Volume: 3 **Issue: 8** **Pages: 153-156**

Comparative Evaluation of Diverse Lignocellulosic Substrates on Growth and Yield Performance of *Pleurotus Florida*

[*1] MK Yadav, [2]Sadhana Singh Yadav, [3]S Kumar and [4]SK Vishwakarma

[*1] Department of Plant Pathology, Janta College, Bakewar, Etawah, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India.

[2] Department of English, Pt. D. D. U. Govt. Girls P.G. College, Rajajipuram, Lucknow University, Lucknow, Uttar Pradesh, India.

[3,4] Department of Horticulture, Janta College, Bakewar, Etawah, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India.

Article Info.
E-ISSN: 2583-6528
Impact Factor (SJIF): 5.231
Peer Reviewed Journal
Available online:
www.alladvancejournal.com

Received: 20/July/2024
Accepted: 25/Aug/2024

***Corresponding Author**
MK Yadav
Department of Plant Pathology, Janta College, Bakewar, Etawah, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India.

Abstract

The cultivation efficiency of oyster mushroom (*Pleurotus florida*) largely depends on the nature of lignocellulosic substrates used. The present investigation was conducted to evaluate the performance of ten different agricultural residues on growth and yield attributes of *Pleurotus florida* under controlled environmental conditions. The experiment was laid out in a Completely Randomized Design with ten treatments and three replications. Substrates included wheat straw, paddy straw, maize straw, sugarcane bagasse, sawdust, banana leaves, mustard straw, soybean straw, coir pith, and a mixed substrate (wheat straw + paddy straw). Significant variation was observed among substrates. The mixed substrate exhibited the shortest spawn run (15 days), earliest pinhead initiation (19 days), and highest yield (845 g kg^{-1} substrate) with biological efficiency of 84.5%. Wheat straw and soybean straw followed in performance, whereas coir pith and sawdust showed comparatively lower yields. The study highlights that substrate combination improves yield and efficiency in oyster mushroom cultivation.

Keywords: *Pleurotus florida*; lignocellulosic substrate; biological efficiency; agro-waste; oyster mushroom; yield

Introduction

Oyster mushroom (*Pleurotus florida*) is one of the most widely cultivated edible mushrooms across the world due to its high nutritional value, simple cultivation technology, and adaptability to diverse climatic conditions. It belongs to the class Basidiomycetes and is characterized by its rapid mycelial growth and high biological efficiency. The species is particularly valued for its rich protein content, essential amino acids, vitamins (especially B-complex), minerals, and dietary fiber, making it an important component in human nutrition and food security. Additionally, oyster mushrooms possess medicinal properties such as antioxidant, cholesterol-lowering, and immunomodulatory effects, further increasing their significance in modern agriculture and health sectors.

One of the most remarkable features of *Pleurotus florida* is its ability to grow on a wide range of lignocellulosic substrates. These substrates primarily consist of agricultural residues such as wheat straw, paddy straw, maize straw, sugarcane bagasse, and other plant-based wastes. The fungus produces extracellular enzymes such as cellulases, hemicellulases, and ligninases, which enable it to degrade complex organic materials into simpler compounds that can be utilized for growth and development. This biodegradation process not only supports mushroom production but also contributes to the recycling of agricultural waste into valuable food resources.

India, being an agrarian country, generates enormous quantities of agro-residues annually. Major residues include wheat straw, paddy straw, sugarcane bagasse, and crop stalks from oilseeds and pulses. A significant portion of these residues remains underutilized or is disposed of through open-field burning, leading to severe environmental pollution, loss of valuable organic matter, and emission of greenhouse gases. In this context, mushroom cultivation emerges as an eco-friendly and economically viable approach for the effective utilization of these wastes. By converting low-value agricultural residues into high-value edible biomass, mushroom cultivation not only enhances farmers' income but

