Effect of tulsi leaf powder along with casing mixture on the growth parameters and yield of white button mushroom [*Agaricus bisporus* (Lange) Imbach]

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 at Mushroom crop room, Department of Plant Pathology, SHUATS, Prayagraj, Uttar Pradesh to evaluate the effect of Tulsi leaf powder (TLP) at different concentrations (1 %, 1.5 %, 2 %, 2.5 % and 3 %) incorporated into casing mixture (alone and combination) *viz.*, Farm yard manure (FYM), FYM + Cocopeat + Sawdust (1:1:1) with an 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 spawn run (15.14 days) and pinhead initiation (15.57 days) as well as maximum pileus diameter (4.63 cm), stalk length (3.77 cm) and stalk diameter (3.01 cm) were recorded in T_5 [FYM + Cocopeat + Sawdust (1:1:1) + TLP @ 3%]. Results have shown that T_5 [FYM + Cocopeat + Sawdust (1:1:1) + TLP @ 3%] had the highest yield (557.9 g), biological efficiency (12.97 %) and C:B ratio (1: 3.18).

Key words: *Agaricus bisporus*, white button mushroom, Casing, Tulsi leaf powder, FYM, Cocopeat, Sawdust.

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 **(Sharma *et al.*, 2017)**. Mushroom production in the world has increased more than five times since 2000 and presently, it stands at as 44 million tonnes (**FAOSTAT, 2023**) Out of the total mushroom produced in India, the share of white button mushroom is 73% . During the period

between 2021- 2022, Bihar (11%) with 28000 tonnes tops the list followed by Maharashtra (10%) , Orissa (9.66%), Haryana, Uttarakhand in the top mushroom producing states in India **[Agricultural and processed food products export development authority of India (APEDA), 2022].**

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. Conventionally two phases of composting are distinguished **(Sinden and Hauser, 1950).** The casing layer is one of the important growing parameter and source of variation in production, quality and uniformity of commercial cropping (**Kaur and Rampal, 2017**) , 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.

Tulsi leaves contains 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 **(Rahman *et al.*, 2011).**

The major fungal diseases including wet bubble, cobweb, dry bubble and competitor moulds. green mould disease is caused by *Trichoderma* spp. has been noted to cause considerable damage, with production losses around 63–65 percentage in mushroom farming. **(Altaf *et al.*, 2022).**

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.

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.

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, 2004**) 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 spawn run.

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 saw dust were obtained from commercial outlet Praygraj.

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 casing mixtures in different concentrations (1 %, 1.5 %, 2 %, 2.5 %, 3 %) for 5 treatments and the untreated check bags were kept as control.

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 16ºC, 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 ℃ and relative humidity of 85-90% for another 8-10 days (till case run).

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 $16\pm2\ ^{0}C$. Low CO_2 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.

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. Yeild (g)
VII. Biological efficiency (%)

Biological efficiency:

Biological efficiency will be calculated as follows (**Change *et al*., 1981**)

$$\textbf{Biological efficiency}: \frac{\text{Total weight of fresh mushroom}}{\text{Total dry weight of compost}} \times 100$$

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.

RESULT AND DISCUSSION

Time taken for the mycelial run on casing layer (days)

The minimum days required for mycelial run on the casing layer was observed in T_5 [FYM + CCP + SD (1:1:1) + TLP @ 3 % (15.14)] followed by T_2 [FYM + Cocopeat + Sawdust (1:1:1) + Tulsi leaf powder @ 1.5 % (17.42)] as compared to other treatments including T_0 untreated control.

Time taken for the Pin head initiation (days)

The minimum days required for pinhead initiation was observed in T_5 [FYM + Cocopeat + Sawdust (1:1:1)+ Tulsi leaf Powder@ 3 % (15.57)] followed by T_4 [FYM + Cocopeat + Sawdust (1:1:1) + Tulsi leaf powder@ 2.5 % (16.85)] as compared to other treatments including T_0 untreated control.

Pileus diameter (cm)

The maximum pileus diameter (cm) was observed in T_5 [FYM + Cocopeat + Sawdust (1:1:1)+ Tulsi leaf Powder@ 3 % (4.63)] followed by, T_3 [FYM + Cocopeat + Sawdust (1:1:1) + Tulsi leaf powder @ 2 % (3.44)] as compared to other treatments including T_0 untreated control.

Stalk length (cm)

The maximum stalk length (cm) was observed in T_5 [FYM + Cocopeat + Sawdust (1:1:1) + Tulsi leaf Powder@ 3 % (3.77)] followed by T_4 [FYM + Cocopeat + Sawdust (1:1:1) + Tulsi leaf powder@ 2.5 % (3.13)] as compared to other treatments including T_0 untreated control.

Stalk diameter (cm)

The maximum stalk diameter (cm) was observed in T_5 [FYM + Cocopeat + Sawdust (1:1:1)+ Tulsi leaf Powder@ 3 % (3.01)] followed by T_4 [FYM + Cocopeat + Sawdust (1:1:1) + Tulsi leaf powder@ 2.5 % (2.76)] as compared to other treatments including T_0 untreated control.

Yeild (g)

The maximum yield (g) was observed in T_5 [FYM + CCP + SD (1:1:1)+ Tulsi leaf powder @ 3 % (557.9)] followed by T_4 [FYM + CCP + SD (1:1:1) + Tulsi leaf powder @ 2.5 % (481.6)] as compared to other treatments including T_0 untreated control which had the lowest yeild (250.8).

