

Effect of Different Substrates on the Growth and Yield of Oyster Mushrooms

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ABSTRACT

Mushroom is a popular nutrient and protein-rich food of the world. Oyster mushroom is the second most popular mushroom after button mushroom all over the world. Growing medium of the mushroom is generally known as substrate. Substrate is the base of mushroom cultivation same as soil for crops. The present study was conducted with the aim to find out the more profitable substrate for the cultivation of Oyster mushroom (Pleurotus flourida). In the present experiment Wheat straw, Paddy straw, maize stalk and pigeon pea husk were used alone and also in a combination of each other with 1:1 ratio(w/w) for the cultivation of Pleurotus flourida. The results obtained during the present experiment, maximum yield (8.2kg/10kg of dry substrate.), minimum days for spawn run (23.00 days), minimum days for first harvesting (27.00 days), maximum days for cropping period (66.00 days), were observed at wheat straw + paddy straw combination. Based on the results obtained, wheat straw + paddy straw. would be recommended as most profitable substrate for the cultivation of Pleurotus flourida. The Benefit cost ratio analysis result showed that the heighest benefit was obtained from use of wheat straw +paddy straw mix as substrate. Again thenon aviability of quality mushroom spawn was found ranked I with highest C-score of 1.52 in an analysis of the constraints faced by the mushroom growers as most sever problem in Gaya district.

Key words: Oyster mushrooms, Wheat straw, Paddy straw, Chickpea straw, Pleurotus djamor, Yield.

INTRODUCTION

Pleurotus species are the most talented group among the cultivated mushrooms, which have ability to degrade many lignocellulosic substrates and are capable to colonize successfully on these substrates. *Plurotus florida* is one of the most successfully cultivated species of these mushrooms and it is considered to be delicious. Pleurotus species contain high potassium to sodium ratio, which

makes mushrooms an ideal food for patients suffering from hypertension and heart diseases. They are also rich source of proteins, minerals and vitamins. The carbohydrate content of mushrooms represents the bulk of fruiting bodies accounting for 50 to 65 per cent on dry weight basis. On a dry weight basis, mushrooms normally contain 19 to 35 per cent proteins where as fat content is very low as compared to carbohydrates and proteins.

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Mushroom production gives additional or alternative income to farmers looking for a value added product and a way to supplement farm income while making use of byproducts or coproducts from other crops. However, development of cost-efficient and alternate substrate to cultivate oyster mushroom without sacrificing mushroom quality is a major focus of many researchers and growers. Therefore, cultivation of *pleurotus florida* on various agricultural residues offers high value products with nutritional and medicinal properties. Hence, the study was undertaken during 2012 to 2016 at Krishi Vigyan Kendra .under on farm trial programmes.. Cultivation of edible mushrooms with agricultural and agro-industrial residues as substrate is an efficient and economically reliable technology for converting these materials into a valuable protein rich food and a cash crop of commercial interest. The last decade has witness an empirical approach towards its cultivation for both largescale industrial or commercial scales compared to the crude conventional method . Growing medium of the mushroom is generally known as substrate. An attractive feature of oyster mushrooms is that they can utilize a large variety of agricultural waste products and transform the lignocelluloses biomass in to high quality food, flavor and nutritive value. The economy of India is agriculturebased, with considerable amount of crop production. Crop residues are largely abundant as agricultural waste after harvest. It is important to dispose agricultural waste in a green way, which is environmentally friendly in this era of climate change.

Mushroom cultivation is one of the most commercially important steps towards diversification of agriculture. Microbial technology can help in large scale recycling of agro waste in India. An alternative way of use of agricultural residues/wastes is in the use of the organic material in mushroom production. Thus, the objective of this study was mainly to assess the effect of different locally available substrates for growth and yield of Oyster mushroom and constraints analysis of

enterprise to suggest precise policy interventions for making the mushroom cultivation beneficial.

