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Effect of different substrates on growth performance of King oyster mushroom (*Pleurotus eryngii*)

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Abstract

The study was focused on evaluating the growth performance of *Pleurotus eryngii* using different agricultural wastes such as paddy straw, wheat straw, soybean straw, finger millet straw, groundnut shells, sorghum straw and maize straw which have economic approach in agro industries as the residues are readily available. From experimental data it was found that, out of seven substrates, paddy straw supported the shortest spawn run duration (18.33 days), the fastest pinhead formation (27.67 days), the earliest fruiting (32.67 days), whereas on groundnut shells takes maximum days for spawn run (25.33days), maximum days for pinhead formation (37.67 days) and maximum days for first harvest (48.33 days).

Keywords: King oyster mushroom, substrates, spawn run, pinhead formation

Introduction

The mushroom is a macro fungus which has a distinct fruiting body and can be hypogeous or epigeous, large enough to be seen by a naked eye and picked up by hand (Chang and Miles 1992) ^[1]. Mushrooms which are grown on organic substrates are fleshy, spore-bearing reproductive structures of fungi. It played an important role as a human food due to its nutritional and medicinal properties. (Etich *et al.*, 2013) ^[2]. Nowadays cultivation of edible mushrooms is one of the most important commercial agricultural industries in the majority of world countries, which might be the only process that combines the protein rich food production with the reduction of environmental pollution (Sanchez 2010; Zhang *et al.*, 2016) ^[3, 4]. Mushrooms are a nutrient dense food source, characterized by elevated levels of protein, essential minerals which includes zinc, calcium, iron, magnesium, manganese, and phosphorus, and various vitamins such as B, C, and D. Additionally, they contain bioactive compounds, including phenolic compounds, while being relatively low in fat content (Kang *et al.*, 2012; Venturella *et al.*, 2015) ^[5, 6]. *Pleurotus eryngii*, commonly known as the King Oyster mushroom, is a species of edible, basidiomycetous, and saprophytic fungus belonging to the family of oyster mushroom. It is also called as Kabul Dhingri, King Trumpet Mushroom, French Horn Mushroom, King Brown Mushroom, and Trumpet Royale. Native to the Mediterranean regions of Europe, the Middle East, and North Africa, its natural distribution spans from the Atlantic Ocean through the Mediterranean Basin and Central Europe to Western Asia and India. *Pleurotus eryngii* exhibits weak parasitic behaviour, capable of surviving on the roots or stem base of living plants within the family Apiaceae (Zervakis *et al.*, 2001; Lewinsohn *et al.*, 2002) ^[24, 7]. *Pleurotus eryngii* is regarded as one of the best species within the *Pleurotus* genus, distinguished by its exceptional cap and stem consistency, culinary attributes, and prolonged shelf life compared to other oyster mushroom species (Yildiz *et al.* 2002) ^[8]. *Pleurotus eryngii*, the King Oyster mushroom, exhibits a remarkable ability to grow on a diverse range of lignocellulosic substrates. Various studies have demonstrated its successful cultivation on wheat straw, soybean straw, corn stalk, millet straw and cotton straw (Kirbag and Akyuz, 2008b) ^[9], mixtures of wheat straw and corn stalk, straws of millet and soybean, stalks of cotton and bean (Akyuz *et al.*, 2011) ^[10] sawdust, soybean straw, rice straw and sugarcane residues (Sardar *et al.*, 2017) ^[11], and date palm fibers (Owaid *et al.*, 2014) ^[12]. India's economy is agriculture-based, with considerable amount of crop production, generating significant agricultural waste in the form of crop

residues after harvest. It is important to dispose agricultural waste in a green way, which is environmentally friendly in this era of climate change. Mushroom cultivation is one of the most commercially important steps towards diversification of agriculture. Microbial technology offers a promising solution for large scale recycling of agricultural waste in India, enabling the conversion of waste into valuable products (Chaubey *et al.*, 2010) ^[13]. Keeping in view the important and obvious potentialities of *Pleurotus eryngii* the investigations was undertaken to find out effect of different cultivation substrates on growth performance of king oyster mushroom.

Materials and Methods

Procurement of pure culture and its maintenance: The pure culture of *Pleurotus eryngii* was obtained from Directorate of Mushroom Research, Chambaghat, Solan and the culture was maintained on malt extract agar medium.

