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Response of various casing materials on the biological efficiency of white button mushroom (*Agaricus bisporus*) under the agro-ecological condition of West Bengal

C. SHANMUGARAJ, K. SARANRAJ AND M. K. BISWAS*
Department of Plant Pathology, Palli Siksha Bhavana, Visva-Bharati University, Sriniketan, West Bengal

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Mushrooms are considered as "Vegetable meat" and "White vegetables" because it contains a high amount of proteins, vitamins, amino acids, carbohydrates and less amount of fat. Mushroom cultivations are a good source of degradation and bioconversion of lignocellulosic agricultural wastes. Button mushroom is the temperate mushroom, which can grow during the winter season throughout the plains of North India. However, it can be grown throughout the year in hills. The experiment was attempted in the cultivation of white button mushroom through the Long Method of Composting under the agro-climatic conditions of the lateritic belt of West Bengal. The casing is a significant step to the cultivation and casing soil plays an important role in primordia initiation and uniform development of fruiting bodies. Various casing mixture proportions followed in the experiment are Spent Mushroom Substrate (SMS) + Garden Loam soil + Farm Yard Manure (FYM) + Sand (1:1:1:1), FYM + Coco peat (4:1), Garden loam soil + FYM + Vermicompost (2:1:1) & FYM + Garden loam soil (1:1). Among the various casing mixtures tried, Garden loam soil + FYM + Vermicompost (2:1:1) was found to be the most appropriate casing mixture, which gave maximum yield (1331.67 g/8 kg bag) and biological efficiency (16.65%). The lowest yield (831.67 g/8 kg bag) and biological efficiency (10.39%) noticed from the bag cased with FYM + Garden loam soil (1:1) mixture.

Key words: Button mushroom,casing mixtures, fruiting bodies, yield, biological efficiency

INTRODUCTION

Button mushroom (*Agaricus bisporus*) is the most popular edible mushroom being cultivated worldwide which contributes 73% of India's total production (Sharma *et al*., 2017). The *Agaricus bisporus* also called as white button, European or temperate mushroom. They belong to the family Agaricaceae, order Agaricales, and class *Basidiomycetes.* It can be cultivated on compost prepared with different agricultural wastes like paddy straw, wheat straw, maize stalks, etc.

In addition to compost, *Agaricus bisporus* also has a separate requirement, i.e., "Casing layer" that stimulates and promotes primordial initiation. The Casing mixture is prepared by using different organic matters of plant and microbial origin and soil. Once they are mixed in different proportions and the resultant mixture should have improved physio-chemical properties such as water holding capacity, pH, bulk density, etc. Mushroom growth promotion by casing may due to change in the temperature, CO_2 concentration, and presence of *Pseudomonas* bacteria in the casing layer (Ebadi *et al*. 2012).

The best material for casing used universally is the "Peat Moss", but in India, peat moss is not available in desired quantity; therefore, well-decomposed spent compost and Farm yard manure (2-3 years old) are being used as casing materials by the growers. (Dhar *et al*. 2003) used commonly available materials in India viz., Farm yard Manure (FYM), Spent Mushroom Substrate (SMS), coir pith, municipal garbage, vermicompost as casing media in button mushroom cultivation. FYM resulted in early pinning and a significantly higher number of fruiting bodies and total yields compared to others. According to Ratnoo and Anila (2012b), the use of vermicompost as a casing material was found superior compared to other casing materials. Maximum yield and number of the fruiting body obtained by using 100% vermi-compost as casing medium. Among the different casing mixtures tested, Coco

*Correspondence: mohankumar.biswas@visva-bharati.ac.in

nut coir pith + FYM + Saw Dust recorded the highest yield than other casing materials (Ram *et al*., 2014). Ratnoo and Anila, (2012) studied the different casing mixtures for a higher yield of button mushroom and observed casing mixtures of FYM + spent compost + sand + soil (1:1:1:1) gave a higher number of fruiting bodies and yield than other casing mixtures tested. Different casing mixtures were used for button mushroom cultivation and maximum yield (0.94 kg/bag), biological efficiency (18.21), and cost-benefit ratio (1:2.08) were recorded with Garden Loam soil + Vermicompost + Farmyard manure (2:1:1) than other casing mixtures.as reported by Binit *et al*. (2017).

