INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2006/08–1–129–131
http://www.fspublishers.org

Effect of Different Methods of Compost Preparation and Lime Concentration on the Yield of *Pleurotus sajor-caju*

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ABSTRACT

This study was undertaken during 2002-2003 at NLC Mushroom Project, Rawalpindi to investigate the effect of different methods of compost preparation (wetting & boiling of wheat straw) and lime concentration (2%, 4% & 6%) on the growth and yield of oyster mushroom (*Pleurotus sajor-caju*). Results indicated that the most rapid mycelial growth (23.0 days) was observed in wetted wheat straw with 2% lime concentration, least duration of pin setting (47.67 days) was found in wetted wheat straw with 2% lime concentration. The maximum number of flushes (5.67) was recorded in wetted wheat straw with 2% lime concentration and the highest yield (295 g/1.5 kg substrate) was obtained from wetting wheat straw + 2% lime concentration. Therefore, wetting of wheat straw is recommended for commercial production of *Pleurotus sajor-caju.*

Key Words: Compost; Lime; *Pleurotus sajor-caju*

INTRODUCTION

The large order Agaricales includes fungi whose fruiting bodies are commonly called mushrooms. Mushrooms are fleshy, sometimes tough, umbrella-like sporophores that bear their basidia on the surface of gills or plates (lamellae). *Pleurotus ostreatus* and *P. sajor-caju*, the oyster mushrooms and their relative *P. sapidus* are also members of the family Tricholomataceae. Both are edible and of excellent flavour. They are either sessile (lacking a stalk) or have a very short lateral stalk (Alexopoulos & Mims, 1979). Mushrooms are loved the world over as delicacy in food and considered as one of the choicest dishes on the meal table due to their taste, flavour and nutritional values (Khan & Khatoon, 1984).

Consumption of edible mushrooms as food and drug is closely related to the history of mankind. Recently, oyster has been added to the list of commercially produced mushrooms. Edible mushrooms are cultivated worldwide under various climatic conditions. Their total annual production in the world is well over 1.2 million tons. These mushrooms are grown on commercial scale in several countries. However, no systematic start has been made to grow them in Pakistan, which has varied climatic zones and abundance of manpower and agro-waste resources (Zafar, 1986). There are about 5000 different species of mushrooms, of which at least 1220 are reported to be edible. A large number of species are reported to produce antibiotics (Wahid, 1981).

The nutritive value of mushroom is estimated to be very high. *Pleurotus sajor-caju*, the Indian oyster mushroom, contains 47.9% protein as compared to only 21% in beef. Mushrooms are low in fat contents (approximately 0.1%) and are therefore, considered an ideal food for weight conscious people and heart patients. The carbohydrate contents are 0.87%. The vitamin content of mushroom is exceptionally high. They are a good source of niacin, riboflavin, folic acid, vitamin C and B_{12}. Mushrooms are also a good source of minerals, especially calcium, phosphorus, potassium and iron (Government of Pakistan, 1984).

Iqbal and Shah (1989) used wheat straw for compost prepration of *Pleurotus sajor-caju* that was mixed with calcium carbonate ($CaCO_3$) to adjust pH 6.4 - 7.8. Due to this mycelium growth takes place rapidly. Gupta (1989) used wheat straw first soaked in tap water for 10 - 12 h, then dipped in hot water for 15 min, cooled, tagged into perforated polyethylene bags and simultaneously spawned with *Pleurotus sajor-caju*. After 15 days, when the straw was fully covered by the mycelium, the bags were removed. The fruiting bodies appeared after 12 - 15 days after the bags were removed and first crop was harvested 2 - 3 days later. The yield obtained was 415 - 535 g/kg straw. Bononi *et al.* (1991) reported that the substrate used for *P. ostreatoroseus* cultivation in plastic bags was compost based on sugarcane bagasse mixed with rice straw and rice bran supplemented with $CaCO_3$. During the cultivation period, temperature varied in the range 3.6 - 31.2°C and RH varied in the range 54 - 100%. The spawn run took 6 - 7 weeks. Harvesting started 5 days after the plastic bags were opened and was completed within 10 weeks.

In Pakistan people use only one method for compost preparation i.e. wetting wheat straw. This method is easy and quick, and avoids the attack of diseases associated with boiling. This study was initiated to determine, which of the compost preparation methods and which lime concentration was best for commercial yield of Indian oyster, *Pleurotus sajor-caju* and highlighting its commercial utility.