Biological efficiency (%) The maximum biological efficiency (%) was observed in T_5 [FYM + Cocopeat + Sawdust (1:1:1)+ Tulsi leaf powder@ 3 % (12.97)] followed by T_4 [FYM + Cocopeat + Sawdust (1:1:1) + Tulsi leaf powder@ 2.5 % (11.19)] as compared to other treatments including T_0 untreated control.

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

Tr no	Treatments	Case run (days)	Pinhead initiation (days)	Pileus diameter (cm)	Stalk length (cm)	Stalk diameter (cm)	Yield (g)	BE (%)	C : B ratio
T0	FYM (Untreated)	21.14	24.14	2.64	2.14	1.77	250.8	5.82	1:1.01
T1	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
T2	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
T3	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
T4	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
T5	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
	SEM	0.36	0.32	0.10	0.05	0.03	13.66	0.31	
	CD (5%)	1.04	0.84	0.29	0.11	0.10	39.17	0.91	

FYM = Farm yard manure, CCP = Coconut coir pith, SD = Sawdust, TLP = Tulsi leaf powder, BE = Biological efficiency, C:B = Cost benfit ratio.

Discussion

The reason for such result may be Tulsi (*Ocimum sanctum*) have suppress the growth of mycoflora present in the casing soil which may have favored the fast growth of *Agaricus bisporus* mycelium. Tulsi at higher concentration promoted faster mycelial run and thus resulted in requiring least days for mycelium run and pinhead initiation. Tulsi has ursolic acid, geranyl acetate, linalool, apigenin, polyphenols, anthocyanins ,eugenol, and many other important compounds which have antifungal properties. 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 *Agaricus bisporus* was obtained. Similar findings have been reported by **Kakraliya and Paswal (2024), Mousumi *et al* (2017)**, **Kakraliya *et al*. (2022),**. **Kumar *et al*. (2023), Pervez *et al*. (2012)** and **Singh *et al*. (2017).**

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 benfit 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.

References

Agricultural and processed food products export development authority of India (APEDA),2022. (www.apeda.in).

Altaf, S., Jan, S. K., Basu, U., Ahanger, S. A., Dave, A., Kakraliya, S. S. and Mushtaq, M. (2022). Sustainable management of green mould disease of white button mushroom using botanicals and biocontrol agents under temperate conditions. *Horticulturae*, 8(9): 768.

Chang, S. T., Lau, O. W. and Cho, K. Y. (1981). The cultivation and nutritional value of *Pleurotus sajor- caju*. *European Journal of Applied Microbiology and Biotechnology*, 12: 58- 62.

Food and Agriculture Organization(FAO), 2023.(www.fao.org)

Kakraliya, S. S., Gupta, S., Choudhary, S., Diskit, S., Paswal, S., Pandit, D. and Khushboo, S. S. (2022). Evaluation of some botanical extract in controlling dry bubble (*Verticillium fungicola*) disease of button mushroom (*Agaricus bisporus*) under the conditions of sub tropics of Jammu. *The Pharma Innovation Journal*, 11(1): 1456-1459.

Kakraliya, S. S. and Paswal, S. (2024). Sustainable management of wet bubble disease (*Mycogone Perniciosa*) in button mushroom (*Agaricus Bisporus*) using botanicals agents under temperate conditions. *Indian Journal of Ecology*, 51(1): 225-230.

Kapoor, J. N. (2004). Mushroom cultivation. Department of Mycology and Plant Pathology,

IARI, New Delhi. PP: 14-6.

Kaur, A.P. and Rampal, V.K. (2017). Assessment of casing mixtures on yield potential and quality of button mushroom (*Agaricus bisporus*) – on farm trial. *International Journal of Current Microbiology and Applied Sciences*, 6(2): 430-436.

Kumar, P., Singh, G., Singh, R., Khilari, K., Singh, D. V. and Prakash, S. (2023). Evaluation of different spices and medicinal plant leaf powder on production potential of milky mushroom (*Calocybe indica*). *The Pharma Innovation Journal*, 12 (9): 128 – 133.

Mousumi, M. A., Pervez, Z., Alam, M. S. and Shahidul, M. (2017). *In vitro* Evaluation of the performance of different plant extracts against the growth of mycoflora associated with the substrate of oyster mushroom. *Journal of Agriculture and Veterinary Science*, 10(1) : 33-36.

Pervez, Z., Islam, M. S. and Islam, S. M. A. (2012). Evaluation of some plant extracts in controlling green mold (*Trichoderma harzianum*) associated with substrate of oyster mushroom. *Bangladesh Research Publications Journal*, 7(3): 194- 200.

Rahman, S., Islam, R., Kamruzzaman, M., Alam, K. and Jamal, A. H. M. (2011). *Ocimum sanctum* : A review of phytochemical and pharmacological profile. *American Journal of Drug Discovery and Development*, (1): 1-15.

Sinden, J. W., and Hauser, E. (1950). The short method of composting. *Mushroom Science*, 1: 52-9.

Singh, S., Lal, A. A., Singh, A., Yaduman, R. and Murmu, R. (2017). Evaluation of some plantextracts in management of dry bubble (*Verticillium fungicola*) disease of white button mushroom[*Agaricus bisporus* (Lange) Imbach]. *Journal of Applied and Natural Sciences*, 8(3): 1205- 1209.