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Effect of different substrates and supplements on the growth and yield of *Pleurotus floridanus* Singer

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Abstract

Pleurotus floridanus Singer was cultivated on wheat straw, paddy straw in pure form and supplement of wheat bran (15%) and lime (4%) to investigate their influence on mycelial growth, primordia appearance their maturity, flush wise yield, total yield and biological efficiency. A best mycelial growth (27.00±1.06 days), first primordia appearance (32.25±1.16 days) their maturity (34.00±0.92 days), maximum yield in each flush, total yield (1054.0 ±34.49g) and highest percent of biological efficiency (105.4%) was recorded on paddy straw + wheat bran 15%. Among all the used combination the slowest mycelial growth (32.00 ±1.30 days), most delay pinhead appearance (43.37 ±0.74 days) their maturity (48.00±1.06 days), minimum yield in each flush, total yield (633.00±22.53g) and lowest percent of B.E (63.37%) was recorded on wheat straw + wheat bran 15% + lime 4%. This study provide a solely information about cultivation and using of best substrate for mushroom cultivation and obtaining effective yield.

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Introduction

Oyster Mushrooms play a key role in recycling of organic matter for healthy environment. By the help of lignocellulose enzyme it converts plants remnant to food (Quimio 1998). With the passage of time a regular increment occur in cultivation of oyster mushroom. In 1997 production of mushroom was 875,000 tons throughout the world (Chang 1999). All over the world it is on third ranking among all cultivated mushroom (Chang 2006). Commonly it is grown on organic matter providing sufficient moisture (Jonathan *et al.*, 2008). It is very testy and having high nutritional value (Furlani & Godoy 2007). It's yield is 317 million metric tons per year by consuming 25% of the burned cereal straws (Chang & Mliles 1989).

Pleurotus species have the ability to activate the immune system of our body by their chemical substance and protect us from viral diseases (Brandt *et al.* 2000). The phenolic compounds in oyster mushroom protect us from the bad effect of free radicals (Kim *et al.* 2009). Mushrooms having rich protein, nutrients Vit B, Vit D, Vit K, Vit A, and Vit C. (Manzi *et al.* 2001). The oyster mushrooms used for anti-inflammatory and immune modulator effects (Lavi *et al.* 2010). They have the aptitude to change plant remnants to variable protein hence can be grown definitely with little costs (Banik &Nandi. 2004). There are large amount of wheat and paddy straw were lying after the harvesting of these crops. Due to easily availability and low cost these materials are suitable for oyster mushroom cultivation. The aim of the present work to investigated a best agro-waste for *Pleurotus floridanus* cultivation, In addition the effect of supplement of wheat bran and lime on their growth and production.

Materials and method

Substrate preparation

This work was conducted in the mushroom house in University of Agriculture, Peshawar. The culture was provided by mushroom laboratory of University of Agriculture, Peshawar. Different substrates i.e., wheat straw and paddy straw were collected from near local fields of Peshawar and were kept in sun for drying. After drying the substrates. were cropped having size 3cm. After cutting it was spread on cemented floor and added the water in order to gain the moisture about 65-70%. For fermentation it is then piled up and concealed by polythene sheet for 24 hours. The Wheat bran (15%) was added and lime 4% on dry weight basis. Each treatment having eight replicates and laid out by using Completely Randomized Design (CRD).

Pasteurization

For pasteurization polythene bags having size 12x18 inches were used. The bags were filled (¾) from fermented substrates. The mouth of bags were sealed by fiber thread and kept in air tight container for two hours at 15 psi on 70°C. After pasteurization the bags were left for a night for cooling in order to ready for spawning. For inoculation 25g of spawn was added to each bag (Peter Oei 2003).

Incubation and Cropping

The inoculated bags were kept in a dark room at 18-23°C for mycellial growth. For maintaining of this specific range of temperature electric exhaust fan was run for 6 hours in daytime. The duration of mycelial growth for covering of 25, 50, 75 and 100% of substrates was noted in term of days. After full colonization the bags were torn up. For keeping the humidity (80-90 %) the water was sprinkled on substrates for two to three times in a day. The pinheads (3-5cm) were arises from all sides of substrate during 5-10 days after complete colonization. It was matured from 2-4 days and then harvested. The time taken for pinhead appearance and their maturity was recorded.

