Comparative assessment of Oyster mushroom (*Pleurotus* spp.) for their growth behaviour and yield performance using wheat straw and finger millet straw as a substrate

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Comparative assessment of Oyster mushroom (*Pleurotus* spp.) for their growth behaviour and yield performance using wheat straw and finger millet straw as a substrate

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Two substrates were tested for growth behavior and yield potential of six *Pleurotus* species. It was found that days required for different growth parameters *viz.,* spawn run period, appearance of pin head, fruiting body formation were minimum in *P. florida* when wheat straw used as substrate, whereas when finger millet straw was used minimum days were taken by *P. flabellatus*. Maximum stipe length was found in *P. eryngii,* maximum cap diameter was observed in *P. florida*.Stipe length was found minimum in *P.ostreatus* and minimum cap diameter observed in *P. eryngii* in both the substrates. Maximum average total yield was found on wheat straw in *P. florida* (872.24 g) with B.E.(87.22%),while minimum in *P. eryngii* (511.30 g) with B.E. (51.13%). In finger millet straw maximum yield was found in *P.florida* (802.29 g) with B.E.(80.22%), while minimum in *P. eryngii* (457.01 g) with B.E (45.70%).

Key words: Biological efficiency, finger millet straw, oyster mushroom**,** *Pleurotus* spp*,* wheat straw, yield.

INTRODUCTION

Oyster mushroom (*Pleurotus* spp.) is an edible fleshy fungus, it is popularly called as Dhingri in India which grows as saprophytes on dead branches of trees. It belongs to the sub division basidi-omycotina. Among different *Pleurotus* species, *P. sajor-caju* is an important edible mushroom which is grown commercially all over the world. Oyster mushroom is gaining popularity in India because of its high yield potential, excellent taste, flavour, texture and longer shelf life. It can be grown within a temperature range of (20- 30 °C). It is cultivated in tropical and subtropical regions of the world. Oyster mushroom can convert easily available unused lignocellulosic agro wastes to edible protein rich food of high market value. Mushroom contains high protein, vitamins and minerals (Caglarirmak, 2007). 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 MT and in Uttarakhand about 1228 MT in 2016 (Anonymous, 2016). Mushroom are recognised as saprophytes depending on their mode of survival and having the potential to degrade or decompose complex organic structure of plants or animals. In nature, oyster mushrooms (*Pleurotus* spp.) degrade dead woods are largely cultivated on ligno-cellulose waste materials (Oei and Nieuwenhuijzen 2005).Mushrooms can not only convert lignocellulosic waste materials into human food, but also can produce notable nutraceutical products, which have many health benefits (Girmay*et al.* 2016). Generally, mushroom cultivation technology is very vital in the tackle against shortage of food, diminishing quality of human health and pollution of the environment, which human beings still face, and will continue to face, due to the continued increase of the world population, natural resource degradation and impacts from climate change (Oseni*et al.* 2012; Chang, 2008).Mushroom cultivation, which is reported to represent the only economically viable bio-technology process for conversion of waste plant residues from forests and agriculture. The

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spent substrate left after harvesting the mushrooms, which is entangled with innumerable mushroom threads (collectively referred to as mycelia), can also be used as animal feed (more palatable), bio-fertilizer for soil fertility enrichment and biogas (Alice and Kustudia, 2004).Earlier workers have reported cultivation of oyster mushrooms (*Pleurotus* spp.) using substrates such as wheat straw and finger millet straw (Ahmed *et al.* 2009; Iqbal *et al.* 2016; Holkar and Chandra 2016; Tiwari *et al*.2019; Tiwari and Ravi,2020).

MATERIALS AND METHODS

The experiment was carried out at Plant Pathology laboratory and Mushroom Research Unit, Department of Plant Pathology, College of Horticulture, VCSG UUHF,Bharsar (Pauri Garhwal) Uttarakhand during 2019-20. Six *Pleurotus* species *viz.,Pleurotus florida,Pleurotus flabellatus, P. ostreatus, P. sapidus, P. sajor-caju* and *P. eryngii* were obtained from Mushroom Research and Training Centre (MRTC) GBPUA&T, Pantnagar, Uttarakhand. The pure cultures of *Pleurotus* spp. were maintained on PDA at 25±2ºC. The spawn called as seed of mu-shroom was prepared from six *Pleurotus* species, using wheat grains (*Triticum aestivum*) (Sainos *et al*. 2006). Well cleaned wheat grains were boiled for 30 min or until the grains become soft and firm without bursting. Excess water drained off from the grains and cooled on a cheese cloth, kept overnight and turned up and down several times with the help of hands. These cooled grains were mixed with chalk powder ($CaCO_3$) and gypsum ($CaSO_4$) in the ratio of (1:3). The grain filled into polypropylene bags and sealed using cotton plugged and autoclaved at 121ºC, with the pressure of 15 lbs psi, for 2 hours. Then bags were inoculated with mycelial culture of *Pleurotus* spp. and kept into the BOD incubator at the temperature of 25±2ºC till the grains were fully impregnated with the mycelium. Six different *Pleurotus* spp. were screened out for growth and yield on wheat straw (WS) and finger millet straw substrate (FMS). The substrates were dipped in water containing 75 ppm Carbendazim + 500 ppm formaldehyde for 18 hours for preventing the mould infestation (Jain, 2005). After 18 hours substrates were dried at 65-70 % moisture. The ingredients were mixed thoroughly with hands and filled in polythene bags (1000g/ bag), spawning was done @ 2% wet weight of substrate with replicated four times of each treatment, substrates filled bags were kept in dark room. The bags were opened after complete spawn run by the help of sterilized knife. For spawn run temperature and relative humidity (RH) have maintained between 15-18ºC and 80-85% respectively. Observations for spawn run period (days), appearance of pin head (days), fruiting body formation (days), stipe length (cm), cap diameter (cm), flush wise yield (g), average total yield (g) and biological efficiency BE. (%) were recorded.

