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Appraisement of growth behaviour and yield potential of *Pleurotus* species on wheat straw as substrate

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Performance of *Pleurotus* species on wheat straw as substrate, observed at various growth stages, were evaluated as yield and biological efficiency (BE). Six *Pleurotus* species viz., *P. florida, P. flabellatus, P. ostreatus*, *P. sapidus, P. sajor- caju* and *P. eryngii* were cultivated on wheat straw. *Pleurotus florida* required minimum period for spawn run (17.70 days), appearance of pin head (22.02 days) and fruiting body formation (27.62 days) ; but it was maximum in *P. eryngii* i.e. (25.60, 32.40 and 37.75 days). Maximum stipe length was observed in *P. eryngii* (7.50 cm) and maximum cap diameter in *P. florida* (8.32 cm); Minimum stipe length was in *P. sapidus* (2.27 cm) and minimum cap diameter in *P. ostreatus* (4.88 cm). Similarly, flush wise yield (g) maximum observed, total yield was found in *P. florida* (912.25 g) and (BE) was maximum (91.22%) on wheat straw. Minimum average total yield was found in *P. eryngii* i.e. (502.75 g) and (BE) i.e. (50.27 %).

Key words: *Pleurotus* species, dhingri mushroom, wheat straw, growth, yield and biological efficiency.

INTRODUCTION

Oyster mushroom commonly known as “Dhingri” is a lignocellulosic fungus and grows naturally in temperate and tropical forests. Oyster mushroom belong to the genus *Pleurotus* which are broadly cultivated as edible mushroom in the world. The name *Pleurotus* has its origin from Greek word *“Pleuro”* which means formed laterally or in a side way position. Huge quantities of lignocelluloses and other waste residues are generated annually through the activities of agricultural, forest and food industries. These materials are lignocellulosic, in which major components are lignin, cellulose and hemicellulose. Mushrooms have got vast potential to degrade these organic wastes to simpler, soluble organic compounds by producing various extracellular enzymes. The genus *Pleurotus* has a complex taxonomic structure and include about 30 species. Fresh fruiting bodies of oyster mushroom indicates a high quality of moisture (90.8%); dry as well as fresh oyster mushrooms are rich in carbohydrate (57.6%), protein (30.4%), fiber (8.7%), fat (2.2%) and ash (9.8%) with 345 kilocalories energy value on 100g dry weight (Iqbal *et al.,* 2016). Oyster mushroom contains most of the mineral salts required by human body, such as K, Na, P, Fe and Ca. Interest in cultivation and consumption of oyster mushroom is increasing largely due to its taste, medicinal and nutritional properties. The present production of this crop in India is only around 21272 metric tonne and in Uttarakhand about 1228 metric tonne in 2016 (Anonymous, 2016). *Pleurotus* spp. has been previously cultivated on chopped wheat straw, paddy straw, cotton waste and saw dust at 22-28ºC and 80-85% humidity for spawn running and 12-18ºC for pin heads formation and maturity of fruiting bodies. The oyster mushrooms can be cultivated successfully under semi controlled conditions in a small space by using agricultural as well as industrial waste and other refuse as substrate. Devi *et al.* (2015) have studied the spawning response of *P. sajor-caju* in two different substrates (wheat and rice) and they have concluded that in wheat, spawn begins to appear after 15-16 days whereas the spawn started to appear after 18-19 days when rice is used as a substrate. Wheat seems to produce more spawn in a shorter period of time than rice. *P. sajor-caju* has been cultivated on farm waste products such

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as banana pseudo stems, paddy and wheat straw compost and sawdust.The cultivation of *P. flabellatus* has been tried on wheat, ragi and rice straw. *Pleurotus* species is known to grow relatively well on cellulosic/carbohydrate materials. It has been observed that among five selected species of *Pleurotus* i.e. *P. ostreatus, P. fiorida, P. fossulatus, P. eryngii* and *P. cornucopiae* for yield, highest yield of (94%) biological efficiency (BE) was obtained with *P. florida* followed by (32%) B.E. for *P. ostreatus* on wheat straw at low temperature ranging (12-16°C) and relative humidity (65-75%). The present investigation has been carried out to determine the effects of various growth and development of different *Pleurotus* species on wheat straw as a substrate.

