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THE PRODUCTIVITY AND FRUIT BODIES QUALITY OF OYSTER MUSHROOM (*Pleurotus florida*) AS AFFECTED BY SOME ORGANIC SUPPLEMENTATIONS

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ABSTRACT

This study was conducted during the period from 2014 to 2015 in Mushroom Research Laboratory (MRL), Horticulture Department, Faculty of Agriculture, Zagazig University to determine the suitable organic supplementations that enhance the yield and fruit bodies quality of oyster mushroom (*Pleurotus florida*). The added organic supplementations were rice bran and wheat bran at rates of 5%, 10% and 15% (*W/W*) of each separately. The best favourable treatment for increasing both diameter and weight of both cap and stipe, number of clusters/bag, early yield and total yield was cultivation of oyster mushroom on rice straw supplied with 15% rice bran, followed by rice straw + 10% rice bran. The highest values of both average cluster weight and dry matter percentage were obtained when mushroom was cultivated on rice straw + 5% rice bran. In addition, rice straw substrate amended with 15% rice bran gave the highest values of biological efficiency percentage. Whereas, cultivation of mushroom on rice straw + 15% wheat bran produced the lowest number of clusters per bag and the lowest biological efficiency percentage, followed by rice straw + 5% wheat bran. On the other hand, growing of oyster mushroom on rice straw + 10% wheat bran recorded the highest values of N, P, K, crude protein and total carbohydrates in fruit bodies, whereas fruit bodies obtained from growing of oyster mushroom on rice straw + 15% rice bran contained the lowest value of potassium and total carbohydrates percentage.

Key words: Supplementations, oyster mushroom, yield, biological efficiency, fruit body quality.

INTRODUCTION

Mushrooms are one kind of edible fungi belonging to class Basidiomycetes. Oyster mushroom (*Pleurotus florida*) is an edible mushroom having excellent flavor and taste. It is a good source of essential amino acids, proteins and minerals (Aletor, 1995). The quality of the waste product (rice straw) is improved due to the degradation of cellulose and hemicellulose by mushroom enzymes and hence, has been rendered more digestible. Thus, rice straw was transformed to a valuable roughage and mushrooms provide an additional income (Mueller and Cantner, 1990). A valuable roughage and enhanced dietary meals and improved human health (Mau *et al.,* 2002).

The mushroom mycelia requires specific nutrients for its growth and the addition of supplements increases mushroom yield by providing specific nutrients for mycelium growth (Oei, 1996). Cereal bran rich in protein is usually added to the substrate in *P. ostreatus* cultivation to stimulate mycelial growth and increase the yield of mushroom (Siddiqui and Khan, 1989; Kinugawa *et al.,* 1994). Trong *et al.* (2000) stated that, the average yield, biological efficiency and production efficiency of *P. eryngii* ATCC 36047 increased significantly with increasing supplementation of the substrate with rice bran. Upadhyay *et al.* (2002) found that supplementation of rice bran (10%) to the substrate gave 17.6% higher yield of *P. ostreatus var. florida* /bag than non supplemented substrate.

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Hyoung-Jun and Johng-Hwa (2013) reported that the optimum conditions for maximum mycelial growth rate of *P. ostreatus* was 9.3% rice bran + 2.4% food waste compost, whereas the optimum conditions for maximum fruit body yield was 12% rice bran + 25% food waste compost.

Many investigators evaluated *Pleurotus sp.* yield when grown on substrates amended with different supplementations and their mixtures. The decrement in mushroom yield might be due to the excess of nitrogen in the initial substrate which affected the degredation of lignin and may prevent the mycelium from developing (Donini *et al.,* 2009). El-kattan and Bahram (1986) reported that cultivation of an oyster mushroom on rice straw supplemented with organic additives containing nitrogenous; *i.e.* wheat bran, soybean meal or dried clover hay at rates of 1-5% significantly increased total mushroom yield. Guo and Huang (1988) mentioned that hyphae of *Pleurotus cystidiosus* grew best on cotton waste medium (80–100% bio-efficiency), followed by wood dust and bagasse media. Wood dust or bagasse media supplemented with 25% rice bran gave the highest yields. The mixture of wood dust and bagasse at a ratio of 1:1, supplemented with 15% rice bran had a bio-efficiency of 52.2%.

This study aimed to evaluate cultivation of oyster mushroom on rice straw amended with different supplementations to enhance the yield and improve mushroom fruit bodies quality.

