COMPARATIVE EVALUATION OF CASING MIXTURES ON THE YIELD POTENTIAL OF BUTTON MUSHROOM *(AGARICUS BISPORUS)*

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ABSTRACT

In order to study the effect of different casing mixtures on the growth and yield of common button mushroom (*Agaricus bisporus)* an experiment was carried out with seven casing mixture formulations. Maximum sporophore (12.33) were obtained by casing mixture of CCP + VC + FYM + SD + Sand and minimum sporophore (5.67) were obtained on casing mixture CCP + FYM. The highest yield of first flush was obtained from the casing mixture of CCP + VC + FYM + SD + Sand (270.33 g) followed by CCP + FYM + SD, VC + FYM, VC + SD + FYM + Sand and CCP + VC + Sand (266.67, 216.67, 213.33 and 196.67), respectively. Casing mixture CCP + VC + FYM + SD + Sand recorded the highest yield (320 g) whereas CCP + FYM (250 g) showed lowest yield in the harvesting of second flush. The total highest yield (1112.26 g) was obtained from casing mixture, CCP + VC + FYM + SD + Sand and lowest yield (736.67 g) from CCP + FYM. Casing mixture of CCP + FYM + SD recorded second highest yield (1033.67 g).Finally all the casing materials were evaluated for their effect on growth parameters and yield of *Agaricus bisporus*. Among the different casing mixtures tested CCP + VC + FYM + SD + Sand and CCP + FYM + SD were found to be better in yield when compared to other casing mixtures. These studies will help to mushroom growers for selecting the most suitable casing materials for better growth behaviour and optimum yield potential of common button mushroom (*A. bisporus*) grown in our country.

Keywords: *Agaricus bisporus*, casing mixtures, growth parameters, yield

INTRODUCTION

India is blessed with varied agro-climatic regions from temperate, tropical to subtropical. This makes India as a suitable place for the production of different types of mushrooms. *Agaricus bisporus* (Lange) Sing. is popularly known as the button mushroom, is extensively cultivated throughout the world and contributes about 40% of the total world production of mushroom. Mushrooms are considered to be healthy food because of their relatively high and qualitatively good protein content and also because of the presence of good vitamins, minerals and low fat content. Verma *et al*. [1] reported that mushrooms are very useful for vegetarian diet because they contain some essential amino acids which are mostly found in animal proteins. In this context mushroom cultivation represent one of the economically viable processes for the bioconversion of agricultural and agro-industrial wastes into a protein rich food, making it a potent weapon against malnutrition in developing countries like India which has lowest per capita consumption of protein in the world [2-5].

Button mushroom is one of the largely grown mushrooms and has the good demand in the market and world trade too. Keeping this view in mind the choice of the farmers for growing of button mushroom depends on easily and locally available casing mixtures. Bhatt *et al*. [6] evaluated seven different casing mixtures prepared from 5 materials viz., FYM, spent compost, Vermicompost, coir pith and press mud, for their yield potential on *A. bisporus*. In a similar studies Dhar *et al*. [7] also reported effect of casing materials on the yield and quality of the fruiting body of button mushroom (*A. bisporus*). Huge quantities of farm yard manure, vermicompost, saw dust and other organic wastes are generated annually through the activities of agricultural, forest and food processing industries. Mushroom yield canbe increased if these locally available casing mixtures are used to produce button mushrooms. Therefore, present investigation was carriedout to see the effect of different casing mixtures on the yield potential and growth parameters of button mushroom (*A. bisporus*).

MATERIALS AND METHODS

Spawn Preparation

Well cleaned wheat grains were boiled for 30 minutes until the grain became soft and were mixed with 2% Chalk (calcium carbonate) and 2% Gypsum (calcium sulphate) [8]. Then grain filled bags were sterilized in an autoclave for 1 h at 121 °C. After sterilization, the bags were allowed to cool down at room temperature and then inoculated with bits of mushroom mycelium (10 days old cultures) of *A. bisporus*. Inoculated bags were incubated at 25±2 °C in a B.O.D. incubator for 16 days. These bags were shaken at 4 days intervals to spread the mycelia and completely impregnated the grains.

