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SUSTAINABLE CULTIVATION OF *PLEUROTUS FLORIDA* USING CAMPUS-DERIVED AGRO-WASTES: A COMPARATIVE STUDY WITH PADDY STRAW

S. Chandraprakash[1*], C. Selvakumar[1], A. Sri Maadhangi[1], T. S. Savitha[1], R. Sindhuja[1], M. Sowntharya[1], J. S. Sreelekshmi[1], M. Srinivasan[2] and B. Muthuraja[3]

[1]Department of Crop Protection, PGP College of Agricultural Sciences, Namakkal, Tamil Nadu, India-637405.

[2]Department of Crop Management, PGP College of Agricultural Sciences, Namakkal, Tamil Nadu, India-637405.

[3]Department of Social Sciences, PGP College of Agricultural Sciences, Namakkal, Tamil Nadu, India-637405.

*Corresponding author E-mail: suriyaprakash235@gmail.com

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ABSTRACT

This study explores the sustainable cultivation of *Pleurotus florida* (oyster mushroom) using agro-wastes derived from the PGP College campus, comparing its yield on different substrates. Four agro-wastes - casuarina needles, coconut leaves, sorghum straw, and paddy straw, were assessed for their efficiency in mushroom production. The experiment focused on identifying the most effective substrate for maximizing mushroom yield and biological efficiency. Results indicated that paddy straw yielded the highest production at 667.67 g, followed by coconut leaves with 407.34 g. Casuarina needles and sorghum straw resulted in significantly lower yields. The study concludes that paddy straw is the most suitable substrate for Pleurotus florida cultivation, providing the best overall yield and biological efficiency, while alternative substrates like coconut leaves show potential for regions lacking paddy straw. Further research is recommended to optimize the use of other substrates.

Keywords **:** sustainable cultivation, *Pleurotus florida*, agro-wastes, mushroom cultivation.

Introduction

Mushrooms, macro fungi with distinct fruiting bodies, can be epigeous (above ground) or hypogeous (below ground). Lacking chlorophyll, they rely on decomposing organic matter for nourishment. This saprophytic role helps address issues like food security and environmental pollution, providing high-quality, biologically valuable food suitable for diverse consumers (Jenita *et al.*, 2021). Edible mushrooms, mainly from the Basidiomycota class, include species like *Agaricus bisporus* (white button mushroom), Lentinus edodes (shiitake), and *Pleurotus spp.* (oyster mushroom), which are rich in protein, vitamins, and minerals. They are particularly beneficial for diabetic patients due to low starch content (Sardar *et al.*, 2020). Globally, around 3,000 mushroom species are edible, with 200 cultivated and 100 economically significant (Attri *et al.*, 2021). Oyster mushrooms (*Pleurotus spp.*), the third most cultivated worldwide, are adaptable to various substrates, thriving in temperate and tropical climates. In India, *Pleurotus florida* is praised for its nutritional value, containing 25-50% protein, essential minerals, and medicinal properties like antioxidant and anti-inflammatory effects (Ng'etich *et al.*, 2013; Babar *et al.*, 2016). Mushroom cultivation efficiently manages agricultural waste, converting it into protein-rich food and improving straw for animal feed. Oyster mushrooms are effective at degrading lignocellulosic residues, transforming agro-waste into valuable resources (Balasubramani *et al.*, 2017). Research supports substrates like sorghum straw and coconut leaves for successful oyster mushroom growth (Deshmukh & Deshmukh, 2013).

Materials and Methods

The study on the "Sustainable Cultivation of *Pleurotus florida* Using Campus-Derived Agro-wastes: A Comparative Study with Paddy Straw" was conducted at PGP College of Agricultural Sciences, Namakkal, from July to September 2024. The location sits at 11.229545° latitude and 78.200957° longitude, at 218 meters above sea level.

Substrates

The research used four substrates for oyster mushroom cultivation: casuarina needles (*Casuarina equisetifolia*), coconut leaves (*Cocos nucifera*), sorghum straw (*Sorghum bicolor*), and paddy straw (*Oryza sativa*) as a control.

Source of Spawn

The spawn of *Pleurotus florida* was sourced from Tamil Nadu Agricultural University (TNAU), Coimbatore.

Mushroom Bed Preparation

Substrates were chopped into 3-5 cm pieces, soaked in water for 12 hours, drained, sterilized at 20 pounds per square inch for 20 minutes, and shade-dried to achieve 60-65% moisture. Polypropylene bags were filled with alternating layers of substrate and spawn (2% of wet weight), sealed, and perforated for air exchange (Jatwa *et al*., 2016).

Optimal Conditions for Cultivating *Pleurotus florida*

The mushroom beds were kept in a spawn-running room with temperatures of 24-28°C for 20 days. Once colonization was complete, the beds were transferred to a cultivation shed with controlled conditions (20-25°C, 80-90% humidity). Primordia appeared 2-4 days after spawn-running, and mushrooms matured within 48 hours of appearance. Harvesting occurred when the mushroom caps curled (Jatwa *et al*., 2016).