MATERIALS AND METHODS

The experiment was carried out during 2017-18, at Plant Pathology laboratory and Mushroom Research Unit, Department of Plant Pathology, College of Horticulture, VCSG UUHF Bharsar, Pauri Garhwal (Uttarakhand). Six *Pleurotus* species namely (*Pleurotus florida, P. flabellatus, P. ostreatus, P. sapidus, P. sajor- caju* and *P. eryngii)* were evaluated for growth and yield basis performance. Observations had recorded for spawn run period (days), appearance of pin head (days), fruiting bodies formation (days), stipe length (cm), cap diameter (cm), flush wise yield (g), total yield (g) and biological efficiency (BE). The pure culture of six *Pleurotus* species were maintained on PDA at 25ºC and obtained from Mushroom Research and Training Centre (MRTC), GBPUA&T, Pantnagar. The wheat grains were used as a substrate for spawn preparation and additives such as chalk powder ($CaCO_3$) and gypsum ($CaSO_4$) were added in the ratio of 1:3. The grain filled into polypropylene bags and bags were sealed using cotton plugged and autoclaved at 121^{0}C, 15 lbs psi, for 2 hrs. Then bags were inoculated with mycelial culture of *Pleurotus* species and kept into the incubator at the temperature of 25^{0}C till the grains were fully impregnated with the mycelium. As substrate wheat straw had cut into small pieces. The chopped substrate was dip in water containing 75 ppm Carbendazim + 500 ppm formaldehyde for 18 hours for preventing the mould infestation (Jain, 2005). After 18 hrs substrate was dried at 65-70 % moisture. The ingredients were mixed thoroughly with hands and filled in polythene bags (1000 g/bag) and spawning was done @ 2% wet weight of substrates. Four replication of each treatment, filled substrates bags were kept in dark room. The bags were opened after complete spawn run with the help of sterilized knife. Environmental factors such as temperature and relative humidity were maintained between 15-18^0 C and 70-90% respectively for spawn running.

$$\text{B. E.\%} = \frac{\text{Weight of fresh mushroom fruiting bodies (gm)}}{\text{Weight of dry substrate (gm)}} \times 100$$

The data was obtained in crop room condition and analyzed by using simple complete randomized design (CRD) with the help of OPSTAT.

RESULTS AND DISCUSSION

The analysis of growth and yield of all six *Pleurotus* species on wheat straw substrate gave more or less significant results. The data have been presented in Table 1 and Table 2 and Fig.1. While determining the effect of wheat straw on different *Pleurotus* species for spawn run, it was observed that the minimum spawn run period (17.70 days) was recorded in *Pleurotus florida* , along with minimum time for first appearance of pinhead (22.02 days) and fruiting body formation (27.62 days), followed by *P. flabellatus* (18.57, 23.67 and 28.75 days respectively) ; in *P. ostreatus* in (20.10, 25.47 and 30.75 days respectively), in *P. sajor caju* spawn run period (22.45 days) followed by *P. sapidus* (22.52 run days). Whereas maximum spawn run was recorded in *Pleurotus eryngii* i.e. (25.60 days) and appearance of pin head (32.40 days) and fruiting body formation (37.75 days). The study indicated that *P. florida* showed best results while other species showed less growth. Pala *et al*. (2012) also observed yield performance of *P. sajor-caju* on different agro-based wastes, in paddy straw: spawn running minimum (17-19 days), Pinhead formation (21-23 days),fruiting body formation (25-27 days) and in wheat straw spawn running minimum (22-24 days), Pinhead formation (28-30 days), fruiting body formation (32-34 days).

Devi *et al.* (2015) they have observed spawning response of *P. sajor-caju* in two different substrates (wheat and rice) and they concluded that in wheat, spawn begins to appear after 15-16 days whereas the spawn started to appear after 18-19 days when rice was used as a substrate. Wheat seems to produce more spawn in a shorter

Table 1: Effect of *Pleurotus* species for time required (days) and various growth stages on wheat straw

Treatments	Spawn run period (days)±SE(m)	Appearance of pinhead (days)±SE(m)	Fruiting body formation (days)±SE(m)	Stipe length (cm)±SE(m)	Cap diameter (cm)±SE(m)
Pleurotus florida	17.70±0.28	22.02± 0.49	27.62 ±0.21	3.65±0.32	8.32±0.27
P. flabellatus	18.57±0.29	23.67 ±0.18	28.75± 0.75	3.85±0.10	7.40±0.15
P. ostreatus	20.10±0.41	25.47± 0.23	30.75 ±1.37	2.30±0.09	4.88±0.21
P. sapidus	22.52±0.21	27.97 ±0.14	32.00 ±0.91	2.27±0.10	5.81±0.33
P. sajor-caju	22.45±0.10	28.47 ±0.66	34.25 ±1.18	3.32±0.19	6.05±0.35
P. eryngii	25.60±0.09	32.40 ±0.66	37.75 ±1.03	7.50±0.12	5.20±0.18
SE(d)	0.36	0.62	1.39	0.24	0.37
C.D.(P=0.05)	0.77	1.32	2.94	0.52	0.78

Table 2: Yield and Biological efficiency (BE) of various *Pleurotus* species on wheat straw

