^{-2}$) and the spawn stored on manure-peat medium for 26 weeks at the temperature of 1-3°C (19.0 $kg \cdot m^{-2}$). The lowest I quality yield gave the spawn of 'Somycel 516' strain stored on manure-peat medium for 16 weeks at the temperature of 1-3°C (13.0 $kg \cdot m^{-2}$). The biggest yield of II quality gave the spawn of 'Somycel 516' strain stored at the temperature of liquid nitrogen for 3 and 24 months (1.5 $kg \cdot m^{-2}$). The lowest yield of II quality was obtained when the spawn was stored on rye grain for 8, 12 and 16 and weeks at the temperature of 1-3°C (0.9 $kg \cdot m^{-2}$).

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Table 3. Influence of the selected methods of spawn storage of the 'Somycel 516' strain on its yields ($kg \cdot m^{-2}$)
Tabela 3. Wpływ wybranych sposobów przechowywania grzybni odmiany 'Somycel 516' na plon pieczarek ($kg \cdot m^{-2}$)

Method of spawn storage	Yield ($kg \cdot m^{-2}$)		
	total	I quality	II quality
Fresh spawn – not stored	20.2	19.2	1.0
On manure-peat medium for 26 weeks at the temperature of 1-3°C	20.0	19.0	1.0
On manure-peat medium for 52 weeks at the temperature of 1-3°C	19.8	18.6	1.2
On manure-peat medium for 16 weeks at the temperature of 4-6°C	18.9	17.7	1.2
On manure-peat medium for 26 weeks at the temperature of 4-6°C	18.6	17.4	1.2
On rye grain for 8 weeks at the temperature of 1-3°C	19.4	18.5	0.9
On rye grain for 12 weeks at the temperature of 1-3°C	18.9	18.0	0.9
On rye grain for 16 weeks at the temperature of 1-3°C	13.9	13.0	0.9
On rye grain for 4 weeks at the temperature of 4°-6°C	19.5	18.4	1.1
On rye grain for 8 weeks at the temperature of 4-6°C	15.2	13.8	1.4
Spawn after the 6th passage	19.2	18.1	1.1
Spawn after the 7th passage	18.9	17.7	1.2
Spawn after the 8th passage	18.7	17.4	1.3
At the temperature of liquid nitrogen for 3 months	19.6	18.1	1.5
At the temperature of liquid nitrogen for 24 months	19.9	18.4	1.5
$LSD_{0.05}$	1.7	1.2	0.3

Discussion

The total yield of both tested strains of mushroom differed significantly depending on the method of spawn storage. Analysing the yields of the first and second quality of the examined strains in relation to the method of storage, the authors failed to observe clear correlations or even trends with regard to the variability of the examined values. Yields of the carpophores of the first and second quality underwent considerable variations without any apparent regularities.

The performed experiments revealed that the storage method of the spawn influenced the yield of fruiting bodies harvested in conditions of commercial cultivation. The obtained results corroborate earlier trials carried out to determine possibilities of reducing the spawn quality which was passaged many times or stored (LELLEY and SCHMAUS 1976, SIWULSKI 1989, GAPIŃSKI and WOŹNIAK 1999, SIWULSKI and SOBIERALSKI 1995).

Conclusions

1. Methods of spawn storage influenced yields of the field mushroom.

2. The highest yield reductions of the examined strains of the field mushroom were observed when the spawn was stored on the rye grain for 16 weeks at the temperature of 1-3^{o}C, on rye grain for 8 weeks at the temperature of 4-6^{o}C and following several times of passaging.

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WPŁYW SPOSOBU PRZECHOWYWANIA GRZYBNI WYBRANYCH ODMIAN PIECZARKI DWUZARODNIKOWEJ *AGARICUS BISPORUS* (LANGE) IMBACH NA PLONOWANIE W WARUNKACH UPRAWY TOWAROWEJ

Streszczenie. Badano wpływ metody przechowywania grzybni pieczarki na plonowanie. W doświadczeniu użyto dwóch odmian pieczarki dwuzarodnikowej: 'Horst U3' oraz 'Somycel 516'. Grzybnię przechowywano na pożywce obornikowo-torfowej, ziarnie żyta lub w ciekłym azocie oraz wielokrotnie pasażowano. W wyniku badań stwierdzono, że sposób przechowywania grzybni wpływał na plonowanie pieczarki. Największy spadek plonu badanych odmian pieczarki powodowało przechowywanie grzybni na ziarnie żyta przez 16 tygodni w temperaturze 1-3°C i przez 8 tygodni w temperaturze 4-6°C oraz wielokrotne pasażowanie.

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