MATERIAL AND METHODS

The field experiment was carried out among mushroom growers in Gaya district of Bihar state. The experiment was conducted for four years (2012-2016) in complete randomized design (CRD) with six treatment and ten replications of each. The following treatments were used for the study –(i) Wheat Straw (ii)Paddy Straw (iii) Pigeon pea husk (iv) Maize Straw (v) Wheat straw + Paddy Straw (1:1) . Thus, there were altogether 100 bags of 2 kg dry weight of substrate was taken for study purpose and the variety used for study was *Pleurotus florida*. These substrates were chopped into small pieces of 1-2 inches (if required), overnight soaked in 0.01 percent Bavistin (50 percent Carbendazim) and 0.05 percent Formalin solution and excess moisture was shed dried up to 65 percent level. Five bags of 2.0 kg substrate were layered wise filled into plastic bags of size 16 inch * 24 inch making five layers each of 200g spawning at periphery of each layer with more spawn in lower and upper most layer. Then after bags were tied at mouth and few holes were made for aeration and were incubated in dark and ventilated room at 25-30 C. temp range from 24 to 27 C, RH from 86 to 95 percent f. or various treatments. The following treatments were used (i)wheat straw(ii) paddy straw(iii) pigeon pea husk (iv)maize straw (v)wheat +paddy straw (1:1). Substrate was soaked overnight in 0.01 percent Bavistin (50 percent Carbendazim) and 0.05 percent formalin solution after soaking and excess moisture was shed dried up to 65 percent moisture level. Five bags of 2.0 kg. of substrate were layer wise filled @ of 2 percent spawning. About twenty replications of each treatment were made at farmers field for authentic result. The yield data was recorded and calculated on the basis of per kg spawn used for 10 kg. of substrate. The benefit cost ratio (B:C) was calculated with Sale price of Mushroom @ Rs.100/kg.

Different constraints were also listed based on review of literature and discussed with experts. These identified constraints were categorized under different heading and the respondents were asked to indicate their response on these point continuum of 'no constraints', 'minor constraints' and 'major constraints'. Constraint score (C score) was calculated through arithmetic mean by assigning different weightage based on the extent of constraint perceived by the entrepreneurs. A score of zero, one and two were assigned to no, minor and major constraint respectively. Based on the mean cumulative constraint score, the ranks were given for constraints.

RESULTS AND DISCUSSION

Five different types of substrates were compared with respect to production of Oyster mushroom. The various substrates used in this study showed variation in spawn run, duration of first fruiting, days to harvests, stipe length, pileus diameter, total yield and final substrate weight.

Effect of different substrate on variation in spawn run, duration of first fruiting, days to harvests, total yield and final substrate weight.

Study reveals that Pigeon pea required least time for mycelium colonization (22 days) followed by rice+ wheat straw (23 days), Paddy straw (24 days), maize straw (24 days)

and longest duration was required for wheat straw (25 days). Similarly, first fruiting and first harvest was found to be faster in wheat+ paddy straw (27 and 30 days) followed by pigeon pea and paddy straw (29 and 31&32 days), respectively. Highest fruiting and harvest duration were recorded in wheat + paddy straw (66 days). Mondal *et al.*⁷, found similar result according to him, the presence of right proportion of alpha-cellulose, hemicellulose and lignin is responsible for higher mycelium running rate in wheat + paddy straw and for the higher mycelial growth in wheat + paddy straw the suitable C: N ratio might be responsible which in turn gives higher yield. Lower mycelium running rate aggravates for lower yield which might be due to presence of various kinds of polyphenolic substances, low content of cellulose and low moisture holding capacity. Similar result was found by Gohl⁴.

The type of agricultural wastes, single or mixtures of two different agricultural wastes used in preparing the farm substrates may be responsible for change in the overall yield of the mushrooms grown in the different farm substrates. Similar result was found by Chukwurah³. Also, the major ecological factors such as temperature, humidity, fresh air and compact material affect the total yield of mushroom¹.

Table 1. Effect of different substrates on first mycelium colonization duration, first fruiting duration, first harvesting duration, yield, of *Pleurotus* mushroom

Treatments	Spawn run	First Fruiting	Harvest duration	Yield (g)/kg S
Paddy Straw	24	29	58	750
Wheat Straw	25	31	60	780
Pigeon pea husk	22	29	56	810
Maize stalk	24	32	58	740
Wheat + Paddy Straw	23	27	66	820

Effect of different substrates on mean yield and final substrate weight of Oyster mushroom

Highest final mean yield was obtained by Wheat+ paddy Straw (820 gm) followed by Pigeon pea husk (810 gm), wheat straw (780 gm) and Paddy straw (750 gm), respectively. The lowest final yield of oyster mushroom was obtained by maize stalk (740gm). In case of final substrate weight of Wheat+ paddy Straw

had lowest (250 gm) followed by, wheat straw (300 gm) and Paddy straw (305 gm), Pigeon pea husk (275 gm), Maize stalk (350 gm) respectively. This suggests that the substrate which is used more by enzymatic activity of fungus gives more yields but in case of husk and stalk substrate the result didn't satisfy this as water holding capacity of mixture was relatively low.

