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Effect of Cocopeat with Agrowaste as casing Materials on Growth and Yield of White Button Mushroom [*Agaricus bisporus* (Lange) Imbach]

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ABSTRACT: *Agaricus bisporus* belongs to Basidiomycetes family and is the most important commercially cultivated mushroom in the world. The rich nutrients like carbohydrates, proteins, lipids, fibers, minerals, and vitamins present this mushroom as famous healthy food. An experiment was conducted at the Mushroom Crop Room, Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The main objectives were to check the effect of casing soils *viz*. Turmeric leaf powder, Drumstick leaf powder, Tea waste powder, Pomegranate skin waste powder, Garlic leaf powder, with Cocopeat powder @ the ratio of (3:1) per 4kg compost in the growth and yield of white button mushroom as well as against the occurrence of fungal contaminant on the casing soil . The study was conducted in Completely Randomised Design under the agro-climatic conditions of Prayagraj (2021-22). The results revealed that the results revealed that T_3[Cocopeat + Turmeric leaf (3:1)] was found to be significantly superior treatment for attaining maximum stalk length (2.93cm), stalk diameter (1.65 cm) and weight of a fruit (28.50 gm) and shortest time for spawn run (19.50). In T_2[Cocopeat + Tea waste], the diameter of pilues was found to be maximum. T_5[Cocopeat + Pomegranate skin waste], recorded minimum days for pinhead initiation on casing layer (16.25), highest yield (688.32 gm), maximum per cent increase in yield over control (75.40). Whereas least contamination of *Trichoderma hazanium* was recorded in T_4[Cocopeat + Garlic leaf (3:1)].

Keywords: *Agaricus bisporus*, Casing, Cocopeat, *Trichoderma harzianum*, Yield.

INTRODUCTION

White button mushroom, scientifically called as *Agaricus bisporus* is an edible basidiomycetes fungus that belongs to the genus *Agaricus*. Globally, China is the largest producer of mushrooms in the world followed by USA, Netherlands, Poland and Spain (FAO, 2021). During the period between 2021- 2022, Bihar tops the list followed by Maharashtra, Orissa, Haryana, Uttarakhand in the top mushroom producing states in India [Agricultural and processed food products export development authority of India (APEDA), 2021].

The required physical and chemical properties of a good casing should be high porosity and water holding capacity (WHC), 7.2–8.2 pH, 2.5–3.5% active lime, and 0.7–0.8% total nitrogen**.** porosity and texture (particle size distribution in the mixture), as well as the water holding capacity, are markedly improved by addition of coconut fiber (UCF), while pH, electrical conductivity, and the contents of soluble cations remain statistically unaltered (Rangel *et al.*, 2017). Tea waste with peat were compared with that of peat casing, as were their effects on yield, mixture of tea production waste with peat in 1:1 (v:v) ratio increased the yield (Gulser and Peksen 2002). Pomegranate peels were found as effective substrate material at 50% pomegranate peels + 50% wheat straw ratios for mushroom cultivation. It has been determined as effective on some parameters, especially yield (Nadir, 2019).

White button mushroom contains high amounts of protein, minerals, vitamin B group, vitamin D and K and also A and C vitamins. The amount of fat, calorie, sodium and cholesterol levels are low in white button mushroom (Saiqua *et al*., 2008).

Mushrooms are the edible fruiting bodies of fungi which have a wide range of nutritional properties and are a delightful meal to the vegetarians (Sharma and Kamil 2014). Mushroom cultivation maintains environmental sustainability which uses agrowastes and converts it into quality food (Kumar *et al*., 2020). The growth and yield parameters of *Agaricus bisporus* are influenced by the substrate and environmental conditions. Being cottage level industry, many diseases occur causing serious losses to the mushroom industry (Amin *et al.*, 2021). Chemical treatment of diseases adversely affects the nutritional and quality of mushrooms.

Mushrooms are highly proteinaceous and have emerged as a source of neutraceuticals due to the presence of medicinal components (Banik, 2010). These are heterotrophic organisms which require external nutrients for growth of vegetative mycelium and

basidiomes (Carrasco *et al.,* 2018). Some human related diseases like hyperlipidemia and diabetes have been treated by use of mushrooms which increased the role of mushrooms as food stuff (Omowumi and Kadiri 2013). *Agaricus bisporus, Pleurotus* spp., *Lentinus edodes, Auricularia* spp., *Flammulina velutipes* and *Volvariella* spp. Are some edible mushrooms cultivated worldwide (Royse *et al.,* 2017).

