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Suitability of Agro-Forest Residues for Cultivation of *Pleurotus florida*

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Abstract

The study conducted to evaluate the suitability of agro-forest wastes for mushroom cultivation (*Pleurotus florida*) indicated that paddy straw was the best substrate and followed by air dry areca nut husk and leaves of *Acacia auriculiformis* for spawn run and pin head formation, number of fruiting bodies and pin heads per bed, fresh weight and biological efficiency of *Pleurotus florida*. The substrates viz. paddy straw, leaves of *Acacia auriculiformis*, dry areca nut husk, fresh areca nut husk, coconut coir and coconut fiber were tried as substrates both as single and in combinations with paddy straw at 1 : 1 ratio in polyethylene bags. Plastic bags were filled with substrates along with layer method of mushroom spawning. The substrates significantly differed for the period of spawn run and pin head formation, number of fruiting bodies and pin heads per bed, fresh weight and biological efficiency. A significant difference was noticed in protein and reducing sugar content of *Pleurotus florida*.
Key words : *Pleurotus florida*, Mushroom, Agro-forest residues, Bioefficiency.

The increase in Indian population has resulted in decrease in cultivable land and consequently fragmentation of land holdings. The resulting effect is decrease in the sustainable agricultural production. The decreased agricultural production had lead to food shortage. The magnitude of food shortage problems will be reduced by following strategic agricultural production which does not require large tracts of land. One such strategy is mushroom cultivation. Mushroom is a rich source of protein, vitamins, and minerals. Mushrooms provide nutritional security, economic stability and employment to rural people. Oyster mushroom (*Pleurotus* sp.) is an efficient lignin degrading fungi and an edible mushroom fungi. *Pleurotus* utilizes different types of lignocellulosic materials for its growth. This property of mushroom is used for the value addition to agricultural residues. One of the feasible and economic methods of converting lignocellulosic materials into edible protein / food is mushroom cultivation (1, 2). The various agricultural and forest litter were tried for the cultivation of *Pleurotus* mushroom (3, 4). But the studies on the suitability of substrates such as areca nut shell, coconut coir, coconut fiber and leaf litter of *Acacia auriculiformis* for the cultivation of mushroom appears to be lacking. Hence the present study was undertaken to identify suitable local agro-forest residues for the cultivation of mushroom.

Methods

Study was conducted in the Mushroom Spawn Production Unit, College of Forestry, Sirsi during the period from October to November, 2009. Six substrates namely Paddy straw (P), leaves of *Acacia auriculiformis* (L), Dry areca nut husk (D) (*Areca catechu*), Fresh areca nut husk (F), Coconut coir (Cr) (*Cocos nucifera*), Coconut fiber (Cfr) (*Cocos nucifera*) were tested as single and in combinations. Different combinations were made by amending paddy straw with other substrates in 1 : 1 ratio wt/wt. There were 11 treatments, each with three replications. All the treatments were compared against paddy straw as control, which has been recommended as the best substrate for the mushroom cultivation. Transparent plastic bags, LDPE (light density polyethylene) were used to cultivate the mushroom. The substrates were collected, cleaned, chopped into about 4—5 cm pieces,

Table 1. Effect of agro-forest residue as substrate on the period of spawn run and pinhead formation of *Pleurotus florida.* Means followed by the same letter within a parameter do not differ significantly at *P*=0.05 by DMRT.

Treatments	Period of spawn run (days)	Period of pinhead formation (days) 1st flush	2nd flush	3rd flush
Paddy straw (P)	22.00d	2.00d	7.33bc	14.00abc
Leaves (L)	22.00d	4.33cd	5.33c	15.33ab
Fresh areca nut shell (F)	21.00e	8.00b	12.00a	15.00ab
Dry areca nut shell (D)	19.33f	4.00cd	11.00ab	17.33a
Coconut coir (Cr)	32.00b	3.00cd	13.33a	16.00a
Coconut fiber (Cfr)	39.00a	17.00a	12.33a	15.67a
P + L	22.00d	2.00d	7.33bc	9.33cd
P + F	19.67f	3.00cd	5.67c	10.00bcd
P + D	21.00e	2.00d	8.33bc	5.00d
P + Cr	26.00c	15.00a	13.67a	14.00abc
P + Cf r	20.00f	5.33c	8.00bc	9.33cd
Lsd at 5%	0.82	2.27	3.43	4.89
CV %	2.00	22.30	21.21	22.42

