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Evaluation of substrates and supplements for enhancing the productivity of paddy straw mushroom (*Volvariella volvacea*)

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Abstract: The present study was taken up to find out the best substrate and supplement for the production of paddy straw mushroom. In evaluation of four locally available substrates for its cultivation, cotton waste substrate produced highest yield (734.8g and 796.2g per bed) and biological efficiency (14.7 % and 15.92 %) in both the cropping period followed by pea straw (12.96 % and 14.16 %), paddy straw (9.32 % and 12.68 %) and wheat straw (8.54 % and 11.32 %) respectively, in both the cropping period. Out of five supplements were evaluated on paddy straw substrate, rice bran enhanced highest yield (821.0g per bed of 5.0 kg dry substrate) followed by wheat bran (791.3g), chick pea grain powder (743.0g), pigeon pea grain powder (704.3g) and pea grain powder (683.0g).

Key words: Fruiting bodies, Substrates, Supplements, *Volvariella volvacea,* Yield

Introduction

Paddy straw mushroom *(Volvariella volvacea)* commonly known as the straw mushroom or the Chinese mushroom, belongs to Phyllum-Basidiomycota, Class-Basidiomycetes, Order-Agaricales, Family-Pluteaceae and Genus *Volvariella*. It is being the third most important cultivated mushroom in the world is well known for its pleasant flavor and taste. Paddy straw mushroom is an edible mushroom of the tropics and subtropics. It was first cultivated in China in 1822 and around 1932-35, it introduced in to Philippines, Malaysia and South-East Asian countries by overseas Chinese. In India, 19 edible species of *Volvariella* have been recorded but only three of them are cultivated namely *Volvariella volvacea, V. diplasia* and *V. esculenta.* and was first cultivated by Thomas in 1943 at Coimbatore. Mushrooms are rich in protein as compared to cereals, pulses, fruits and vegetables. Their protein may be considered intermediate to that of animal and vegetable protein. Fresh paddy straw mushroom contains about 90% water, and on dry weight basis it has 30-43% crude protein, 1-6% fat, 12- 48% carbohydrates, 4-10% crude fiber and 5.13% ash. It also contain appreciable amount of vitamins and minerals like thiamine, riboflavin, niacin, biotin, pentathonic acids, folic acid and vitamin B12. Thiamine and riboflavin contents of *V. volvacea* are about 1.2 and 3.3 mg/100 g, respectively. It also possesses medicinal compounds. Hence, mushrooms contribute an ideal dish for diabetic, heart, blood pressure and cancer patients (Ahlawat and Tewari, 2007).

India produces about 700 million tones of agricultural by products, which can profitably be utilized for the cultivation of mushrooms. Currently, we are using 0.03% of these residues for producing around 1.2 lakh tons of mushrooms. India contributes less than 1% of the total world mushroom production. Even if we use 2% of the total agro-residues for mushroom production, we can produce 7.0 million tones of fresh mushroom, which will be equal to current global button mushroom production (Anonymous, 2011). Climatic conditions prevailing in India are best suited for its cultivation. Paddy straw mushroom cultivation does not require more agricultural land and capital investment. It has shorter growing period and can be successfully cultivated as indoor and outdoor on various agricultural residues in natural environmental conditions, at a wide range of temperature (30-40°C) with high relative humidity. Hence, this mushroom has good scope for cultivation in India where high temperature with high humidity condition prevails. Various agricultural wastes along with supplementations with various materials can be used in the cultivation of paddy straw mushroom for enhancement of yield of this mushroom. Walting (1994) stated that very little research work has been extended to this mushroom by Indian workers during recent past, hence, there is need to do serious efforts to solve the problems concerning the cultivation of *Volvariella* spp. Keeping in view the importance of paddy straw mushroom among people in India, an experiment was conducted, taken two cropping period (July and August) in 2013 to find out the best substrate and supplement for enhancing the productivity of the mushroom.