MATERIALS AND METHODS

This study was carried out in Mushroom Research Laboratory (MRL), Faculty of Agriculture, Zagazig University during the period between 2014 and 2015 years to determine the suitable organic supplementations rate that enhance the yield and fruit bodies quality of oyster mushroom.

This experiment included seven treatments which were the combinations between two organic supplementations either rice bran (RS) or wheat bran (WB) at three rates; *i.e.,* 5%, 10% and 15% weight/weight (*W/W*) mixed with rice straw as follows : Rice Straw (RS), RS + (5 % *W/W*) Rice Bran, RS + (10% *W/W*) RB, RS + (15% *W/W*) RB, RS + (5% *W/W*) Wheat Bran, RS+(10% *W/W*) WB and RS + (15% *W/W*) WB.

These treatments were arranged in a randomized complete block design system with three replicates, and each replicate consisted of two polyethylene bags 60 X 40 cm.

The spawn material of *Pleurotus florida* (strain 14) was obtained from The Central laboratory of agriculture climb (CLAC), Giza, Egypt.

Preparation of Substrates and Cropping

Rice straw were chopped into pieces (15 - 20 cm), boiled for two hours, then the substrates were left to cool to reach to ambient room temperature and drain the excess water until moisture content reached about 70% (Zadrazil, 1978). Both of wheat bran and rice bran were sterilized in an autoclave for 15 minutes at 121°C and added at different rates to each bag just before spawning. The rice straw (3 kg wet substrate) were inoculated with pure grain spawn of *P. florida* (strain 14) at 150g / 3 kg of wet substrate in polyethylene bags (60 cm depth X 40 cm diameter).

The inoculated polyethylene bags were placed in growth room at the temperature 25 ± 3°C with less ventilation and darkness for spawn running. When such bags become full of mycelial growth, they were perforated by sterilized blade and transferred to the mushroom cropping room, (20 ± 3°C and 85 – 95% relative humidity using a foggy system).

Data Recorded

Mature fruit bodies of all harvests were picked up at the marketable stage and the following data were recorded:

Growth characters

Two oyster mushroom clusters were taken from each treatment of the first flush to determine: cap diameter, stipe diameter, cap weight and stipe weight.

Yield and its components

At suitable harvesting stage, all clusters (till the end of experiment) were harvested and the following data were recorded : number of clusters/bag, average of cluster weight (g), early yield (g), total fresh yield/bag (g) and relative total yield. Biological efficiency (BE%) was calculated according to the following equation (Chang *et al.,* 1981):

$$\frac{\text{fresh weight of total yield}}{\text{weight of dry substrate}} \times 100$$

Chemical Constituents

The chemical constituents of different used substrates were recorded in Table 1.

Dry matter percentage (DM%)

A sample (50g of fruit bodies) from each replicate was dried in an electrical oven at 105°C till constant weight and DM(%) was determined according to (AOAC, 1980).

Minerals determination

N, P and K contents were determined in both fruit bodies and substrates before spawning (after supplementations) according to the methods advocated by Jackson (1970), Bremner and Mulvaney (1982) and Olsen and Sommers (1982), respectively. In addition, crude protein (%) was calculated by multiplying N (%) by 4.35 and 6.25 in mushroom fruit bodies and substrates, respectively (Fujihara *et al.,* 1995).

Total carbohydrates (%)

It was determined in the dried fruit bodies following the method described by (Dubois *et al.,* 1956).

Statistical Analysis

The collected data were subjected to analysis of variance according to Snedecor and Cochran (1982) and Duncan multiple range test was used for comparison among means Duncan (1958).

RESULTS AND DISCUSSION

Physical Characters of Fruit Bodies

Data in Table 2 show that organic supplementations (rice bran, wheat bran) at different rates (5%, 10% and 15% (*W/W*) of each) had significant effect on diameter and weight of both cap and stipe of fruit bodies in both seasons. It is clear that rice straw (RS) + 15% (*W/W*) rice bran (RB) gave the highest values of both diameter and weight of both cap and stipe of mushroom fruit bodies, followed by RS +10% (*W/W*) RB, whereas RS + 15% (*W/W*) WB gave the lowest values in this respect followed by RS + 5% (*W/W*) WB in the 1st and 2nd seasons.