MATERIALS AND METHODS

The study was conducted at National Logistic Cell (NLC) Mushroom Project, Swan Camp, Rawalpindi, during

2002-03. The different steps involved in conducting these studies were as under:

Spawn preparation. A strain of oyster (*Pleurotus sajar-caju*) was taken from Culture Bank of NLC Spawn Production Laboratory. The culture was multiplied on corn flour meal agar medium (the ingredients of corn flour meal agar were Corn Flour 20 g, Dextrose 20 g, Peptone 01 g, Agar 20 g, Water 1 liter). The medium was sterilized at 121^{o}C and 15 pounds per square inch (psi) pressure for 15 min in an autoclave. The medium was then poured in to 90 mm petri dishes aseptically. Then the culture of oyster was transferred into these petri dishes. Petri dishes were then incubated at 25^{o}C for 15 days. Sorghum grains were soaked over night and excessive water was drained off the next day. Spreading of sorghum grains under shade was carried out to attain 70% moisture level, and then 2% gypsum was mixed. The treated grains were filled in bottles, which were then plugged with cotton. These bottles were sterilized at 121^{0}C on 15 psi pressure for 20 min. On cooling, the bottles were inoculated with bits of multiplied culture and incubated at 25^{0}C for 15 days.

Compost preparation. Wheat straw was used for compost preparation. Compost was prepared by using two methods.

Wetting and boiling of wheat straw. Well-chopped wheat straw was selected. The straw was spread over the floor and sprinkled with water. Care was taken to ensure thorough wetting of the straw without letting the water leach away. Three different concentrations of lime viz., 2, 4 and 6% were used. The compost was covered with a sheet over night. Next day, the compost was filled into polypropylene bags. These bags were tied with threads and on cooling the bags were spawned. Alternatively, wheat straw was boiled in water in a huge pan and kept on boiling for 45 min. Wheat straw was sieved and squeezed in order to remove excessive water. Boiled wheat straw was spread over clean floor and turned over several times to attain 70% moisture level. Boiled wheat straw was squeezed in hand and if only one or two drops were dropped then it mean it attained 70% moisture level. Three different concentrations of lime viz., 2, 4 and 6% were incorporated in to boiled wheat straw. This mixture was filled into polypropylene bags and spawned immediately. The experiment thus consisted of the following six treatments:

1. Wetted wheat straw with 2% lime concentration.
2. Wetted wheat straw with 4% lime concentration.
3. Wetted wheat straw with 6% lime concentration.
4. Boiled wheat straw with 2% lime concentration.
5. Boiled wheat straw with 4% lime concentration.
6. Boiled wheat straw with 6% lime concentration.

These treatments were replicated three times in a completely randomized design.

Data collection. Data were collected on the following parameters:

Mycelial growth. Mycelial growth for *P. sajor-caju* was measured for the days required against all lime and compost treatments.

Time to pin setting. Pin setting is the stage at which the mycelium of *Pleurotus sajor-caju* was turned in to small pin-head like structures. The bags with fully run mycelium were then opened. Gentle sprinkling of water was carried out to lower carbon dioxide near the vicinity of bag. Number of days from spawning to pin setting was recorded.

Number of flushes. Total number of flushes was recorded.

Yield. Yield was estimated by weight of sporophore per 1.5 kg substrate.

Statistical analysis. Data were arranged and analyzed by applying two factors factorial completely randomized design (Steel & Torrie, 1980) using statistical software MSTATC.

RESULTS AND DISCUSSION

Mycelial growth period (days). The minimum mycelial growth period (23.0 days) was recorded in wetted wheat straw with 2% lime concentration (Table I). This duration was significantly ($P < 0.05$) less as compared with wetted wheat straw with 4% lime or boiled wheat straw with 6% lime. Overall, 2% lime concentration gave more rapid mycelial growth than either 4% or 6%, while the compost preparation methods had non-significant effect. The optimal water contents of *Pleurotus* substrate was adjusted to 70% wet weight. This water level favours loss of organic matter, degradation of lignin and release of water-soluble substances used as criteria for substrate preparation. In case of mycelial running in days wetted wheat straw with 2% lime concentration was found to be the best and it had a pH of 7.3. Basidiomycetes group of fungi require almost neutral pH medium for their growth. pH of all six treatments was between 6.9 - 7.6. So, it was concluded that mycelial growth was influenced by sterilization method, pH and availability of free set sugar and phenolic compounds (Tillay & Terry, 1963). Our results are in close agreement with those reported by Bhandari *et al.* (1991).

Time to pin setting (days). The least duration (47.67 days) for pin setting was recorded in wetted wheat straw with 2% lime concentration. However this did not differ significantly from the other treatment combinations (Table II). Wetting method gave earlier pin setting than boiling, but differences due to lime concentrations were non-significant. It might be due to the end of colonization period the plastic bags were opened and by doing so growth conditions were changed and formation of fruiting body induced earlier and more. Key factors for primordial formation and development of fruiting bodies were temperature, light, relative humidity and composition of air (O_2 & CO_2) (Alexopolous & Mims, 1979). The results are in line with findings of Shanmughavel and Velliangori (1994).

