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Evaluating the impact of various agricultural substrates on the growth and yield performance of oyster mushroom (*Pleurotus* sp.)

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Abstract

This study, titled "Comparative Effect of Different Substrates on the Growth and Yield of Oyster Mushroom (*Pleurotus* sp.)," was conducted at the Institute of Agricultural Technology, Isabela State University, Cauayan City, Isabela, from April to June 2023. The primary objective was to evaluate the effectiveness of various substrates - sawdust, rice straw, banana leaves, mungbean pods, and corn cobs – on the growth and yield of oyster mushrooms. Utilizing a Completely Randomized Design (CRD), the experiment involved 15 bags for each substrate type. Key parameters measured included spawn run, mushroom length, width, and weight. Results indicated that the spawn run did not significantly differ among substrates in the first three weeks, with mean values ranging from 2.81 to 3.35 cm. However, significant differences were observed in mushroom dimensions and weight, with mungbean pods yielding the longest (6.15 cm), broadest (6.45 cm), and heaviest mushroom (80.15 g). The findings suggested that mungbean pods served as an effective substrate for enhancing the growth and yield of oyster mushrooms. Consequently, the study recommended the use of locally available materials, particularly mungbean pods, for improved *Pleurotus* mushroom production, thereby contributing to sustainable agricultural practices and food security.

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Introduction

Oyster mushrooms (*Pleurotus* sp.) belonged to the Tricholomataceae family and ranked as the second most widely cultivated mushroom globally. They were particularly popular in Asia, America, and Europe due to their simple and low-cost production methods. The growing interest in oyster mushrooms was largely attributed to their taste, nutritional value, and medicinal properties. These mushrooms could effectively degrade agricultural waste and thrived across a wide range of temperatures. Ideal substrates for cultivation typically contained low nitrogen and high carbon levels, utilizing materials rich in cellulose, hemicellulose, and lignin, such as rice straw, wheat straw, waste paper, leaves, and sugar cane residue. However, the yield and quality of oyster mushrooms were influenced by the chemical and nutritional content of the substrates used. To enhance the growth and development of sporophores, it was essential to use supportive substrates during the mushroom production process. Various agricultural substrates had been employed for cultivating oyster mushrooms, with the growth and yield varied significantly based on the substrate type, as noted by Dhakal *et al.* (2020). A worldwide survey conducted by Chang (1999) identified over 200 different substrate types that support effective growth of *Pleurotus* sp.

Most additives used in cultivation were organic materials like rice bran, corn gluten meal, corn bran, and molasses. Despite their importance, many farmers remained unaware of the role these additives play in mushroom cultivation. Additionally, various locally available organic substrates such as rice straw, grasses, and banana leaves were often either burned or used as livestock feed. Given that substrate selection was crucial for determining mushroom yield, this study aimed to evaluate the performance of oyster mushrooms (*Pleurotus* sp.) using different substrate sources.

Materials and methods

Collection of substrates for mushroom production

In order to prevent potential contamination, various materials were collected immediately after harvest to serve as substrates. These materials included sawdust, rice straw, banana leaves, mungbean pods, and corn cobs. Collecting these substrates promptly after harvest ensured their quality and suitability and quality.

Preparation of growing substrates

The different materials gathered were sundried and shredded properly to enhance the pre-decomposition process and ease of bagging.

Mixing and fermentation of substrates

All the necessary materials were prepared like rice bran, agricultural lime, muscovado sugar, sawdust and different agricultural waste. A small amount of substrate was mixed first like sugar, and agricultural lime followed by the rice bran. The substrates were mixed two to three times and mixed larger amount of substrates like saw dust and other agricultural waste. It was also important to add an adequate amount of water to the mixture and cover it with plastic sheet to facilitate the fermentation process. This was a very important process before bagging. Substrates to be used in mushroom production needed to be fermented first prior to bagging.

Bagging and pasteurization

The substrates were bagged manually using a bagger 7 to 10 days after fermentation process. Each fruiting bag, made from 6x10 inch polypropylene (PP), typically weighs 800 grams. Using steel drum, pasteurization was done for at least 4-6 hours to ensure proper sterilization.

The pasteurization process was extended by letting it cool inside the drum over night before unloading the fruiting bags from the steel drum. Place the pasteurized fruiting bags in a secure and cool dry place to avoid contamination.

Spawning and incubation

Before starting the spawning process, it was essential to gather all necessary materials, including an alcohol lamp, grain spawn, paper, cotton, 70% alcohol, and rubber bands. During spawning, 15 to 20 grain spawn were placed in each fruiting bag. The bags were then covered with cotton balls and paper, which were secured in place using rubber bands.

After inoculation, the inoculated fruiting bags were placed in the incubation room for a period of 25 to 30 days. During this time, the fruiting bags were regularly monitored, and any contamination.