Data Presentation and Evaluation of Biological Efficiency

Data collected included spawn-running time, bud initiation, harvest timing, number of flushes, total yield, and biological efficiency. Biological efficiency, calculated as the percentage of fresh mushroom yield to dry substrate weight, was determined for each agro-waste substrate (Sardar *et al*., 2020).

Statistical Analysis

The yield data were analysed using a completely randomized design (CRD) with one-way analysis of variance (ANOVA). Statistical significance was determined at $P<0.05$ for all analyses. The data were processed using AGRES software (Balasubramani *et al*., 2017).

Results and Discussion

This chapter presents and discusses the findings from the study on the sustainable cultivation of *Pleurotus florida* using campus-derived agro-wastes, with a comparison to paddy straw as a control. The investigation focused on various growth parameters, yield, and biological efficiency.

Spawn Running

The duration of spawn running varied significantly between substrates. Casuarina needles exhibited the shortest spawn-running period at 12.34 days, outperforming other substrates. Coconut leaves and sorghum straw required 20.34 and 21.34 days, respectively, while paddy straw, a commonly used substrate in mushroom cultivation, took the longest at 23.00 days. This suggests that casuarina needles can significantly reduce the spawn-running period, making it an efficient substrate for early growth. However, faster spawn running does not necessarily correlate with higher yields or biological efficiency (Table 1).

Bud Initiation

Similar trends were observed for bud initiation. Buds appeared earliest on casuarina needles, after just 13.34 days. Coconut leaves and sorghum straw required 22.34 and 23.34 days, respectively, while paddy straw took the longest at 24.67 days. Casuarina needles' rapid bud initiation makes them a promising substrate for quick crop cycles, though this advantage may be offset by lower yields (Table 1).

First Harvest

The time to first harvest followed the same pattern, with mushrooms on casuarina needles ready for harvest in 15.34 days. Mushrooms on coconut leaves and sorghum straw took 24.34 and 25.34 days, respectively, and paddy straw required the longest time, 26.67 days. Despite casuarina needles showing the quickest time to harvest, the quantity of mushrooms produced on this substrate was significantly lower than that grown-on paddy straw (Table 1).

Harvest and Yield Performance

Casuarina needles, while demonstrating the fastest growth, yielded significantly less, with 267.34 grams of mushrooms and a biological efficiency of 26.73%. Sorghum straw also yielded less, with 312.34 grams and a biological efficiency of 31.23%. In contrast, paddy straw achieved the highest yield of 667.67 grams and a biological efficiency of 66.76%, making it the best-performing substrate. Coconut leaves yielded 407.34 grams with a biological efficiency of 40.73%, indicating that they could serve as a viable substrate, particularly where they are readily available. The critical difference (CD) values for yield (51.95%) and biological efficiency (3.1634%) confirmed that the differences between substrates were statistically significant at the 5% level (Table 2 & Plate1).

Sporocarp Details

Paddy straw also excelled in the number of flushes and the average size of the mushrooms. It produced the highest number of flushes, with 16.00 flushes at the first harvest and 13.67 flushes at the second harvest. Mushrooms grown on paddy straw had the largest average diameter per flush at 6.77 cm, suggesting that paddy straw supports both a higher number and larger size of mushrooms. Coconut leaves supported 13.34 flushes at the first harvest but saw a decrease to 6.67 flushes at the second harvest, with a flush diameter of 4.70 cm. Casuarina needles and sorghum straw produced fewer and smaller mushrooms. Casuarina needles supported 12.00 flushes at the first harvest and 8.34 at the second, with the smallest flush diameter of 2.40 cm. Sorghum straw produced 8.34 flushes at the first harvest and 6.34 at the second, with an average flush diameter of 4.17 cm. The differences in the number of flushes and flush diameters were statistically significant, with CD values of 1.8027 for the first harvest, 2.1741 for the second harvest, and 0.4770 cm for flush diameter at the 5% level (Table 3).

The results underscore the varying impacts of different substrates on the growth, yield, and biological efficiency of *Pleurotus florida*. Casuarina needles were the most efficient in terms of spawn running, bud initiation, and time to first harvest. However, they yielded the least amount of mushrooms and had the lowest biological efficiency, consistent with findings by Sutha Raja Kumar *et al.* (2019), who noted similar limitations with casuarina needles for *Hypsizygus ulmarius* cultivation. The low yield and efficiency may be due to the lower lignocellulosic content and the presence of inhibitory compounds such as tannins.

Paddy straw, a well-established substrate in mushroom cultivation, outperformed all other substrates in yield and biological efficiency. The high yield of 667.67 grams and biological efficiency of 66.76% align with findings from Balasubramani *et al.* (2017), who reported superior performance with paddy straw due to its rich lignocellulosic content. The high cellulose and hemicellulose content in paddy straw likely provided an optimal environment for mycelial growth and fruiting body formation.

