



# Effect of Tulsi Leaf Powder along with Casing Mixture on the Growth Parameters and Yield of White Button Mushroom [*Agaricus bisporus* (Lange) Imbach]

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## Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## ABSTRACT

*Agaricus bisporus* (Lange) Imbach commonly known as white button mushroom, is the most widely accepted food globally with nutritional and medicinal properties. The present experiment was conducted during the Rabi season 2023 - 2024 at Mushroom crop room, Department of Plant Pathology, SHUATS, Prayagraj, Uttar Pradesh to evaluate the effect of tulsi leaf powder at different concentrations (1 %, 1.5 %, 2 %, 2.5 % and 3 %) incorporated into casing mixture (alone and combination) viz., farm yard manure, farm yard manure + cocopeat + sawdust (1:1:1) with an

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objective to monitor the growth and yield aspects of white button mushroom. Among all treatments used in the study, the results revealed that minimum average time taken for completion of case run (15.14 days) and pinhead initiation (15.57 days) as well as maximum pileus diameter (4.63 cm), stalk length (3.77 cm), stalk diameter (3.01 cm), maximum yield (557.9 g), biological efficiency (12.97 %) and highest cost benefit ratio (1: 3.18) was recorded in farm yard manure + cocopeat + sawdust (1:1:1) + tulsi leaf powder @ 3%. These results indicated that incorporating tulsi leaf powder @3% in casing mixture improves the growth and yield of *A. bisporus*.

**Keywords:** *Agaricus bisporus*; casing, cocopeat; FYM; sawdust, tulsi leaf powder, white button mushroom

## 1. INTRODUCTION

“The white button mushroom (*Agaricus bisporus*) is the most widely cultivated species of edible mushroom and it is a popular cultivar among the artificially grown fungi of the world. It belongs to the phylum Basidiomycota, class Agaricomycetes, order Agaricales and family Agaricaceae. These are wonderful sources of proteins, vitamins, minerals and low in calories and cholesterol” [1]. Mushroom production in the world has increased more than five times since 2000 and presently, it stands at as 44 million tonnes [2]. Out of the total mushroom produced in India, the share of white button mushroom is 73%. “During the period between 2021- 2022, Bihar (10.82%) with 28000 tonnes tops the list followed by Maharashtra (9.89%), Orissa (9.66%), Haryana, Uttarakhand in the top mushroom producing states in India” [3].

“The white button mushroom [*Agaricus bisporus* (L) sing]. is cultivated on a substrate consisting of a composted mixture of wheat straw compost is prepared in a sequence of processes. Composting and casing are considered the essential steps for the cultivation of *A. bisporus*. The most important step for the cultivation of white button mushroom is the casing layer” [4]. “The casing layer is one of the important growing parameter and source of variation in production, quality and uniformity of commercial cropping, 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 can be increased if these available casing mixtures are used to produce button mushrooms”. Kaur and Rampal, [5].

“The yield and quality of mushrooms are dependent on casing mixtures mainly affected by a wide variety of biotic and abiotic factors. The major biotic factors, viz., fungi, nematodes, mites,

insects, pests, and flies, lead to a decrease in mushrooms' yield and quality. Various chemicals are used to control the biotic factors, which leads to a decrease in the yield of button mushroom also. The utilization of these chemicals creates many secondary effects in resistance to pesticides, environmental pollution, and a decrease of non-target organisms, including beneficial microbes. The ingestion of formaldehyde may lead to nausea, vomiting, diarrhea with bloody stool, renal failure, liver failure and tumor development and irreversible neurotoxicity” [6]. Moreover, these days people are more concerned about organic food. Therefore, the present study was planned to evaluate effect of tulsi leaf powder along with casing mixture on the growth parameters and yield potential of white button mushroom (*Agaricus bisporus*).

### 1.1 Materials and Methods

**Procurement of Spawn:** The spawn strain – *Agaricus bisporus* (DMR NBS-5), was procured from Directorate of Mushroom Research, Chambaghat, Solan, Himachal Pradesh.

### 1.2 Composting

“The basic materials for compost, wheat straw was taken from Agro farm. Other ingredients like wheat bran, urea, potassium (Murate of Potash), phosphorus (Single Super Phosphate), gypsum and lindane were obtained from commercial out let. The compost was prepared by long method of composting. Wetted wheat straw had spread thinly over entire floor of the composting yard and then gradually wetted by sprinkling water, till the straw was taken no more water. The straw was then turned for even wetting at the stage and water content was maintained at 75 per cent. The moist straw was mixed with wheat bran and fertilizer 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 water was sprayed to make up the loss of water due to evaporation. Profenofos insecticide was mixed at 7 turning for prevention of insects pests. Total eight turning was 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 palms" [7].

### 1.3 Spawning

A unit of 5 kg mildly wet compost was used for each bag in perforated polypropylene bag, which was equally distributed in 6 treatments including control which contain 7 replications each. The moisture content of the compost at the time of spawning was kept around 25-30%. The spawn thoroughly mixed with the compost at the rate of 7.5 g/kg compost Kapoor, [8] and pressed moderately. The sterilized newspaper was placed on the top of compost bag to preserve moisture and kept folded on top and transferred in to the dark room for spawnrun.