Hanging

Once the fruiting bags were fully ramified, they were hung in the growing house using a growing rack.

Care and maintenance

Monitor the temperature regularly and water the fruit bags using an atomizer if needed. Smoke the growing house using coconut husk to prevent the presence of insect pests that infested the fruiting bags. Contaminated fruiting bags were discarded immediately by burning.

Harvesting

Harvesting was conducted when the mushroom caps reached their maximum diameter. The mushrooms were carefully picked by twisting gently to avoid leaving any stalk behind. Post-harvest, the weight of the mushrooms was recorded to evaluate yield.

Results and discussion

Five (5) different agricultural wastes were used as substrates to determine their performance in terms of growth and yield performance of oyster mushroom. Spawn run in first, second, and third week was presented in Table 1. The initial (first week) spawn run across the different substrates showed no significant variation, indicating that all substrates provided a comparable environment for mycelial colonization. The mean values ranged from 2.81 to 3.35, suggesting that the substrates were equally effective in supporting the early growth phase of the oyster mushroom.

Table 1. Spawn run in first, second, and third week

Treatment	Spawn run (1st week)	Spawn run (2nd week)	Spawn run (3rd week)
T_1 -Sawdust	2.95	4.59	12.39
T_2 -Rice straw	2.97	7.17	14.02
T_3 -Banana leaves	2.95	6.20	14.55
T_4 -Mungbean	2.81	6.88	14.44
T_5 -Corncobs	3.35	8.12	15.15
Anova result	ns	ns	ns
C.V. (%)	15.27%	14.43%	10.50%

Table 2. Mushroom length, mushroom width, and weight of mushroom on different substrates

Treatment	Mushroom length	Mushroom width	Weight of mushroom
T_1 -Sawdust	4.35b	4.98b	68.35b
T_2 -Rice straw	4.32b	4.97b	68.38b
T_3 -Banana leaves	2.33c	3.20c	55.40c
T_4 -Mungbean	6.15a	6.45a	80.15a
T_5 -Corncobs	4.30b	4.97b	68.37b
Anova result	**	**	**
C.V. (%)	15.10%	16.20%	10.15%

In the second week, the spawn run continued to show no significant differences among the treatments. The mean values increased significantly, ranging from 4.59 to 8.12, indicating that the mycelium was actively colonizing the substrates. This suggested that the substrates were conducive to mycelial growth, with corn cobs showing the highest mean value, which may have indicated a favorable composition for mycelial development.

By the third week, the spawn run results remained statistically similar across the different substrates, with mean values ranging from 12.39 to 15.15. This consistency in growth rates across substrates reinforced the idea that all tested substrates were viable options for oyster mushroom cultivation, although corn cobs again exhibited the highest mean value, suggesting a potential preference for this substrate.

The length of the mushrooms was significantly influenced by the type of substrate used. Mungbean pods yielded the longest mushrooms, with a mean length of 6.15 cm, indicating that this substrate not only supported mycelial growth but also promoted the development of larger fruiting bodies. In contrast, sawdust produced no measurable length, highlighting its inadequacy as a substrate for optimal growth (Table 2).

Similar to length, the width of the mushrooms was significantly affected by the substrate. Mungbean pods again led with a mean width of 6.45 cm, while rice straw, corn cobs, and saw dust were comparable with mean values ranging from 4.97 to 4.98 cm. This suggested that mungbean pods provided superior nutritional and structural support for mushroom development.

The weight of the harvested mushrooms was also significantly influenced by the substrate type. Mung bean pods produced the heaviest mushrooms, averaging 80.15 grams, while rice straw, corn cobs, and sawdust yielded comparable weights ranging from 68.35 to 68.38 grams respectively. This indicated that mungbean not only enhanced growth in terms of size but also contributed to a higher biomass yield.

Conclusion

The results indicated that the spawn run during the first week post-inoculation did not show significant variation among the substrates, with mean values ranging from 2.81 to 3.35. In the second and third weeks, the spawn run also remained comparable across treatments, with values between 4.59 to 8.12 and 12.39 to 15.15, respectively. Notably, the substrate type significantly influenced the physical characteristics of the mushrooms. Mungbean pods yielded the longest (6.15 cm) and broadest (6.45 cm) mushrooms, as well as the heaviest weight (80.15 g), outperforming other substrates.

The findings of this study indicated a significant impact of substrate choice on the growth and yields of oyster mushrooms. Specifically, the use of mungbean pods emerged as the most effective substrate, enhancing key growth parameters such as spawn run, mushroom length, width, and weight. This suggested that incorporating locally available agricultural residues, particularly mungbean pods, can optimize mushroom production. The results advocated for the adoption of mungbean as a viable substrate in oyster mushroom cultivation, which could lead to improved yields and contribute to sustainable agricultural practices. Further research is recommended to explore the potential of other agricultural wastes and their combinations to maximize mushroom production efficiency.

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