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INTRODUCTION OF TOWER SYSTEM FOR THE CULTIVATION OF MUSHROOMS (*PLEUROTUS* SPP.)

TASNIM KAUSAR AND S.I. ZAFAR
PCSIR Laboratories Complex, Shahrah-e-Jalaluddin Roomi, Lahore-54600, Pakistan

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Scaling up of the mushroom cultivation from 1.5 kg rice straw/tray to 18 kg/tower (120 cm long, 70 cm diameter) and double layer spawning method improved the yield of the crop by 4 - 5%. Tower system has two fold advantages as no wood is required for making the trays and shelves, thus reducing the cost. Secondly, the yield was more (5 %) than tray system as the system provides a long verticle sides all around the bed for fruitification.

Key words: Tower system, *Pleurotus* spp., Cultivation.

Introduction

In the past, edible mushroom collected from pastures were dried, stored and marketed. The boom in mushroom consumption all over the world during the past 30 years has converted this one time luxury vegetable into an important and popular part of every day food. As a source of protein, the mushroom is richer than many other plant sources [1-3]. Mushroom can be compared more favourably with other crops in terms of yeild per unit area, cereals for instance, give an annual yield 3000 kg/hectare but mushrooms may give upto 2 million kg/ha. The produce of an acre of land can be transformed into ten times as much fungus protein as meat protein [4].

In Pakistan people are only familiar with wild mushrooms growing during Monsoons in the plains of Punjab, Sindh, NWFP and Azad Kashmir. No attention as yet has been paid to cultivate mushroom on industrial scale, though Pakistan has a high potential of agricultural wastes, i.e. 36 million metric tonnes annually [5]. Channeling of these wastes into efficient and productive system is a dire need of the time. It is estimated that if half of the quantity of wheat and paddy straws available in Pakistan, is used as bedding material for cultivation of oyster mushroom, it will convert these wastes into 2.13 million metric tonnes mushrooms which can bring a valuable exchange of 10,500 million dollars annually [6].

Kausar *et al.* [7-9] have reported the effect of temperature, quality and quantity of substrate and effect of nitrogen sources on the yield of *Pleurotus sajor-caju* rice straw as substrate.

The present studies were undertaken to scale up oyster mushroom cultivation and to see the effect of different spawning methods on the yield of mushrooms. The bed for the mushroom cultivation was also designed and prepared in a specific way so as to enhance the yield which ultimately will step up the mushroom cultivation technology in our country.

Materials and Methods

Maintenance of culture, preparation of inoculum and spawn of *Pleurotus* spp., i.e. *P. sajor-caju* and *P. ostreatus* was reported earlier [10].

Preparation of bed.. Bed was prepared on an ordinary mulberry basket in the centre of which a bamboo was fixed. The bamboo was hollow from inside and holes of 15 mm dia. were made at a distance of 10 cm. These holes helped in exchange of gases. 18 kg of hot and pasteurized substrate (rice straw) was packed in the shape of a tower measuring 120 cm long and 70 cm diameter (Fig. 1). A polyethylene sheet was wrapped around th tower and allowed to cool overnight.

Spawning. After unwrapping the bed after 24 hrs, 5% spawn of *Pleurotus* spp. (w/w basis) was spreaded. The substrate was spawned in the tower by following methods.

(a). *Surface spawning.* The spawn was spread evenly on the surface of chopped rice straw.

(b). *Double layer spawning.* The substrate was spawned by punching 10 cm deep at a distance of 15 cm, followed by spreading the remaining 2nd/3rd spawn on the surface.

(c). *Spot spawning.* The spawn was placed in lump 15x15 cm apart on the surface of the substrate.

Fruitification and harvesting. The bed was uncovered after 21 days when it had turned white due to the growth of mycelium. After completion of spawn running, the temperature of the spawning room was brought down to 20 ± 1°C in winter and 25 ± 1°C in summer, for fruitification. In a week, pinheads appeared which turned into full oyster shaped fruit bodies later on. The full sized mushroom were cut by a sharp knife. Two more crops were obtained at the intervals of 8-10 days.

Results and Discussion

Oyster mushrooms, i.e. *P. sajor-caju* and *P. ostreatus* were grown on 18 kg rice straw packed cylindrical tower (length 120 cm, dia. 70 cm) with a central aeration arrangement from bottom to top (Fig. 1). The effect of different spawning methods, i.e. surface spawning, double layer spawning and spot spawning (5% w/w basis), on the yield is shown in Table 1. The average yeild of *P. sajor-caju* and *P. ostreatus* varied from 55.85 to 76.50% and 57.17 to 73.39% respectively, maximum being in double layer spawning method and minimum in spot spawning method. It was also observed that spot spawning showed development of other saprophytic moulds such as *Psathyrella* spp., *Aspergillus* spp. and *Rhizopus stolonifer*. The statistical analysis showed significant difference ($P \leq 0.05$) between methods of spawning (Table 2-3).