MATERIALS AND METHODS

All the experimental research works were conducted at the Mushroom Research Laboratory, Department of Plant Pathology, Palli Siksha Bhavana (Institute of Agriculture),

Visva-Bharati, Sriniketan, Birbhum district, West Bengal. The experiment was conducted by Completely Randomized Design with 3 replications.

Compost preparation

Compost preparation is the most essential component in white button mushroom cultivation. It can be done by the long method, short method, and indoor method. For this study, an initiative was undertaken to produce the white button mushroom with the available substrate (paddy straw) following the long method of composting under the agro-climatic conditions of West Bengal. Compost is a fermented selective substratum on which the mushroom mycelium grows and mushroom eventually develops. It is produced under aerobic fermentation at a temperature between 50-60^{0}C in seven turnings on 6, 10, 13, 16, 19, 22, and 25th day and the end product can get on the 28th day(Fig.1a &b). It is the end product of the aerobic decomposition process in which cereal straws and other organic matters are decomposed by microorganisms.

Spawning

After the compost preparation, the compost should be filled in polythene bags with 0.5 to 2 % spawning rate. Spawning can be done by either mixed spawning or layer spawning. Spawns can be prepared either in bottles or bottles and used for spawning For this study, S-11strain spawn used in 2 % spawn rate with layer spawning was followed. The compost bags were transferred to the cropping room and maintained the temperature @ 24^{0}C with 90% RH. After completion of spawn run i.e. 15 days the bags are ready for casing (Fig. 2a &b).

Preparation of casing material

The casing materials are collected during the spawn run period. The various requirements such as Garden soil, Vermicompost are collected from the Experimental Farm, Department of Agronomy, Visva-Bharati, Sriniketan. Farm Yard Manure was collected from Model Dairy and Poultry Farm, Department of Animal Science, Visva-Bharati, Sriniketan. Coco peat was procured from the Coir pith processing unit, Salem, Tamil Nadu. The casing mixture was sterilized in an autoclave for 2 hr at 121.6^{0}C at 15 psi and allowed to cool at room temperature overnight.

To assess the best Casing mixture proportions in button mushroom cultivation for higher yield and biological efficiency under agro-climatic conditions of the lateritic belt of West Bengal. Various casing mixture proportions including Spent Mushroom Substrate (SMS) + Garden loam soil + FYM + Sand (1:1:1:1), FYM + Coco peat (4:1), Garden loam soil + FYM + Vermicompost (2:1:1), and FYM + Garden loam soil (1:1) were assessed to determine their effects on case run period, days for the first harvest, the number of fruiting bodies harvested, Yield and Biological efficiency. Data of all the parameters are presented in Table 1.

Casing of the bed

Complete spawn run indicates the white colour of the compost bed due to white mycelial growth of *Agaricus bisporus*. The sterilized casing materials were spread over the surface of the bed at 4 cm thickness. After casing, the beds were maintained at the temperature 16-18^{0}C with 90% RH. Case run period may vary to different casing materials used. The different casing mixtures were used to evaluate the yield and BE of button mushroom cultivation (Fig 3 a &b).

