J. Mycopathol. Res. ***53(1)*** *: 31-39, 2015;* (ISSN 0971-3719)

Mushroom cultivation a prosperous venture for improvement of livelihood of poor tribal in Tripura

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Received : 07.03.2014 Accepted : 24.06.2014 Published : 27.04.2015

Mushroom cultivation in Tripura becomes much popular during the recent years. The moderate temperature and high humid conditions of this state favoured three commercially important edible mushrooms, like, oyster, paddy straw and milky mushrooms, to grow successively round the year. The oyster mushroom species, like, *Pleurotus sajor-caju*, *P. flabellatus* and *P. florida*, were cultivated throughout the year at ICAR research farm to determine seasons and their productivity. Of the three species, *P. sajor-caju* was the most productive, while, *P. florida* was the least. The oyster mushrooms grew well on rice straw through out the year. However, the period from September to January was more favourable for fructification with optimum production of fruit bodies of BE 85.8 to 95.7%. The meteorological parameter, monthly average of daily maximum temperature, was the most fit (r^2 = 0.59 and r = -0.77) to correlate the yield in the regression equation Y = 2524 – 64X. Apart from rice straw, several other agricultural and forest residues, like saw dust, hulled maize cob, mustard residue, sesame residue with capsule shell, pea haulms, arhar pod shell, mustard pod shell, black gram pod shell, brinjal stem and pineapple leaf were found as alternate substrates to grow oyster mushroom. As regards the paddy straw mushroom (*Volvariella volvacea*), June to October was found suitable period to cultivate in Tripura. The agricultural residues like, paddy straw, pea haulms, pea pod shell and rajmash pod shell were found suitable substrate to grow that mushroom. The milky mushroom, *Calocybe indica*, grew well during the period starting from April to August. It gave better yield on arhar pod shell, paddy straw, pea haulms and tomato haulms than other agricultural residues. Of the three edible mushrooms, oyster mushroom cultivation with the use of *P. sajor-caju* on rice straw is most popular in Tripura. However, the adoption of milky mushroom cultivation from April to August, which was comparatively unfavourable season for oyster mushroom cultivation, may open a new vista due to its high productivity during the period with average BE 55 to 70%. This office has developed 215 new mushroom growers during the last 5 years and more than 400 tribal farmers have been trained on mushroom cultivation, following improved methods. All the trainees are cultivating mushroom in small scale for both domestic conservation and to earn money by selling their produces. Mushroom spawns are being sold regularly to the farmers and medium scale mushroom entrepreneurs as developed by this centre. The demand for mushroom spawn requirement is increasing day by day due to huge number of tribal growers interested to cultivate mushroom on commercial basis. Hence the mushroom cultivation has great prospects in the state to increase livelihood of the poor tribal inhabitants, however, the shortage of quality spawn supply is hindering the progress.

Key words: Mushroom cultivation, *Pleurotus* spp., *Volvariella volvacea*, *Calocybe indica*, agricultural residues, seasons, livelihood improvement, tribal entrepreneur development