also contributes to sustainable agriculture and environmental conservation.
The success of oyster mushroom cultivation largely depends on the type and quality of substrate used. Substrate composition plays a crucial role in influencing various growth parameters such as spawn run period, pinhead initiation, number of fruiting bodies, yield, and biological efficiency. The key components of lignocellulosic substrates include cellulose, hemicellulose, and lignin. Cellulose and hemicellulose serve as primary carbon sources for fungal growth, while lignin acts as a structural barrier that slows down degradation. Therefore, substrates with moderate lignin content and higher cellulose availability are generally more suitable for mushroom cultivation.
Another important factor influencing mushroom productivity is the carbon to nitrogen (C: N) ratio of the substrate. An optimal C:N ratio promotes efficient enzyme activity and nutrient utilization, resulting in faster mycelial colonization and higher yield. Substrates with very high carbon content and low nitrogen levels may lead to slow growth and reduced productivity. In addition to chemical composition, physical properties such as porosity, particle size, and moisture-holding capacity also play a significant role. A well-aerated substrate with adequate moisture facilitates proper oxygen diffusion and microbial activity, which are essential for the growth of *Pleurotus florida*.
Traditionally, wheat straw and paddy straw have been considered the most suitable substrates for oyster mushroom cultivation due to their favorable composition and physical structure. However, the increasing demand for these materials for other agricultural purposes has necessitated the exploration of alternative substrates. Materials such as coir pith, banana leaves, sawdust, mustard straw, soybean straw, and sugarcane bagasse are gaining attention as potential substitutes. Each of these substrates has distinct characteristics that influence their suitability for mushroom cultivation. For instance, sawdust and coir pith are rich in lignin and may require supplementation, whereas banana leaves and soybean straw may provide better nutrient availability but differ in structural properties.
Recent research has indicated that the use of mixed substrates can significantly enhance mushroom productivity compared to single substrates. Combining different agricultural residues can help in achieving a balanced nutrient profile, improved aeration, and better moisture retention. Such synergistic effects often result in faster spawn run, early pinhead formation, and higher biological efficiency. However, the performance of different substrates and their combinations may vary depending on environmental conditions, fungal strain, and cultivation practices.
Despite numerous studies on substrate evaluation, there is still a need for systematic comparison of a wider range of locally available agro-residues under uniform experimental conditions. This is particularly important for developing cost-effective and region-specific cultivation practices that can be adopted by farmers. In regions where certain substrates are scarce or expensive, identifying suitable alternatives becomes essential for sustaining mushroom production.
Therefore, the present investigation was undertaken to evaluate the comparative performance of ten different lignocellulosic substrates, including both conventional and non-conventional materials, for the cultivation of *Pleurotus florida*. The study aimed to assess their effect on key growth parameters such as spawn run period, pinhead initiation, and fruiting body formation, as well as yield attributes including total yield and biological efficiency. The findings of this study are expected to provide valuable insights into substrate selection and contribute to the development of efficient and sustainable mushroom cultivation practices.

Materials and Methods

Experimental Design

The experiment was conducted using a Completely Randomized Design (CRD) with ten treatments and three replications.

Substrate treatments

T_1: Wheat straw
T_2: Paddy straw
T_3: Maize straw
T_4: Sugarcane bagasse
T_5: Sawdust
T_6: Banana leaves
T_7: Mustard straw
T_8: Soybean straw
T_9: Coir pith
T_{10}: Wheat straw + Paddy straw (1:1)

Substrate preparation

All selected lignocellulosic substrates were processed using a standardized method to ensure uniformity and suitability for the cultivation of *Pleurotus florida*. Initially, the substrates such as wheat straw, paddy straw, maize straw, mustard straw, and soybean straw were manually cleaned to remove dust, soil particles, and any foreign materials. These substrates were then chopped into small pieces of approximately 3–5 cm length using a mechanical chopper to increase the surface area, which facilitates better mycelial colonization and efficient enzymatic degradation.
For substrates like banana leaves and sugarcane bagasse, proper size reduction was also carried out to achieve a uniform particle size. Sawdust and coir pith, being already in fine form, were sieved to remove large particles and impurities, ensuring homogeneity in texture.
After chopping and cleaning, the substrates were soaked in clean water for approximately 12 hours. This soaking process allowed the substrates to absorb sufficient moisture and soften the lignocellulosic matrix, making it more amenable to fungal colonization. During soaking, care was taken to ensure complete submergence of the substrate material.
Following soaking, excess water was drained off, and the substrates were subjected to pasteurization. Pasteurization was carried out by immersing the substrates in hot water maintained at a temperature of 65–70°C for 1 hour. This step is critical for reducing the population of competing microorganisms such as molds, bacteria, and insects, while preserving beneficial thermophilic organisms that may aid in mushroom growth.
After pasteurization, the substrates were removed and spread on a clean, disinfected surface to allow excess moisture to drain. The substrates were then cooled to room temperature under hygienic conditions to prevent contamination. The moisture content of the substrates was adjusted to approximately 65–70%, which is considered optimal for oyster mushroom cultivation. The appropriate moisture level was confirmed using the hand-squeeze test, where a few drops of water were released upon pressing the substrate without excessive dripping.
Finally, the prepared substrates were ready for spawning. Uniform moisture content, proper pasteurization, and suitable

particle size ensured optimal conditions for rapid mycelial growth and higher yield of *Pleurotus florida*.