Yield and biological efficiency

The international standard size of button mushroom as, membrane closed, only just forming stem length

Table 1: Evaluation of different casing materials for higher yield and biological efficiency

Treatments	CRP	DFFH	No. of FH	Yield (g)	B.E (%)
Spent Mushroom Substrate (SMS) + Garden loam soil + FYM + Sand (1:1:1:1)	13.33	10.33	104.67	1121.67	14.02
FYM + Coco peat (4:1)	10.67	8.00	94.67	1010.00	12.63
Garden loam soil + FYM + Vermicompost (2:1:1)	14.33	11.33	122.00	1331.67	16.65
FYM + Garden loam soil (1:1)	16.00	12.67	73.00	831.67	10.39
SE(m)(±)	0.41	0.41	1.65	6.45	0.08
CD @ 1%	1.33	1.33	5.38	21.05	0.26
CV (%)	5.21	6.68	2.90	1.04	1.04

Fig.1: Compost of *Agaricus bisporus* (a) and compost being filled in bag (b)

not to exceed 2 cm (3/4 inch), cap diameter 2.5 to 6 cm (1-2.5 inches). It should be harvested at a stage when the cap diameter is twice the length of the stipe or stem. The biological efficiency was calculated by the following formula,

$$\text{Biological efficiency (\%)} = \frac{\text{Weight of fresh mushroom (g)}}{\text{Weight of compost (g)}} \times 100$$

RESULTS AND DISCUSSION

In the present study, different casing materials were evaluated for the cultivation of button mushrooms. FYM + Coco peat (4:1) casing proportion showed an early case run period and first harvest (10.67 and 8.00 days) followed by SMS + Garden loam soil + FYM + Sand (1:1:1:1) proportion (13.33 and 10.33 days) and Garden loam soil + FYM + Vermicompost (2:1:1) proportion (14.33 and 11.33 days). FYM + Garden loam soil (1:1) took maximum case run and first harvest period (16.00 and 12.67 days) than others.The maximum number of sporophores (122/8 kg bag) was obtained from the bed cased with Garden loam soil + FYM + Vermicompost (2:1:1) followed by (104.67/8 kg bag) from SMS + Garden loam soil + FYM + Sand (1:1:1:1) and (94.67/8 kg bag) from FYM + Coco peat (4:1) cased beds. The average number of fruiting bodies (73/8 kg bag) obtained from FYM + Garden loam soil (1:1) was found to be CRP – Case Run Period, DFFH – Days For First Harvest, No. FH – Number of Fruiting bodiesHarvested, B.E – Biological Efficiency

Yield and biological efficiency were the main criteria to check the effect of different Casing materials used in the cultivation of *Agaricus bisporus*. The maximum yield and biological efficiency (1331.67 g/8 kg bag and 16.65%) were obtained from the beds cased with Garden loam soil + FYM + Vermicompost (2:1:1) followed by (1121.67 g/8 kg bag and 14.02 %) from the beds cased with Spent Mushroom Substrate (SMS) + Garden loam soil + FYM + Sand (1:1:1:1) and (1010.00 g/8 kg bag and 12.63%) from the beds cased with FYM + Coco peat (4:1). The minimum Yield and Biological efficiency were obtained (831.67 g/8 kg bag and 10.39%) from the beds cased with FYM + Garden loam soil (1:1). All the treatments differed significantly from each other.

The results of the present study clearly showed that Garden loam soil + FYM + Vermicompost (2:1:1) is the best casing materials for the cultivation of white button mushroom (*Agaricus bisporus*) that gives the highest number of sporophore production, yield, and biological efficiency followed by the casing mixtures such as SMS + Garden loam soil + FYM + Sand (1:1:1:1) and FYM + Coco peat (4:1). The present investigation collaborated with the findings of(Binit *et al*., 2017). The second best casing material obtained is inlined with the find