Coconut leaves emerged as a viable alternative substrate, with a yield of 407.34 grams and a biological efficiency of 40.73%. This finding is supported by Bhawna and Thomas (2003), who also noted the effectiveness of coconut leaf stalks for cultivating species like *Pleurotus florida* and *P. sajor-caju*. Although the biological efficiency was lower compared to previous research, coconut leaves remain a promising alternative, especially where they are readily available.

Sorghum straw was less effective in this study, yielding 312.34 grams with a biological efficiency of 31.23%. This finding aligns with earlier research by Jahangir *et al.* (2015), who found lower yields when sorghum straw was used compared to other substrates. The lower yield and biological efficiency may be due to the nutrient

Conclusion

This study demonstrates that while Casuarina Needles perform exceptionally well in terms of spawn running, bud initiation, and early harvest times, their overall yield and biological efficiency are considerably lower than that of Paddy Straw and Coconut Leaves. Paddy Straw proved to be the most effective substrate for the sustainable cultivation of *Pleurotus florida*, offering the highest yield, biological efficiency, and mushroom quality. However, Coconut Leaves emerged as a viable alternative, especially in regions where Paddy Straw is not readily available, producing substantial yields and relatively large mushrooms. Casuarina Needles and Sorghum Straw, although capable of supporting mushroom growth, were less effective and are not recommended for high-yield commercial cultivation. Future studies could focus on optimizing the use of these alternative substrates, particularly in terms of enhancing their nutritional composition, to improve their performance in mushroom cultivation.

Table 1: Days for Bud Initiation and First Harvest of *Pleurotus florida* on Various Agro-wastes

Treatments	Substrates	Average Days for spawn running*	Average Days for Bud Initiation*	Average Days for First Harvest*
T1	Casuarina Needles	12.34^a	13.34^a	15.34^a
T2	Coconut Leaves	20.34^b	22.34^b	24.34^b
T3	Sorghum Straw	21.34^c	23.34^b	25.34^b
T4	Paddy Straw	23.00^d	24.67^c	26.67^c
		CD (0.05) = 0.9414	**CD (0.05) = 1.0871**	**CD (0.05) = 1.0871**

* Mean of three replications Figures followed by same letters are not significantly different

Table 2: Performance of Various Agro-wastes on the Growth of *Pleurotus florida*

Treatments	Substrates	Average Yield* (g)	Biological efficiency* (%)
T1	Casuarina Needles	267.34^{c}	26.73^{c} (31.13)
T2	Coconut Leaves	407.34^{b}	40.73^{b} (39.65)
T3	Sorghum Straw	312.34^{c}	31.23^{c} (33.97)
T4	Paddy Straw	667.67^{a}	66.76^{a} (54.82)
		CD (0.05) = 51.95	**CD (0.05) = 3.1634**

* Mean of three replications
Values in parentheses are arcsine-transformed values
Figures followed by same letters are not significantly different

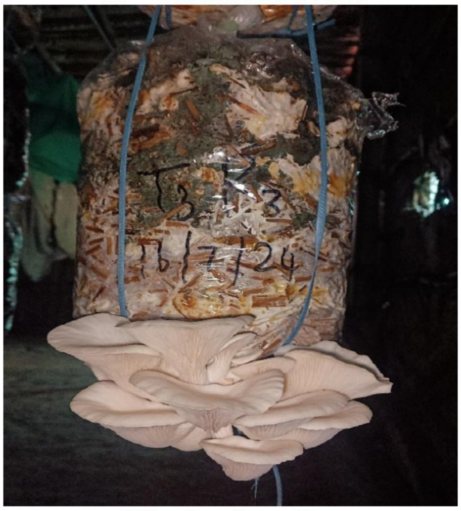
Table 3: Sporocarp Details of *Pleurotus florida* on Various Agro-wastes

Treatments	Substrates	Average Number of Flushes at First Harvest*	Average Number of Flushes at Second Harvest*	Average Diameter of a Single Flush (cm)*
T1	Casuarina Needles	12.00^{b}	08.34^{b}	02.40^{d}
T2	Coconut Leaves	13.34^{b}	06.67^{b}	04.70^{b}
T3	Sorghum Straw	08.34^{c}	06.34^{b}	04.17^{c}
T4	Paddy Straw	16.00^{a}	13.67^{a}	06.77^{a}
		CD (0.05) = 1.8027	**CD (0.05) = 2.1741**	**CD (0.05) = 0.4770**

* Mean of three replications
Figures followed by same letters are not significantly different

T1 – Casuarina Needles

T2 – Coconut Leaves



T3 – Sorghum Straw

T4 – Paddy Straw

Plate 1: Performance of Various Agro-wastes on the Growth of Oyster Mushroom (*Pleurotus florida*)

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