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Effect of Different Casing Material on Yield Parameters of Button Mushroom (*Agaricus bisporus*) in Temperate Conditions

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Abstract

Button Mushroom (*Agaricus bisporus*) is the most popular mushroom variety grown and consumed all over world. In India, its production earlier was limited to the winter season, but with technology development, these are produced almost throughout the year in small, medium and large farms, adopting different levels of technology. The species being grown in most farms is the white button mushroom (*Agaricus bisporus*) belonging to Class Basidiomycetes and Family Agaricaceae. The current investigation was carried out to evaluate different casing substrates for its cultivation viz. five different casing substrates in order to identify their effect on the growth and yield of white button mushroom (*Agaricus bisporus*). Maximum number of buttons harvested (48) and maximum yield (1.68kg) with highest biological efficiency of 16.8% were obtained from cocopeat casing which was followed by vermicompost casing. The results revealed that the pinhead initiation was significantly fastest in cocopeat and it was delayed in FYM + soil. Yield attributing characters like stalk length, stalk diameter and pileus diameter varied form 29.4 – 31.2 mm, 15.4 – 17.2 mm and 40.6 – 44.4 mm respectively. Therefore, when considering the cost effectiveness and the high yield, best casing mixture for button mushroom was cocopeat.

***Key words*:** *Agaricus bisporus*, Casing, Spawn run, Cocopeat, Vermicompost

Mushrooms are reproductive structures that belong to a separate group of organisms called fungi. They are achlorophyllous and grows as heterotroph by feeding on dead and decaying organic materials. The vegetative parts of mushrooms consist of thread like thin mycelia which penetrate into the substratum and are generally not visible on the surface. After the mycelium has grown profusely, it forms the reproductive structure (Sporocarps). Their nutritional worth is similar to that of many vegetables, and they are frequently seen as a reasonable alternative to meat. Their diverse range of nutrients provides numerous health and nutritional advantages to humanity [1-2].

Agaricus bisporus is the most important commercial grown crop around the world and in india also, commonly known as white button mushroom grows both as a seasonal crop and in high tech cultivation units. The share of button mushroom in India is maximum amounting to 73% followed by oyster mushroom which contributes about 16%, 2016 [3]. It requires two different substrates to form the fruiting bodies i.e. the compost for nutrition on which it grows vegetatively and the casing soil in which the suitable physicochemical/biological conditions stimulate the initiation process of pin head formation for fruit body production. Two major components of the compost mixture are plant material and animal manure. Generally, plant materials include paddy straw, paddy husk, and rice bran. Poultry manure is used as an animal manure. Gypsum and urea are used as inorganic sand for providing nitrogen respectively. In spite of being nutritionally deficient medium, casing layer plays an important role in the production of button mushroom.

Crop residues such as grain crop straws are characterized by the predominance of lignocelluloses with cellulose, hemicellulose and lignin as the main components [4-7]. In India, agricultural residues are referred to as agrowastes, and as a result of agricultural activities, 620 million tons of agrowastes are created year [8-9]. Using such crop residue as a mushroom substrate would subsequently convert them into a more protein-rich biomass and influence the mushroom yields [10]. The high potential of such substrates for growing mushroom could be economically attractive and profitable for farmers and agriculture more widely. Besides, it is converting farm waste into useful products which could later help maintain the nutrient requirement of crops, soil physical and chemical condition, and also gives a better way to utilise agro-waste rather than just burn it in the field, which helps in tackling climatic as well as soil degrading factors [11]. In India, button mushroom industry is one of the high demanding industries at present. But local production is not enough to meet the button mushroom demand of the local market. The climatic condition prevailing in higher altitudes of India is suitable for the successful cultivation of button mushroom. Cultivation of button mushroom is being undertaken by the farmers on large scale, especially in cooler hilly regions. One crop can easily take during the winter season in the plains and foot hills of North India and other parts of country where temperature goes below 20 °C accompanied with high relative humidity. Huge quantities of farm yard manure,

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vermicompost, cocopeat and other organic wastes are generated annually through the activities of agricultural, forest and food processing industries. Mushroom yield can be increased if these locally available casing mixtures are used to produce button mushrooms [12]. The Indian subcontinent is well-known throughout the world for having a wide range of agroclimatic zones and habitats that support a high diversity of mushrooms [13-14]. Therefore, present investigation was carried out to see the effect of different casing mixtures on the growth parameters and yield potential of button mushroom in Kashmir.