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INTRODUCTION

Mushrooms are a group of fungi having large sporophores. They occur seasonally all over the world in various habitats varying from sandy plains to thick forests or green meadows to roadside pathways. These mushrooms are of various shapes, sizes, colours and tastes. Several of them are edible of which only a few (20) have been brought under commercial cultivation and 4 to 5 are under industrial scale of production in about 100 countries (Chang and Miles, 1991). The major mushroom growing countries in the world are China, Germany, Netherlands, Canada, France, U.K., Sweden, USA, Italy, Taiwan, Korea and Indonesia. Seven genera, viz. *Agaricus*, *Lentinus*, *Volvariella*, *Pleurotus*, *Auricularia*, *Flammulina* and *Tremella* contribute about 89% of the total world production. The mushroom production in Western countries is mostly dominated by the production of button mushroom (*Agaricus bisporus*), while, that in East Asian countries is dominated by speciality mushrooms (Chang, 2007). The cultivation of mushroom has first started in France sometimes during the year in seventeenth century. Thereafter, its cultivation has flourished to different European, North American and Southeast Asian countries. In India, the mushroom cultivation, in true sense, has started during the year 1961 with the launch of a scheme of ICAR at Solan in Himachal Pradesh. At present, the global production of mushroom, which mostly represents the production of only 7-8 mushroom species, exceeds 10 million tons that valued above 25 billion dollars. In India, on the other hand, the total annual production of all kinds of mushroom is at best 1 lakh metric ton (Biswas *et al.*, 2012). Mushroom is a useful recycler of the waste materials, particularly of the agricultural residues. A large variety of agricultural residues which are not suitable as fodder of cattle may also be used for mushroom cultivation. Growing mushrooms on agricultural residues is a traditional practice and that followed even today with certain modifications and improvement. In the present studies, the possibility of different mushroom cultivation with the use of various agricultural and forest residues has been estimated under Tripura condition. In addition, several measures have been taken up to improve livelihood of poor tribal of the state.

MATERIALS AND METHODS

Oyster Mushroom

Three different species of oyster mushrooms, viz. *Pleurotus sajor-caju, P. flabellatus* and *P. florida*, were cultivated under in house condition in Tripura every month during the period starting from January, 2004 to December, 2007. Cultivation of these mushrooms was done following the method of Vijay and Sohi (1987) with certain modifications. The small pieces/cut substrates were simultaneously water soaked and disinfected chemically by immersing the substrates in the water containing 500 ppm formalin and 75 ppm carbendazim for over night (18-20 hrs). The excess water was drained out by keeping the wet substrates in heaps on a slanted platform. Thereafter, depending upon the moisture holding capacity, the substrate materials were sun dried for an hour or so to evaporate the excess moisture, thus keeping 60-65% moisture in the substrates at the time of spawning. Mushroom cultivation was done in perforated polythene bags each of whichwas filled with 1 kg of substrate and one bag (150 g) of spawn placing in layers. The bags were kept at room temperature in dark for about 18-20 days for spawn running. After spawn running, the polythene bags were cut open and the mycelia grown-substrates were allowed for fruit body formation in the mushroom house where humidity was raised by hanging wet gunny cloths and watering on the substrates was done regularly. Fully developed fruit bodies were plucked and weighed for recording data. The biological efficiency was calculated mathematically to determine production of fresh fruit bodies from 100 kg of dry substrate.

Effects of Straw types and disinfection methods

Straws of both kinds of rice, 'Aush' and 'Aman', were used for mushroom cultivation. The straws were cut into small pieces and water soaked for over night (18-20 hrs) followed by fuming with boiled water for 2 hrs. in case of 'Fume disinfection', while, cut straws were soaked in the solution of 20 L of water, 25 ml of formalin and 3 g of Bavistin mixture for 18-20 hrs. in case of 'Chemical disinfection', before preparation of mushroom bed. Transparent and perforated polythene bag filled with 3 kg of wet straw (= 1 kg of dry straw) was used as mushroom bed. Spawning was done with 150 g of rice-grain spawn in each bag.

Influence of monthly variation on the production of mushroom

Influence of monthly variation on the production of mushroom was studied by preparing mushroom bag with 1kg of rice straw and I bag (150 g) of spawn, and keeping three replicates. Spawning was done on 1st week of every month. The meteorological data were recorded every day at morning (7 am) and afternoon (4pm).The monthly averages of the recorded meteorological data were correlated with the corresponding mushroom yields, considering the latter one as dependent variable in regression analysis.

Efficacy of different agricultural residues and saw dust on the production of mushroom

Different agricultural residues and saw dust were used for this study. The experiment was set up during favourable months, keeping three replicates for each substrate. In each replicate 1kg of substrate and 1 bag (150 g) of spawn were used for mushroom bag preparation. The rest of the methods were as described earlier.