Number of flushes. The maximum number of flushes (5.67) was recorded in wetted wheat straw with 2% lime (Table III). All the other treatments except wetted wheat straw with 6% lime or boiled wheat straw with 4% lime

Table I. Effect of different methods of compost preparation and lime concentration on time (days) required for mycelial growth of *Pleurotus sajor-caju*

Method of compost preparation	Lime concentration 2%	4%	6%	Mean
Wetting wheat straw	23.00 C	35.00AB	25.00 C	27.66
Boiled wheat straw	25.00 C	27.66BC	36.00 A	29.55
Mean	24.00 B	31.33A	30.50 A	

LSD for Factor A. Method of compost preparation (n = 9) N.S. LSD for Factor B. Lime concentration (n = 6) 5.72; LSD for Interaction of A x B (n = 3) 8.09

Table II. Effect of different methods of compost preparation and lime concentration on time (days) required for pinheads of *Pleurotus sajor-caju*

Method of compost preparation	Lime concentration 2%	4%	6%	Mean
Wetting wheat straw	47.66	48.66	50.33	48.88 B
Boiled wheat straw	56.66	54.00	59.00	56.55 A
Mean	52.16	51.33	54.66	

LSD for Factor A. Method of compost preparation (n = 9) 3.82 LSD for Factor B. Lime concentration (n = 6) N.S.; LSD for Interaction of A x B (n = 3) N.S.

Table III Effect of different methods of compost preparation and lime concentration on number of flushes of *Pleurotus sajor-caju*

Method of compost preparation	Lime concentration 2%	4%	6%	Mean
Wetting wheat straw	5.67 A	2.67 B	5.33 A	4.55
Boiled wheat straw	3.67 B	5.33 A	3.67 B	4.22
Mean	4.66	4.00	4.50	

LSD for Factor A. Method of compost preparation (n = 9) N.S. LSD for Factor B. Lime concentration (n = 6) N.S.; LSD for Interaction of A x B (n = 3) 1.25

Table IV Effect of different methods of compost preparation and lime concentration on yield (g/1.5 kg substrate) of *Pleurotus sajor-caju*

Method of compost preparation	Lime concentration 2%	4%	6%	Mean
Wetting wheat straw	295.00	260.00	272.00	275.33
Boiled wheat straw	294.00	293.00	256.00	281.33
Mean	294.50	276.50	264.00	

LSD for Factor A. Method of compost preparation (n = 9) N.S. LSD for Factor B. Lime concentration (n = 6) N.S.; LSD for Interaction of A x B (n = 3) N.S.

gave significantly ($P < 0.05$) lower number of flushes. The main effects of both compost preparation methods as well as lime concentrations were non-significant. This might be due to when the bags were opened then composition of air changed mean O_2 increased and CO_2 reduced so high flushes appears and also it might be due to relative humidity and temperature factor (Alexopolous & Mims, 1979). Our results support the work of Lozano (1990).

Yield (g/1.5 kg substrate). The maximum yield (295 g/1.5 kg substrate) was recorded in wetted wheat straw with 2% lime (Table IV). However, this level of yield was not significantly ($P > 0.05$) higher when compared with the yields from the other treatments. The main effects of compost preparation methods and lime concentration were also not significant. When the number of flushes are more yield is higher. The yield of Pleurotus sajor-caju depends on genetic properties of fungal spp (subspecies, strain), substrate quality, structure and culture conditions. Substrate quality include moisture contents, lime concentration, resultant pH value and legninocellulatic activity of the substrate and mycelium. Wetted wheat straw with 2% lime concentration and boiled wheat straw with 2% lime concentration gave highest yield but there is a great difference in pH values i.e. 7.6 and 6.9, respectively. Moisture contents are almost same. The factor left is enzymatic activity and growth response in relation to environmental factors. Growth factor may be due to genetic properties of *Pleurotus spp* (Tillay & Terry, 1963; Zadrazil, 1976). Similar observations were also recorded by Badshah *et al*. (1992). So, from this study it was concluded that wetting wheat straw treatments were best for commercial production of *Pleurotus sajor-caju*.

CONCLUSION

It was concluded that wetted wheat straw performance was superior and 2% lime concentration was the best. Our conclusions about wetting and boiling treatments should be further tested. Genetic properties of strains of *Pleurotus sajor-caju* and enzymatic activities and chemical composition of substrate before and after colonization should also be investigated.

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(Received 22 October 2005; Accepted 29 November 2005)