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Evaluation of various organic substrate for maximization of biological efficiency of *Pleurotus* species

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Abstract
Mushrooms are the saprophytic species that can flourish by solubilizing the complex cellulosic elements of substrate. Different ligno-cellulosic agricultural wastes can be utilize at commercial level and according to availability, for mushroom production and maximization of biological efficiency. Use of agricultural by-product for cultivation of mushroom is most feasible and efficient conversion of ligno-cellulosic substrate into edible form thus solves the problem of pollution and burning of agri-wastes

Keywords: Cellulosic elements, mushroom, solubilizing

Introduction
Mushrooms are acholorophyllous macroscopic organism usually saprophytic in nature derives its nutrition from ligno-cellulosic molecules present in the substrate. Oyster mushroom (*Pleurotus* species) belongs Tricholomataceae and is usually found clustering naturally on dead trees at spring season (Lee, 1993). Among all species of mushroom, the oyster mushroom is the second widely cultivated mushroom worldwide following the *Agaricus bisporus* (Kües and Liu, 2000). *Pleurotus* spp. are popular and widely cultivated throughout the world mostly in Asia, America and Europe because of their simple, low cost production technology and high biological efficiency (Mane *et al*., 2007). Different agro-wastes can be used for *Pleurotus* species cultivation, it wasfound that rice husk, sorghum stover, saw dust, cottonwaste, cocoa bean shell, and saw dust such as Gliricidiamixture were suitable substrates for the cultivation ofedible mushroom (Belewu, 2003). Various substrates have effects on the growth, yield and B.E. ofmushrooms (Ponmurugan to *et al*., 2007). The cultivation of edible mushroom offers one of the most feasible and economic method for the bioconversion of agro-lignocellulosic wastes Bano *et al.,* 1993; Cohen *et al.,* 2002). The technology can also limit air pollution associated with burning agriculture wastes as well as to decrease environmental pollution due to unutilized agricultural wastes.

Material and method
The pure culture of strains of *Pleurotus* species was obtained from All India Co-ordinated Mushroom Improvement Project (AICMIP), Department of Plant Pathology, Indira Gandhi Krishi Vishwavidalaya, Raipur, (C.G.). The pure culture obtained and stored at 4℃ for all kinds of study. All the substrates were obtained from the Instructional Farm, College of Agriculture, I.G.K.V., Raipur (C.G.).

Preparation of mother spawn
The mother spawn of *Pleurotus* sp. (strain- PL-16-04) was prepared on wheat grains. Clean, healthy and bold sized grains were taken as substrate for preparation of mother spawn. Grains were washed and soaked in water for overnight. On next day, water was decanted and grains were boiled for 10-15 minutes till they became soft while the seed coat remained intact. Thereafter, excess water was run off and evenly spread on muslin cloth for cooling. The cooled grains were mixed with calcium carbonate (0.5 percent) and calcium sulphate (2 per cent) on wet weight basis to avoid stickiness of grains and maintenance of pH. In empty glucose bottles, these processed grains were filled up to half capacity and plugged with non-absorbent cotton then sterilized in autoclave at 20 Ibs psi for 2 hours. After sterilization, bottles were cooled and inoculated with small bit of pure culture and incubated for 15 days at

25 ± 2℃ till the white mycelium covered all grain surfaces. The mother spawn was prepared in sufficient quantity and used when required.

Preparation of planting spawn

It was prepared in poly propylene bag (6" × 11" -150 gauges) wheat grains were processed and filled in bag in similar way as prepared mother spawn. Each bag contained 250 g. wheat grains then these bags were sterilized. After cooling bags were aseptically inoculated with 10-15 gm of mother spawn and incubated at 25 ± 2℃. the inoculated bags were incubated and frequently examined for any types of contamination and those exhibiting contaminations were immediately discard and those showing white, silky, uniform strand mycelial growth. Covering all the grains were used during experimentation.

