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Effect of different agricultural wastes on the yield of oyster mushroom (*Pleurotus florida*) cultivation

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Abstract
Oyster mushroom can be grown on cellulose rich material but are more sensitive to lignified substrates. Six different locally available plant wastes *viz.*, banana leaves, casurina needle, coir pith, sugarcane trash, water hyacinth and paddy straw were tried as substrates for the cultivation of *Pleurotus florida.* The highest per cent biological efficiency was recorded on paddy straw (74. 2 %) followed by banana leaves (70. 5 %), water hyacinth (66. 5 %), sugarcane trash (62.8 %) and in rest of the substrates B.E was less than 60 per cent. The polybag beds provided with ten holes at random recorded minimum spawn run days, minimum days for pin head formation, maximum sporophore yield and biological efficiency. A local method *viz*., hanging rope system was highly economical and recorded highest yield with very less investment compared to rack system.

Keywords: *Pleurotus florida,* Agricultural waste

Introduction
Currently, millions of tonnes of agro wastes like coir pith, sugarcane trash, other cereal trash to name a few are generated every year in India. Significant quantities of these are either burnt, causing environmental pollution or left in field to be accumulated for long time to undergo very slow degradation (Shivabasu 2017) [8] It is estimated that about 355 million tonnes of crop residue is generated annually and about 170 million is left out for burning and incorporating into soil in manure form (Tewari and Pandey, 2002) [5]. Even if one per cent of this lignocellulosic agro wastes are diverted to production of mushrooms, India will become a major mushroom producing country in the world.
In the recent times, the cultivation of *Pleurotus sp*. had excelled next to *Agaricus bisporus*. *Pleurotus* is an efficient lignin, cellulose and hemicelluloses degrading mushroom and can grow well on different types of lignocellulolosic materials. Growing oyster mushrooms on cereal straw wastes results in production of nutrient rich food and helps in an efficient management of straw. Present paper opts to find out the suitable locally available substrate for cultivation of *P. florida.*

Materials and Methods
Methods of cultivation of *P. florida*
All the substrates were pasteurized by soaking in water mixed with 75 ppm carbendazim and 500 ppm Formalin for 15-18 h. Three replications were maintained for each treatment and the beds were incubated at 28 ± 2°C for spawn running and cropping. A relative humidity of around 80 to 90 per cent was maintained in the growing rooms.

Polybag method
Transparent polythene bags of 60 × 30 cm size with a thickness of 100 gauge and cylindrical beds were prepared using 0.5 kg of paddy straw on dry weight basis following layer spawning method as described by Sivaprakasm (1980) [4] with below mentioned modification. The un chopped whole straw was made into coils and used. A layer of coiled paddy straw was placed at the bottom of polythene bag, over this a few g of spawn was sprinkled. In this manner five layers of coiled paddy straw and four layers of spawn were kept in the polythene bag and then bag was tied at the top (modified cylindrical bed method). The mushroom beds were hung from the ceiling by means of ropes (‘uri ‘method) instead of the usual method of keeping them in tiers made a bamboo or *Casurina* stacks. Ten holes of one cm diameter were made at random in the polythene bags. The beds were kept in cropping room, were the temperature was maintained at 23 to 28°C and relative humidity at 80 to 90 per cent. Water was sprinkled

regularly as in the standard cylindrical bed preparation method. The following yield parameters were studied in all the experiments.

Effect of no. of holes on the polybags on the yield of *P. florida*

The beds were prepared as in polybag method and varying no. of holes *viz*., 2, 4, 6, 8, 10 and 12 were punched in the polybag beds to assess their effect on the yield of *P. florida*.

Results and Discussion

Results presented in Table 1 showed that paddy straw require minimum of 18.59 days for spawn run followed by other substrate like, banana leaf, water hyacinth, Sugarcane trash which required (20.10 – 23.00 days). The time taken for pin head initiation were also found to be minimum in case of paddy straw (24.82 days) followed by, Water hyacinth, banana leaf and maximum was in case of Coir pith. Paddy straw was found significantly superior than other substrate giving74.2 % B.E. banana leaf (70.5 %) was the second best substrate followed by Water hyacinth (66.5 %). Coir pith gave very poor yield recording (38.00 %). Superiority of paddy straw was reported earlier by several workers (Geetha and Sivaprakasam, 1994; Singh *et al*., 1995; Dubey, 1999) [6, 7]. They also reported that paddy straw produced the highest number of sporophore of *Pleurotus* spp.