Spawn preparation: The spawn was prepared in polypropylene bags. The wheat grains were cooked in boiling water to the extent that starch did not come out of the grains. After cooking 4% calcium carbonate and 2% gypsum, calculated on the basis of weight of the boiled grains, were mixed. Then these wheat grains were packed in polypropylene bags and sterilized in an autoclave at 121 °C for 30 min followed by inoculation with pure mycelia culture and then incubated at 28±2 °C for 7-10 days for mycelia growth until the mycelium fully cover the wheat grains. When all the wheat grains in polypropylene bags were run over by mycelium then they were used as spawn for mass multiplication of mushroom on different substrates.

Substrates preparation: King oyster mushroom was grown on various substrates viz., sorghum straw, paddy straw, wheat straw, soybean straw, finger millet straw, groundnut shell and maize straw. The experiment was laid out by using these straws of different crops by chopping them into 3-5cm. pieces size and soaked in fresh water for 12-18hrs. After 12-18 hrs substrates were taken out from water and excess water from substrates was allowed to drain off and then these substrates were autoclaved for sterilization for 1 hr at 15 lbs pressure and then the substrates were transferred to sterilized spawning room and allowed to cool down.

Crop management: The polyethene bags of the size 14x18" having 100 gauge thicknesses were sterilized by dipping in @ 2% formalin prior to use and lower corners of the bags were tied with thread so that the bag assumes a round shape. During filling the straw, spawning was done by multilayering @ 2 percent of wet weight basis of the substrate. The bags were filled up to their 90 percent capacity and mouths were closed tight with threads. With the help of sterilized needle, about 20-25minute holes all-round the filled bags were made. Each bag of agro waste filled with 3 kg weight for individual treatment to get expected result. After spawning, the bags were incubated in dark at an ambient room temperature of 28 °C in mushroom house. After completion of spawn run the bags were opened

and casing was done by using coco pit, vermicompost and soil in an appropriate proportion. Water was sprayed on the casing material to keep it wet. Then after completion of case run these bags were then kept on wooden racks in cropping room of the mushroom house for fruiting. The temperature of cropping room was maintained between 16 to 18 °C after the completion of case run. Humidity of the cropping room was maintained at 85 to 90 percent by frequent sprays of water on the walls and floor. The beds were maintained up to the harvest of the third flush.

Period between mushroom flushes

The time taken between flushes was calculated by using following formula

$$\text{Period between flushes} = \frac{\text{days taken from first harvest to last harvest}}{\text{Total number of flushes}}$$

Results and Discussion

Pleurotus eryngii was grown on different cultivation substrates viz. Paddy straw, Wheat straw, Soybean straw, Finger millet straw, Groundnut shells, Sorghum straw, and Maize straw. The progress of the mushrooms was closely monitored, with observations recorded on the number of days required for spawn run, pinhead formation, days required for first, second, and third harvests and period between mushroom flushes.

As shown in table 1 out of seven substrates, paddy straw (T₁) supported the fastest mycelial growth, achieving complete coverage in 18.33 days, closely followed by soybean straw (T₃) and wheat straw (T₂) with 18.67 and 19.33 days, respectively. Whereas, groundnut shells (T₅) exhibited the slowest growth, requiring 25.33 days to complete the spawn run. Akyuz and Yildiz (2007) ^[14] also reported that, the duration of mycelium development in *Pleurotus eryngii* varied between 15-27 days, depending on the type of substrate utilized. Sawant *et al.* (2022) ^[15] reported a spawn running period of 17-19 days for *Pleurotus sajor-caju* cultivated on soybean straw, which is consistent with the findings of the present study. Additionally, they observed that the maximum duration for spawn running was recorded on groundnut straw, aligning with the results of this study, where groundnut straw required the longest time to complete spawn running.