Biological efficiency

Following formula was used for finding the biological efficiency.

$$\text{Biological efficiency}\% = \frac{\text{Weight of fresh mushroom fruiting bodies}}{\text{Weight of dry substrate}} \text{x100}$$

Statistical analysis

All the noted data was subjected to analysis of variance (ANOVA) by applying completely randomized design (Steel *et al.* 1996). The statistical software package Statistix 8.1 was used for analysis.

Means were separated by least significant difference (LSD) test at 5% probability. Each mean was calculated from eight replicates.

Results

Spawn running

The result revealed that fast mycelial growth was occurred on Paddy straw + wheat bran 15% and lowest mycelial growth was occurred on wheat straw + wheat bran 15% + lime 4% showing in Table 1.

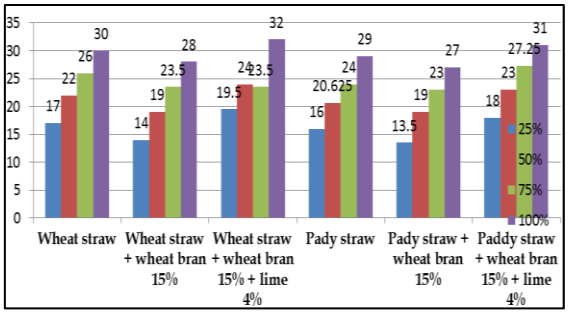

Fig. 1. Mycelial growth of Oyster mushroom (*Pleurotus floridanus* Singer) on different substrate.

Table 1. Mycelial growth, Days of Pinhead appearance and maturity of *Pleurotus floridanus* Singer.

S. No	Substrate	Mycelial growth				Primordia appearance	Days of maturity
		25%	50 %	75%	100%		
1	Wheat straw	17.00±1.30^{bc}	22.00± 1.06^{b}	26.00±1.30^{b}	30.00±0.75^{bc}	39.00± 1.19^{c}	42.50±1.060^{c}
2	Wheat straw + wheat bran 15%	14.00±1.06^{d}	19.00±1.69^{d}	23.50±0.92^{c}	28.00± 2.00^{de}	33.75±1.98^{e}	36.00±1.60^{e}
3	Wheat straw + wheat bran 15%+ lime 4 %	19.50±1.41^{a}	24.00±1.06 0^{a}	28.00±1.19^{a}	32.00±1.30^{a}	43.37±0.74^{a}	48.00± 1.06^{a}
4	Paddy straw	16.00±1.30^{c}	20.62±0.74^{c}	24.00±0.92^{c}	29.00±1.69^{cd}	37.62± 1.30^{d}	40.87±1.24^{d}
5	Paddy straw + wheat bran 15%	13.50±0.92^{d}	19.00±1.06 0^{d}	23.00±1.06^{c}	27.00± 1.06^{e}	32.25±1.16^{f}	34.00±0.92^{f}
6	Paddy straw + wheat bran 15%	18.00±1.30^{b}	23.00±1.06a^{b}	27.25±1.03^{a}	31.00±1.19^{ab}	41.87± 1.24^{b}	46.37±1.18^{b}

The results are mean of eight replicates. Data with different letters with in the some column indicate the significant difference at $P < 0.05$.

Primordia and Fruiting bodies formation

The first primordia appearance was occurred on paddy straw + wheat bran 15% as compared to other substrates, while the wheat straw + wheat bran 15% + lime 4% was took maximum time for pinhead appearance. The Paddy straw + wheat bran 15% took shortest time from primordia appearance to maturity, while wheat straw + wheat bran 15% + lime 4% was took maximum time for maturity.

Flush wise and total yield

The result showed that among all substrates the maximum yield was obtained on first flush followed by second and third flushes as shown in Table 2. In case of total yield the highest yield was recorded on Paddy straw + wheat bran 15% followed by wheat straw + wheat bran 15%, while the lowest yield was recorded on wheat straw + wheat bran 15% + lime 4%.