Materials and Methods

Evaluation of different substrates for the yield of Paddy straw mushroom: In order to find out the best substrates for its cultivation in Eastern Uttar Pradesh, four substrates namely, Paddy straw (PS), Pea straw (PS), Wheat straw (WS) and Cotton waste (CW) were evaluated for better yield of the paddy straw mushroom. The method of cultivation described by Thakur *et al.* (2003) was

used in this experiment with minor modification. Five Kg dry weight of each substrate was kept in a bed. Spawning was done @ 1.5% dry weight basis of the substrates and 25 g chick pea grain powders were sprinkled over spawn surface on the bed of each substrate. The experiment was conducted in RBD with 5 replications.

Preparation of substrate: Fresh hand-threshed unscrambled paddy straw as well as straw of other substrates was made into bundles of 15-25 cm. diameter and 45 cm length. Twenty such bundles were used for preparation of a bed. These bundles were steeped in a water tank having solution of 125 ml formalin, 5.0 g Carbendazim and 1.5 % calcium carbonate in 100 liter water. Water tank was closed with polythene sheet and kept as such for 18 hours. After wetting, straw was removed from water tank and put on clean concrete floor for removing excess water.

Preparation of beds and Spawning: The five moistened bundles of paddy straw as well as all other substrates were used in one layer on a raised structure. Spawning was done by pushing the spawn grains inside the straw around the periphery of the first layer in a line, about 4-5 cm away from the outer edges. A small quantity of chickpea flour was sprinkled over the spawned surface. The second layer of straw bundles was prepared by keeping the straw bundle in just opposite direction of those of the first layer in crisscross manner. Spawning and dusting of chickpea powder was done as earlier. The straw of the 3rd layer was placed in opposite direction of the second layer. On the third layer spawning and dusting of c powder was made through the surface. Fourth layer was prepared by placing the straw bundle in the same direction of the second layer. This layer was the covering layer and spawning did not require. For preparation of such bed 5.0 kg of paddy straw / straw of other substrates (on dry weight basis), 75 g of spawn and 25 g of chickpea powder were used. Now whole beds were pressed to remove the entrapped air for effective spawn run and subsequently covered with a transparent polythene sheet after light sprinkling of water.

Care after spawning: The spawned beds were covered by a transparent polythene sheet for maintaining required humidity (80-85%) and temperature (30-35°C) for rapid growth of the mycelium. These beds were watched daily for spawn run and watered in morning time for maintaining humidity. When full growth of the mycelium of fungus was seen in the substrate, the polythene cover was removed. After removing the polythene sheet, beds were sprinkled with water daily by sprayer and allow entry of fresh air for maintaining a temperature of 28-32°C with 80% humidity in cropping rooms for primordial / pinheads development. The floor, walls and roof of the rooms were also sprinkled by tap water with the help of sprayer and atomizer frequently.

Effect of different supplements on the yield of *V. volvacea:* In order to enhance the yield of paddy straw mushroom, five supplements namely, rice bran, wheat bran, chick pea grain powder, pea grain powder and pigeon pea grain powder were evaluated. Twenty five g grain powder of each supplement was sprinkled separately over spawn surface per bed of paddy straw substrate. The experiment was conducted in RBD with 3 replications.

Observations recorded: The yield and yield attributing parameters, e.g., days taken for spawn run, pin head formation, time taken for first harvest were recorded in each treatment from two consecutive cropping period (spawning on 2nd July 2013 and 12th August 2013). The biological efficiency was calculated using the following formula.

$$\text{Biological efficiency (\%)} = \frac{\text{Fresh weight (g) of mushrooms harvested}}{\text{Dry weight (g) of substrate}} \times 100$$

Results and Discussion

It is evident from the data presented in table-1 that the days taken for spawn run in different substrates varies from 9-13 days, while days taken for pin head formation ranged from 15-18 days. Paddy straw and pea straw substrates were taken minimum (9-10) days for spawn run, whereas cotton waste and wheat straw were taken slightly maximum (11-13) days for spawn run in both the cropping periods. Paddy straw and wheat straw substrates also produce earlier pin head formation (15-16 DPS) and first harvest (18-19 DPS) compared to cotton waste (17 days and 18 days) and wheat straw 18 days and 21 days for pin head formation and first harvest, respectively. It is evident that maximum number of fruiting bodies per bed was obtained from cotton waste substrate (62.4 in first and 57 in second time) followed by pea straw, wheat straw and paddy straw substrates. In respect of yield, cotton waste substrate also produced significantly highest yield (734.8g and 796.2g per bed of 5.0 kg dry substrates) in both the cropping period and biological efficiency (14.7% and 15.92 %) followed by pea straw (12.96 % and 14.16 %), paddy straw (9.32 % and 12.68 %) and wheat straw (8.54 % and 11.32 %). The results of present study supported by the findings of Sindhu, *et al*. (2001-2002) and Jiskani *et al*. (2004). In their studies, paddy straw and cotton waste substrate gave highest number of flushes and highest yield. However, Singh and Singh (2012) found wheat straw as best substrate than paddy straw.

