# *Original Research Article*

## Evaluation of Different Non-Conventional methods of Cultivation on yield and biological efficiency of Paddy straw mushroom (*Volvariella volvaceae*).

**Abstract:** A study was conducted to determine the impact of Different Non- Conventional methods of Cultivation on yield and biological efficiency of *Volvariella volvaceae*. Among the different methods viz., bed method, partial compost method (3 days), partial compost method (6 days), partial compost method (9 days), intact straw + partial compost, Chopped paddy straw in polythene bags, Rolled paddy straw in polythene bag were experimented on yield and biological efficiency. However, the bed method of cultivation proved its well suitability among all the methods tested and gave highest yield and biological efficiency (1920 g and 15.0%) followed by partial compost method (3 days), single layer of straw + partial compost, partial compost (6 days) which exhibited (1025 g and 10.25%), (840 g and 8.40%) and (720 g and 7.20%) respectively. Maximum average weight of sporophore (24.6 g) was observed from bed method of cultivation which was significantly superior amongst all the methods evaluated followed by partial compost (3 days), single layer of straw + partial compost, partial compost (9 days) at 18.30 g, 16.15g and 15.5 g respectively. Smaller sizes of sporophores were noticed on partial compost (6 days) at average weight of 15 g. Average weight of sporophores noticed in chopped paddy straw and rolled paddy in polythene bag method were 12.2 g and 10 g respectively. Considering the major drawback of *Volvariella* that it has very low biological efficiency, bag method of cultivation was aimed to increase the biological efficiency of paddy straw mushroom.

**Key words**: Paddy straw mushroom, Partial compost, Sporophores, Yield, Biological efficiency.



## INTRODUCTION

Mushrooms are the fleshy reproductive structures of fungi, characterized by their ability to produce and disperse spores. These fruiting bodies are commonly found above ground, either on soil or on the organic matter that serves as their nutrient source. Fungi exhibit distinct characteristics in their nutrient acquisition methods, setting them apart from both plants and animals. Mushrooms are highly regarded due to their desirable taste, flavour, and medicinal attributes and are known to possess high-quality proteins, unsaturated fatty acids, essential minerals, and a variety of vitamins. Mushrooms exhibit low levels of fat, carbohydrates, and salts, while being abundant in dietary fibre. Mushrooms possess the capacity to facilitate the conversion of intricate structures into simpler forms through the synthesis of diverse enzymes. These enzymes enable the degradation of agricultural residues such as cereal straws, coconut wastes, millet straws, sawdust, and coffee wastes, as well as the decomposition of forest and industrial byproducts. A significant amount of renewable lignocellulosic waste is produced annually as a result of agricultural practices. The utilization of mushroom cultivation as a means to convert nutritionally deficient waste materials into a valuable source of nourishment presents a promising opportunity for the bioconversion of lignocellulosic wastes. This approach holds potential for economic viability. There exists a wide range of substrates that have been utilized

for mushroom cultivation purposes. Among these, the predominant substrate employed for mushroom production in rice-producing countries is paddy straw, while cotton wastes are commonly utilized in industrial areas. In West Bengal it can be adopted for year round cultivation as it requires high temperature and due to the easy availability of basic substrate (Paddy straw). This mushroom can be successfully cultivated on several crop residues like Paddy straw, Cotton wastes, Wheat straw and industrial wastes. The Government has taken up many initiatives for popularizing the mushroom cultivation but, the production of mushroom is very low in comparison to other states. According to Biswas (2014), the cultivation of mushrooms serves as a viable means of generating additional income for impoverished farmers, thereby enhancing their overall standard of living. Additionally, this practice offers a valuable solution to address malnutrition concerns by providing a source of high-quality protein to supplement their daily diets. The cultivation of straw mushrooms in India was initially undertaken by Su and Seth in 1940. However, it was Thomas et al. who successfully demonstrated the scientific cultivation of straw mushrooms using spawn in 1943. Referred to as the Chinese mushroom, this particular mushroom variety is highly regarded in South Asian nations due to its exceptional taste, abundant protein, amino acid, vitamin, and mineral composition (Thakur and Vijay, 2006). Despite the commercialization of paddy straw mushroom, there is a lack of sufficient knowledge regarding mushroom biology and the appropriate production procedures, including the management of competitor moulds, diseases, and insect pests. The existing body of literatures pertaining to these aspects remains insufficient. In light of these considerations, the current study sought to assess the impact of different methods of cultivation on the growth parameters and harvests of the Paddy straw mushroom.