The variations in the growth and yield parameters of the different mushrooms may be due to the biological structure of the substrate (Mahbuba, 2010) [3]. The enhanced yield observed in paddy straw substrates could be due to the presence of favourable nutrients that are better utilized by the fungus. *Pleurotus* spp. has the capacity to degrade cellulose, hemicelluloses and lignin and to produce fruiting bodies. The poor growth and yield observed with coir pith and saw dust substrate could be attributed to the rich lignin content in them and poor ability of *P. florida* to degrade lignin like substances.

Table 1: Effect of bed substrate on the growth and sporophore yield of *P. florida*

Tr. No.	Substrates	Spawn run (days)	Pinhead formation (days)	Total duration	No of sporophore bed^{-1}	Total yield (g bed^{-1})	Biological efficiency (%)
1	Banana leaves	20.10^{b}	25.37^{b}	55.42^{b}	103.10^{b}	0.705^{b}	70.5
2	Coirpith	30.42^{f}	37.12^{f}	69.45^{f}	67.02^{f}	0.38^{f}	38
3	Casurina needle	25.60^{e}	32.16^{d}	65.14^{e}	81.70^{e}	0.56^{e}	56
4	Sugarcane trash	23.00^{d}	29.00^{d}	61.40^{d}	89.35^{d}	0.628^{d}	62.8
5	Water hyacinth	21.50^{c}	26.42^{c}	58.20^{c}	96.52^{c}	0.665^{c}	66.5
6	Paddy straw	18.59^{a}	24.82^{a}	52.15^{a}	110.37^{a}	0.742^{a}	74.2

Values not sharing a common superscript differ significantly at P < 0.05 (DMRT)

Effect of number of holes in the polybags on the yield of *P. florida*

The data depicted in table 2 revealed that provision of holes in the polythene bags showed positive effects in enhancing the yield parameters when compared to control. Among the treatments, the poly bags provided with ten holes at random recorded the minimum spawn run days, minimum days for pin head formation, day of the first harvest and the maximum yield of mushrooms and biological efficiency (18.10 days, 22.25 days, 26.10 days, 0.74 g bed^{-1} and 74 %, respectively).

Kaul (1987) [2] emphasized the requirement of optimum levels of CO_2 for the initiation of fruiting bodies. An increase in the holes beyond ten would have resulted in the beds failing to maintain adequate temp. and loss of moisture levels, due to excess evaporation thereby exposing the fungus to moisture stress which recorded a reduction in the sporophore yield parameters. Beds with less number of holes generally recorded poor growth. This might be due to lack of aeration and excessive accumulation of CO_2 (Eswaran *et al*., 1998) [1]. Thus, it can be concluded that, provision of adequate number of holes in the polythene bags is a must to maintain optimum aeration, moisture and temp. Levels to facilitate enhancement in the sporophore yield.

Table 2: Effect of number of holes on the polybags on the sporophore yield of *P. florida*

Tr. No	Number of holes on polybags	Spawn run (days)	Pinhead formation (days)	Days for 1st harvest	Yield (g bed^{-1})	Biological efficiency (%)
1	0	25.20^{e}	20.86^{f}	35.90^{f}	0.38^{g}	38
2	2	25.52^{e}	28.48^{e}	33.52^{e}	0.44^{f}	44
3	4	23.70^{d}	26.95^{d}	30.82^{d}	0.59^{e}	59
4	6	22.75^{c}	26.90^{d}	30.80^{d}	0.67^{c}	67
5	8	20.20^{b}	25.40^{c}	29.85^{c}	0.68^{c}	68
6	10	18.10^{a}	22.25^{a}	26.10^{a}	0. 74^{a}	74
7	12	18.20^{a}	23.80^{b}	27.71^{b}	0.71^{b}	71

Values not sharing a common superscript differ significantly at P < 0.05 (DMRT)

Table 3: Methods of storage of beds in mushroom shed (20 x60^{1})

Tr. No.	Particulars	Hanging rope system	Rack system	% increase / decrease over rack system
1	No of beds accommodated	1200 beds	1000 beds	20.00^{+}
2	Cost involved	Rs.5000	Rs.25000	80^{-}
3	Yield (Total)	1000Kg	800 kg	25.00^{+}
4	Total income 60 days	1,00,000	80,000	25.00^{+}

+ = Increased; - = decreased

Method of storage of beds in mushroom shed (20x60[1])

A local method *viz.,* hanging rope system was followed and compared with existing method *viz.,* rack system. In mushroom shed size (20x60[1]) by hanging rope system 1200 beds were accommodated, where as in rack system 1000 beds could be accommodated. Cost involved for hanging rope system was only Rs. 5000 and in rack system the cost would be Rs. 25000. The total income for 60 days in hanging rope system was about 1,00,000 and only 80,000 in rack system. In hanging rope system about 20 per cent extra beds could be accommodated compared to rack system. The movement of rat is restricted in hanging rope system

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