Mushroom bed preparation

The wheat straw, paddy straw, sesamum straw and soybean straw (chopped) and their combination were used as substrate for growing of oyster mushroom (*Pleurotus* sp.). The substrates were dipped in water (which has already mixed with 75 ppm carbendazim and 500 ppm formaldehyde) for 14 hours as per the method described by Vijay and Sohi (1987). Thereafter, excess water was drained off and straw was spread over on sloppy, cemented floor till the moisture content of straw remained 65-70 percent. Before spawning, formaldehyde was sprinkled on floor and then the spawn was mixed in substrate through layering method @ 4 percent on wet weight basis. The spawned substrates were filled in poly propylene bags (12" × 18" -150 gauges) and mouth of the spawned bags were tied with the help of nylon string. For perforation, 8-10 holes were made in each bag with the help of nail to allow free passage of air within the bags.

A unit of 6 kg dry straw substrate was used for each treatment, which was equally divided in four bags per replication and number of replications were three. The spawned bags were kept in mushroom growing room, where appropriate temperature (20-25℃) and relative humidity (75-85 percent) were maintained by frequently sprinkling of water on walls and floor. After complete colonization of substrate by mushroom mycelium (spawn run), the bags were cut and poly propylene bags were removed. The compact mass of aggregated straw termed as 'bed' were ready for hanging to the iron racks.

Experimental details

Design	CRD (Completely Randomized Design)
Treatments	10
Wheat	Wheat+Soybean
Paddy	Wheat+Sesame
Sesame	Paddy+Soybean
Soybean	Paddy+Sesame
Wheat+Paddy	Soybean+Sesame
No. of replications	3
No. of bags/replications	4
Total no. of bags	120
Method of spawning	Layer method

Biological efficiency

The yield was expressed in biological efficiency and calculated using formula (Chang *et. al.,* 1981).

$$\text{Biological Efficiency (\%)} = \frac{\text{Fresh weight of mushroom}}{\text{Dry weight of substrate}} \times 100$$

Results and discussion

Pleurotus species can be cultivated on different agricultural waste having lingo-cellulosic property. Agricultural wastes like, wheat straw, paddy straw, maize straw, pigeon pea straw, etc. can be used to utilize to grow oyster mushroom. The performance of different substrate and their combination were studied on spawn run, yield and various yield attributing characters of PL-16-04 strain of *Pleurotus* spp. and results are presented in table.

Minimum days required for spawn run (14.4 days) by sesamum substrate, followed by substrate combination of wheat and sesamum straw (1:1) (14.6 days) and wheat straw (16 days). Maximum days required for spawn run (25.7 days) by soybean straw followed by substrate combination of paddy+sesamum straw (1:1) (22.0 days), wheat+soybean (20.4 days), paddy+sesamum straw (19.6 days), soybean+sesamum straw (1:1) (19.2 days) and paddy straw alone (19.2 days).

Different substrate significantly influenced the pin head initiation with respect to different substrate used. Significantly less (4.4 days) time for pin head initiation taken by sesamum straw followed by wheat (5.0 days), wheat+sesamum (5.0), wheat+paddy straw (5.4 days), paddy straw alone (5.6 days), and sesamum straw (5.8 days) were significantly at par with each other. While significantly more time required by soybean straw (7.9 days) and next were paddy+soybean (7.8 days) and whaet+soybean straw (7.0 days).

The highest number of sporophores per bags was also differ with different substrate used. Highest number of sporophores were obtained from paddy+sesamum straw (83.8) and lowest were found in soybean straw (74.0). Highest weight of fruiting boby was observed in paddy+soybean (9.50) whereas lowest was observed in wheat straw (7.71).