## MATERIALS AND METHODS

The present investigation was carried out at the mushroom farm of Visva-Bharati, Department of Plant Protection, PSB, Bolpur, Birbhum, and West Bengal. The test fungi were obtained from Centre of Tropical Mushroom Research and Training, Orissa University of Agriculture and Technology, Bhubaneswar and were maintained for further study on Potato Dextrose Agar (PDA) medium. Selected healthy grains for spawn preparation were boiled and it was spread on a thin polythene sheet to remove excess water. To maintain proper pH Calcium carbonate of 2% dry weight of grains were mixed and 200 grams of grains were transferred to 25cm $\times$ 15 $cm$ polypropylene bags and plugged it with non absorbent cotton. The cotton plugged glass bottles are sterilized at 22psi for 2 hours then allowed to cool for overnight and transferred to inoculation chamber. Under sterilized laminar flow chamber over flame of spirit lamp a small quantity of stock culture were transferred to polythene bags of size 25cm × 15cm. Inoculated bags were kept at 28 $\pm$ 1℃. After complete mycelial growth of bags it is ready to transfer on bed substrate.

**Conventional method:**

In bed method of cultivation, to arrange the beds, four bundles were positioned adjacent to each other, followed by another four bundles placed in a similar manner but from the opposite side. This arrangement ensured that the open ends of the bundles overlapped in the middle, resulting in the formation of a single layer consisting of eight bundles. The second, third, and fourth layers were constructed in a manner consistent with the number of layers specified for each treatment. Intermittent spawning was conducted at a rate of 2% on a dry weight basis, with the spawning occurring between the first, second, third, and fourth layers. The spawning was performed with a margin of 12cm – 15cm from the edges. The beds were compressed from above and

subsequently enveloped with a pristine, see-through plastic sheet in order to uphold a consistent level of humidity (ranging from 80% to 85%) and temperature (ranging from 30 to 35℃). Following a period of 7 to 8 days subsequent to spawning, the plastic sheets were extracted, while maintaining a temperature range of 28 to 32℃ and a relative humidity of approximately 80%. Mushrooms started appearing after 4 – 5 days of sheet removal and the beds were kept for next 20 days for cropping. When necessary, the bags were sprayed with tap water once or twice per day to maintain a relative humidity between 80 and 85 percent.

**Non conventional method:**

Partial compost method, bag method of cultivation was followed during this experiment. In polythene bag method ( Rolled straw and chopped straw) of cultivation 500 g dry substrates / bag were spawned and were filled in the perforated polypropylene bags of size 16 × 18 inch. The substrates were chopped into 1.5" – 2" size and treated chemically by soaking into 75 ppm /Bavistin and 500 ppm formalin for 16-18 hours. After soaking the substrates were spread over a clean inclined plain for draining off excess water and when the moisture content was about 70-80% spawning was done. In rolled straw method the substrate was sterilized as mentioned for chopped method and paddy straw was rolled inside bag and spawning was done 2% of dry weight of substrate.

In partial compost preparation, the area was disinfected with 2% formalin solution to kill the unwanted organisms. Water is sprinkled over the straw and frequently turned till it attains 75% moisture. Excessive wetting of straw was avoided. A heap was made. On 3$^{rd}$, 6$^{th}$ and 9$^{th}$ day of composting the compost was taken for bed preparation. A thin layer of intact straw was spread in bottom and partial compost was spread over the intact straw upto height of 2 inches and then spawning was done by leaving the margin of 12 to 15 cm from edges.

The Biological Efficiency (B.E.) was computed using Chang's (1981) standard formula.

$$\text{B. E}(\%) = \frac{\text{Fresh weight of mushroom}}{\text{Air} - \text{dried substrate}} \times 100$$

**RESULTS AND DISCUSSION**

To find out the suitable technique for cultivation of paddy straw mushroom seven methods i.e. bed method, partial compost method (3 days), partial compost method (6 days), partial compost method (9 days), Intact straw + partial compost, Chopped paddy straw in polythene bags, Rolled paddy straw in polythene bag were evaluated during the cropping season and the data obtained on different parameters are given in the table 1.

It was evident from the table- 1, that the methods tested for cultivation of paddy straw mushroom showed different responses in terms of yield, biological efficiency and spawn run period. All the methods produced fair quantity of yield of paddy straw mushroom in the locality. However, bed method of cultivation proved its well suitability among all the methods tested and gave highest yield and biological efficiency (1920 g and 15.0%) followed by partial compost method (3 days), single layer of straw + partial compost, partial compost (6 days) which exhibited (1025 g and 10.25%), (840 g and 8.40%) and (720 g and 7.20%) respectively. Partial compost (9 days) gave minimum yield and biological efficiency (682g and 6.2%) Fig (1). In bag method of cultivation chopped paddy straw gave highest yield and biological efficiency (449 g and 11%) when compared to rolled paddy straw which yielded and biological efficiency of (320 g and 8%). Spawn run period was found minimum (9.25 days) in bed method of cultivation followed by partial compost (3 days), single layer of straw + partial compost and partial compost (6 days) which took 15, 16 and 17 days respectively. Maximum time (20 days) was taken by partial

compost (9 days). Spawn running period of chopped straw and rolled straw filed in polythene bags was 13 and 14.5 days respectively.