### 1.4 Preparation of Casing Mixtures

The selected basic material for preparation of casing soil such as Farm yard manure was obtained from Agro-farm, SHUATS and other casing materials, cocopeat and sawdust were obtained from commercial outlet Praygraj.

### 1.5 Preparation of Botanicals (Tulsi leaf powder)

Fresh tulsi leaves were collected, well dried in sunlight and then made into fine powder with the help of mortar pestle and mixer. The dried powder of the selected botanical was mixed with the untreated check bags were kept as control.

Tulsi leaves contain ursolic acid, major compound such as geranyl acetate, linalool, flavonoids such as apigenin, polyphenols, anthocyanins and luteolin, eugenol, methyl chavicol, thymol or sesquiterpene alcohols have been reported to possess antifungal activity [9].

### 1.6 Procedure

The different casing material viz., FYM, Cocopeat, Sawdust was used alone and different casing mixture with Tulsi leaf powder (TLP). [FYM, FYM + CCP + SD (1:1:1) + TLP @ 1 - 3%]. First coir pith was soaked in water for 2

hours. Initially individual casing materials, FYM, Sawdust, Cocopeat sterilization was done by using 2% formalin solution. The disinfection process was carried out at a temperature not less than 16°C, hence at lower temperature formalin doesn't evaporate and therefore wouldn't be effective. Before applying the casing layer to the compost, it was kept under a polythene film so that evaporation occurs and thereby making the casing layer free from contaminants. Each of the casing materials was applied to seven uniform bags (replicates) containing spawned compost. The fourty two bags were arranged in a Completely Randomized Design (CRD) in a covered mushroom crop room. After casing is done the temperature of the room was again maintained at 23±2 °C and relative humidity of 85-90%for another 8-10 days (till case run).

### 1.7 Fruiting and Harvesting

The mycelium emerged on casing soil after 10 days, the environmental conditions were changed in cropping room by providing fresh air through ventilation and light for 6-8hrs, relative humidity 90-95% were maintained by spraying of the water thrice a day. The temperature of cropping room was maintained at 16±2 °C . Low CO<sub>2</sub> concentration (0.08- 0.15%) is favorable for reproductive growth at this stage. Pin heads were appeared between 13-16 days after casing and they became ready for harvesting within next one week.

### 1.8 Observations were Recorded

- I. Mycelium run on casing layer (days)
- II. Initiation of pinheads (days)
- III. Pileus diameter (cm)
- IV. Stalk length (cm)
- V. Stalk diameter (cm)
- VI. Yield (g)
- VII. Biological efficiency (%)

### 1.9 Biological Efficiency

Biological efficiency was calculated as follows [10].

Biological efficiency = Total weight of fresh mushroom / Total dry weight of compost \* 100

**Cost benefit ratio:** The cost benefit ratio was calculated using following formula:

C: B ratio = Net returns / Total cost of cultivation

**Table 1. Effect of tulsi leaf powder along with casing mixture on the growth parameters and yield of white button mushroom (*Agaricus bisporus*)**

Trt. no	Treatments	Case run (days)	Pinhead initiation (days)	Pileus diameter (cm)	Stalk length(cm)	Stalk diameter (cm)	Yield (g)	BE (%)	C : B ratio
T <sub>0</sub>	FYM (Untreated)	21.14	24.14	2.64	2.14	1.77	250.8	5.82	1:1.01
T <sub>1</sub>	FYM + CCP + SD (1:1:1) + TLP @1%	19.00	21.42	3.10	2.32	2.30	295.1	6.85	1:1.20
T <sub>2</sub>	FYM + CCP + SD (1:1:1) + TLP @1.5%	17.42	20.42	3.21	2.97	2.37	350.1	8.14	1:1.55
T <sub>3</sub>	FYM + CCP + SD (1:1:1) + TLP @2%	16.57	20.14	3.44	3.06	2.40	382.7	8.89	1:1.86
T <sub>4</sub>	FYM + CCP + SD (1:1:1) + TLP @2.5%	16.42	16.85	3.69	3.13	2.76	481.6	11.19	1:2.61
T <sub>5</sub>	FYM + CCP + SD (1:1:1) + TLP @3%	15.14	15.57	4.63	3.77	3.01	557.9	12.97	1:3.18
<b>SEM (±)</b>		0.36	0.32	0.10	0.05	0.03	13.66	0.31	
<b>CD (0.05)</b>		1.04	0.84	0.29	0.11	0.10	39.17	0.91	

Trt no = Treatment Number, FYM = Farm Yard Manure, CCP = Coconut Coir Pith, SD = Sawdust, TLP = Tulsi Leaf Powder, BE = Biological Efficiency, C:B = COST Benefit Ratio

### 1.10 Statistical Analysis

"In this experiment Complete Randomized Design (CRD) was followed. The analysis of variance (ANOVA) technique was applied for drawing conclusion from data". "The calculated values were compared, the tabulated values at 5% level of probability for the appropriate degree of freedom" [11].