A comparison of mean values by DMR test revealed that double layer spawning method was siginificantly different ($P \leq 0.05$) from spot spawning method but showed non-significant difference with surface spawning method (Table 4-5).

The lower yields by spot spawning (55.88 to 57.17%) and surface spawning method (66.61 to 69.71%) in case of *P. sajor-caju* and *P. ostreatus* seemed mainly because of lesser mycelial ramification in the depth of substrate layers. Shandilya *et al.* [11] and Singh [12] also made similar observations in *Agaricus bisporus* and *P. sajor-caju* while studying different spawning techniques.

The change in the design of bed while scalling up the cultivation from tray to tower improved the yield of *P. sajor-caju* and *P. ostreatus* from 72.30 to 76.50% and 68.20 to 73.39% respectively. The reason being that the tower because of large surface area contained lesser amount of straw per unit area (0.04 g/cm^3) as compared to tray (0.08 g/cm^3). Moreover, good aeration of the substrate from bottom to top of the tower not only supplied required amount of oxygen for mushroom growth but also facilitated the removal of gases produced during fermentation.

TABLE 1. EFFECT OF METHOD OF SPAWNING ON YIELD OF *P. SAJOR- CAJU* AND *P. OSTREATUS*.

Spawning method	*P. sajor-caju*		*P. ostreatus*	
	A	B	A	B
Surface spawning	12.56	69.77	11.99	66.61
Double layer spawning	13.77	76.50	13.21	73.39
Spot spawning	10.06	55.85	10.29	57.17

A = Average yield (four replicates) in kg of fresh fruit bodies per 18 kg substrate. B = Average yield (in %) - fresh fruit bodies/dry straw.

TABLE 2. ANALYSIS OF VARIANCE OF METHODS OF SPAWNING ON THE YIELD OF *P. SAJOR-CAJU*.

Source of variance (S.O.V)	Degree of freedom (D.O.F)	Sum of squares (S.O.S)	Mean of squares (M.S)	F.ratio
Between spawning methods	2	28.63	14.31	3.87*
Error	98	29.54	3.69	-
Total	11	58.17	18.00	-

* Significant at 5% level

TABLE 3. ANALYSIS OF VARIANCE OF METHODS OF SPAWNING ON THE YIELD OF *P. OSTREATUS*.

Source of variance (S.O.V)	Degree of freedom (D.O.F)	Sum of squares (S.O.S)	Mean of squares (M.S)	F.ratio
Method of spawning	2	17.27	8.63	6.34*
Error	9	12.32	1.36	-
Total	11	29.59	9.99	-

* Significant at 5% level

TABLE 4. DUNCAN'S MULTIPLE RANGE TEST OF METHODS OF SPAWNING ON THE YEILD OF *P. SAJOR-CAJU*

Methods of spawning	Mean(x)	13.77 - x	12.56 - x	10.06 - x
Spot spawning	10.06	3.71*	2.5*	_
Surface spawning	12.56	1.21^{NS}	_	_
Double layer spawning	13.77	_		

*Significant at 5% level, NS = Non significant.

TABLE 5. DUNCAN'S MULTIPLE RANGE TEST OF METHODS OF SPAWNING ON THE YEILD OF *P. OSTREATUS*

Methods of spawning	Mean(x)	13.21 - x	11.99 - x	10.29 - x
Spot spawning	10.29	2.92*	1.7*	_
Surface spawning	11.99	1.22^{NS}	_	_
Double layer spawning	13.21	_		

*Significant at 5% level, NS = Non significant

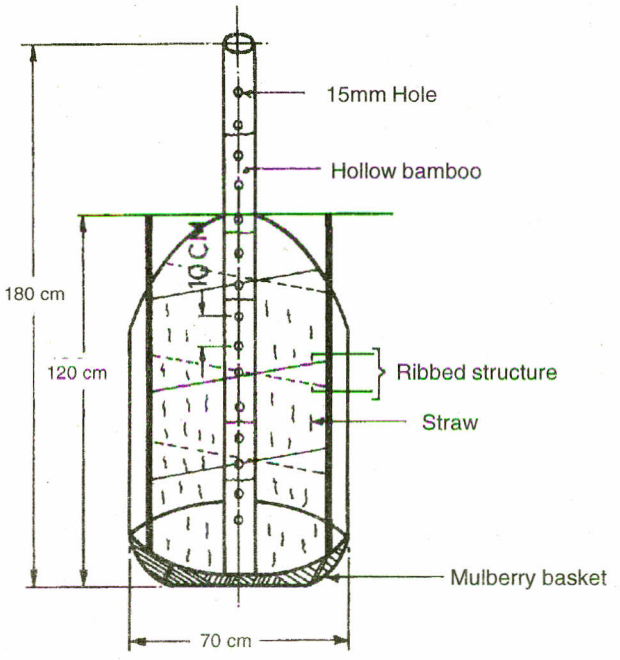

Fig. 1. Frontal view of tower for cultivation of mushrooms

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