Table 2. Flush wise yield, Total yield (gram) of oyster mushroom (*Pleurotus floridanus* Singer)

S. NO	Substrate	1st flush	2nd flush	3rd flush	Total yield	B.E %
1	Wheat straw	380.00±8.43^{d}	220.00±13.98^{d}	168.00±6.69^{a}	768.00±17.39^{c}	76.87±3.22^{c}
2	Wheat straw + wheat bran 15%	476.00±10.81^{b}	354.00±10.05^{b}	166.00±7.55^{a}	996.00± 18.81^{b}	99.62±2.19^{b}
3	Wheat straw + wheat bran 15% + lime 4%	341.00±8.99^{f}	204.00±15.63^{e}	88.00±12.67^{c}	633.00± 22.53^{e}	63.37±2.77^{e}
4	Paddy straw	395.00±12.79c	246.00±8.78^{c}	145.00±9.03^{b}	786.00±17.67^{c}	78.62±4.06^{c}
5	Paddy straw + wheat bran 15%	498.00±16.38^{a}	386.00±15.23^{a}	170.00±14.21^{a}	1054.00±34.49^{a}	105.40±2.38^{a}
6	Paddy straw + wheat bran15% + lime 4%	364.00±6.94^{e}	241.00±8.63^{c}	97.00±12.34c	702.00±21.72^{d}	70.25±1.48^{d}

The results are mean of eight replicates. Data with different letters with in the same column indicate the significant difference at $P < 0.05$.

Biological efficiency

The result showed that highest biological efficiency 105.40% was observed on Paddy straw + wheat bran 15% and the lowest 63.37% was recorded on Wheat straw + wheat bran 15% + lime 4%.

Fig. 1. 1. Mycelial growth 2. Pin head appearance 3. Fruiting body.

Discussion

Addition of wheat bran 15% considerably affects the mycelial growth. It is because it provides a moderate amount of C: N level which is essential for best mycelial growth. Generally the *P. floridanus* shows a best mycelial growth at pH of 7.2, but supplementation of 4% lime $Ca(OH)_2$ increase the pH level up to 8.3 which minimize their rate of spreading. Similar results were observed by (Philippoussis *et al.* 2001, Sopit 2006). Bhatti *et al.* (1987) also reported that difference of C: N ratio significantly effect mycellial growth.

The variation in time taken for primordial appearance on different agro-wastes was examined by several workers. Ramzan *et al.* (1982) grow five *P. ostreatus* strains on paddy and wheat straw. They found 20-40 days for pinhead appearance. Kimenju *et al.* (2009) investigated that primordia appearance depend upon on the nature of substrate and different level of supplement. Ashraf *et al.* (2013) investigated that different pH level extremely effect the number of pinhead formation. Shah *et al.* (2004) also found 25-30 days in primordia formation on sawdust + wheat straw, sawdust + leaves, sawdust, wheat straw + leaves, wheat straw, leaves. The difference in time from primordial appearance to maturity was also observed by many workers. Heltay (1977) observed that *P. florida* took 49 days for maturity of primordia on different agro-waste viz., rye, wheat bran and barley straw. Khanna and Garcha (1981) found 20-24 days and Tan (1981) found 30 days.

The yield of mushroom is inversely proportional to the number of flushes. It gives the highest yield in first flush and decreases to second and third. Adedokun *et al.* (2016) also observed same phenomena on *P. floridanus*. In current study the maximum yield was obtained on substrate having some additional material as compare to using pure substrate, similar phenomena was also observed by Dhanda *et al.* (1996), who reported that supplementation to substrate can improve the yield of *Pleurotus sp* as compare pure substrate. Pathmashini *et al.* (2008) reported that rice, maize, kurakkan and sorghum straw

are the best substrates, but the addition of organic material significantly increases the yield of mushroom. Baysal *et al.* (2003) observed maximum yield of *Pleurotus ostreatus* on supplementation of 20% rice husk to paper waste. Onyango *et al.* (2013) reported that 10% wheat bran supplementation can extremely increase yield of mushroom.

The addition of specific amount of inorganic substrate effectively increases the biological efficiency. Nunez & Mendoza (2002) observed 50.8 to 106.2% B.E of *Pleurotus ostreatus* on different substrates. Mane *et al.* (2007) investigated that difference in Biological efficiency is due to variation of spawn quantity, species of fungi and addition of different supplement to substrate. Sharma & Madan (1993) observed 103.8% of B.E on leguminous plant. *Pleurotus. sajor-caju* gives 80-120% of B.E on cotton waste (Graham & Clyde, 1985).

It can be concluded that for obtaining of effective yield of mushroom supplementation of some other material is very necessary as compare to using pure substrate. Further work is necessary to improve the method of cultivation, choice of authentic substrate for best yield.

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