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

The data obtained in crop room condition and analyzed by using simple CRD (Complete Randomized Design) with the help of OPSTAT software.

RESULTS AND DISCUSSION

The various results obtained are presented in (Tables1, 2, 3 and 4). Six *Pleurotus* spp. *viz., P. florida, P. flabellatus, P. ostreatus, P. sapidus, P. sajor-caju* and *P. eryngii* were studied. Among all the *Pleurotus* spp. grown on wheat straw(WS) spawn run period in (days); minimum days required for *P.florida*(19.50),maximum for *P. eryngii* (26.50).In finger millet straw (FMS) minimum in *P. flabellatus* (21.50) and maximum in *P. eryngii* (28.25). Appearance of pinhead (days);on (WS) minimum in *P. florida* (23.25) and maximum in *P. eryngii* (30.25); on FMS minimum in *P. flabellatus i.e.* (25.50) and maximum in *P. eryngii* (33.50). Fruiting body formation (days); on (WS) minimum in *P. florida* (28.75) and maximum in *P.eryngii* (37.25); on FMS minimum in *P. flabellatus* (30.75) and maximum in *P. eryngii* (39.75).

Earlier workers had reported related results (Ahmed *et al.* 2009 ; Iqbal *et al.* 2016; Holkar and Chandra 2016 ; Tiwari *et al*. 2019). Appearance of pin head was initiated within 4-5 days after complete spawn run on both substrates. After appearance of pin head the bags were kept for fruiting body formation, 5-6 days taken for fruiting body formation by all *Pleurotus* spp on both the substrates.Similar findings were also observed by Kimenju *et al.* (2009); Naeem *et al.* (2014); Tiwari *et al.* (2019); Tiwari and Ravi(2020).

Table 1: Growth parameters of different *Pleurotus* species on wheat straw

Treatments	*Pleurotus* spp. on wheat straw				
	Spawn run period (days) ±SE(m)	App. of pinhead (days)±SE(m)	Fr. body formation (days)±SE(m)	Stipe length (cm)±SE(m)	Cap.dia. (cm)± SE(m)
Pleurotus florida	19.50±1.04	23.25±0.47	28.75±0.85	3.50±0.64	7.95±0.55
Pleurotus flabellatus	20.75±2.05	24.50±1.04	29.25±0.85	3.67±0.18	7.25±0.25
Pleurotus ostreatus	21.50±0.95	25.25±0.85	31.50±0.64	2.12±0.12	5.75±0.25
Pleurotus sapidus	23.75±0.85	27.50±1.32	33.50±0.86	2.50±0.28	5.50±0.28
Pleurotus sajor-caju	22.25±0.47	26.50±0.64	32.75±0.47	3.25±0.47	5.52±0.47
Pleurotus eryngii	26.50±0.64	30.25±0.85	37.25±0.85	8.25±0.47	4.37±0.23
Mean	22.37	26.20	32.16	3.88	6.05
SE(d)	1.59	1.28	1.06	0.58	0.47
CD(p=0.05)	3.37	2.71	2.25	1.22	1.00

Table 2: Growth parameters of *Pleurotus* species on finger millet straw

Treatments	*Pleurotus* spp on finger millet straw				
	Spawn run period (days)±SE(m)	Appearance of pin head (days)±SE(m)	Fruiting body formation (days)±SE(m)	Stipe length(cm) ±SE(m)	Cap diameter(cm) ±SE(m)
Pleurotus florida	22.75±0.62	26.50±1.55	31.75±0.85	3.62±0.68	7.90±0.39
Pleurotus flabellatus	21.50±0.64	25.50±1.44	30.75±0.85	3.65±0.20	7.20±0.27
Pleurotus ostreatus	23.25±0.62	27.75±0.75	32.50±1.55	2.10±0.13	5.67±0.22
Pleurotus sapidus	25.50±1.93	29.50±0.64	34.75±1.79	2.45±0.34	5.45±0.29
Pleurotus sajor-caju	24.50±1.32	28.25±1.43	33.50±1.32	3.40±0.57	5.70±0.43
Pleurotus eryngii	28.25±1.10	33.50±1.04	39.75±1.10	8.20±0.27	4.47±0.20
Mean	24.29	28.50	33.83	3.90	6.06
SE(d)	1.62	1.62	1.75	0.59	0.44
CD(p=0.05)	3.44	3.44	3.71	1.25	0.94

Stipe length and cap diameter(cm) of *Pleurotus* spp grown on wheat straw and finger millet straw,maximum was found in *P. eryngii* onboth the substrates and minimum was found in *P.ostreatus*. Stipe length and cap diameter characters were not much influenced by substrates, variation among these characters on the basis of substrate was not quit much similar findings have observed by Girmay*et al.* (2016);Tiwari *et al*. (2019); Tiwari and Ravi(2020).