It contains vitamin B, D and K, and a very rich source of protein. In this mushroom, fat and cholesterol level is very low. Among all cultivated mushroom, it is one of the most popular and cultivated mushroom in world (Gbolagade *et al*., 2006).

A. bisporus is considered to have high biological activity, low toxicity and has significance folklore and ethnopharmacological significance. Apart from food and food beverages it has a role in perfumery, cosmetic industries and pharmaceutical industries **(**Caglarirmak, 2009). Wild *A. bisporus* were referred for customer due to their flavour and texture (Sadiq *et al*., 2008). It has been reported that lots of primary and secondary metabolites responsible for the therapeutic activity for the prevention and treatment of many diseases such as cancer, hyperlipidemia, microbial diseases, cardiovascular problems, liver diseases, and immune problems. *A. bisporusis* a litter degrading basidiomycete commonly found in humic rich environments which are useful as a model organism and cultivated in large scale for the food industry. Due to its ecological niche, it produces a variety of enzymes for detoxification and degradation of humified plant litter (Gonaus *et al*., 2016).

A. bisporus contains bioactive compounds that have been shown to exhibit immunomodulating and anticancer properties. The Canadian Cancer Society recommends consumption of *A. bisporus* mushroom because of its effectiveness against human diseases. It was reported that brown *A. bisporus* polysaccharide possessed strong immunostimulatory and antitumor bioactivity in vivo and in vitro (Zhang *et al*., 2014).

In the present diet conscious era, mushrooms are increasingly considered as a future vegetable and their consumer demand has markedly expanded in the recent years owing to its medicinal and nutritional properties. Mushrooms are considered as a potential substitute of muscle protein on account of their high digestibility. In addition to protein, mushroom is an excellent source of Vitamin- D, minerals such as potassium, iron, copper, zinc and manganese, low in calories, fat free, cholesterol free, gluten free and very low in sodium.

MATERIALS AND METHODS

In-vivo experiment was be conducted in the Mushroom Crop Room at Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P., India during the period in between October 2021 to March 2022. The production of white button mushroom depends to greater extent upon quality of compost, spawn, casing material and crop management practices. Though, casing is called as nutritionally deficient medium yet, it plays an important role in productivity of white button mushroom. Casing involves covering the top of mushroom beds with a layer of appropriate soil mixture after mycelium has impregnated the compost. Casing is generally done to make a platforrn, where uniform fruitification can take place and also to provide anchorage and essential reserves for developing porophores of the mushroom. Casing also helps in proper exchange necessary for fruit body initiation and its further development. Mushroom productivity is also affected by various physical, chemical and microbiological characteristics of casing materials such as water holding capacity, pH, electrical conductivity structure and texture of the substrate (casing) used and microbial population etc. Wheat straw was selected as substrate for composting. Wheat straw was selected as substrate for composting. Long method composting was followed which took 35 days to complete where 2 additional turnings were given due to the presence of ammonia smell. Spawn of *Agaricus bisporus* was procured from the Directorate of Mushroom Research, Solan, Himachal Pradesh, India. Spawn strain was DMR – A 121. Spawn was applied @7.5g/kg compost (Kapoor, 2004). Four kilograms of compost was filled in each bag. A total of six treatments replicated four times including a control were taken up under Completely Randomized Design. Compost filled bags were kept in the dark room until complete colonization was done with fungal mycelium for casing.

All the Four substrates (Pomegranate pear, Drumstick leaves, Turmeric leaf, Garlic leaves) and, Tea waste, was collect from different localities of Prayagraj. It will be weighed, washed, sterilised with formalin and dried after which it will be powdered and packed in polypropylene bags and sealed.

The casing materials are T_0-Cocopeat(control), T_1-Cocopeat+ Drumstick leaf powder (3:1), T_2-Cocopeat + Tea waste powder (3:1), T_3-Cocopeat + Turmeric leaf powder (3:1), T_4-Cocopeat + Garlic leaf powder(3:1), and T_5-Cocopeat + Pomegranate peel powder (3:1) and applied at 3 cm thickness in cylindrical polythene bags 36×22 cm of 100 gauge. Compost filled bags were kept in the dark room until complete colonization was done with fungal mycelium for casing.

Plate 1: T_0 Cocopeat (Control).

Plate 2: T_1 Cocopeat+ Drumstick leaf (3:1).

Plate 3: T_2 Cocopeat + Tea waste.

Plate 4: T_3 Cocopeat + Turmeric leaf.