The effect of various methods of cultivation on the average number and weight of sporophores also recorded. Maximum average weight of sporophore (24.6 g) was observed from bed method of cultivation which was significantly superior amongst all the methods evaluated followed by partial compost (3 days), single layer of straw + partial compost, partial compost (9 days) at 18.30 g, 16.15g and 15.5 g respectively. Smaller sizes of sporophores were noticed on partial compost (6 days) at average weight of 15 g. (Fig 2). Average weight of sporophores noticed in chopped paddy straw and rolled paddy in polythene bag method were 12.2 g and 10 g respectively.

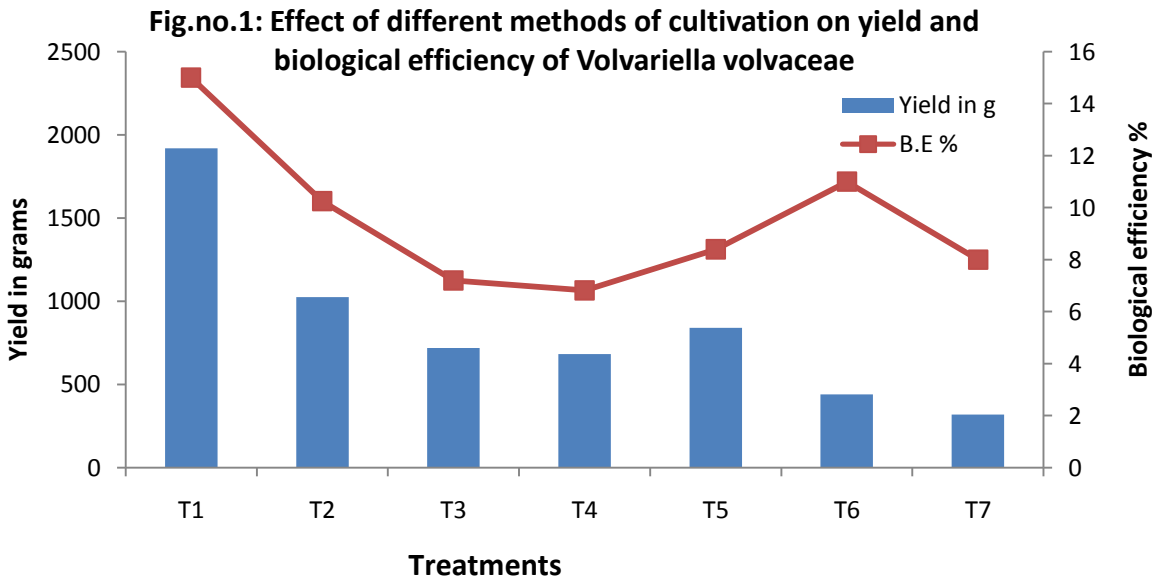
Considering the major drawback of *Volvariella* that it has very low biological efficiency, bag method of cultivation was aimed to increase the biological efficiency of paddy straw mushroom. In present investigation highest yield and biological efficiency was obtained from bed method which further confirms the results of Biswas and Layak (2014). Cylindrical poly bag method for cultivation of paddy straw was initiated by Sudha *et al*. (2017) and obtained good yield and biological efficiency. The findings of various polythene bag methods undertaken were corroborated with the above reports. *Sclerotium rolfsii* a disease causing pathogen found in partial compost beds which lead to low yield and biological efficiency. *Sclerotium rolfsii* inhibits the spawn run (mycelial proliferation) of the mushrooms and their fruiting bodies. Pasteurization and conditioning of substrates have been used as preventive measures to overcome *Sclerotium rolfsii*. *Sclerotium rolfsii* as the main contaminant of paddy straw mushroom beds raised out of non-pasteurized straw (Pani and patra 1997).

Table.1Evaluation of different methods of cultivation for higher biological efficiency of Paddy straw mushroom.