It is evident from the results presented in table -2, that out of five supplements evaluated on paddy straw substrate, rice bran enhanced highest yield (821.0g per bed of 5.0 kg dry substrate) followed by wheat bran (791.3g), chick pea grain powder (743.0g), pigeon pea grain powder (704.3g) and pea grain powder (683.0g). Yield obtained from each supplementation differ significantly from one another and enhanced the yield and biological efficiency significantly over the control. While in respect of number of fruiting bodies, pea grain powder supplement produced maximum number of fruiting bodies (56.0) followed by wheat bran (51.0), pigeon pea grain powder (49.33), rice bran (47.0) and chick pea grain powder (41.0). Most of the supplement did not differ significantly number of fruiting bodies from one another. These results are in close agreements with the findings of Bahukhandi (1989), Kaur, *et al*. (2004) and Tripathy *et al*. (2011), they reported that yield of *Volvariella volvacea* increased by adding rice/ wheat bran at 2% of dry weight basis of the paddy straw. Matiru *et al*. (1992) reported coconut sawdust supplemented with *ipil-ipil* [*Leucaena leucocephala*] meal, cornmeal, chicken manure or rice bran enhanced mycelial growth significantly. Corn meal (20%) and corn meal (10%) + rice bran (10%) also enhanced primordial formation.

On the basis of findings, it is also concluded that paddy straw mushroom cultivation should be done on cotton waste /pea straw or paddy straw substrate. Since cotton waste is not available

Cotton waste

Pea straw

Paddy straw

Wheat straw

Fig. 1: Fruiting bodies grown on different substrates

Table-1: Effect of different substrates on yield of paddy straw mushroom

Treatment (Substrates)	Cropping period	Spawn run (Days)	Pin head formation (DPS)*	First harvest (DPS)*	No. of fruiting bodies/bed (g)	Wt. off ruiting bodies/bed (g)	Biological efficiency (%)
Paddy straw	I	9	15	18	37.6	466.6	9.32
	II	10	15	19	46.0	634.0	12.68
Pea straw	I	9	16	19	53.0	648.8	12.96
	II	10	16	19	55.8	708.0	14.16
Cotton waste	I	11	17	21	62.4	734.8	14.7
	II	13	17	21	57.0	796.2	15.92
Wheat straw	I	11	18	22	41.2	427.4	8.54
	II	12	18	22	51.2	566.2	11.32
C.D. at 5%	I	-	-	-	3.145	2.704	
	II	-	-	-	5.834	6.387	

*DPS = Days post spawning

Table-2: Evaluation the different supplements on paddy straw substrate for the yield of *Volvariella volvacea*

Treatment (Supplements)	Spawn run (days)	Pin head formation (Days)	First harvest (Days)	No. of fruiting bodies /bed (g)	Weight of fruiting bodies/bed (g)	Biological efficiency (%)
Rice bran	9	13	18	47.0	821.0	16.42
Wheat bran	10	13	18	51.0	791.3	15.82
Chick pea grain powder	9	13	19	41.0	743.0	14.86
Pea grain powder	10	14	20	56.0	683.0	13.66
Pigeon pea grain powder	10	14	20	49.3	704.3	14.08
Control	11	15	21	41.33	649.66	12.99
C.D. at 5%	-	-	-	4.501	5.000	-

in desired amount in the eastern region of Uttar Pradesh, hence its cultivation preferably done on pea straw or paddy straw substrate and this substrate must be supplemented with rice bran or wheat bran to enhance the yield of this mushroom.

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