The favourable effect of using rice bran supplement for increasing cap and stipe weight of mushroom fruit body (Table 2) may be due to that rice bran contains vital basic nutrients being required for mushroom growth. In this regard, Fasidi *et al.* (2008) came to similar results and concluded that rice bran contains important nutrients and vitamins which play vital roles in synthesis of nucleic acid, protein and chitin which important for mushroom growth. They added that supplementing of mushroom substrate with rice bran increased significantly average weight of fruiting bodies. These results are in harmony with those reported by Siddiqui and Khan (1989), Kinugawa *et al.* (1994) and Hyoung-Jun and Johng-Hwa (2013).

Yield and its Components

The obtained results in Table 3 indicate that rice straw supplied with rice bran and wheat bran at different rates reflected significant effect on number of clusters/bag, average of cluster weight, early yield and total yield/bag in the 1st and 2nd seasons. Cultivation of mushroom on RS + 15% (*W/W*) RB increased number of clusters/ bag, early yield/bag and total yield/bag (421.11 and 1102.90g /bag in the 1st and 2nd seasons, respectively), followed by RS + 10% (*W/W*) RB. Whereas RS + 15% (*W/W*) WB decreased these characters, followed by RS + 5% (*W/W*) WB in the 1st and 2nd seasons, respectively.

As for average of cluster weight, the substrate RS which was supplied with 5% (*W/W*) RB increased average of cluster weight (55.36 and 81.63g /bag in the 1st and 2nd seasons, respectively), compared to other tested treatments. The stimulative effect of supplying mushroom growing substrate with rice bran on total yield/bag may be due to that RS + 15% (*W/W*) WB increased both diameter and weight of cap and stipe of fruit bodies (Table 2) and number of clusters/bag (Table 3) and this; consequently, increased mushroom yield/bag. The increases in total yield/bag were about 24.95 and 40.67% for RS + 15 % (*W/W*) RB and 16.37 and 32.43% for RS + 10% (*W/W*) RB over RS alone in the 1st and 2nd seasons, respectively. The decreases in total yield/bag were about 26.74 and 56.5% for RS + 15% (*W/W*) WB/bag and 13.63 and 47.7% for RS + 5% (*W/W*) WB as compared to RS alone in the 1st and 2nd seasons, respectively.

Table 1. Chemical analysis of the substrates before spawning (after supplementation with rice bran and wheat bran) during 2015 year

Character / Treatment	N (%)	P (%)	K (%)	Protein (%)
RS	1.63 bc	0.39 a	0.78 bcd	10.20 bc
RS + 5% RB	1.58 c	0.43 a	0.70 d	9.86 c
RS + 10% RB	1.69 abc	0.22 cd	1.01 a	10.61 abc
RS + 15% RB	1.96 a	0.21 d	0.88 b	12.26 a
RS + 5% WB	1.57 c	0.25 cd	0.84 bc	9.85 c
RS + 10% WB	1.67 abc	0.32 b	0.75 bcd	10.49 abc
RS + 15% WB	1.92 ab	0.27 c	0.71 cd	12.02 ab

RS: Rice straw, RB: Rice bran, WB: Wheat bran

Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of probability, according to Duncan's multiple range test.

Table 2. Effect of rice bran and wheat bran supplements on physical characters of oyster mushroom fruit bodies during 2014 and 2015 years

Character / Treatment	Diameter (cm)				Weight (g)			
	Cap		Stipe		Cap		Stipe	
	2014 season	2015 season	2014 season	2015 season	2014 season	2015 season	2014 season	2015 season
RS	8.13 d	8.86 d	0.99 c	0.73 c	11.70 cd	13.11 d	1.70 d	4.05 d
RS + 5% RB	8.28 c	8.97 cd	1.00 c	1.86 a	11.90 c	14.16 c	1.83 c	5.55 c
RS + 10% RB	9.16 a	9.72 ab	1.09 b	1.44 ab	13.75 b	15.21 b	2.07 b	6.78 a
RS + 15% RB	9.21 a	9.99 a	1.57 a	1.79 ab	15.26 a	21.78 a	5.29 a	6.94 a
RS + 5% WB	7.78 e	8.04 e	0.97 cd	1.30 b	10.91 d	10.32 e	1.53 e	3.72 de
RS + 10% WB	8.67 b	9.33 bc	1.08 b	1.74 ab	12.99 b	14.50 bc	2.05 b	6.34 b
RS + 15% WB	7.77 e	7.75 e	0.94 d	0.47 c	10.88 d	10.16 e	1.44 e	3.61 e

RS: Rice straw, RB: Rice bran, WB: Wheat bran

Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of probability, according to Duncan's multiple range test.