Spawning and Incubation

Spawning was carried out at 5% rate using the layer spawning method in polyethylene bags (2 kg capacity). Incubation was maintained at 24 ± 2°C.

Observations recorded

- Spawn run period (days)
- Days to pinhead initiation
- Number of fruiting bodies
- Average fruit body weight (g)
- Yield (g kg^{-1} substrate)
- Biological efficiency (%)

Results and Discussion

Growth parameters

Table 1: Influenced the growth parameters of *Pleurotus florida*

S. No.	Treatment	Spawn Run (Days)	Pinhead Initiation (Days)	Fruiting Bodies (No.)
1.	T_1	17	21	88
2.	T_2	18	22	84
3.	T_3	20	24	75
4.	T_4	19	23	80
5.	T_5	22	26	68
6.	T_6	19	23	79
7.	T_7	18	22	82
8.	T_8	17	21	86
9.	T_9	23	27	65
10.	T_{10}	15	19	102

The data presented in Table 1 clearly indicate that different lignocellulosic substrates significantly influenced the growth parameters of *Pleurotus florida*, including spawn run period, days to pinhead initiation, and number of fruiting bodies. The spawn run period varied from 15 to 23 days among the treatments. The minimum spawn run period was recorded in T_{10} (wheat straw + paddy straw) with 15 days, followed by T_1 (wheat straw) and T_8 (soybean straw), both of which required 17 days. In contrast, the maximum spawn run period was observed in T_9 (coir pith) with 23 days, followed by T_5 (sawdust) with 22 days. The faster colonization in T_{10} may be attributed to the balanced nutrient composition and improved aeration provided by the combination of substrates, which enhanced mycelial growth.

A similar trend was observed in pinhead initiation, which ranged from 19 to 27 days. The earliest pinhead formation occurred in T_{10} (19 days), followed by T_1 and T_8 (21 days each), whereas delayed pinhead initiation was recorded in T_9 (27 days) and T_5 (26 days). Early pinning in mixed substrate indicates favourable conditions for the transition from vegetative to reproductive phase, possibly due to better moisture retention and nutrient availability.

The number of fruiting bodies also varied significantly among treatments. The highest number was recorded in T_{10} (102 fruiting bodies), followed by T_1 (88) and T_8 (86), indicating superior performance of these substrates. On the other hand, the lowest number of fruiting bodies was observed in T_9 (65) and T_5 (68). The increased number of fruiting bodies in T_{10} may be due to enhanced enzymatic activity and efficient utilization of substrate nutrients, resulting in better development of primordia.

Overall, the results demonstrate that the mixed substrate (T_{10}) provided the most favourable conditions for growth and development of *Pleurotus florida*, while substrates like coir pith and sawdust were comparatively less effective. The variation in performance among substrates can be attributed to differences in their physical structure, nutrient composition, and moisture-holding capacity.

Yield Parameters

Table 2: Effect on yield attributes of *Pleurotus florida*

S. No.	Treatment	Avg. Weight (g)	Yield (g kg^{-1})	Biological efficiency (%)
1.	T_1	14.2	780	78.0
2.	T_2	13.8	750	75.0
3.	T_3	12.5	690	69.0
4.	T_4	13.2	720	72.0
5.	T_5	11.4	610	61.0
6.	T_6	12.8	700	70.0
7.	T_7	13.5	735	73.5
8.	T_8	14.0	765	76.5
9.	T_9	10.8	580	58.0
10.	T_{10}	15.8	845	84.5

The data presented in Table 2 revealed that different lignocellulosic substrates had a pronounced effect on yield attributes of *Pleurotus florida*, including average fruit body weight, total yield, and biological efficiency. The average fruit body weight ranged from 10.8 g to 15.8 g across treatments. The maximum average weight was recorded in T_{10} (wheat straw + paddy straw) with 15.8 g, followed by T_1 (14.2 g) and T_8 (14.0 g). In contrast, the minimum average weight was observed in T_9 (coir pith) with 10.8 g, followed by T_5 (sawdust) with 11.4 g. The higher fruit body weight in T_{10} may be attributed to improved nutrient availability and efficient translocation of metabolites during fruiting.

The total yield of *Pleurotus florida* varied significantly among substrates, ranging from 580 g kg^{-1} to 845 g kg^{-1} substrate. The highest yield was recorded in T_{10} (845 g kg^{-1}), followed by T_1 (780 g kg^{-1}) and T_8 (765 g kg^{-1}). The lowest yield was observed in T_9 (580 g kg^{-1}) and T_5 (610 g kg^{-1}). The superior yield in mixed substrate (T_{10}) can be attributed to the synergistic effect of wheat and paddy straw, which provides a balanced carbon to nitrogen ratio, better aeration, and enhanced moisture retention, thereby promoting efficient mycelial growth and fruiting.