sterilized chemically by soaking the substrates for 12 hours in chemical solution prepared out of bavistin (fungicide), formalin (disinfectant) and chloropyriphos (insecticide) at the rate of 0.15 g/liter, 1.3 ml/liter and 0.07 ml/liter respectively in distilled water. After 12 hours of soaking, the substrates were spread over a clean, sterile surface for evaporation of moisture from the substrates so as to get 65—75% moisture level in the substrates. The moisture level in the substrates in the substrates was determined by squeeze test. Inner surface of poly bags of size 3.65 m × 5.48 m was surface sterilized with 70% ethanol, filled with the sterilized substrates separately. The quantity of substrates filled in each poly bag was 1 kg each for paddy straw, leaves of *Acacia auriculiformis*, dry areca nut husk, coconut fiber, Paddy straw + leaves of *Acacia auriculiformis*, Paddy straw + dry areca nut husk, Paddy straw + fresh areca nut husk, Paddy straw + coconut coir, Paddy straw + coconut fiber and 3 kg each for fresh areca nut husk and coconut coir, the substrates were inoculated layer wise at the periphery with the mushroom spawn of *Pleurotus florida* produced in the Mushroom Spawn Production Unit, College of Forestry, Sirsi. The spawn was inoculated at the rate of 5% i.e., 50g spawn/bag.

After inoculation, poly bags were kept for incubation in spawn running room and the temperature between 25—26 C and relative humidity between 75—80% was maintained in the spawn running room. Spawn run period was ranged from 17—30 days. After spawn run period poly bags were cut open and mushroom beds were hanged down with coconut fiber rope. Water was sprayed twice a day on to mushroom beds. Mushroom beds were maintained up to harvest of third flush. Sporophores were harvested periodically. Fresh weights of all the three flushes were recorded and the total fresh weights of harvested fruiting bodies measured as total yield of mushroom. The biological efficiency (yield of mushroom per kg substrates on dry weight basis) was computed by the following formula.

Table 2. Effect of agro-forest residue as substrate on number of pinheads and fruiting bodies of *Pleurotus florida.* Means followed by the same letter within a parameter do not differ significantly at *P*= 0.05 by DMRT.

Treatments	Number of fruiting bodies 1st flush	2nd flush	3rd flush	Number of pinheads 1st flush	2nd flush	3rd flush
Paddy straw (P)	14.67a	12.67abc	17.67a	38.33a	47.33a	29.33a
Leaves (L)	5.67bc	10.00bcde	12.67ab	38.33a	32.00ab	27.33a
Fresh areca nut shell (F)	4.67bc	2.67f	3.33d	23.67ab	7.67ab	5.00b
Dry areca nut shell (D)	4.67bc	7.33cdef	7.00bcd	25.00ab	17.33ab	28.33a
Coconut coir (Cr)	4.00c	4.33ef	5.00cd	5.00b	6.00b	4.33b
Coconut fiber (Cfr)	3.00c	3.33f	3.33d	5.00b	7.33ab	4.33b
P + L	14.00a	14.33ab	6.67bcd	29.33ab	22.00ab	32.67a
P + F	8.00b	9.33bcde	9.67bc	25.33ab	46.00ab	31.00a
P + D	16.33a	10.67bcd	5.00cd	39.67a	21.00ab	8.67b
P + Cr	6.00bc	5.00def	2.33d	6.33b	6.67b	4.67b
P + Cf r	3.67c	16.67a	7.00bcd	25.00ab	39.67ab	23.67a
Lsd at 5%	3.27	5.21	5.48	26.51	34.85	12.09
CV %	24.92	34.92	44.42	65.60	88.97	39.16

Table 3. Influence of agro-forest residue as substrate on the fresh weight of *Pleurotus florida.* Means followed by the same letter within a parameter do not differ significantly at *P*=0.05 by DMRT.

Treatments	Fresh weight of mushroom (g/bed) 1st flush	2nd flush	3rd flush	Total fresh weight
Paddy straw (P)	255.33a	181.33a	151.33a	578.00a
Leaves (L)	74.00d	100.00c	80.00b	254.00c
Fresh areca nut shell (F)	70.00d	5.67d	2.00c	77.67d
Dry areca nut shell (D)	120.00c	104.67bc	76.67b	301.33c
Coconut coir (Cr)	12.00e	2.37d	1.47c	15.83d
Coconut fiber (Cfr)	2.63e	5.33d	1.60c	9.56d
P + L	230.00a	143.33abc	40.00bc	413.33b
P + F	146.00bc	161.33ab	81.33b	388.67b
P + D	255.00a	90.00c	47.33bc	392.33b
P + Cr	14.33e	2.23d	1.97c	18.53d
P + Cf r	154.00b	120.67bc	25.00bc	299.67c
Lsd at 5%	32.27	54.17	56.18	79.11
CV %	15.63	38.15	71.32	18.59

$$\text{Bioefficiency (\%)} = \frac{\text{Fresh wt of mushroom}}{\text{Dry wt of substrate}} \times 100$$

Mushroom samples were dried to a constant weight at 60 C, the dried mushroom samples were powdered and one gram of powdered sample was used to estimate protein and reducing sugar content of the mushroom. Soluble protein and reducing sugar content in dry mushroom sample was estimated by Lowry's method and DNS method respectively (5, 6). Observation on the weight of fresh mushroom, the period of spawn run, number of fruiting bodies and yield were recorded. The treatments were organized in completely randomized block design. The data were analyzed statistically by using statistical software MSTAT-C. Means were separated by Duncan's Multiple Range test (DMRT).