Compost preparation

For the basic materials for compost, wheat straw were collected from Agro Farm, Banaras Hindu University. Other ingredients like wheat bran, urea, potassium (Murate of Potash), phosphorus (Single Super Phosphate), gypsum, molasses and lindane were procured from market.

Table 1. Formulation of the compost for button mushroom

Ingredients	Quantity (kg)
Wheat straw	600
Wheat bran	60
Urea	7.5
Murate of potash	6.0
Single Super phosphate	6.0
Molasses	9.0
Gypsum	60
Lindane Dust	0.5

Procedure

The compost was prepared by long method of composting (LMC), using the method developed by Mantel *et al*. [9]. Wetted wheat straw was spread thinly over entire floor of the composting yard and then gradually wetted by sprinkling water, till the straw was taking no more water. The straw was then turned for even wetting at this stage and water content was maintained at 75 per cent. The moist straw was mixed with wheat bran and fertilizers uniformly scattered over the straw. A heap was made after each turning but not compressed tightly so as to maintain the aerobic condition in the compost heap. Gypsum was mixed at the third turning and at each turning. Lindane was mixed at 7th turning for prevention of insects pests. Total eight turnings were done and each turning at four days interval. The compost was then ready for spawning i.e. it was dark brown in colour and without any smell of ammonia and had sufficient moisture content (68-70%) when pressed between the palms.

Spawning

The compost was mixed with mushroom spawn @ 2.5 kg/quintal compost and spawned compost was filled (4 kg/bag) in a cylindrical polythene bag (size 40 x 40 cm) and compost filled bags were covered with newspaper sheets to prevent loss of moisture content from mushroom beds, placed in growing chamber, where temperature ranged between 22-28 ºC (Ram and Holkar [10].

Preparation of casing mixtures

The selected basic material for preparation of casing soil such as farm yard manure was obtained from Agro-farm, B.H.U. and other casing materials viz., coir pith, saw dust, vermi-compost and sand were obtained from local market.

Procedure

Seven casing mixture formulations were used as casing for investigations.

i. Coconut coir pith + FYM + Saw dust (1:1:1).
ii. Vermi compost + Saw dust + FYM + Sand (1:1:1:1)
iii. Coconut coir pith + FYM (1:1)
iv. Coconut coir pith + Vermi compost + FYM + Saw Dust + Sand (1:1:1:1:1)
v. Vermi compost + FYM (1:1)

vi. Coconut coir pith + Vermi compost + Sand (1:1:1)

vii. Coconut coir pith + Vermi compost + FYM (1:1:1)

First Coconut coir pith was soaked in water for 24 hours before mixing. Initially individual casing materials viz., FYM, sawdust, coconut coir pith, sand and vermicompost were sterilized in a horizontal autoclave at a temperature of 121 ºC for 20 minutes. Sterilized casing materials were taken out to cool down at room temperature by spreading on well cleaned cemented floor.

Observations and Measurement

The newspaper sheets were removed and the surface of compost was uniformly layered about 3.5 cm by casing formulations. Mushroom beds were sprayed regularly with water to keep the casing soil adequately moist. The recorded temperature of cropping room was ranged 18-24 ºC during harvesting period. Observations were recorded on fruiting bodies of *Agaricus bisporus* in each bag on the following parameters.

i. Initiation of pin heads (Days after spawning)

ii. Average diameter of fruit bodies (cm)

iii. Average weight of fruit body (g).

iv. Yield from each flush and total yield (g).

Each treatment was replicated three times and the yield data were statistically analyzed by Complete Randomized Design (CRD).

RESULTS AND DISCUSSION

Mushroom bags were completely colonized by mushroom mycelium within 20 days and then covered by different casing soil for following observation of growth stages.

Initiation of pin head

Data pertaining to the time taken for initiation of pin heads are presented in Table 2. The casing mixture of VC+ FYM took maximum time (i.e. 38.67 days) CCP + VC + FYM + SD + sand took minimum time period (35 days). These casing mixtures differed non-significantly among themselves.

