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Comparative Yield Potential of Various *Pleurotus* spp./ Strains of Himachal Pradesh using Wheat Straw as Substrate

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A B S T R A C T

A total of 21 isolates of *Pleurotus* were procured/ collected from different sources, for conducting studies on yield potential using wheat straw as substrate. The species of genus *Pleurotus* show great diversity in their adaptation to varying agro-climatic conditions. Various species/strains of *Pleurotus* were collected/procured from different sources. Majority of the species/strains were collected from the natural habitat during surveys conducted in different localities of Himachal Pradesh during monsoon months of the year. Some of the species were procured from NRCM Solan. Isolations from the fresh specimen, collected from the wild were made following the standard tissue culture technique. Experimental fruiting of 21 isolates under mushroom house conditions revealed that the spawn run (11.6 days) and pinning initiation (16.6 days) was quick in *Pleurotus* sp. III followed by *P. sapidus* and *Pleurotus* sp. I. Maximum biological efficiency of 92 per cent was recorded in *P. flabellatus* I on the basis of two flushes.

Introduction

Pleurotus species constitute one of the choicest edible mushrooms, known by several names all over the world as 'Hiratake', 'Shimaji' or 'Houbitake' (Mizuno and Zhuang, 1995; Bononi *et al.*, 1995). However, it is commonly known as 'Oyster Mushroom' and in India recognized by the name 'Dhingri Mushroom'. The species of *Pleurotus* are generally saprophytic and wood destroying fungi attacking both cellulose and lignin components of wood and are widespread in the temperate zones of the world (Zadrazil and Kurtzman, 1984). The species of *Pleurotus* grow wild in the forests of hilly areas and cultivated in temperate and sub-tropical regions of the world. These mushrooms are grown on unfermented cereal straws with good productivity. Oyster mushroom is well known for its culinary properties and broad adaptability under varied agro-climatic conditions. In terms of total world production of mushrooms in 2005 which is 5 million tons, *Pleurotus* constitutes 25 per cent and ranks second among the cultivated mushrooms (Anonymous, 2007). In 1997, *Pleurotus* production in world was reported to be 875,600 tons contributing 14.2 per cent to the total world mushroom production. Representatives of genus *Pleurotus* form a heterogeneous group of edible species of high

commercial importance (Zervakis *et al.,* 2004). The species of genus *Pleurotus* show great diversity in their adaptation to the varying agro-climatic conditions. This flexible nature of the genus gives it more importance than any other cultivated mushroom (Zadrazil and Dube, 1992). *Pleurotus* spp. cultivation was first started in the 19th century on tree stumps (Flack, 1917). In India, *Pleurotus* cultivation was standardized by Bano and Srivastava (1962) utilizing *P. flabellatus* and the first domesticated species was *P. ostreatus*. Later, *P. sajor-caju* gained much importance after Jandaik and Kapoor (1974) first reported its cultivation on banana pseudo stem and chopped paddy straw. Different substrates have been used by several workers for the cultivation of *Pleurotus* spp. viz. cotton waste (Chang *et al.,* 1981), jowar straw and groundnut pod (Khandar *et al.,* 1991), wheat straw (Gupta and Langer, 1988), rubber wood waste (Mathew *et al*, 1991). Thomas *et al.,* (1998) have reported rice straw, as the most widely used substrate in Asia for the cultivation of *Pleurotus* spp. Mendeel *et al.,* (2005) used cardboard, saw dust and plant fibres for the cultivation of *Pleurotus* spp. Similarly Mendez *et al.,* (2005) utilized maize and pumpkin straw as substrates. Several diverse substrates like lignocellulosic materials (Yildiz *et al.,* 2002), unpretreated spent beer grains (Wang *et al.,* 2001), banana and rice straw (Bonatti *et al.,* 2004), various dry weed plants (Das and Mukherjee, 2007), peat moss based substrate (Tawiah and Martin, 2006) have also been used for the cultivation of *P. ostreatus*. Silva *et al.,* (2002) have used cotton peel as substrate for *P. pulmonarius*. Wheat bran supplemented with umbrella plant was used for cultivation of *P. eryngii* (Ohga and Royse, 2004). Thus, the present study was carried out with the objective to determine the high yielding *Pleurotus* spp. using wheat straw as a substrate. Also, it was planned to determine which *Pleurotus* spp took minimum and maximum days for spawn run, pinning initiation and biological efficiency.