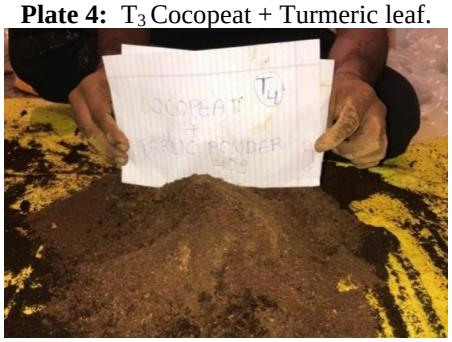

Plate 5: T_4 Cocopeat + Garlic leaf (3:1).

Plate 6: T_5 Cocopeat + Pomegranate skin waste (3:1).

After casing is done the temperature of the room is again maintained at 23±2°C and relative humidity of 85-90% for another 8-10 days. Low CO_2 concentration is favorable for reproductive growth at this stage. For fruiting under favorable environmental condition *viz.* temperature (initially 23 ± 2°C for about week and then 16 ± 2°C), moisture, (2- 3 light sprays per day for moistening the casing layer) humidity (about 85%) proper ventilation and CO_2 concentration (0.08-0.15%) the fruit body initials which appear in the form of pin heads start growing and gradually develop into button stage. Harvesting was done by holding them gently and twisting them in clockwise and anti-clockwise directions without any residues of stub and without disturbing the other fruiting bodies.

The observations recorded were time taken for complete spawn run (days), pinhead initiation (days), growth characteristics like pileus length (cm), pileus diameter (cm), stalk length (cm) and stalk diameter (cm) weight of a fruit (gm), and yield (gm).

Picture- fruiting bodies of treatment T_1

Picture- fruiting bodies of treatment T_2

Picture- fruiting bodies of treatment T_3

Picture- fruiting bodies of treatment T_4

Picture- fruiting bodies of treatment T_5

RESULTS AND DISCUSSION

Effect of cocopeat with different agrowaste on number of days required for flavour **run on the casing layer of *Agaricus bisporus.*** Temperature and humidity play a major role on the mycelium run of mushroom. During this process of cultivation process, maximum temperature was 35.6°C during the (4th week of October) and minimum temperature was 5.2°C during the (3rd week of January). In the present study, minimum days required for flavour run on the casing layer and pinhead initiation was observed in T_3 [Cocopeat + Turmeric leaf (3:1) (19.50)] followed by)], T_1 [Cocopeat+ Drumstick leaf (3:1) (19.75)], T_5 [Cocopeat + Pomegranate skin waste (3:1) (20.50)], T_2[Cocopeat + Tea waste (3:1) (21.00)], T_4 [Cocopeat + Garlic leaf (3:1) (3:1) (22.00)] compared to control T_0 [Cocopeat alone (23.50)].

Effect of cocopeat with agrowaste as casing materials on number of days required for pinhead initiation on the casing materials. The data presented in Table 1 and Fig. 1. Revealed that minimum days required for pinhead initiation was observed in T_5 [Cocopeat + Pomegranate skin waste (3:1)], followed by T_1 [Cocopeat + Drumstick leaf (3:1)], T_2 [Cocopeat + Tea waste (3:1)], T_3 [Cocopeat + Turmeric leaf (3:1)], T_4 [Cocopeat + Garlic leaf (3:1)] as compared to T_0 [Cocopeat].

Effect of cocopeat with agrowaste as casing materials on pileus diameter (cm) of *Agaricus bisporus.* The data presented in Table 1 and Fig. 1 revealed that the diameter of pileus was maximum in T_4 [Cocopeat + Garlic leaf (3:1)], followed by T_2 [Cocopeat + Tea waste (3:1)], T_3 [Cocopeat + Turmeric leaf (3:1)], T_5 [Cocopeat + Pomegranate skin waste (3:1)], T_1 [Cocopeat+ Drumstick leaf (3:1)], as compared to T_0 which had the lowest diameter of pileus

Effect of cocopeat with agrowaste as casing materials on stalk diameter (cm) of *Agaricus bisporus.* The data presented in Table 1 and Fig. 1 revealed that the maximum stalk diameter was observed in T_3 = Cocopeat + Turmeric leaf (3:1) followed by T_2[Cocopeat + Tea waste] (3:1) T_5 [Cocopeat + Pomegranate skin waste (3:1)] T_1 [Cocopeat+ Drumstick leaf] (3:1) T_4 [Cocopeat + Garlic leaf] (3:1) as compared to T_0 which had the lowest stalk diameter.