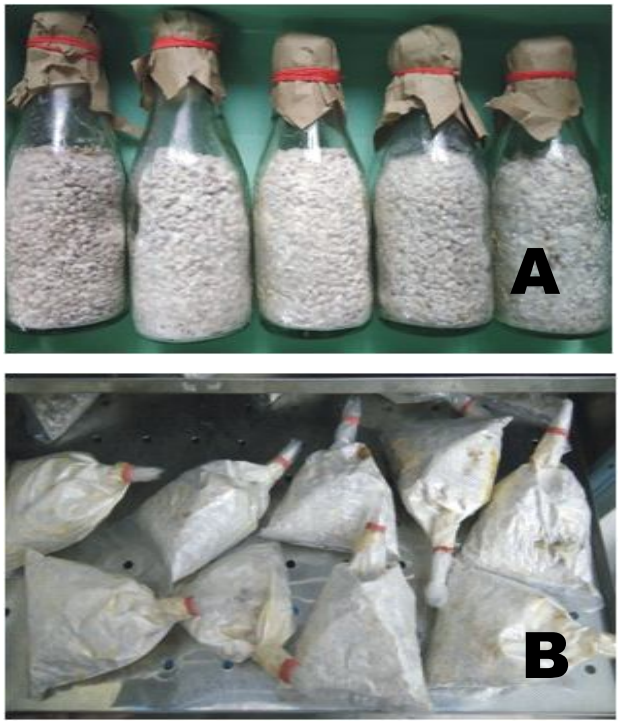

Fig.2: Mother spawn (A) and commercial spawn (B) of *Agaricus bisporus*

Fig.3 : Incubation of beds of *A.bisporus* (A) and (B) Full grown fruit body

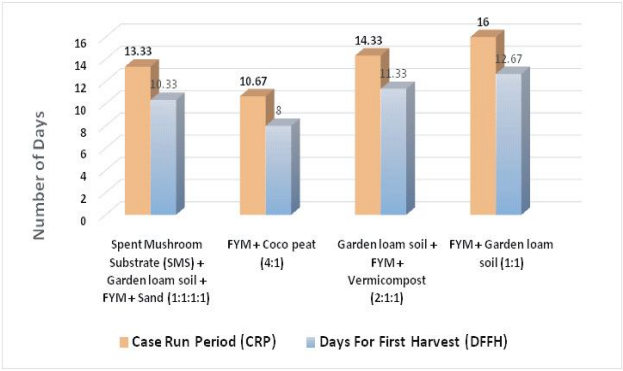

Fig.4: Effects of different casing materials on growth and harvest of *Agaricus bisporus*

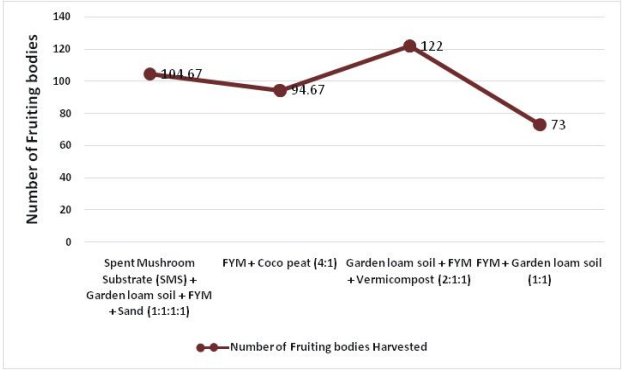

Fig. 5: Effects of different casing materials on sporophore production of *Agaricus bisporus*

ings of Ratnoo and Anila (2012a). Even though beds cased with FYM + Coco peat (4:1) proportion casing mixture obtained less yield and biological efficiency than others, they took a minimum period for case run and First harvest.

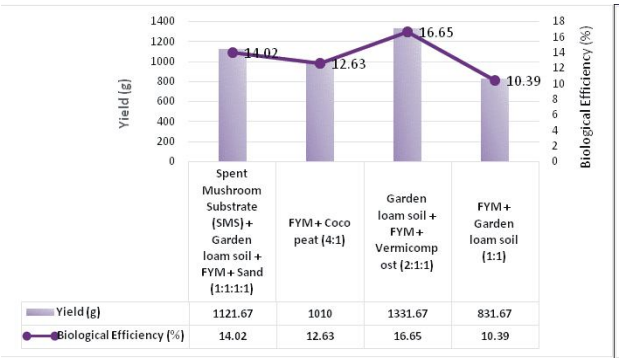

Fig.6: Effects of different casing materials on Yield and Biological Efficiency of *Agaricus bisporus*

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