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Evaluation of agricultural wastes for growth and yield of oyster mushrooms (*Pleurotus florida*)

Suraj Soni, Ram Chandra and Ayushi Sharma

Abstract
An experiment carried out to investigate the possibility and potential use of different agricultural wastes as a substrate for production of oyster mushroom. Five different type of substrates such as wheat straw, rice straw, mustard straw, maize straw and mixture of wheat and rice straw were used for the cultivation of oyster mushroom. Among the different substrates, wheat straw performed significantly better on growth and yield of oyster mushroom (*P. florida*) compare to other substrate used in this study. Most of the mushroom producers use wheat straw for the cultivation of oyster mushroom and it is really one of best substrate used in this study, rice straw is also a good substrate for the production of oyster mushroom. Although the amount of yield in rice straw is lower than the wheat straw, other substrates such as wheat straw + rice straw, mustard straw and maize straw can also be used as alternative substrates for the cultivation of P. florida. This study showed that wheat straw is one of the best substrate among all and would be recommended for production of oyster mushroom.

Keywords: *Pleurotus florida*, substrates, growth and yield

Introduction
Oyster mushroom production is the best economical and relatively short biological process for bioconversion of such materials into protein rich foods. For the production of oyster mushrooms, there is various types of agricultural waste or raw substrate materials present which can be utilise to produce different species of mushrooms such as wheat straw, paddy straw, molasses, chicken manure, gypsum, sugar cane bagasse, rice straw, tea wastes, dried leaves of mango, date palm leaves, blackberry leaves, banana leaves, water hyacinth, rice bran, coffee straw, cotton straw, saw dust and so forth (Biswas and Singh 2011) [1]. These raw materials available in India in a very large quantity. In year 2012-13 the production of wheat and paddy in India was estimated to be 93.5 and 76.53 million tons respectively, and it was reach to 100 million tons in the year 2016-17. Although raw substrate of crops used as a fodder but almost 50% of the crop residues are still potentially available for production of mushrooms (Biswas and Singh 2011) [1]. Agricultural wastes are rich in ligno-cellulosic components which are difficult to breakdown and hard to dispose off, so farmers burn them out but it is not the solution of agro-wastage because of burning causes loss of micro and macronutrient from the soil which is neccesary to crops production, burning causes ultimately less production or nutrional deficient production of crops. Some of the agro-wastage are used as fodder for animal but they can also be used as substrate for the production of mushroom. Agricultural wastes are rich in various types of nutrients and they can be effectively use for the mushroom cultivation. Agricutural wastes disposal is difficult to manage as excess of nutrients in them can cause leaching is left in field, as a compost. Mostly they are disposed by means of incineration which causes pollution hence, there is always high demand of agro-wastes management idea which is cost effective and causes less pollution so the cultivation of mushrooms on agricultural wastes fulfills these requirements. These agro wastes processing not only reduces environmental pollution but the by product of mushroom cultivation is also a good source of animal feed, manure and soil conditioner. It is estimated that nearly 700 million tons of organic wastes is generated annually in India which is either burned or land filled that causes serious environmental pollution (Harshvardhan, *et al.* 2017) [2] and that is why cultivation of mushroom has a very high scope in India as well as also in other countries because agro wastes such as rice husk, wheat bran, rice straw, wheat straw, mustard straw, and leaves of mango, maize straw have been identified as as most economically important wastes for mushroom cultivation. Pandey and Ghosh (2008) [4] reported that the *Pleurotus sajor-caju* was successfully grown on all the agricultural wastes for growth and yield. There are different types of agricultural wastes which influencs directly to growth and yield potential of mushrooms. thus, the objective of this work was to evaluate influence of locally available

different agricultural wastes on growth and yield potential so as to find out suitable agro-waste for cultivation of oyster mushroom (*Pleurotus florida*).

Materials and Methods

This experiment was conducted in year 2019 during January to June in Mushroom Spawn Laboratory, Department of Mycology and Plant Pathology, Banaras Hindu University, Varanasi. Mushroom spawn was prepared on wheat grain and spawning in different substrates like wheat straw, rice straw, mustard straw and maize straw for observation of growth and yield of *Pleurotus florida.*

Substrate preparation

Well dried agricultural residues (wheat straw, rice straw, mustard straw and maize straw) was taken and broken into small pieces. These agricultural wastes were soaked in water for 18 hours. Drained out excess of water from the substrates and moist substrates was sterilized in an autoclave at 121 ^{o}C at 15 lb/sq. inch pressure for 15 to 20 minutes. After that these substrate was then allowed to cool at room temperature and previously prepared spawn in glass bottle was used to spawning the substrates. Spawned substrates were filled in polythene bags and kept free to tie the bags with the help of thick thread or rubber bands. These bags were kept vertically in dark room and maintained the temperature to 24 ^{o}C to 28 ^{o}C and relative humidity of 80% to 85%. After completion of colonized mycelial growth, polythene bags were removed and sprayed regularly with water to these compact mushroom beds to provide adequate moisture. Four flushes of mushrooms were harvested during the total cropping period.

Observation and measurement: Following parameters were observed during this investigation.