Effect of supplements of saw dust on the production of mushroom

This experiment was conducted with saw mill saw dust (@ 1kg/ bag) which was supplemented with 200 g of *bhushi* (wheat bran and husk mixture used as fodder of cattle), wheat flour or *kuro* (rice bran and husk mixture used as fodder of cattle) before water soaking and disinfection. Rest of the procedure was same as described earlier.

Paddy straw mushroom

Paddy straw mushroom (*Volvariella volvacea*) was cultivated at ICAR research farm in Tripura every month during the period from April to November following the method of Purkayastha *et al.* (1981) with certain modification. The paddy straw as available was immersed in a chemical solution, consisting 3 g Carbendazim and 25 ml Formalin per 20 L of tap water, for overnight (18-20 hrs). Later, the excess solution was drained out on a raised platform in sun. Four nylon threads were arranged in crisscross manner on a plain and clean surface, keeping a little gap between the threads. Thereafter, a wooden frame, measuring 30 cm X 30 cm. X 30 cm, was placed on the ropes. Wet and disinfected straw as made ready by earlier methods were put inside the frame and pressed with a hand palm to form a layer. Some bits of spawn grain were sprayed over the straw layer. A few amount of gram dal powder was also sprayed over the spawned layer. This was done repeatedly to form 4-5 layers. The top most layer was the covering layer and kept as unspawned. Then the frame was taking out and the bed was tied with the 4 nylon threads on pressing with hand palms. For preparation of one such bed, 3 kg (dry weight) paddy straw, one packet (150 g) of paddy grain spawn and 100 g of gram dal powder were used. Five bamboo strips of 30 cm length and with one end sharp were inserted half of their length into the bed at four corners as inclined and at the middle of top as straight. The bed was kept on a rack inside a room where enough diffused day-light was present and that was covered by a transparent polythene sheet, keeping 15 cm gap between the sheet and bed, with the support of five inserted bamboo strips. The lower portion of the bed was kept uncovered. The watering to the bed was done as and when required. To determine the seasons for cultivation, three mushroom beds of paddy straw was set on first week of every month starting from April to November for two consecutive years, like, 2006 and 2007. Simultaneously, meteorological data of the corresponding month were recorded and correlated with yield using the tools of multiple regressions. As regards the substrate evaluation, different substrates composed of agricultural residues alone or in combination were used during the favourable months, June-July, consecutively for two years. The rest of the procedure was same as mentioned earlier. In each case three replicates were kept. The mushroom fruit body was harvested at elongation stage for recording data.

Milky mushroom

The cultivation of milky mushroom was done on various agricultural residues in polythene bags following the method of Trivedi *et al.* (1991) with certain modifications. The substrates were cut into small pieces and emerged for 16-18 hrs in disinfecting solution as practiced for oyster mushroom cultivation. The excess solution of the wet substrates was drained out and dried in sun to keep 60-70% moisture there in. The disinfected substrate 1 kg and one packet of spawn (150 g) were filled in layers in a perforated polythene bag (size 45 cm × 35 cm. The inoculated bag was closed

and incubated in dark. During spawn running stage casing soil was made ready by mixing field soil, sand and well decomposed cow dung manure in 1:1:1 ratio. The mixture was suspended in the disinfecting chemical solution for 48 hrs. The excess water was removed by decanting slowly the whole material on a clean surface. The material was kept as such for drying enough in order to make that fragile by hand palm pressure. On completion of spawn run i.e. on 18th day the mouth of the bag was open and the casing soil was sprayed over the myceliated substrate up to 2.5cm" height of thickness. The mushroom bed was kept in mushroom house on a rack for fruit body production. Watering was done regularly to keep the upper surface of casing soil as moist. Mushroom bags were prepared with the use of paddy straw on first week of every month starting from April to November during the years 2006 and 2007 at ICAR Research farm to determine the seasons for cultivation in Tripura. The experiments in studying the effects of different agricultural residues and different compositions of casing soil were set up during the favourable months of the mushroom. Four replicates were kept in each. The data on mushroom yields and days required for fruit body production were recorded.