MATERIALS AND METHODS

Pure culture

Pure culture of button mushroom was prepared under own plant pathology laboratory of FoA, Wadura, SKUAST-Kashmir.

Experimental site

The experiment was conducted in Division of Plant Pathology, Wadura SKUAST-Kashmir, Kashmir located in upcountry north zone of Kashmir at an elevation of 1524 m above sea level.

Materials

Plastic trays, balance, sprayer, tape, pH meter, compost, casing materials and planting material such as spawn were used during the study.

Method

Compost preparation

Mushroom compost is the substrate on which button mushroom grows. The bio chemical activities of a number of microorganisms make the substrate for the growth of mushroom (*Agaricus bisporus*) as the mycelia of Button mushroom is not able to take nutrition from raw straw of substrate. The process of compost making is known as composting. Quality of the mushroom compost depends on three factors, such as nature and quality of basic materials, organic and inorganic supplements and management of the compost during composting etc. [15].

Table 1 Ingredients for long method

Materials	Quantity (kg)
Straw (any locally available)	100
Wheat bran	10
Mustard cake	5
Urea	1.2
Poultry manure	10
Gypsum	5

Mixture preparation and pile making

There are two compost preparation methods such as long method and short method. Long composting method is done without pasteurization process and long method is also cheap as comparative to short method. The long method of composting is usually practiced in areas where facilities for steam pasteurization is not available. We have also followed this method in the experiment. In this method, the first turning is given about six days after making pile of substrate. The second turning is given on the tenth day followed by third one on the thirteenth day when gypsum is added. The fourth, fifth and sixth turnings are given on the sixteenth, nineteenth and twenty-second day. On the twenty-fifth day the seventh turning is given by adding 10% BHC (125 g) and the eighth turning is given on the twenty-eighth day after which it is checked whether there is any smell of ammonia present in the compost. The compost is ready for spawning only if it doesn't have any smell of ammonia; otherwise, a few more turnings are given at an interval of three days till there is no smell of ammonia. The whole thing is mixed thoroughly in every turning and made into a stack (almost 5 feet high, 5 feet wide and of any length can be made with the help of wooden boards).

Spawning

The above prepared compost was used for spawning. The spawn should be white with silky mycelium and free from undesirable smell. Before starting the spawning, spawning area, utensils and implements used in the spawning was treated with 2% formalin solution. The workers should also wash their hands with soap so as to prevent infections to the compost. Spawning was done @ 0.5–0.75% (In 1 00 kg compost mix 500–750 gm spawn).

Casing

Casing means covering the compost with a thin layer of soil or soil-like material, after the spawn has spread in the compost (spawn run) [15]. Casing is not nutritionally rich when compared with compost. It can create a stress, necessary for the induction of fruit bodies. Casing also provides water for the growth and development of fruit bodies and maintains humidity and temperature in cropping room by evaporative cooling. It provides a medium of low osmotic value compared to compost and hence provides a proper mix for developing pin heads and support to developing fruit bodies.

Preparation of casing mixture

Five different base materials viz., vermicompost, cocopeat, FYM + Sand + Soil, FYM + Soil and FYM (control) were selected for preparation of casing mixtures which were obtained from Agro farm of SKUAST-K, Wadura and commercial outlet of Sopore. Casing materials were used alone and in combination. Before use, casing mixtures were sterilized using 5% formaldehyde/litre of water (50 ml formalin and 1 litre water). Observations were recorded for their effect on growth behaviour of button mushroom.

