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Research Article

Performance of Edible Mushroom Varieties Under Different Agricultural Substrates

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ABSTRACT

The study was conducted at Dr. Emilio B. Espinosa, Sr. Memorial State College of Agriculture and Technology (DEBESMSCAT) Cabitan, Mandaon, Masbate. The experimental design used was 3 x 7 CRD factorial with three varieties of mushrooms (Pink Oyster, White Abalone, and Milky Mushroom), seven agricultural substrates as treatments, Treatment A (70% rice straw and 30% sawdust), Treatment B (70% rice straw and 30% corn cob), Treatment C (70% rice straw and 30% Carbonized Rice Hull), Treatment D (100% rice straw), Treatment E (100% sawdust), Treatment F (100% corn cob) and Treatment G (100% Carbonized Rice Hull). The experiment was replicated three times with a total of 945 fruiting bags. Height, fresh weight, and the number of fruiting bodies are the data that was observed in the study. The result showed that in terms of growth performance, a nonsignificant result was observed in the height performance of the mushroom varieties inoculated in substrates with 70% rice straw, 30% corn cob, and 100% carbonized rice hull. Similarly, the number of mushroom fruiting bodies produced differed among mushroom varieties inoculated. Mushrooms inoculated in 100% carbonized rice hull attained more fruiting bodies than other tested varieties. Mushrooms inoculated in 100% corn cob produced a significantly higher number of mushroom fruiting bodies than other treatments. Finally, the weight of mushroom fruiting bodies produced in 70% rice straw and 30% carbonized rice hull applications was statistically significant for all agricultural substrates inoculated. The researcher concluded that using agricultural substrates other than carbonized rice is effective in mushroom production.

Keywords: *Agricultural substrates, Fruiting bodies, Growth, Mushroom spawn*

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Introduction

Mushroom is an edible crop rich in protein, essential amino acids, fiber, potassium, and vitamins with lower cholesterol and fats. Growing this edible crop is an economically feasible biotechnology process for recycling various lignocellulosic wastes, which are abundant in agricultural farms (Girmay et al., 2016). Likewise, mushrooms are recognized as essential food sources and are widely used as protein sources by the growing world population. Global mushroom production output was estimated at approximately 11.9 million tons annually in 2019 (FAOSTAT, 2022).

In the Philippines, the mushroom cultivation initiatives started in 1995, with the lowest production volume of 355 metric tons (MT) in 2009. Most of the mushrooms consumed were imported from different countries in South East Asia, like China, Taiwan, Thailand, Malaysia, Korea, and Japan. Mushroom farming in the country is economically possible due to lower production costs, plenty of suitable substrates from agricultural wastes, and high demand, which will be profitable to the mushroom growers (Chang et al., 2014). Currently, mushroom growers in the country commonly cultivate oyster mushrooms, shiitake mushrooms, golden oyster mushrooms, and white button mushroom varieties (Brosas, 2023). To support the growing demand for mushroom cultivation in the country, the Department of Agriculture initiated the Community-based Mushroom Production (CBMP) funded initially under the DA AgriPinoy Rice Program, which was launched in September 2013 primarily to raise farm productivity and incomes in rice-based farming communities, Increase and improve the nutritional quality of food supply in rural areas, and Utilize farm waste materials such as rice straw and rice hull in the production of edible mushrooms (DA, 2017).

Success in mushroom cultivation requires proper technique and good-quality substrates to avoid contamination. Agricultural crop production produced wastes that can be used as potential substrates for mushroom culture. Most of this organic matter containing cellulose, hemicelluloses, and lignin can be used as a mushroom substrate that directly influences the quality and quantity of mushroom production harvests (Dubey et al., 2019). Therefore, the microbial dynamics and communities of the composting substrates can seriously affect mushroom production. Hence, substrate composition and microbial diversity changes during the cultivation process can impact the production of high-quality substrates and result in the high biological efficiency of mushrooms (Suwannarach et al., 2022).

The production of edible mushrooms with agricultural farm residues, such as rice, corn cob, and sawdust, is a value-added process to convert these materials into a primary substrate to produce protein-rich food (Zhang et al., 2002). This agricultural substrate, when correctly processed, will increase the accumulated biological efficiency of mushrooms (Das et al., 2007). The primary purpose of this study is to evaluate the performance of different mushroom varieties under different agricultural substrates.