Materials and Methods

i) Collection, isolation and maintenance of pure culture

Various species/strains of *Pleurotus* were collected/procured from different sources. Majority of the species/strains were collected from the natural habitat during surveys conducted in different localities of Himachal Pradesh during monsoon months of the year. Some of the species were procured from NRCM Solan (Table 1). Isolations from the fresh specimen, collected from the wild were made following the standard tissue culture technique (Gomborg, 2002). Young and fresh specimens were first washed with a jet of sterile water and cut across the pileal region with the help of a sterilized sharp blade to get 2-3 mm bits. These bits were dipped in 0.1 per cent Mercuric chloride solution with the help of sterilized forceps for 5-10 seconds and were given five washings in sterilized distilled water and placed on sterilized filter paper to remove excess moisture. The sterilized bits were then transferred to Yeastal Potato Dextrose Agar medium slants and incubated at 22 $\pm$ 2^{o}C. The stock cultures were maintained in the refrigerator at 4^{o}C. Sub-culturing of the stock cultures was done after a period of 7-10 days on fresh YPDA slants.

ii) Preparation of spawn

Wheat grains were sieved for the removal of undesirable materials and given 2-3 washings with water in a wide mouth container. The grains were then boiled in water for 15 minutes and soaked in hot water for 12-15 minutes. Water was decanted and the grains were spread on a wire-mesh for 7-8 hours for surface drying of grains. 18.0 g gypsum and 6.0 g calcium carbonate were added to one kg

of wheat grains. 300 gms of boiled grains were filled in glucose bottles upto two third of the total volume, plugged with non-absorbent cotton and autoclaved at 22 lbs p.s.i. pressure at 126^{o}C for 1.5 hours. Sterilized bottles were kept in the room for 24 hours to remove the excess moisture. The bottles were then kept for overnight cooling in room, under the UV light for 30 minutes. A 5 mm mycelial bit from fresh culture was transferred aseptically to one side of the bottle and another bit to the other side of the bottle and kept at 22 $\pm$ 2^{o}C. Incubated bottles were shaken weekly until there was a complete mycelial colonization of wheat grains. Fully colonized spawn bottles were then used for spawning of the bags.

iii) Spawning

For conducting fruiting trials of various species/strains, cloth bags were filled with 250 gms of wheat straw. The bags were dipped in water overnight and were pasteurized in hot water at 65-70^{o}C for 6 hours and then boiled in a drum for 1.5 to 2 hours. Wheat straw was cooled after spreading on a sterilized polythene sheet and tightly filled in polypropylene bags having small holes for aeration. Layer spawning was done and the bags were tied at the top and properly labelled. Spawned bags were kept in the mushroom house (Temperature 22 $\pm$ 2^{o}C and relative humidity 80-85%) for spawn run. After complete spawn run, the bags were torn opened and hanged with the help of plastic rope on an iron frame for fruiting. The data on spawn run, pinning initiation, fruiting behaviour and yield pertaining to various isolates were recorded.

Results and Discussion

A total of 21 isolates were collected /procured from different sources to have a fairly large sample size for determining the yield attributes and potential of each collected sample on wheat straw. Experimental fruiting of 21 isolates under mushroom house conditions revealed that the spawn run (11.6 days) and pinning initiation (16.6 days) was faster in *Pleurotus* sp. III followed by *P. sapidus* and *Pleurotus* sp. I (Table 2). Varying period of spawn run and pinning initiation has been reported for various species on different substrates by several workers from time to time (Baysal *et al.,* 2003). All the 21 isolates of *Pleurotus* were evaluated for their spawning behaviour following the standard technique (Munjal, 1973).