Livelihood improvement of tribal people

Two different programmes were taken up to improve livelihood of poor tribal in Tripura as follows:

Introduction of mushroom cultivation as a new venture in backward district

Introduction of mushroom cultivation at Balaram and Marcherra clusters in Dhalai was started in the month of May, 2008. Mushroom cultivation is a new practice in the areas of Balaram and Maracherra villages. So at initial stage, the mushroom cultivation was introduced by giving training and demonstration to popularize this venture. The spawn and other requisite materials were supplied from this centre. Then the farmers were allowed to cultivate oyster mushroom on intact straw with steam disinfection method. They were kept under close supervision by the ICAR personnel in giving necessary directions and other inputs from time totime to combat diseases, pests and adverse climatic conditions. In this way considerable number of farmers learned the cultivation techniques and produced mushroom for the first time in their houses. After that, several steps were taken towards commercialization of the venture. In doing so, the interested farmers, whowere able to produce mushroom, were selected for the construction of mushroom units. The low cost mushroom sheds were prepared in the houses of the progressive farmers. The farmers earned money from selling of fresh mushroom in the local markets. Now the process of mushroom cultivation is a regular practiceat Balaram and Maracherra .

Development of small entrepreneur amongst the tribal youths

In this programme, tribal people, especially, tribal youths were given training in large scale mushroom production with the use of chemical disinfection and intact paddy straw to minimize cost of production and to gain more profit. They were financially supported to prepare low cost mushroom sheds and supplied spawn materials and other requisites freely to grow mushrooms as entrepreneurs. Further, mushroom spawns were sold to the established mushroom entrepreneurs and non-adopted mushroom growers. Monitoring of mushroom cultivation was done frequently to make them success in producing mushroom from each bed.

RESULTS AND DISCUSSION

It was observed that all three mushroom species, viz., *Pleurotus sajor-caju, P. flabellatus* and *P. florida* grew well under in house condition of Tripura. However, amongst them, *P. sajor-caju* gave highest yield of fruit bodies with production efficiency 52.5% on Aush rice straw followed by *P. flabellatus* (42.2%) and *P. florida* (21.2%), respectively. The present study revealed that the yield of oyster (*P. sajor-caju*) mushroom was higher on Aman-rice straw than that on Aush rice straw. Further, the yield of mushroom (BE: 100.83% on Aman-rice straw, 52.5% on Aush-rice straw) with chemical disinfected straw substantiated the yield observed with fume-disinfected straw. This higher yield with chemical one is due to the increased biological efficiencies of substrates.

It was indicated that all three oyster mushroom species developed fruit bodies in every month through out the year, while, that cultivated under in house condition at ICAR research farm in Tripura during the period w.e.f. January, 2004 to December, 2007 (Table 1; Fig.1). However, of the years,

Table 1 : Production efficiencies of three oyster mushroom species under Tripura condition during the year January 2004- December 2007

Month	*Pleurotus sajor-caju*			*Pleurotus flabellatus*			*Pleurotus florida*	
	Days required for 1st harvest	Yield (g)	BE (%)	Days required for 1st harvest	Yield (g)	BE (%)	Yield (g/kg substrate)	BE (%)
January	25	858	85.8	31	371	37.1	627	62.7
February	26	680	68.0	33	378	37.8	348	34.8
March	31	328	32.8	35	347	34.7	272	27.2
April	33	325	32.5	34	424	42.4	221	22.1
May	36	371	37.1	34	421	42.1	297	29.7
June	24	347	34.7	34	648	64.8	377	37.7
July	24	383	38.3	30	716	71.8	390	39.0
August	26	527	52.7	29	887	88.7	233	23.3
September	27	626	62.6	33	803	80.3	519	51.9
October	25	769	76.9	32	725	72.5	664	66.4
November	25	957	95.7	35	364	36.4	761	76.1
December	26	919	91.9	40	283	28.3	675	67.5
CD at 5%	1.5	76.2	-	NS	126	-	-	-