Effect of cocopeat with agrowaste as casing materials on stalk length(cm) of *Agaricus bisporus.* The data presented in Table 1 and Fig. 1 revealed that the maximum stalk length(cm)was observed in T_3 [Cocopeat + Turmeric leaf (3:1)] followed by [T_1 Cocopeat+ Drumstick leaf (3:1)] T_5 [Cocopeat + Pomegranate skin waste (3:1)], T_2[Cocopeat + Tea waste (3:1)], T_4 [Cocopeat + Garlic leaf (3:1)] as compared to T_0 which had the lowest stalk length.

Table 1: Effect of cocopeat with different agrowaste of growth parameters of *Agaricus bisporus.*

Sr. No.	Treatments	Spawn run (In days)	Pinhead initiation (In days)	Pileus diameter (cm)	Stalk diameter (cm)	Stalk length (cm)	Weight of a fruit	Yield
T_0	Cocopeat	23.50	20.75	2.30	1.13	1.58	12.23	56.68
T_1	Cocopeat+ Drumstick leaf powder (3:1)	19.75	16.75	4.83	1.38	2.48	21.26	122.33
T_2	Cocopeat + Tea waste powder (3:1)	21.00	17.00	5.20	1.60	2.20	24.50	131.93
T_3	Cocopeat + Turmeric leaf powder (3:1)	19.50	17.50	4.58	1.65	2.93	28.50	108.60
T_4	Cocopeat + Garlic leaf powder (3:1)	22.00	18.50	4.05	1.30	1.65	17.75	84.80
T_5	Cocopeat + Pomegranate peel powder (3:1)	20.50	16.25	4.23	1.50	2.38	26.75	229.443
	S. Em	0.328	0.445	0.108	0.073	0.083	1.322	4.297
	CD (0.05)	0.975	1.322	0.319	0.217	0.248	3.927	9.783

Effect of cocopeat with agrowaste as casing materials on the yield of *Agaricus bisporus.* The data presented in Table 1 and Fig. 1 revealed that the maximum yield (*gm*) was recorded in T_5 [Cocopeat + Pomegranate skin waste (3:1)] followed by T_2 [Cocopeat + Tea waste (3:1)], T_1 [Cocopeat+ Drumstick leaf (3:1)], T_3[Cocopeat + Turmeric leaf (3:1)], T_4 [Cocopeat + Garlic leaf (3:1)], as compared to T_0 which had the maximum incidence of disease.

Effect of cocopeat with agrowaste as casing materials on weight of a fruit of *Agaricus bisporus.* The data presented in Table 1 and Fig. 1 revealed that maximum weight of a mushroom fruit was recorded in T_3[Cocopeat + Turmeric leaf (3:1)], followed by T_5 [Cocopeat + Pomegranate skin waste (3:1)], T_2 [Cocopeat + Tea waste (3:1)], T_1 [Cocopeat + Drumstick leaf (3:1)], T_4 [Cocopeat + Garlic leaf (3:1)], as compared to T_0.

The above findings are in agreement with Ram and Holkar (2009) reported that maximum fruit bodies were recorded in coconut coir pith + vermicompost + FYM + saw dust + sand casing mixture. Similar result were obtained by Nadir (2019). Pomegranate peels were found as effective substrate material at 50% pomegranate peels + 50% wheat straw ratios for *Pleurotus* cultivation. It has been determined as effective on some parameters, especially yield (Nadir, 2019). Pin head formation was recorded in FYM+BRH (1:1), FYM + Cocopeat, FYM+BS and FYM with total number of 23 days after casin (Jarial *et al.*, 2005). Using tea production waste alone as a casing was not acceptable for assured yield when it was compared with peat. But, a mixture of tea production waste with peat in 1:1 (v:v) ratio increased the yield (Gulser and Peksen 2002).

CONCLUSIONS

During this study, it was evident that the presence of cocopeat + pomegranate peel powder in the treatments showed significant increase in the production as compared to control, pileus diameter(cm), stalk length(cm), and stalk diameter(cm) are maximum in cocopeat + turmeric leaf powder, cocopeat + tea waste powder had the maximum pileus diameter. Cocopeat with pomegranate peel powder, turmeric leaf powder or tea waste powder are good for the casing and garlic leaf powder contains sulphur- containing compounds, such as allicin, alliin and ajoene, enzymes, which have anti-microbial properties including anti-fungal property. This is inhibits the growth of the fungal contaminants. However, the present study only was limited to one rabi season 2021-22 under prayagraj conditions, therefore, to substantiate the present result more trials are needed for 2-3 seasons for further research. The highest yield was recorded in Cocopeat + Pomegranate skin waste contains potassium, sodium, iron and zinc which favours the better growth of mycelium.

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