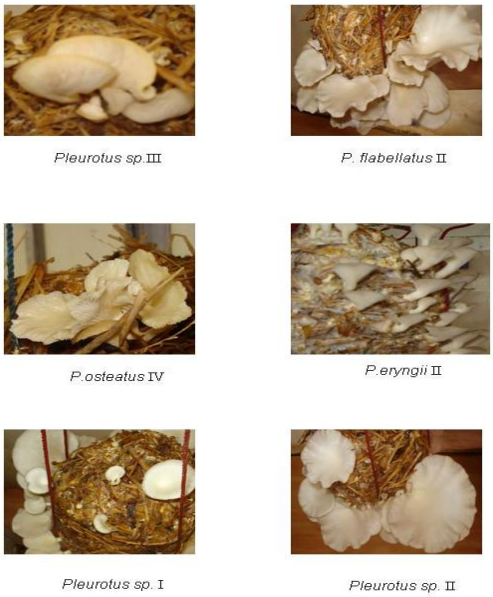
Table.2 Comparative yield potential of various *Pleurotus* species / strains on wheat straw

S. No	SPECIES / STRAINS	SPAWN RUN (DAYS)	PINNING INITIATION (DAYS)	YIELD (g/250g dry substrate)	BIOLOGICAL EFFICIENCY (%)
1.	*Pleurotus eryngii* I	13.3	17.3	200.0	80.0
2.	*Pleurotus sapidus*	12.6	16.6	205.0	82.0
3.	*Pleurotus* sp.I	12.6	16.3	214.1	85.6
4.	*Pleurotus florida*	14.6	18.3	218.3	87.3
5.	*Pleurotus flabellatus* II	16.6	20.6	220.8	88.3
6.	*Pleurotus ostreatus* IV	14.6	17.6	190.8	76.3
7.	*Pleurotus flabellatus* I	14.3	19.6	230.0	92.0
8.	*Pleurotus* sp.II	16.3	21.3	107.5	43.0
9.	*Pleurotus ostreatus* III	14.3	18.3	211.6	84.6
10.	*Pleurotus cornucopiae*	16.3	20.6	227.5	91.0
11.	*Pleurotus eryngii* II	14.6	18.6	226.6	90.6
12.	*Pleurotus* sp.III	11.6	16.6	225.8	90.3
	C.D (5%)	**0.97**	**0.97**	**5.99**	**2.39**

Table.1 Source of collection of various *Pleurotus* species/strains

SOURCE	NAME	SPECIES /STRAINS
Collection from wild	P11	*Pleurotus sp.*II
	P5	*Pleurotus cystidiosus* I
	P21	*Pleurotus ostreatus* IV
	P3	*Pleurotus flabellatus* II
	P4	*Pleurotus cornucopiae*
	P12	*Pleurotus cystidiosus* II
	P6	*Pleurotus pulmonarius*
	P8	*Pleurotus fossulatus* I
	P10	*Pleurotus fossulatus* II
	P18	*Pleurotus sp.*IV
	P19	*Pleurotus sp.*V
	P20	*Pleurotus ostreatus* III
	P7	*Pleurotus* sp.I
	P15	*Pleurotus sp.*III
	P17	*Pleurotus eryngii* II
NRCM, Solan	P1	*Pleurotus sapidus*
	P2	*Pleurotus flabellatus* I
	P9	*Pleurotus florida*
	P13	*Pleurotus ostreatus* I
	P14	*Pleurotus eryngii* I
	P16	*Pleurotus ostreatus* II

Fig.1 Various fructified isolates of *Pleurotus* spp. under the mushroom house conditions



The experimental fruiting trials were conducted under the mushroom house conditions. However, among 21 isolates only twelve showed fructification (Fig. 1). The fruiting trials were observed to note the various attributes. It was observed that the spawn run (11.6 days) and pinning initiation (16.6 days) was quick in *Pleurotus* sp. III followed by *P. sapidus* and *Pleurotus* sp. I. Maximum biological efficiency of 92 per cent was recorded in *P. flabellatus* I on the basis of two flushes. Mendeel *et al.,* (2005) evaluated the biological efficiency of three *Pleurotus* species namely *P. columbinus*, *P. sajor-caju* and *P. ostreatus* on organic wastes, reported a maximum biological efficiency (134.5%) in *P. columbinus* on cardboard. Similarly, we also got a higher biological efficiency of 91% in *P. cornucopiae*. Though, further studies are required to ascertain the best substrate using the different substrates for the cultivation of *Pleurotus* spp./strains.

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