First flush showed maximum yield in comparison to other flushes and 4th flush have been shown minimum yield in comparison to other flushes in both the substrates. In case of wheat straw, maximum total yield was observed in *P. florida* (872.24g) and minimum was found in *P.eryngii* (511.30 g), where as in other way finger millet straw maximum total yield was also found in *P. florda* (802.29 g) and minimum in *P. eryngii* (457.01 g). It was observed that the yield components (yield attributes) of different *Pleurotus* spp were found affected by the use of different substrates or agro waste material. Yield and biological efficiency of *Pleurotus*spp grown on wheat straw was higher in *P.florida* (87.22%) biological efficiency as compared

Table 3: Yield performance of different *Pleurotus* species on wheat straw

Treatments	Yield (g)/1000 g dry sub strate of wheat straw					
	1st flush(g) ±SE(m)	2nd flush(g) ±SE(m)	3rd flush(g) ±SE(m)	4th flush(g) ±SE(m)	Totalyield(g) ±SE(m)	Biological efficiency(%)
Pleurotus florida	285.58 ±5.30	250.57 ±4.07	192.95 ±4.70	143.13 ±2.92	872.24 ±12.24	87.22
Pleurotus flabellatus	261.43 ±8.16	220.64 ±3.91	170.29 ±9.69	130.79 ±3.47	783.16 ±15.83	78.31
Pleurotus ostreatus	248.46 ±3.63	210.70 ±3.67	167.88 ±2.53	125.64 ±1.95	752.70 ±19.71	75.27
Pleurotus sapidus	258.79 ±3.93	217.23 ±6.21	171.64 ±6.54	132.85 ±1.42	780.53 ±20.04	78.05
Pleurotu sajors-caju	252.80 ±4.46	212.63 ±4.77	152.11 ±7.48	115.48 ±5.24	733.02 ±13.60	73.30
Pleurotus eryngii	165.72 ±5.37	135.47 ±2.82	121.27 ±3.15	88.83 ±2.63	511.30 ±24.85	51.13
Mean	245.46	207.87	162.69	122.78	738.82	-
SE(d)	7.57	6.18	8.78	4.50	25.77	-
CD(p=0.05)	16.04	13.09	18.59	9.53	54.57	-

Table 4: Yield performance of different *Pleurotus* species on finger millet straw

Treatments	Yield (g)/1000 g dry sub strate of finger millet straw					
	1st flush(g) ±SE(m)	2nd flush(g) ±SE(m)	3rd flush(g) ±SE(m)	4th flush(g) ±SE(m)	Totalyield(g) ±SE(m)	Biological efficiency (%)
Pleurotus florida	270.83 ±4.01	235.41 ±2.05	170.45 ±5.46	125.58 ±2.08	802.29 ±39.29	80.22
Pleurotus flabellatus	252.57 ±4.44	205.51 ±6.46	153.59 ±14.41	115.75 ±5.41	727.43 ±12.10	72.74
Pleurotus ostreatus	237.35 ±3.56	190.34 ±4.50	150.64 ±4.06	112.52 ±1.91	690.86 ±38.57	69.08
Pleurotus sapidus	250.16 ±4.18	203.72 ±9.66	146.59 ±5.15	108.96 ±4.17	709.44 ±10.55	70.94
Pleurotus sajor-caju	240.45 ±3.58	198.96 ±3.14	138.63 ±4.49	91.41 ±3.94	669.47 ±9.09	66.94
Pleurotus eryngii	160.23 ±2.15	130.68 ±4.49	95.30 ±5.44	70.78 ±2.21	457.01 ±15.00	45.70
Mean	235.26	194.10	142.53	104.16	676.08	-
SE(d)	5.28	7.95	10.49	5.00	34.62	-
CD(p=0.05)	11.18	16.84	22.22	10.60	73.31	-

with finger millet straw was found in *P.florida* (80.22 %). Minimum was found in *P. eryngii* on WS*i.e.* (51.13%) and FMS *i.e.*(45.70%) biological efficiency.Tiwari and Ravi (2020) also reported that out of six *Pleurotus* species with regard to growth behaviour and yield potential, maximum total yield was found in *P. florida* (912.25 g) and (BE) was maximum (91.22%) on wheat straw and minimum average total yield was found in *P. eryngii* (502.75 g), ie, 50.27%.

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