Table 2 : Performances of oyster mushroom cultivation on different agricultural and forest residues in Tripura

Mushroom species	Substrate	Days required for 1st harvest	Yield of fruit body (g)	BE (%)
P. sajor-caju	Black gram pod shell	24	601	60.1
	Maize stalk	26	322	32.2
	Pea haulms	19	694	69.4
	Rice straw	25	673	67.3
	Saw dust (saw mill)	29	331	33.1
	Sesame residue (stem with capsule shell)	24	587	58.7
	Toria residue (stem)	29	677	67.7
	Toria pod shell	22	293	29.3
	CD at 5%	1.2	133.1	-
P. florida	Black gram pod shell	25	752	75.2
	Brinjal stem	26	1020	102.0
	Gram haulms	22	342	34.2
	Groundnut haulms	24	325	32.5
	Maize stalk	20	544	54.4
	Paddy straw	27	645	64.5
	Pea haulms	19	815	81.5
	Pine apple leaf	24	422	42.2
	Saw dust	42	228	22.8
	Sesame residues	23	265	26.5
	CD at 5%	4	186	-

Table 3 : Month wise production pattern of *Volvariella volvacea* during different years in Tripura

Month	2006		2007		Pooled		
	Days required for 1st harvest (number)	Yield / bed of 3kg paddy straw (g)	Days required for 1st harvest (number)	Yield / bed of 3kg paddy straw (g)	Days required for 1st harvest (number)	Yield / bed of 3kg paddy straw (g)	Biological efficiency (%)
April	12.00	396.67	12.67	403.33	12.33	400.00	13.33
May	13.33	308.33	11.33	343.33	12.33	325.83	10.83
June	13.67	520.00	11.67	643.33	12.67	581.67	19.36
July	10.00	528.33	11.67	713.33	10.83	620.83	20.66
August	10.00	590.00	12.33	690.00	11.17	640.00	21.33
September	11.00	560.00	12.33	783.33	11.67	671.67	22.37
October	11.67	470.00	11.00	763.33	11.33	616.67	20.53
November	13.67	280.00	14.33	533.33	14.00	406.67	13.53
CD at 5%	1.95	131.76	1.32	189.66	1.45	118.20	-

Table 4 : Effects of substrate materials on fruit body production of *Volvariella volvacea* in Tripura

Substrate	2006		2007		Pooled		
	Days required for first harvest	Yield/bed (g)	Days required for first harvest	Yield/bed (Kg)	Days required for first harvest	Yield/bed (Kg)	Biological efficiency (%)
Pea haulms	12.00	353.33	11.33	410.00	11.67	381.67	12.72
Pea haulms + toria sticks	12.00	270.00	12.00	393.33	12.00	331.67	11.05
Pea haulms + paddy straw	11.00	556.67	11.67	486.67	11.33	521.67	17.38
Arhar pod shell	-	0	22.00	16.67	22.00	8.33	0.27
Rajmash pod shell	13.67	533.33	12.33	653.33	13.00	593.33	19.78
Pea pod shell	13.33	640.00	12.33	823.33	13.17	731.67	24.39
Gram haulms	13.67	170.00	12.33	213.33	13.00	191.67	6.39
Lentil stick + paddy straw	13.33	443.33	11.67	530.00	12.50	486.67	16.22
Mustard sticks + paddy straw	11.33	466.67	10.33	516.67	10.83	491.67	16.39
Paddy straw (Control)	11.33	573.33	10	790.00	10.67	681.67	22.72
CD at 5%	NS	146.88	1.34	117.41	1.12	96.65	-

the period from September to February was more favourable for fructification (with BE 62.6 to 95.7% in case of *P. sajor-caju*, BE 64.8 to 88.7% in *P. flabellatus* and BE 51.9 to 76.1% in *P. florida*), with optimum production of fruit bodies during November to January, than the months from March to August. The correlation studies of six meteorological parameters, viz., monthly average of daily maximum temperature, monthly average of daily minimum temperature, monthly average of daily RH at morning, monthly average of daily RH at afternoon, total monthly rainfall and number of rainy days in a