	Yield (g)/1000g substrate					
Treatments	Harvesting of 1st flush ±SE(m)	Harvesting of 2nd flush ±SE(m)	Harvesting of 3rd flush ±SE(m)	Harvesting of 4th flush ±SE(m)	Total yield (g) ±SE(m)	B.E. (%)
Pleurotus florida	279.50 ±24.17	253.25 ±1.20	235.00 ±1.22	144.50 ±1.84	912.25 ±117.25	91.22
P. flabellatus	241.25 ±3.11	228.75± 1.48	162.75± 1.25	111.25± 1.10	744.00± 121.15	74.40
P. osteratus	237.56 ±2.05	217.50 ±1.70	163.50 ±1.50	107.50 ±1.19	726.06 ±116.84	72.60
P. sapidus	240.05 ±0.44	225.00 ±1.78	161.25 ±0.75	110.00 ±0.70	736.25 ±120.05	73.62
P. sajor-caju	240.12 ± 3.41	222.50 ±1.04	148.00 ±0.00	100.00 ±1.87	710.62 ±112.23	71.06
P.eryngii	157.00 ±1.29	148.75 ±1.70	113.25 ±1.79	83.75 ±1.31	502.75 ±67.58	50.27
SE(d)	14.28	2.13	1.74	1.98	143.60	-
C.D.(P=0.05)	30.23	4.52	3.68	4.19	304.04	-

period of time than rice. Similar work was done by Holkar and Chandra (2016) and Iqbal *et al.* (2016).

In case of stipe length, the maximum stipe lengths were recorded in *Pleurotus eryngii* i.e. (7.50 cm) followed by *P. flabellatus, P. florida, P. sajor caju, P. ostreatus* (3.85, 3.65 ,3.32 and 2.30 cm respectively).Whereas, the minimum stipe length was recorded in *P. sapidus* (2.27 cm). The maximum cap diameter was recorded in *P. florida* (8.32 cm) followed by *P. flabellatus, P. sajor caju, P. sapidus, P. eryngii* (7.40, 6.05, 5.81 and 5.20 cm), whereas minimum cap diameter was recorded in *P. ostreatus* i.e.(4.88 cm). Patel and Trivedi (2016) found that *P. sajor-caju* showed that highest length of stem was recorded in paddy straw substrate (3.08 cm), followed by sugarcane trace (2.79 cm), wheat straw (2.55 cm) and Mango dry leaves (2.25 cm). Gupta and Sharma (2014) reported that three grains *viz.*, wheat, rice and gram were tested for production of *P. sajor caju* spawn. Oyster mushroom i.e. (*P.sajor caju)* spawn has been recognized as a highly potential converter of cheap cellulosic material into valuable protein at a very nominal cost. In the results obtained during the present investigation, rice grains (8.33 days) were found to be the best grains for speedy development of spawn of *Pleurotus sajor caju, w*hereas wheat and gram grains (12.33 days) took same period of spawn development of *P. sajor caju*. Jayachandran *et al.* (2017) tested three grains *viz* sorghum, rice, and wheat grain were for the production of *Pleurotus florida* spawn, its yield and bio efficiency(BE) . The result showed that

Pleurotus florida

Pleurotus flbellatus

Pleurotus ostreatus

Pleurotus sapidus

Pleurotus sajor-caju

Pleurotus eryngii

among the three, rice grain, on the basis of better spawn production, pinhead formation, stalk length, pileus diameter, pileus thickness, yield (383.81±0.24) and bio efficiency (76.76%) was found to be the best substrate for spawn development of *P. florida,* whereas sorghum (12days) yield (303.63±0.01) and B.E. (60.72%) and wheat grain (13days) yield (283.21±0.01) and B.E. (56.64%) took period of spawn development of *P. florida.*

Flush wise yield (g) per 1000 (g) substrate, was recorded maximum in *Pleurotus florida* i.e. 1st, 2nd 3rd and 4th (279.50, 253.25, 235.00 and 144.50 g) and minimum yield was found in *P. eryngii* 1st, 2nd , 3rd and 4th (157.00, 148.75, 113.25 and 83.75 g). Maximum average total yield was found in *P. florida* (912.25 g) followed by *P. flabellatus*, *P. sapidus*, *P.osteratus*, *P. sajor caju* (744.00, 736.25, 726.06 and 710.62 g), whereas the minimum yield was found in *P. eryngii* (502.75 g). Girmay *et al.*(2016) observed growth and yield performance of P.ostreatus grown on wheat straw and other substrates. Iqbal *et al.* (2016) found that in *P. florida,* flush wise yield, total yield and also

biological efficiency (BE) was maximum recorded on wheat straw substrate. Related results also found by Chauhan *et al.* (2014) who recorded highest BE in lantana i.e. (75.23%), wheat straw (72.26%) and lowest in saw dust, sugarcane bagasse and poplar leaves. Holkar and Chandra (2016) observed five *Pleurotus* species for their growth behavior and yield performance on wheat straw, among these maximum B.E. (74%) was obtained in *P. florida*. Pala *et al*. (2012) found that maximum total yield of *P. sajor-caju* in paddy straw and wheat straw comparison to other apple leaves and chinar leaves. Fanadzo *et al*.(2010) observed that wheat straw had superior performance over maize stover and thatch grass when cultivating *P. sajor-caju.*

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