Time taken for harvesting of different flushes

The harvesting of first flush ranged between (40.67 to 44.47 days). It is evident from the Table 2 that application of two casing mixture CCP + FYM + SD and CCP + VC + SD + FYM + Sand showed significant difference in time taken for harvesting of first flush. The casing mixture CCP + VC + FYM + SD + Sand was taken minimum time (40.67 days) for harvesting of first flush and maximum time (44.67 days) by application of CCP + FYM+ SD.

The harvesting of second flush in two casing mixture i.e. VC + SD + FYM + Sand and VC + FYM took the same time period (62.67 days) and these casing mixture differed non-significantly among themselves. The range of time taken for harvesting second flush was found between (60.33-66.67 days). Third flush was harvested in the range of 77.33 to 85.00 days on various casing mixtures. The performance of casing CCP + FYM + SD was better than other casing mixture. Application of casing mixture CCP + VC + FYM + SD + Sand differed significantly in time taken for harvesting of third flush with that of CCP + FYM + SD + Sand.

The data evaluated the time taken for harvesting of fourth flush showed the non-significant difference between casing mixtures. It revealed information regarding total crop period. The crop period was observed maximum (i.e. 95.66 days) with application of CCP +VC + FYM + SD and VC + SD + FYM + Sand, whereas, the crop period was minimum (90.33 days) with application of CCP + VC + Sand casing mixture.

Table 2. Effect of casing mixtures on growth behaviour of button mushroom (*Agaricus bisporus*)

Casing mixtures	Initiation of pin heads (days)	Time taken for harvesting of flushes (days)				Total crop period (days)
		Ist flush	IInd flush	IIIrd flush	IVth flush	
CCP + FYM + SD (1:1:1)	38.33	44.67	60.00	77.33	94.66	94.66
CCP + FYM (1:1)	36.67	43.33	61.33	77.67	93.33	93.33
VC + SD + FYM + sand (1:1:1:1)	37.00	41.67	62.66	80.67	95.66	95.66
CCP + VC + sand (1:1:1)	35.67	41.33	61.66	81.00	90.33	90.33
VC + FYM (1:1)	38.67	43.33	62.67	76.67	94.00	94.00
CCP + VC +FYM + SD + sand (1:1:1:1:1)	35.00	40.67	60.33	85.00	95.66	95.66
CCP + VC + FYM (1:1:1)	36.33	42.67	60.33	76.67	92.33	92.33
$SEm_{\pm}$	2.24	0.78	1.07	1.32	2.96	2.96
C.D. (P= 0.05)	6.90	2.41	3.30	4.07	9.12	9.12

CCP = Coconut coir pith, FYM = Farm yard manure, SD= Saw dust, VC = Vermi compost.
Initiation of pin head: Days recorded after spawning
Harvesting of flushes: Days recorded after spawning

Number and Weight of sporophore

Data pertaining to the number of sporophores per bag from different flushes has been given in Table 3. Maximum sporophore (12.33) were obtained by casing mixture of CCP + VC + FYM + SD + Sand and minimum sporophore (5.67) were obtained with application of casing mixture CCP + FYM. The results indicate that there was significant difference between the number of sporophore with casing of CCP + VC + FYM + SD + Sand and VC + FYM, CCP + VC + Sand with CCP + FYM and CCP + FYM + SD with CCP + FYM.

It was intended that number of sporophore was always found to be reduced in the fourth flush as compared to Ist, IInd and IIIrd flushes. Similarly, the casing mixture CCP + VC + Sand showed minimum sporophores (2.67) and CCP + VC + FYM + SD + Sand showed maximum sporophores (6.33). Casing mixture CCP + VC + Sand and CCP + VC + FYM + SD + Sand differed significantly with respect to number of sporophores.

The weight of sporophores was calculated as average weight for each treatment Table 3. In observation, heavy weight of sporophores were obtained with the casing of CCP + VC + FYM (1:1:1) (i.e. 36.00 g) and less weight of sporophore were obtained with casing mixture CCP + FYM (1:1) (27 g).