A. Growth behaviour (in days)

1. Spawn run period
2. Pinhead initiation
3. First harvesting
4. Second harvesting
5. Third harvesting
6. Fourth harvesting

B. Yield potential (in gram)

1. Yield of first flush
2. Second flush
3. Third flush
4. Fourth flush

Results and discussion:

The data pertaining the growth period of *Pleurotus florida* on five substrates for spawn run period, initiation of pin head, harvesting of 1st flush, 2nd flush and harvesting of 3rd flush 4th flush given in table 1. The spawn run period of all the substrate for oyster mushroom (*Pleurotus florida*) ranged between 14 days to 19 days. Spawn run period was significantly vigorous and rapid in wheat straw and it required 14 days and in mustard straw which also required 14 days followed by rice straw which required 15 days, substrate mixture of wheat straw + rice straw required 16 days while maize straw required 19 days to complete the total spawn run time. Time required for initiation of pin-heads ranged from 18 days to 27 days. It was evidenced that 18 days required for substrate wheat straw, 19 days were required for mustard straw and for rice straw and mixture of wheat + rice straw required 20 days while maize straw required 27 days for initiation of pin-heads. Minimum time 18 days required for initiation of pin-heads in wheat straw and maximum time 27 days were required for initiation of pin-heads in maize straw. The actual time required for harvesting of first flush of all the substrate ranged between 22 days to 34 days. Wheat straw was required 22 days for harvesting of first flush followed by mustard straw which required 24 days, rice straw and mixture of rice + wheat straw required 26 days to 27 days, in which rice straw required 27 days and wheat straw + rice straw required 26 days. Maximum time required for the harvesting of first flush in maize straw which was 34 days. The time required for the harvesting of second flush ranged between 35 days to 42 days in which maximum time required for the second flush was taken by maize straw which was 42 days while the minimum time required in wheat straw and mustard straw which was 35 days followed by rice straw 36 days. Data pertaining to harvesting of third flush revealed that, 47 days to 50 days were required, in which minimum time required for harvesting of third flush was taken by wheat straw and mixture of rice straw + wheat straw which was 47 days. Fourth flush was first completed from mushroom bed of wheat straw and it took 56 days. Maximum time recorded from maize straw and its cropping period completed in 64 days.

Yield potential

Yield of all the five substrates was compared and it was found that highest yield was obtained from the first flush and subsequently decreases after that in second, third and fourth flush (Table -2). Total yield was measured using the sum of three flushes. The results revealed that highest yield 385.37 gm was obtained in wheat straw from first flush whereas lowest yield from the first flush 289.21 gm was obtained in maize straw. A significant decrease in second flush of all the substrates but in second flush the highest yield in wheat straw which was 275.23 gm was obtained and lowest 248.56 gm in wheat + rice straw was obtained. Highest yield in harvesting of third flush was obtained 168.78 gm from wheat straw and lowest yield 118.23 gm was obtained in maize straw. From fourth flush minimum yield was obtained in maize straw i.e 32.57 gm and maximum yield was found in rice straw i.e 98.76 gm. The results showed that maximum total yield was recorded 918.83 gm in wheat straw while minimum total yield was recorded 702.76 gm in maize straw. Finally wheat straw was found best substrate for both growth behaviour and yield potential of *Pleurotus florida.* This result was conformity to the findings of Tirkey, *et al.* (2017) [5] and Neupane, *et al.* (2018) [3] who reported that different substrates for growth and yield of oyster mushroom. This investigation can help to mushroom growers for selection of suitable substrate for better yield of oyster mushroom.

Conclusion

As a conclusion we can state that the wheat straw is a suitable and one of the best residue for oyster mushroom (*P. florida*). it is also proved that the production of oyster mushroom on wheat straw was taking less days and significantly higher yield in comparison to other substrates but other substrates such as rice straw, wheat straw + rice straw, mustard straw and maize straw can also be used as alternative substrates for the cultivation of *P. florida.*

Table 1: Comparative evaluation of different substrates for growth behavior of oyster mushroom (*P. florida*)

Substrates	Mushroom growth period recorded in days after spawning					
	SRP	PHI	First Harvesting	Second Harvesting	Third Harvesting	Fourth Harvesting
Wheat straw	14.33	18.33	22	35.66	47.33	56
Rice straw	15	20.33	27.66	36.33	49.33	62.33
Wheat straw + rice straw	16	20.66	26.33	39.33	47.66	59.33
Mustard straw	14.33	19.33	24.66	35.33	48.33	62.33
Maize straw	19.66	27.66	34	42.66	50.33	64

SRP= spawn run period, PHI= pin-head initiation,

Table 2: Comparative evaluation of different substrates for yield potential of oyster mushroom (*P. florida*)

Substrates	First flush (gm)	Second flush (gm)	Third flush (gm)	Fourth flush (gm)	Total yield (gm)
Wheat straw	385.37	275.23	168.78	89.45	918.83
Rice straw	372.73	265.26	165.89	98.76	902.64
Wheat straw + rice straw	355.62	248.56	142.66	59.40	806.24
Mustard straw	323.32	255.12	123.85	45.23	747.52
Maize straw	289.21	262.75	118.23	32.57	702.76

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