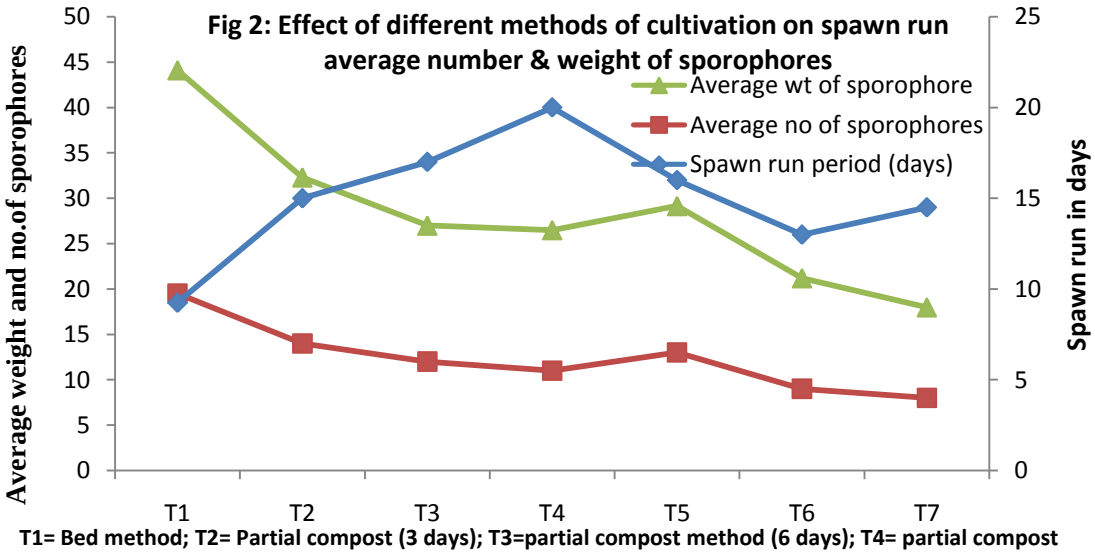
| Method of cultivation | Quantity of substrate(Kg) /replication | Spawn run (in days)* | Average number of sporophores* | Average weight of sporophores (g)* | Total bed yield (g)* | Average bed yield (g)* | Biological efficiency (%) |
|---|---|---|---|---|---|---|---|
| Bed method (4 layers) | 12.8 | 9.25 | 19.50 | 24.6 | 1920 | 480.00 | ***15.0*** |
| Partial compost (3 days) | 10 | 15 | 14.0 | 18.30 | 1025 | 256.25 | ***10.25*** |
| Partial compost (6 days) | 10 | 17 | 12.0 | 15.0 | 720 | 180.00 | ***7.20*** |
| Partial compost (9days) | 10 | 20 | 11.0 | 15.5 | 682 | 170.5 | ***6.82*** |
| Single layer of straw+ Partial compost | 5+5 | 16 | 13.0 | 16.15 | 840 | 210.00 | ***8.40*** |
| Chopped paddy straw in polythene bags | 4kg | 13 | 9 | 12.2 | 440 | 110.00 | ***11.00*** |
| Rolled paddy straw in polythene bags | 4kg | 14.5 | 8 | 10.0 | 320 | 80.0 | ***8.00*** |
| **SE m(±)** | | **0.63** | **1.61** | **1.14** | | **18.67** | |
| **CD@** | | **1.86** | **4.73** | **3.36** | | **54.90** | |

| | | | | |
|---|---|---|---|---|
| **CV%** | **8.47** | **26.01** | **14.5** | **19.03** |

*Average of three replications




**T1= Bed method; T2= Partial compost (3 days); T3=partial compost method (6 days); T4= partial compost method (9 days); T5= Intact straw + partial compost (3 days) ;T6 Chopped paddy straw in polythene bags; T7= Rolled paddy straw in polythene bag**




**T1= Bed method; T2= Partial compost (3 days); T3=partial compost method (6 days); T4= partial compost**

**Graphical representations on effect of different methods of cultivation.**

## CONCLUSION

To find out a suitable technique for cultivation of paddy straw mushroom seven methods i.e. bed method, partial compost method (3 days), partial compost method (6 days), partial compost method (9 days), Intact straw + partial compost, Chopped paddy straw in polythene bags, Rolled paddy straw in polythene bag method were evaluated. Bed method of cultivation gave highest yield and biological efficiency (1920 g and 15.0%) followed by partial compost method (3 days), single layer of straw + partial compost, partial compost (6 days) which exhibited (1025 g and 10.25%), (840 g and 8.40%) and (720 g and 7.20%) respectively. Partial compost (9 days) gave minimum yield and biological efficiency (682g and 6.2%). In bag method of cultivation chopped paddy straw gave highest yield and biological efficiency (449 g and 11%) when compared with rolled paddy straw in bag method which yielded and biological efficiency of (320 g and 8%). *Sclerotium rolfsii* were found in partial compost beds (9 days) which leads to low yield and biological efficiency. Spawn run period was found minimum (9.25 days) in bed method of cultivation followed by partial compost (3 days).

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