Length of stalk

The length of stalk was measured in average for each treatment as given in Table 3. The maximum stalk length (3.05 cm) was recorded in the casing of CCP + VC + FYM (1:1:1) where as minimum stalk length (2.03 cm) was observed in the casing of VC + SD + FYM + sand (1:1:1:1) The length of stalk in casing CCP + VC + FYM (1:1:1) was found highly significant to CCP + FYM + SD (1:1:1) and other casing soils.

Yield of flushes and total yield

It is evident from the Table 3 that the highest yield of first flush was btained from the casing mixture of CCP + VC + FYM + SD + Sand (270.33 g) followed by CCP + FYM + SD, VC + FYM, VC + SD + FYM + Sand and CCP + VC + Sand (266.67, 216.67, 213.33 and 196.67), respectively. Casing mixture CCP + VC + FYM + SD + Sand showed the highest (320 g) yield whereas CCP + FYM (250 g) showed lowest yield in the harvesting of second flush. In the 3rd flush, maximum yield was obtained from casing CCP + VC + FYM + SD + Sand (305.33 g) where as lowest yield was obtained

Table 3. Effect of casing mixtures on growth parameters and yield of button mushroom (*Agaricus bisporus*)

Casing mixtures	No. of sporophores per bag at diff. flushes				Wt. of sporophores (g)	Length of stalk (cm)	Yield of different flushes (g)				Total yield (g)
	I st	II nd	III rd	IV th	Av.	Av.	I st	II nd	III rd	IV th	
CCP + FYM + SD (1:1:1)	8.00	8.33	9.67	4.33	28.33	2.17	266.67	302.00	298.3	216.6	1083.67
CCP + FYM (1:1)	5.67	5.33	4.67	3.67	27.00	2.07	183.33	200.00	256.6	196.6	836.67
VC + SD + FYM + sand (1:1:1:1)	8.00	11.67	10.67	5.00	29.67	2.03	213.33	246.67	226.6	200	886.00
CCP + VC + sand (1:1:1)	7.33	6.33	6.33	2.67	32.00	2.07	196.67	233.3	216.6	186.6	833.33
VC + FYM (1:1)	8.00	8.33	8.33	3.33	31.67	2.07	216.67	250.0	233.3	183.3	883.33
CCP + VC + FYM + SD + sand (1:1:1:1:1)	12.33	13.67	11.00	6.33	30.33	2.05	270.33	320.00	305.33	216.6	1112.26
CCP + VC + FYM (1:1:1)	6.67	6.33	5.33	4.33	36.00	3.05	190.33	205.00	250.0	190.67	836.00
$SEm_{\pm}$	0.91	1.00	0.69	0.77	0.72	0.15	56.42	19.03	17.30	16.29	
C.D. (P= 0.05)	2.81	3.08.	2.14	2.37	2.26	0.45	24.23	41.47	27.33	35.50	

from CCP + FYM (196.6 g). There was significant difference in yield obtained between casing mixture VC + FYM and CCP + FYM and between CCP + FYM + SD and VC +SD + FYM + Sand.

The highest total yield (1112.26 g) was obtained from casing mixture, CCP + VC + FYM + SD + Sand and lowest yield (736.67 g) was obtained from CCP + FYM. The second highest yield (1033.67 g) was obtained from CCP + FYM + SD casing mixture.

This finding was in accordance with the result of Dhar *et al*. [11] who used eight commonly available casing materials in India viz, FYM, SMC, CCP, MG, VC, Terracare-A, Terracare-B and FYM + SMC to identify the suitable casing materials for use in button mushroom cultivation. Coir pith results in early pinning and significantly higher number of fruit bodies and total yield. Our result also confirmed the findings of Pardo *et al*. [12] who evaluated different casing materials for the cultivation of button mushroom. All the casing materials were evaluated for their effect on growth parameters and yield of *Agaricus bisporus*. Among the casing mixtures, CCP + VC + FYM + SD + Sand and CCP + FYM + SD were found to be better in yield compared to other casing mixtures. The finding of present study will help the farmers for selection and better utilization of locally available casing materials for obtaining higher yield of button mushroom (*A. bisporus*) to increase their income.

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