Harvesting

Mushrooms mostly appear in flushes at an optimum temperature of 15°C. It generally takes seven to 8 days to come to the button stage from the first appearance of the formation of a pin head. Button mushrooms were harvested by twisting the mushrooms gently clock-wise, and then anti clock-wise and afterwards it was pulled up very softly. Along with the mushrooms, soil particles of the casing mixture also came up clinging with the mycelia threads of the mushroom. The lower portion of the stipe was cut with a sharp knife and kept in the trash box. The cleaned mushrooms were collected in another box. When all the mushrooms of the desired size have been harvested, the next stage was to fill up the holes with a mixture of sterilized casing mixture [15].

Treatments

Five different casings were prepared and used as treatments. Casing prepared having Farmyard manure (FYM) was used as control. T_1: Cocopeat, T_2: Vermicopost, T_3: FYM + Soil + Sand, T_4: FYM + Soil, T_5: FYM (Check).

RESULTS AND DISCUSSION

Effect of casing mixtures on growth and yield of button mushroom

Five different casing materials were evaluated to see the effect on growth and yield of button mushroom and data are presented in (Table 2). Pinhead initiation differed significantly concerning different casing materials and yield attributing characters like stalk length, stalk diameter, pileus diameter, number of fruiting bodies and yield also found significant [16].

Table 2 Effect of different casing materials on yield and growth parameters of white button mushroom

Casing materials	Pin head initiation (No. of days)			Stalk length (mm)			Stalk diameter (mm)			Pileus diameter (mm)			No. of fruiting bodies			Yield (gm)			BE (%)		
	1st cycle	2nd cycle	Pooled	1st cycle	2nd cycle	Pooled	1st cycle	2nd cycle	Pooled	1st cycle	2nd cycle	Pooled	1st cycle	2nd cycle	Pooled	1st cycle	2nd cycle	Pooled	1st cycle	2nd cycle	Pooled
Cocopeat	12.40	12.8	12.6	31.2	30	30.6	17	16.8	16.9	43.4	41.6	42.5	48.4	47.4	47.9	1694	1659	1676.5	16.9	16.5	16.7
Vermicompost	13	14	13.5	29.4	30.4	29.9	17.2	16.8	17	41.6	42.6	42.1	39.8	39.4	39.6	1393	1379	1386	13.9	13.7	13.8
FYM + Soil	14.4	14.8	14.6	30.4	30.8	30.6	17	15.4	16.2	44.4	42.6	43.5	29.8	29.6	29.7	1043	1036	1039.5	10.4	10.3	10.35
FYM + Sand + Soil	14.8	15.4	15.1	30.8	30.2	30.5	17.2	16.2	16.7	41.6	40.6	41.1	22.4	22.2	22.3	784	777	780.5	7.8	7.7	7.75
FYM (Control)	15.45	17.4	16	30.4	31.4	30.9	16.8	16.2	16.5	41.2	40.8	41	19.2	20.2	20.75	672	707	689.5	6.7	7.07	6.88
C.D.	0.861	0.939		1.85	1.87		1.04	1.04		1.561	1.561		1.753	1.712		.066	.068		.653	.677	