## 2. RESULTS

**Time taken for the mycelial run on casing layer (days) and Pin head initiation (days):** The minimum days required for mycelial run on the casing layer was observed in T<sub>5</sub> [FYM + cocopeat + sawdust (1:1:1)+ tulsi leaf powder @ 3% (15.14)] followed by T<sub>4</sub> (16.42) and T<sub>3</sub> (16.57) as compared to other treatments including T<sub>0</sub> untreated control.

The minimum days required for pinhead initiation was observed in T<sub>5</sub> [FYM + cocopeat + sawdust (1:1:1)+ tulsi leaf powder@ 3 % (15.57)] followed by T<sub>4</sub> (16.85) and T<sub>3</sub> (20.14) as compared to other treatments including T<sub>0</sub> untreated control.

**Pileus diameter (cm) :** The maximum pileus diameter (cm) was observed in T<sub>5</sub> [FYM + cocopeat + sawdust (1:1:1)+ tulsi leaf powder@ 3 % (4.63)] followed by, T<sub>4</sub> [FYM + cocopeat + sawdust (1:1:1) + tulsi leaf powder@ 2.5 % (3.69)] and T<sub>3</sub> [FYM+ cocopeat + sawdust (1:1:1) + tulsileaf powder @ 2 % (3.44)]. T<sub>4</sub> and T<sub>3</sub> found to be non-significant each other.

**Stalk length (cm) :** The maximum stalk length (cm) was observed in T<sub>5</sub> [FYM + cocopeat + sawdust (1:1:1) + tulsi leaf powder@ 3 % (3.77)] followed by T<sub>4</sub> [FYM + cocopeat + sawdust (1:1:1) + tulsi leaf powder@ 2.5 % (3.13)] and T<sub>3</sub> (3.06) as compared to other treatments including T<sub>0</sub> untreated control.

**Stalk diameter (cm) :** The maximum stalk diameter (cm) was observed in T<sub>5</sub> [FYM + cocopeat + sawdust (1:1:1)+tulsi leaf Powder@ 3 % (3.01)] followed by T<sub>4</sub> [FYM + cocopeat + sawdust (1:1:1) + tulsi leaf powder@ 2.5 % (2.76)] and T<sub>3</sub> (2.40) as compared to other treatments including T<sub>0</sub> untreated control.

**Yield (g) and Biological efficiency (%) :** The maximum yield and biological efficiency ( 557.9g and 12.97 %) was recorded in T<sub>5</sub>[FYM + cocopeat + sawdust (1:1:1)+ tulsi leaf powder @3%] followed by (481.6g and 11.19 %) from the T<sub>4</sub> [FYM + cocopeat + sawdust (1:1:1) + tulsi leaf powder@ 2.5% ] as compared to other treatments including T<sub>0</sub> untreated control which had the lowest yield and biological efficiency (250.8g and 5.82%).

**Cost benefit ratio :** The maximum cost benefit ratio was recorded in T<sub>5</sub> [FYM + cocopeat + Sawdust (1:1:1)+tulsi leaf powder@ 3% (1:3.18)] followed by T<sub>4</sub> [fym + cocopeat + sawdust (1:1:1) + tulsi leaf powder@ 2.5% (1:2.61)] as compared to other treatments including T<sub>0</sub> untreated control.

### 3. DISCUSSION

The probable reason for such findings may be that tulsi (*Ocimum sanctum*) has ursolic acid, major compound such as geranyl acetate, linalool, flavonoids such as apigenin, polyphenols, anthocyanins and luteolin, eugenol, and many other important compounds which have antifungal properties. These may have suppressed the growth of mycoflora which may have favored the fast growth of *Agaricus bisporus* mycelium. Also casing materials having high water holding capacity appears to be directly related to porosity and bulk density, which promote faster and uniform mycelium spread. These factors would have directly affected microbial build up and initiation of pin heads of *Agaricus bisporus*. Due to the inhibitory effect of *Ocimum sanctum* on the growth of weed molds and dry bubble, wet bubble incidence due to which larger fruiting bodies and higher yield of *A. bisporus* was obtained. Addition of tulsi leaf powder in casing mixture provided a sufficient level of nutrients to obtain maximum growth and yield potential of *A. bisporus*. Also recorded maximum yield of *A. bisporus*, in tulsi leaf powder at 2.5 - 3% concentration. Similar findings have been reported by Pervez et al. [12], Mousumi et al. [13], Singh et al. [14], Kakraliya et al. [15], Kumar et al. [16] and Kakraliya and Paswal [17],[18-20].

### 4. CONCLUSIONS

Casing mixture of FYM + Cocopeat + Sawdust (1:1:1) + @ Tulsi leaf powder at 3% recorded minimum days for spawn run and pinhead initiation as well as maximum pileus diameter (cm), stalk length (cm), stalk diameter (cm), yield (g), biological efficiency (%) and highest cost benefit ratio of *Agaricus bisporus* (White button mushroom). The results of the present study are of one crop season (October 2023- March 2024) under Prayagraj agroclimatic conditions as such more trials should be carried out in future to validate the present findings.

### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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