As per the data shown in table 1 paddy straw (T₁) showed the shortest duration of 27.67 days for pinhead formation after spawning which is followed by soybean straw (T₃) and wheat straw (T₂) with 29.33 and 30.67 days, respectively. In contrast, groundnut shell (T₅) had the longest duration of 37.67 days, indicating a delayed pinhead formation compared to other treatments. The present study's findings are in concurrence with the results reported by Raghunathan *et al.* (1996) ^[16], Yildiz and Karakaplan (2003) ^[17], and Khanna *et al.* (1992) ^[18], who observed that, the duration required for pinhead formation ranged from 22-27 days, 20-23 days, and 24-30 days, respectively. Ohga (2000) ^[19] and Akyuz and Yeliz (2008) ^[9] who also reported that the primordial initiation days were found to be changeable, depending on the biological structure of raw materials used.

Table 1: Days required for spawn run and pinhead formation of *Pleurotus eryngii*

Tr. No.	Treatment detail	Days required for spawn run*	Days required for pinhead formation*
T ₁	Paddy straw	18.33	27.67
T ₂	Wheat straw	19.33	30.67
T ₃	Soybean straw	18.67	29.33
T ₄	Finger millet straw	22.33	33.67
T ₅	Groundnut straw	25.33	37.67
T ₆	Sorghum straw	21.67	33.33
T ₇	Maize straw	21.33	32.67
	SE±	0.45	0.54
	CD (0.05)	1.38	1.67

* = Mean of three replications

The data regarding total days required for first, second and third harvest is shown in Table 2. Treatment T₁ (paddy straw) took minimum days for first, second and third harvest i.e 32.67 days, 45.33 days and 59.67 days respectively while the treatment T₅ (groundnut shells) exhibited the longest duration for the first, second and third harvest i.e 48.33 days, 64.67 days and 81.33 days respectively after

spawnings. Similar findings were recorded by different scientists who did studies on *Pleurotus spp.* and reported total harvest periods, ranging from 50-55 days (Bao *et al.*, 2004; Ohga & Royse, 2004) [21, 22], 56-59 days (Obatake *et al.*, 2003) [23], and 30-72 days (Philippoussis *et al.*, 2001) [24], with a specific study citing a harvest period of 70 days (Ohga, 2000) [19].

Table 2: Days required for first, second and third harvest of mushroom

Tr. No.	Treatment detail	First Harvest*	Second harvest*	Third harvest*
T ₁	Paddy straw	32.67	45.33	59.67
T ₂	Wheat straw	38.33	51.67	66.33
T ₃	Soybean straw	35.67	48.67	63.33
T ₄	Finger millet straw	43.67	58.33	73.67
T ₅	Groundnut straw	48.33	64.67	81.33
T ₆	Sorghum straw	41.67	55.33	70.67
T ₇	Maize straw	40.67	54.33	69.33
	SE±	0.33	0.50	0.45
	CD (0.05)	1.01	1.53	1.38

* = Mean of three replications

The data regarding period required between mushroom flushes is presented in Table 3 revealed that, Treatment T₁ (paddy straw) had recorded the shortest interval between flushes, with an average of 9 days as compare with rest of the treatments. Whereas, as like previous results the Treatment T₅ (groundnut shells) had the longest interval between flushes, with an average of 11 days. Present findings are in closely related with the result given by Iqbal *et al* (2005) [25] who also conducted the trial on effect of different substrates on the yield of king oyster mushroom (*Pleurotus eryngii*) and stated that, the interflush interval ranges from 4.7 to 8 days. Also Bhatti *et al.* (2007) [26] supported this study by getting different flushes with an interval of 6.33 to 16.72 days.

Table 3: Period between mushroom flushes

Tr. No.	Treatment detail	Period between mushroom flushes*
T ₁	Paddy straw	9.00
T ₂	Wheat straw	9.33
T ₃	Soybean straw	9.77
T ₄	Finger millet straw	10.00
T ₅	Groundnut straw	11.00
T ₆	Sorghum straw	9.66
T ₇	Maize straw	9.55
	SE±	0.18
	CD (0.05)	0.57

* = Mean of three replications

Conclusion

The results of this study clearly indicate that, paddy straw was the most superior substrate for king oyster mushroom

cultivation. Specifically, it demonstrated the shortest spawn run duration (18.33 days), the fastest pinhead formation (27.67 days) and the earliest fruiting (32.67 days). In conclusion, the findings of this investigation unequivocally demonstrate that paddy straw is the optimal substrate for king oyster mushroom cultivation. It consistently outperformed other substrates in all evaluated parameters.

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