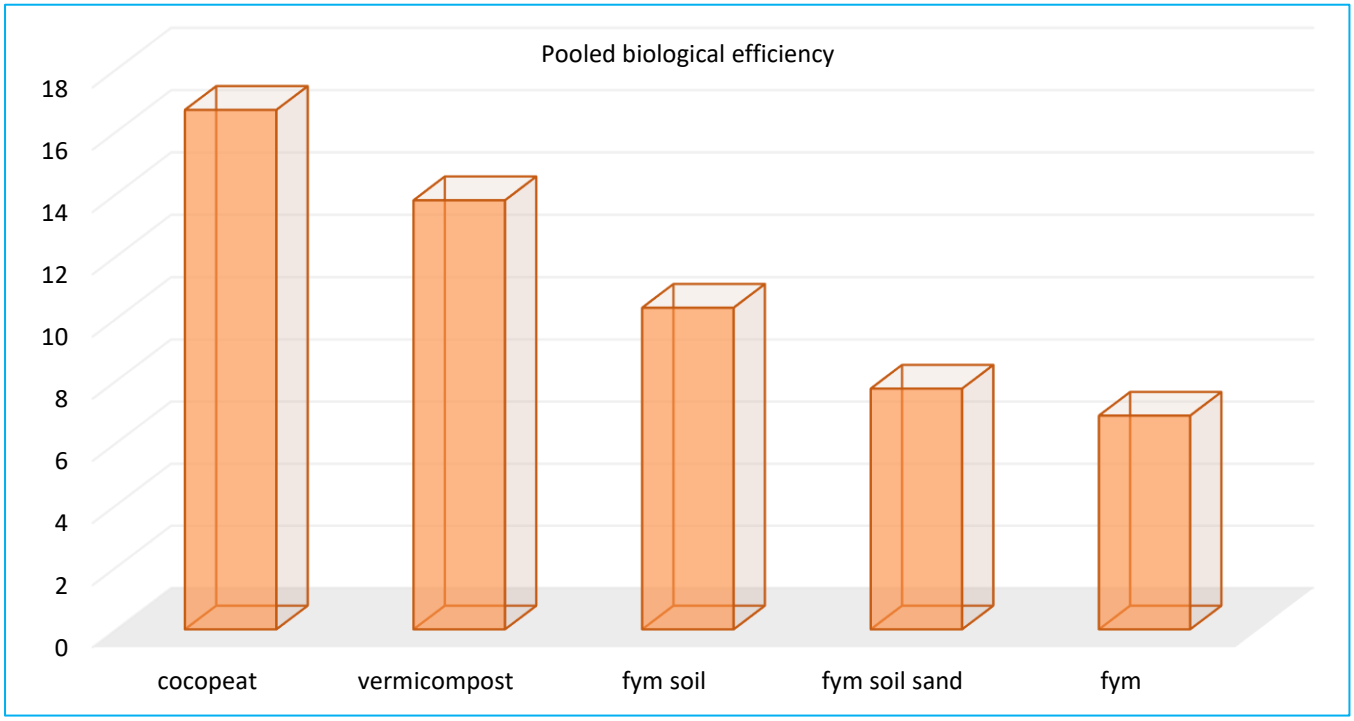

Fig 1 Graphical representation of pooled biological efficiency

Number of pin heads

Button mushroom pinheads specifically refer to the early developmental stage of button mushrooms (*Agaricus bisporus*). Pinhead initiation was fastest (12.25 days) in bag which had cocopeat as casing material followed by vermicompost (13.37 days) and FYM (14.12 days), where it was delayed in FYM + soil (15.62 days). Different casing materials can impact factors like water retention, aeration, and nutrient availability, all of which can influence the development of pinheads. It's essential to choose a casing material that provides the right balance of moisture and aeration for successful pinning and subsequent mushroom growth [17].

Morphological attributes of fruiting body

Button mushrooms are known for their small to medium size, with the caps being tightly closed when young. The significant range of different morphological characters with different casing materials is following, Stalk length, stalk diameter, pileus diameter and number of fruiting bodies varied from 29.4 – 31.2 mm, 15.4 – 17.2 mm, 40.6 – 44.4 mm and 19.2 – 48.4 respectively. The standard sized sporocarp was observed in cocopeat casing material as Cocopeat has excellent water retention properties, making it an ideal substrate for mushroom growth [18-19].

Yield

The yield of button mushrooms (*Agaricus bisporus*) can vary depending on several substrates. The maximum (1676.5 gm) fresh yield obtained from bag which had cocopeat with highest (16.7%) biological efficiency while minimum (689.5 gm) fresh yield recorded from bag which had FYM + soil (1:1) as casing material with lowest (7.3%) biological efficiency [20].

CONCLUSION

Since many years, people have utilized mushrooms for food and medical reasons. The purpose of our research was to evaluate how various button mushroom casing materials affected the mushroom's yield. Though they also provide a useful reference for future research on casing materials for mushroom cultivation, our results were in accordance with earlier findings.

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