Table 5 : Impact of introduction of mushroom cultivation as a new venture in Livelihood improvement in Dhalai, the most backward district in Tripura

Particulars	Amount (No/Rs)
Number of households grow mushroom regularly	67
Number of spawn bags used per year	1800
Total mushroom production (kg) per year	588
Total Income per year	117600
Net profit per year	81600

month, with the mushroom yield of *P. sajor-caju* revealed that the monthly average of daily maximum temperature was the most fit (r^2 = 0.59 and r = -0.77) to correlate the yield in the regression equation, Y = 2524 – 64X, considering yield (Y) as

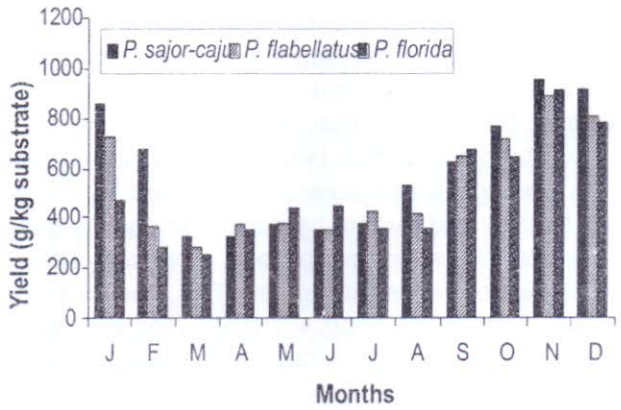

Fig. 1: Productivity of oyster mushrooms on rice straw under Tripura condition

dependable variable of temperature (X), indicating the preference of low temperature for reproductive growth by the fungus. However, in case of other two oyster mushrooms, individual effect of

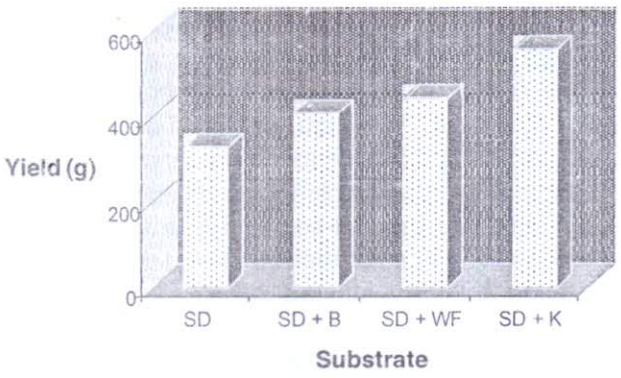

Fig. 2: Effect of supplements to saw dust on the yield of *Pleurotus sajor-caju*. SD. Saw dust; B. *Bhushi*; WF. Wheat flour; K. *Kuro*.

temperature was not significant, although, the correlation studies following the tools of multiple regression of six meteorological parameters, viz.,

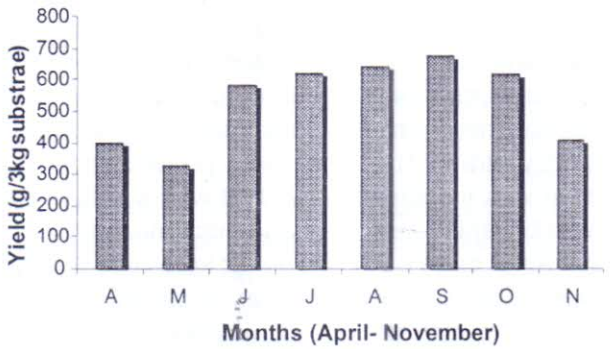

Fig. 3 : Productivity of paddy straw mushroom (*Volvariella volvacea*) on rice straw under Tripura condition

monthly average of daily maximum temperature, monthly average of daily minimum temperature, monthly average of daily RH at morning, monthly average of daily RH at afternoon, total monthly rainfall and number of rainy days in a month, with the mushroom yield revealed that all the abiotic