Results and Discussion

Pleurotus florida took minimum period of 19.33 days for the complete colonization in paddy straw followed by was fresh arecanut husk (21 days) (Table 1). Maximum period of colonization was observed in the substrates of coconut fiber and coconut coir and there was only localized colonization without spreading to entire substrates. Further amendment of paddy straw with coconut fiber and coconut coir reduced the period of spawn run (22 and 20 days). Maximum fresh weight, biological efficiency, maximum number of fruiting bodies, pinheads were recorded during the first flush and subsequently there was reduction in weight during second and third flush (Table 2). This could be due to exhaustion of usable lignocellulosic materials present in the substrates by *Pleurotus florida* during the later growth stages.

Table 4. Influence of agro-forest residue as substrate on bioefficiency, protein and reducing sugar content of *Pleurotus florida.* Means followed by the same letter within a parameter do not differ significantly at *P*=0.05 by DMRT.

Treatments	Bio-efficiency (%)	Protein (%)	Reducing sugar (%)
Paddy straw (P)	77.07a	7.13a	0.36abc
Leaves (L)	25.40e	5.4a	0.40abc
Fresh areca nut shell (F)	2.42f	7.12a	0.23bcd
Dry areca nut shell (D)	44.98bc	7.32a	0.27bcd
Coconut coir (Cr)	0.48f	5.11a	0.09d
Coconut fiber (Cfr)	1.24f	6.17a	0.08d
P + L	54.38b	5.10a	0.19cd
P + F	51.14b	5.75a	0.59a
P + D	39.23cd	7.55a	0.19cd
P + Cr	1.85f	5.62a	0.07d
P + Cf r	29.97de	5.90a	0.48ab
Lsd at 5%	10.39	6.10	0.24
CV %	20.44	57.76	51.48

Paddy straw was found to be an ideal substrate as it supported for maximum fresh weight yield (578g/bed) with biological efficiency of 77.07% followed by dry arecanut husk (301.33 g/bed) with biological efficiency of 44.98% individual substrates. In case of substrate combinations, P + L supported maximum fresh weight (413.33 g/bed) with biological efficiency of 39.23% (Tables 3 and 4). This could be due to the ideal blending of lignocellulosic substances present in paddy straw with other substrates which would have increased the availability of nutrients for the growth of *Pleurotus florida* on paddy straw, dry arecanut husk, and leaves of *Acacia auriculiformis*. However, variations in the period of spawn run, period of pinhead formation, number of fruiting bodies and pinheads, fresh weights and biological efficiency of *Pleurotus florida* was observed with respect to

substrates. The similar trend on the observation of mushroom cultivation was reported earlier (7—9).

Significant differences in the fresh weight and biological efficiency were recorded for different substrates. Observations on enhanced fresh weight and biological efficiency on leaves of *Acacia auriculiformis*, dry arecanut husk and fresh arecanut husk on amendment with paddy straw were noticed. In the present study paddy straw was found to be superior over all other substrates. This was in conformity with the findings of earlier workers (9—13).

Per cent soluble protein and reducing sugar in the mature fruiting bodies varied significantly for *Pleurotus florida* cultivated on different substrates (Table 4). Dry arecanut husk had recorded higher per cent protein (7.32%) followed by were substrates of paddy straw and fresh arecanut husk. *Pleurotus florida* cultivated on coconut coir contained lowest protein content. In case of substrate combinations, *Pleurotus florida* cultivated on paddy straw + dry arecanut husk had given maximum protein content (7.55%) and the lowest was on the paddy straw + fresh arecanut husk. Reducing sugar content of *Pleurotus florida* cultivated on leaves of *Acacia auriculiformis* was maximum (0.40%) followed by was on paddy straw (0.36%) and the least sugar content was on coconut fiber (0.08%). In substrate combinations the maximum reducing sugar content was observed in *Pleurotus florida* cultivated on paddy straw and fresh arecanut husk and the minimum was on paddy straw + coconut fiber (0.08). The protein content of *Pleurotus florida* reported by earlier workers was ranged from 1.6 to 38.7% (14—16). This variation in protein content could be due to the variations in the method used for the estimation of protein, type of substrate used for the cultivation of mushroom and stage of harvest of mushroom.

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