Table 3. Effect of rice bran and wheat bran supplements on yield and its components of oyster mushroom during 2014 and 2015 years

Character / Treatment	Number of clusters / bag		Average of cluster weight (g)		Early yield / bag (g)		Total yield / bag (g)		Relative yield (%)	
	2014 season	2015 season	2014 season	2015 season	2014 season	2015 season	2014 season	2015 season	2014 season	2015 season
RS	5.67 bc	12.34 cd	59.44 a	63.53 b	76.63 ab	162.29 c	337.00 e	784.00 c	100	100
RS + 5% RB	6.34 abc	12.34 cd	55.36 a	81.63 a	75.08 b	219.99 b	351.00 d	1007.30 b	104.15	124.48
RS + 10% RB	8.34 a	14.00 b	47.02 b	74.16 ab	92.66 a	238.17 ab	392.17 b	1038.30 ab	116.37	132.43
RS + 15% RB	8.00 ab	18.00 a	52.64 ab	61.27 b	82.54 ab	242.23 a	421.11 a	1102.90 a	124.95	140.67
RS + 5% WB	5.34 c	11.00 d	54.51 ab	37.27 d	68.46 bc	103.52 d	291.07 f	410.00 d	86.37	52.29
RS + 10% WB	7.34 abc	13.34 bc	50.31 ab	76.16 ab	70.49 bc	220.11 b	369.25 c	1016.0 ab	109.56	129.59
RS + 15% WB	5.34 c	6.67 e	46.24 b	51.13 c	54.00 c	79.58 e	246.90 g	341.04 d	73.26	43.50

RS: Rice straw, RB: Rice bran, WB: Wheat bran

Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of probability, according to Duncan's multiple range test.

In this connection, Bolton and Blair (1982) and Fasidi *et al.* (1996) found that rice husk is a good source of supplements for increasing mushroom yield because of its richness in vitamins which are good stimulants for high mushroom yield. In addition, Fasidi *et al.* (2008) reported that very good mushroom pilei were produced from substrates supplemented with rice bran (containing 1.3% N). These results are in harmony with those reported by Siddiqui and Khan (1989), Kinugawa *et al.* (1994), Trong *et al.* (2000), Upadhyay *et al.* (2002) and Hyoung-Jun and Johng-Hwa (2013).

Biological Efficiency and Dry Matter Percentage

Respecting biological efficiency (BE%), data presented in Table 4 illustrate that, in general, cultivation of oyster mushroom on RS amended with 15% (*W/W*) RB gave the highest value of BE % (42.11 and 110.29% in the 1st and 2nd seasons, respectively) with no significant differences when compared with RS + 10% (*W/W*) RB and RS + 5% (*W/W*) RB. Rice straw supplemented with 15% (*W/W*) WB gave the lowest values of BE% (24.69 and 34.10% in the 1st and 2nd seasons, respectively).

As for dry matter (%), the obtained results in Table 4 indicate that RS + 5% (*W/W*) RB as substrate for cultivation mushroom increased dry matter percentage in fruit bodies by 13.00 and 14.37% in the 1st and 2nd seasons, respectively (Table 4). These results agreed with those reported by Trong *et al.* (2000).

Fruit Bodies Quality

Significant effect was found due to adding rice bran and wheat bran at different rates to rice straw on N, P, K, crude protein and carbohydrates in mushroom fruit bodies compared to rice straw only, with few exceptions in both seasons (Table 5). The highest values of N, P, K, crude protein and carbohydrates in fruit bodies were obtained when mushroom was cultivated on substrate supplemented with 5 and 10% wheat bran. This may be due to that substrate supplemented with 5 and 10% wheat bran contains relatively high N and crude protein (before spawning) compared to rice straw alone or supplemented with rice bran.