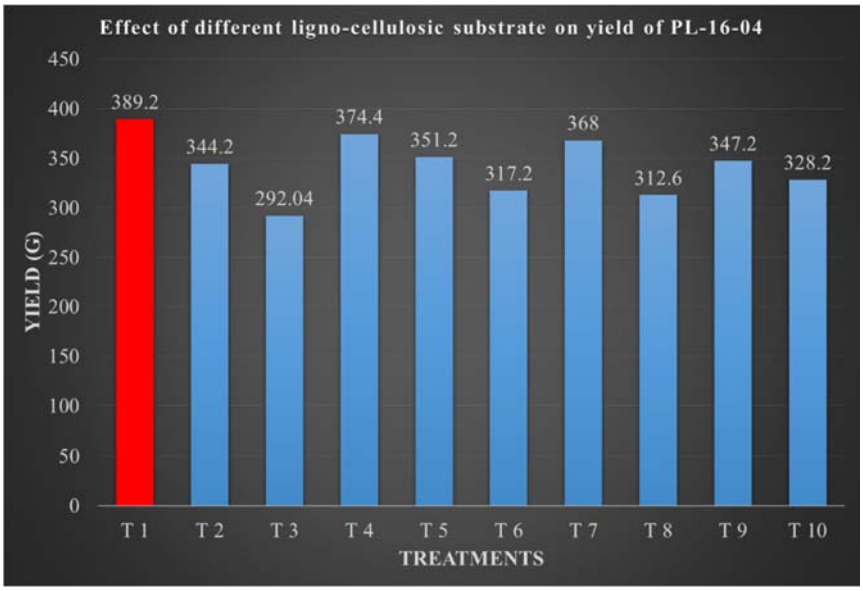
Similarly maximum diameter of fruiting body was observed on substrate combination of paddy+sesamum (1:1) (pileus 5.33 cm) followed by paddy straw (pileus 5.03 cm), whereas minimum size of fruiting body was observed on substrate combination of wheat+sesamum (1:1) (pileus 3.70 cm) followed by wheat straw and substrate combination of soybean+sesamum (1:1) (pileus 4.37cm) and (pileus 4.37cm), respectively. Whereas, maximum size of stipe was observed in paddy+sesamum (1:1) (2.27 cm) and minimum in wheat straw (1.56 cm). Maximum weight of sporophores was found in paddy+soybean (1:1) (9.50 g) and minimum in wheat straw (7.71 g).

Highest fresh yield was recorded from wheat straw (389.2 g) with B.E. (77.84%) followed by sesamum straw (374.40 g) with B.E. (74.88 %). On other hand lowest yield was found on soybean straw (292.04 g) with B.E. (58.40%) followed by substrate combination of paddy and soybean (1:1) (312.6 g) with B.E. (62.52%).

Table 1: Evaluation of different ligno-cellulosic agro-wastes and their combination on yield and yield attributing characters of PL-16-04 strain of *Pleurotus* species (strain-PL-16-04)

S.No.	Treatments	Spawn run (days)	Pin head initiation (days)	No. of basidiocarps per bag *	Sporophores size (cm)**		Sporophore weight (g)	Yield (g)	B.E. (%)
					Pileus	Stipe			
T 1	Wheat straw	16	5	78.2	4.37	1.56	7.71	389.2	77.84
T 2	Paddy straw	19.2	5.6	74.8	5.03	1.97	7.89	344.2	68.84
T 3	Soybean straw	25.7	7.9	74	4.95	2.12	9.23	292.04	58.408
T 4	Sesamum straw	14.4	4.4	81.4	4.69	1.89	8.11	374.4	74.88
T 5	Wheat + Paddy straw (1 : 1)	18.2	5.4	80.12	4.61	1.89	8.87	351.2	70.24
T 6	Wheat + Soybean straw (1 : 1)	20.4	7	77.8	4.29	2.2	8.77	317.2	63.44
T 7	Wheat + Sesamum straw (1 : 1)	14.6	5	75.6	3.7	2.08	9.42	368	73.6
T 8	Paddy + Soybean straw (1 : 1)	22	7.8	80.7	4.94	1.67	9.50	312.6	62.52
T 9	Paddy + Sesamum straw (1 : 1)	19.6	5.8	83.8	5.33	2.27	8.94	347.2	69.44
T 10	Soybean + Sesamum straw (1 : 1)	19.2	7.2	72.7	4.37	1.89	8.20	328.2	65.64
SE(m)±		0.758	0.597		0.234	0.177		5.449	
C.D.		2.173	1.712		0.659	0.497		15.632	

* Average of 5 replication. **Average of 10 basidiocarp



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