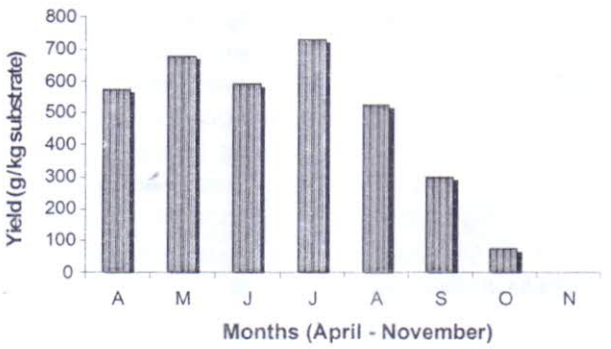

Fig. 4 : Productivity of milky mushroom (*Calocybe indica*) under Tripura condition

factors in combination played a significant role on mushroom yield (R^2 = 0.558; Multiple R = 0.747 in case of *P. flabellatus*).

As regards the efficacy of different agricultural residues, such as, black gram pod shell, maize stalk, sesame residue (stem with capsule shell), toria residue (stem), toria pod shell,, brinjal stem, gram haulms, groundnut haulms, maize stalk, paddy straw, pea haulms, pineapple leaf, and saw dust, it was found that among the substrates used, black gram pod shell, pea haulms, rice straw, sesame residue (stem with pod shell), brinjal stem, paddy straw, black gram pod shell, maize stalk, pea haulms and toria residue (stem) were more or less equally effective to produce oyster mushroom, although, pea haulms required the shortest time period for fruit body production (Table 2). The yield on pineapple leaf waste (BE 42%) was also con-

siderable. The present study reports several additional substrates of worthless nature effective to produce more or equal amount fruit bodies to that as obtained from the conventional substrate like, paddy straw. The mushroom production on saw dust was increased when that was supplemented with bhushi (wheat bran and husk mixture used as fodder of cattle), wheat flour or kuro (rice bran and husk mixture used as fodder of cattle) @ 20% of the dry substrate (Fig. 2). However, maximum enhancement of yield was obtained when saw dust was supplemented with kuro. This increment in yield in supplemented saw dust was due to the presence of more starchy substance.

The paddy straw mushroom (*Volvariella volvacea*) producing gray to light brown fruit bodies and salmon coloured spore print on white paper, grew well from June to October in both 2006 and 2007 with BE 19.36-22.37 (Table 3; Fig.3). It was observed that in Tripura all the fruit bodies developed in one flush of 1-3 days time period span and there was no further flush of fruit bodies. This finding is quite distinct as development of fruit bodies of paddy straw mushroom in two to three flashes at seven to eight days intervals are common in all most all tropical places. This contrasting finding might be due to absence of required optimum temperature (35°C) for reestablishment of mycelia in the used substrate.

As regards the effect of abiotic factors, such as, maximum and minimum temperatures of the day, R.H. at morning and evening, total monthly rainfall and number of rainy days in month, it was found that all the factors significantly correlated (multiple R = 0.828) with the yield, while used multiple regression tools for analysis. The cropping was regular due to disinfection of substrates. The mushroom could grow in all ten substrates composed of agricultural residues alone or in mixture, except arhar pod (Table 4). Further, among the substrates, the mushroom production on pea pod shell and rajmash pod shell was at par with paddy straw, although in both the cases fruit body developed latter than that of paddy straw. These two agricultural residues are equally good and additional new substrate materials of *V. volvacea*. In pea haulms, the mycelia of *V. volvacea* grew very well and covered the substrate with whitish mycelial mat within 6-7 days but the fruit body formation was less than that of paddy straw. This suggests that pea haulms need somewhat different condition or chemicals for maintaining proper C/N ratio in the substrate to trigger the transition from vegetative phase to reproductive phase of *V. volvacea*. Since, poor yield of this mushroom was earlier observed due to undesirable shift of C/N ratio of substrate (Purkayastha *et al.*, 1981; Garcha *et al.*, 1989).