Table 4. Effect of rice bran and wheat bran supplements on biological efficiency and dry matter percentage of oyster mushroom during 2014 and 2015 years

Character / Treatment	Biological efficiency (%)		Dry matter (%)	
	2014 season	2015 season	2014 season	2015 season
RS	33.70 e	78.40 c	10.05 d	7.50 cd
RS + 5% RB	35.10 d	100.73 b	13.00 a	14.37 a
RS + 10% RB	39.21 b	103.83 ab	9.39 e	12.34 b
RS + 15% RB	42.11 a	110.29 a	12.90 a	12.53 b
RS + 5% WB	29.10 f	41.00 d	10.73 c	7.20 d
RS + 10% WB	36.93 c	101.60 ab	11.77 b	7.84 c
RS + 15% WB	24.69 g	34.10 d	8.29 f	7.17 d

RS: Rice straw, RB: Rice bran, WB: Wheat bran

Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of probability, according to Duncan's multiple range test.

Table 5. Effect of rice bran and wheat bran supplements on fruit bodies quality of oyster mushroom during 2015 year

Character / Treatment	N (%)	P (%)	K (%)	Crude protein (%)	Carbohydrates (%)
RS	4.20 b	0.75 ab	4.01 ab	18.28 b	43.38 c
RS + 5% RB	4.59 ab	0.77 ab	3.79 abc	19.99 ab	42.27 c
RS + 10% RB	4.48 ab	0.75 ab	3.53 cd	19.49 ab	38.33 d
RS + 15% RB	4.59 ab	0.79 ab	3.15 d	19.97 ab	36.51 e
RS + 5% WB	4.63 ab	0.88 ab	3.92 abc	20.15 ab	46.92 a
RS + 10% WB	5.03 a	0.90 a	4.03 a	21.88 a	47.48 a
RS + 15% WB	4.46 ab	0.74 b	3.61 bc	19.40 ab	45.10 b

RS: Rice straw, RB: Rice bran, WB: Wheat bran

Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of probability, according to Duncan's multiple range test.

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تأثيـر بعـض الإضـــافـــات العضـــوية علـى إنتاجية وجودة الأجسام الثمرية لعيش الغراب المحارى

حسن أحمد دراز نصر ـ محمود عبد العزيز إبراهيم خليل ـ حامد محمد الهادى عريشه ـ عبدالله برديسى

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أجريت هذه الدراسة خلال الفترة من ٢٠١٤ ـ ٢٠١٥ بمعمل أبحاث عيش الغراب، التابع لقسم البساتين، كلية الزراعة – جامعة الزقازيق، وذلك لتحديد أنسب إضافات عضوية لزيادة المحصول ومكوناته، بالإضافة إلي تحسين صفات جودة الأجسام الثمرية لفطر عيش الغراب المحاري ، وقد استخدمت الإضافات العضوية التالية : وهى سرس الأرز وردة القمح بنسب ٥%، ١٠% ، ١٥% من كل منهما على حده، وكانت أفضل معامله هي زراعة عيش الغراب المحاري على بيئة قش الأرز + ١٥% سرس الأرز والتي أدت لزيادة قطر ووزن كل من القبعة والساق ، وحجم الأجسام الثمرية للكيس، وزيادة المحصول المبكر والمحصول الكلى للكيس ، تليها بيئه قش الأرز + ١٠% سرس الأرز، كما سجلت أعلى القيم لكل من متوسط العنقود الثمري ونسبة المادة الجافة الكلية للأجسام الثمرية عند زراعة فطر عيش الغراب على بيئة قش الأرز + ٥% سرس الأرز، كما تم الحصول على أعلى نسبة كفاءة بيولوجية عند الزراعة على بيئة قش الأرز + ١٥% سرس الأرز، بينما أنتجت بيئة قش الأرز المضاف لها ١٥% (وزن / وزن) ردة قمح أقل عددا من العناقيد الثمرية للكيس الواحد وأقل نسبة كفاءة بيولوجية ، يليها بيئة قش الأرز + ٥% ردة قمح، ومن ناحية أخري فقد أظهرت النتائج أن زراعة فطر عيش الغراب على بيئة قش الأرز + ١٠% ردة قمح قد أدت إلى زيادة محتوى الأجسام الثمرية لفطر عيش الغراب من النيتروجين، الفوسفور، البوتاسيوم ، البروتين ونسبة الكربوهيدرات الكلية ، بينما أدت زراعة فطر عيش الغراب المحارى على بيئة قش الأرز + ١٥% سرس الأرز إلى الحصول على أقل قيمة لمحتوى الأجسام الثمرية من عنصر البوتاسيوم ونسبة الكربوهيدرات الكلية.

المحكمون :

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