Table 2. Effect of different substrates on total yield and final substrate weight of *Pleurotus* mushroom

Treatments	Total yield (gm)	Final substrate weight (gm)
Paddy straw	750	250
Wheat straw	780	300
Pigeon pea husk	810	275
Maize stalk	740	350
Wheat + Paddy Straw	820	250

ECONOMIC ANALYSIS

The Benefit cost Ratio result showed that higher economic benefit was obtained from use of wheat + Paddy Straw as substrate for cultivation of *Plurotus florida* with highest B:C Ratio (2.6) Wheat + Paddy Straw(2.6)

followed by Wheat straw (2.5) and Pigeon pea husk (2.4) Maize Stalk (2.4) and Paddy Straw (2.3). As per the result of B:C Ratio mushroom growers were suggested and recommended to use a mixture of Wheat and paddy as substrate to get maximum benefits.

Table 3. Total Cost

Treatments	Cost of materials	Rate of substrates (10 kg)	Total cost
Paddy straw	250 Rs.	70	320
Wheat straw	250 Rs.	60	310
Pigeon pea husk	250 Rs.	80	330
Maize stalk	250 Rs.	50	300
Wheat + paddy Straw	250 Rs.	65	315

Table 4. Benefit Cost ratio Analysis

Treatments	Total yield (kg/kg spawn/10 kg substrate)	Gross Cost (Rs. /kg)	Gross Return (Rs. /kg)	Net Return (Rs. /kg)	B:C Ratio
Paddy straw	750	320	750	430	2.3
Wheat straw	780	310	780	450	2.5
Pigeon pea husk	810	330	810	480	2.4
Maize stalk	740	300	740	440	2.4
Wheat + paddy Straw	820	310	820	510	2.6

Constraints analysis of mushroom growers in Gaya district

Besides the economic analysis of mushroom entrepreneurs there is need felt also to analyse the constrains they are facing in cultivation of mushroom lack of skilled labour, technical information, quality Spawn and problems of diseases and pests were found as major constrains by the mushroom grower of Gaya district, which was followed by lack of working capital and exploitation by the middlemen in the market. Michael *et. al.*⁶, Singh *et al.*, emphasised the importance of group approach in marketing to succeed in mushroom cultivation. Singh and Suresh⁸

concluded in their study that lack of availability of quality mushroom spawn and high price of mushroom spawn along with more prone to disease and pests' infections were major problems identified in mushroom cultivation.

Exploitation by middleman in the marketing was found to be the second biggest problem. The growers were offered very low price by the middle man even though the price of mushroom in local market is fairly good. According to Michael *et. al.*⁶, the major problem faced by the mushroom grower was how to sell rather than how to grow. Similar

constraint was reported as reason for loss of mushroom enterprises by Celik and Paker² Huge cost of inputs is also seen as next major constraints suggesting that the straw, the spawn, the polythene, chemicals and other raw

materials are costly for mushroom growers. Table shows that mushroom growers experiences so many different kinds of constraints which affects the prospects of their entrepreneurship.

Table 5. Various Constraints faced by the mushroom growers of district with their C-score and Ranks

CONSTRAINTS	C- SCORES	RANK
Financial constraints		
Huge cost of inputs	1.25	IV
Lack of working capital	1.07	VI
High cost of labour	0.98	IX
Situational constraints		
Non-a viability of spawn	1.52	I
Lack of skilled labour	0.97	X
Contaminations in spawn	0.88	XII
Maturity of spawn	0.75	XIII
Unsuitable environment	0.90	XI
Technological constraints		
Lack of technical information	1.27	III
Exploitation by middle men	1.44	II
Pest and disease problem	1.23	V
Marketing constraints		
Lack of storage facilities	1.02	VIII
No good price for product	0.90	XI
Quality standard	1.03	VII
Market accessibility	1.07	VI

CONCLUSION

The result obtained through the above study that wheat straw + paddy straw mix substrate is more efficient for production and profitability in oyster mushroom production in comparison to all other substrate selected for study. The total yield and b:c ratio of wheat + paddy straw mix indicates that this combination of substrate may provides reasonable price to the mushroom growers with more profit.

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