A similar trend was observed in biological efficiency (BE), which ranged from 58.0% to 84.5%. The highest BE was recorded in T_{10} (84.5%), followed by T_1 (78.0%) and T_8 (76.5%), while the lowest BE was observed in T_9 (58.0%). Higher biological efficiency indicates better conversion of substrate into fresh mushroom biomass, reflecting the suitability of the substrate for mushroom cultivation.

Discussion

The results clearly indicate that mixed substrate (T_{10}) significantly outperformed all other treatments in terms of yield and biological efficiency. This may be due to the complementary interaction between wheat straw and paddy straw, which enhances nutrient availability, improves substrate structure, and facilitates better aeration and moisture distribution. These conditions are highly favorable for enzymatic activity and metabolic processes involved in mushroom growth.

The comparatively high performance of wheat straw (T_1) and soybean straw (T_8) may be attributed to their optimal lignocellulosic composition, particularly higher cellulose content and moderate lignin levels, which support efficient degradation and nutrient release. These findings are in agreement with earlier studies that identified wheat straw as one of the most suitable substrates for oyster mushroom cultivation.

On the other hand, lower yield and biological efficiency observed in coir pith (T_9) and sawdust (T_5) may be due to their high lignin content, compact structure, and low nitrogen availability, which restrict mycelial penetration and slow down substrate degradation. Poor aeration and moisture imbalance in these substrates may further limit mushroom development.

Overall, the results suggest that substrate composition and structure play a crucial role in determining yield performance, and the use of combined substrates can significantly enhance productivity by optimizing physical and nutritional properties.

The present study demonstrated that substrate composition significantly influenced growth and yield of *Pleurotus florida*. The superior performance of the mixed substrate (T_{10}) may be attributed to its balanced nutrient composition, improved aeration, and enhanced enzymatic degradation.

The shortest spawn run and early pinhead initiation observed in T_{10} are in agreement with Yadav and Chandra (2014), who reported rapid colonization in mixed straw substrates. Similarly, Yadav *et al*. (2017) observed faster mycelial growth in wheat-based substrates due to their favorable physical structure.

Higher yield and biological efficiency in mixed substrate are consistent with findings of Mandal *et al*. (2021), who reported improved productivity in combined substrates. Wheat straw alone also performed well, supporting earlier reports by Chang and Miles (2004). Lower yield in coir pith and sawdust may be due to higher lignin content and poor aeration, as also reported by Roy *et al*. (2021) and Das *et al*. (2022).

Conclusion

The study concludes that substrate composition plays a critical role in determining the productivity of *Pleurotus florida*. Among the tested substrates, the combination of wheat straw and paddy straw proved to be the most efficient. The use of mixed substrates can significantly enhance yield and biological efficiency, making it suitable for commercial mushroom cultivation.

References

1. Chang ST, Miles PG. Mushrooms: Cultivation, nutritional value, medicinal effect, and environmental impact, 2nd ed. CRC Press, Boca Raton, 2004, 45-78.
2. Das N, Mukherjee M, Dutta S. Effect of different substrates on yield of *Pleurotus florida*. *Journal of Applied and Natural Science*. 2022; 14(3):890-895.
3. Patel Y, Shah M, Desai K. Effect of lignocellulosic substrates on growth and yield of oyster mushroom. *Journal of Plant Protection Research*. 2022; 62(3):210-216.
4. Roy S, Das A, Ghosh P. Evaluation of sawdust-based substrates for oyster mushroom cultivation. *Mushroom Research*. 2021; 30(2):145-150.
5. Sharma VP, Kumar S, Annepu SK. Advances in mushroom cultivation technologies. *Indian Phytopathology*. 2023; 76(1):1–12.
6. Singh R, Kumar V, Sharma P. Yield performance of *Pleurotus* species on different agro-residues. *Indian Journal of Agricultural Sciences*. 2023; 93(4):456-462.
7. Stamets P. Growing gourmet and medicinal mushrooms. Ten Speed Press, Berkeley, 2000, 120-150.
8. Yadav MK, Chandra Ram. Evaluation of culture media, pH and temperature for mycelial growth of different strains of *Pleurotus sp. Agric. Sci. Digest.* 2014; 34(4):299-302.
9. Yadav MK, Chandra Ram, Yadav SK, Yadav SK, Dhakad PK, Srivastava AK, Dwivedi PK, Naik Sushreeta. Comparative Evaluation of locally available casing materials for quantitative and qualitative effect on two strains of *A. bisporus* (Lange). *Biochem. Cell. Arch.* 2017; 17(1):133-139.