Methods

Research Design and Layout

The study used a 3x7 Completely Randomized Design with two factors and three replications. Factor A composed of mushroom varieties (Pink oyster, Milky mushroom, and White abalone), and Factor B is the agricultural substrate (70% rice straw and 30% sawdust, 70% rice straw and 30% corn cob, 70% rice straw and 30% Carbonized Rice Hull, 100% rice straw, 100% Sawdust, 100% Corn Cob, and 100% Carbonized Rice Hull).

Substrate Preparation and Management

Chemical-free agricultural substrates, including rice straws, sawdust, carbonized rice hulls, and corn cobs, were collected. Substrates were chopped and soaked in clean water for 8–9 hours. After soaking, the substrates were rinsed, drained, and air-dried overnight to remove excess water. Substrates were mixed and distributed to different treatments, such as rice straw mixed with sawdust (70:30), rice straw and corn

cob (70:30), rice straw and carbonized rice hull (70:30), and 100% rice straw, 100% sawdust, 100% corn cob, and 100% carbonized rice hull. A ¾ kilo per mixed substrate was packed inside the 8x14 polypropylene plastic, and it was covered with paper and sealed with the rubber band. The fruiting bags were sterilized in drums and heated for 6–8 hours. After sterilization, the fruiting bags were unloaded and placed in a cool place. After sterilization, the fruiting bag was inoculated with the pure subculture (spawn) mushroom. Two teaspoons of spawn were inoculated into the fruiting bag and plugged with PVC pipe, rubber band, cotton, and paper to avoid contamination. Fruiting bags were entirely covered with black clothes for 21 days in the incubation room, and water spraying outside the polypropylene plastic was done after the incubation period. Finally, the whole mushroom was harvested by holding the base of the mushroom with bare hands and applying a simple twisting motion.

Data Gathering

Fifteen representative samples per treatment were randomly selected. The following growth parameters were gathered:

1. **Height of Fruiting Bodies.** This was measured in terms of centimeters using a ruler from the base of the stipe up to the pileus of mushrooms. Height was measured every harvesting.
2. **Number of Fruiting Bodies.** Fruiting bodies of different varieties were counted every harvest.
3. **Fresh Weight of Fruiting Bodies.** Weight per mushroom variety per treatment was weighted using a weighing scale.

Statistical Tools and Analysis

The researcher used the two-factor experiment using Complete Randomizer Designed (CRD), and all data gathered were statistically analyzed using Statistical Tools for Agricultural Research (Version 2.0.1). Treatment mean differences were analyzed using Duncan's Multiple Range Test (DMRT) at 1% and 5% levels of significance. Statistical Tool for Agricultural Research (STAR) is a computer program for data management and basic statistical analysis of experimental data (Capon et al., 2017; Gulles et al., 2014).

Result and Discussion

Total Number of Mushroom Fruiting Bodies

The number of mushroom fruiting bodies of different mushroom varieties inoculated in different agricultural substrates is presented in Table 1. Data revealed that a mixture of rice straw (70%) and carbonized rice hull (30%) obtained the highest number of fruiting bodies collected compared to other agricultural substrates tested. The combination of rice straw and carbonized rice hull was statistically significant over the agricultural substrates with 100% carbonized rice hull. Similarly, the number of fruiting bodies of the pink oyster and milky mushroom varieties was comparable. However, the number of collected fruiting bodies obtained a non-significant result over the white abalone mushroom variety. The result of the study further explained that the number of fruiting bodies was not affected by the kind and mixture of substrates used as fruiting media.

Height of Mushroom Fruiting Bodies

The height variation of mushroom varieties under different agricultural substrates revealed a significant result. The mushroom fruiting bodies applied with a mixture of 70% rice straw and 30% corn cob produced the tallest height, while 100% carbonized rice hull produced the shortest fruiting body height. On the other hand, the height performance of the 100% carbonized rice hull substrate differs significantly from that of the other agricultural substrates used as growing media. Furthermore, the height of different mushroom varieties has a significant response in terms of agricultural substrates as fruiting media. Mushroom fruiting bodies inoculated with a pink oyster variety were the tallest among mushroom varieties, while the milky mushroom variety obtained the shortest height. The result shows that the pink oyster and milky mushroom

varieties do not significantly differ in height performance. However, the white abalone variety significantly differs in height from the two tested mushroom varieties.