The milky mushroom, *Calocybe indica* (P & C), developed fruit bodies while cultivated from April to October in 2006 and 2007 at ICAR Research farm in Tripura. However, the period from April to August was more suitable for its effective cultivation with mean production efficiency (BE) 54.1 to 69.4% (Fig. 4). The mushroom required 41-52 d for its first harvest. As regards the influence of different agricultural residues, such as, arhar pod shell, brinjal stem, french bean haulms, french bean pod shell, lentil haulms, maize cob, paddy straw, pea haulms, pine apple leaf and tomato haulms, it was found that all the residues were effective to produce fruit bodies of *C. indica*. However, amongst them, arhar pod shell, paddy straw, pea haulms and tomato haulms were equally good substrates for milky mushroom, producing significantly higher yields than other. The present study added three more good substrates for cultivation of this mushroom. Particularly, the yield (BE 73.8%) on tomato haulms is very much encouraging, because the haulms are left as wastes due to its non utilization as fodder of domestic animals. It was also observed that casing soil prepared with the mixture of garden soil, sand and cow dung manure (SSM) in 1:1:1 ratio and that supplemented separately with 0.5%, 1.0%, 2.0% and 3.0% $CaCO_3$ gave more or less equal yield of *C. indica* and there was no significant difference among the five treatments. The present study indicates that SSM (1:1:1) was enough to produce considerable amount (BE 75.5%) of fruit bodies of milky mushroom on paddy straw substrate. The high yield in the present investigation might be due to the presence of organic matter in casing soil which favoured the growth of mushroom into the soil-sand mixture and the texture of soil and sand particles initiated the fruit body formation, thus, substituted the effect of $CaCO_3$.

In the month of May, 2008 mushroom cultivation was first introduced in two clusters (Balaram and Maracherra) of Dhalai district in Tripura, giving *in situ* training and demonstration at the farmers' houses. Initially, 6 self help groups (SHGs, like, Abachanga, Khabaksha, Sharda, Pohor, Bokri Bodol and Loknath) and 50 beneficiaries were per-

tained in training programme. Later on, several trainings and demonstrations were given on mushroom cultivation with the use of different agricultural wastes in different methods. The farmers learned the techniques of oyster mushroom cultivation and successful introduction of mushroom cultivation was made in the two clusters of Dhalai district in Tripura. Now, mushroom cultivation is being carried out by several farmers in both the village clusters. They are selling fresh mushroom in local markets @ Rs. 200/- per kg. In all, 215 poor farmers are cultivated oyster mushrooms in low cost mushroom sheds and their dwelling houses. They produced 2783 kg of fresh mushroom and earned Rs. 5, 56,600 by selling @ Rs. 200/- per kg. However, at late stage assessment, 67 farmers became regular mushroom growers cultivating mushroom in small scale (Table 5).

In developing small entrepreneurs of mushroom cultivation amongst the tribal youths, the entrepreneurs were developed using three different activities, such as, (1) conduction of training, (2) spawn, cultivating materials distribution and low cost mushroom shed preparation and (3) spawn selling. In all, 400 tribal farmers/youths were given training by giving spawn and polypropylene bags freely, 2480 spawn packets were sold to the medium scale entrepreneurs and revenue generated amounting to Rs.19840/-.

Mushroom cultivation in Tripura becomes much popular during the recent years. Mushroom spawns are being sold regularly to the farmers and to the medium scale mushroom entrepreneurs as developed by this centre. The demand for mushroom spawn requirement is increasing day by day due to huge number of tribal growers interested to cultivate mushroom on commercial basis. Hence, the mushroom cultivation has great prospects in the state to increase the livelihood of poor tribal inhabitants, however, the shortage of quality spawn supply hindering the progress.

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