Table 1. Number of mushroom fruiting bodies under different agricultural substrates

Substrates	Total Number of Fruiting Bodies (AB)			
	Pink Oyster	Milky Mushroom	White Abalone	**Substrates Mean(B)**
70% rice straw and 30% sawdust	46.60	63.10	43.30	**51.00[a]**
70% rice straw and 30% corn cob	38.80	42.70	41.40	**40.97 [a]**
70% rice straw and 30%CRH	47.10	57.10	49.30	**51.17 [a]**
100% rice straw	46.60	42.50	39.80	**42.97 [a]**
100% Sawdust	55.50	52.00	43.70	**50.40 [a]**
100% Corn Cob	63.00	51.60	41.20	**51.93 [a]**
100% CRH	8.50	8.50	8.20	**8.40 [b]**
Mean (A)	**43.73[a]**	**45.36[a]**	**38.13[b]**	

** Substrates total of the same superscript is not significantly different at 1% by DMRT.*
** Variety total of the same superscript is not significantly different at 5% by DMRT.*

Table 2. Number of Mushroom Fruiting bodies with different kinds of substrates

Substrates	Total Number of Fruiting Bodies (AB)			
	Pink Oyster	Milky Mushroom	White Abalone	**Substrates Mean(B)**
70% rice straw and 30% sawdust	34.80	30.10	32.00	**32.30[a]**
70% rice straw and 30% corn cob	34.50	31.50	33.90	**33.30[a]**
70% rice straw and 30%CRH	34.80	31.70	32.00	**32.83[a]**
100% rice straw	31.80	30.50	33.80	**32.03[a]**
100% Sawdust	32.90	32.90	32.20	**32.67[a]**
100% Corn Cob	30.60	32.00	32.40	**31.67[a]**
100% CRH	10.10	9.10	9.80	**9.67[b]**
Mean (A)	**29.93[a]**	**28.24[b]**	**29.44[a]**	

** Substrates total of the same superscript is not significantly different at 1% by DMRT.*
** Variety total of the same superscript is not significantly different at 5% by DMRT.*

Weight in Grams of Mushroom Fruiting Bodies

Plant weight variation in different agricultural substrates was highly significant based on the analysis of variance. The mean weight obtained by mushroom fruiting bodies applied with 70% rice straw and 30% Carbonized Rice Hull was the highest among substrates tested, while the mean weight obtained with 100% Carbonized Rice Hull got the lowest mean height accordingly. On the other hand, substrates with 100% corn cob and 70% rice straw, and 30% Carbonized Rice Hull are significant in weight in grams. In contrast, using 100% Carbonized Rice Hull as fruiting substrates resulted in a non-significant weight in grams compared to other agricultural substrates tested. Likewise,

the weight in grams of different mushroom varieties also significantly varied in weight performance. The pink oyster and white abalone mushroom varieties obtained a significant weight range of 638.90 to 653.80 grams. However, the milky abalone mushroom variety got a mean weight of 616.90 grams which is statistically insignificant over the other mushroom varieties.

Table 3. The weight of Mushroom Fruiting Bodies with different kinds of substrates

Substrates	**Total Number of Fruiting Bodies (AB)**			
	Pink Oyster	Milky Mushroom	White Abalone	**Substrates Mean(B)**
70% rice straw and 30% sawdust	111.00	94.00	108.30	104.43[a]
70% rice straw and 30% corn cob	105.50	100.30	107.20	104.33[a]
70% rice straw and 30%CRH	115.30	104.30	112.80	110.80[a]
100% rice straw	108.80	99.10	106.40	104.77[a]
100% Sawdust	90.20	90.60	91.20	90.67[a]
100% Corn Cob	99.10	105.30	89.60	98.00[a]
100% CRH	23.90	23.30	23.40	23.53[b]
Mean (A)	**93.40[a]**	**88.13[b]**	**91. 27[a]**	

** Substrates total of the same superscript is not significantly different at 1% by DMRT.*
** Variety total of the same superscript is not significantly different at 5% by DMRT*

Conclusion

Based on the finding of this study, the following conclusion was drawn.

1. Pink oysters and milky mushroom varieties obtained a significant number and height of fruiting bodies regardless of agricultural substrates used as fruiting media.
2. Pink oysters and white abalone varieties got the tallest height and weight of Mushroom Fruiting bodies.
3. Mushroom cultivation is feasible using different agricultural substrates as fruiting media except for carbonized rice hulls.

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