Environment & Ecology 35 (1A) : 336—340, January—March 2017
Website : environmentandecology.com ISSN 0970-0420

Effect of Environmental Conditions on Yield and Yield Attributing Parameters of Straw Mushroom (*Volvariella* spp.)

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Received 2 April 2016, Accepted 4 May 2016; Published online 31 May 2016

Abstract Present study deals with the influence of time of spawning on the yield and yield attributing parameters of two *Volvariella* species throghout the year. The highest yields of 1612.67g/bed (16.12% BE) was obtained from the crop raised in the month of July in *Volvariella volvacea* and 1273.33 g/bed (12.73% BE) were obtained from the crop raised in the month of August in *Volvariella diplasia*. The winter months were not suitable for raising both the *Volvariella* spp. in outdoor conditions. The biological efficiency of both the species were, however, in the range of 9.64-11.67% in *V. volvacea* and 3.40—10.26% in *V. diplasia*.

Keywords Straw mushroom, Seasonal influence, Biological efficiency.

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Introduction

Paddy straw mushroom (*Volvariella* spp.) is sixth most important mushroom cultivated in the world with an annual production of 108800 metric tons accounting for over 3% of the total production of 5 million tons [1]. It is cultivated in large scale in the coastal states like Odisha, Andhra Pradesh, Tamil Nadu, Kerala and West Bengal [2]. The edible straw mushroom *Volvariella volvacea* (Bull. Ex Fr.) Sing., is a mushroom of tropics and subtropics and has been in cultivation for many years in China and other Asian countries. There are two species of *Volvariella* namely *Volvariella volvacea* and *Volvariella diplasia* which are commercially grown in India.

Climatic condition of Odisha is congenial for the year round production of paddy straw mushroom cultivation. The present studies were carried out to fond out seasonal influence on the yield and yield attributing parameters on two species of paddy straw mushroom.

Materials and Methods

In an attempt to explore the cultivation of *Volvariella volvacea* and *Volvariella diplasia* round the year, beds were raised at monthly intervals from January to December covering three seasons. In Odisha, paddy straw mushroom is grown from March-October in both coastal and inland districts. However, in recent years, the cultivation has been extended from

Table 1. Influence of time of spawning on yield of *V. volvacea*.

Treatments	Days to pinhead emergence	Days to first harvest	Number of sporophore	Average of weight of sporophore (g)	Weght of fruiting bodies (g)	Biological efficiency (%)
T_1 Jan 2011	16.33	21.00	11.33	15.27	168.00	1.68
T_2 Feb 2011	15.00	20.33	42.67	18.14	714.00	7.14
T_3 Mar 2011	9.67	14.00	62.67	18.84	1167.67	11.67
T_4 Apr 2011	10.33	14.33	59.67	16.47	982.67	9.82
T_5 May 2011	10.33	14.33	56.67	16.96	964.33	9.64
T_6 Jun 2011	8.67	12.33	61.67	18.18	1121.00	11.21
T_7 Jul 2011	9.33	14.00	84.67	19.10	1612.67	16.12
T_8 Aug 2011	10.67	14.67	72.00	17.89	1286.33	12.86
T_9 Sep 2011	9.00	13.67	63.00	18.30	1157.67	11.57
T_{10} Oct 2011	8.67	13.67	61.33	15.82	969.00	9.69
T_{11} Nov 2011	12.00	16.00	49.33	15.69	775.67	7.75
T_{12} Dec 2011	18.00	22.00	15.67	15.06	239.00	2.39
CD (0.05)	0.966	0.88	7.28	1.01	24.16	–
CV (%)	4.96	3.28	8.05	3.49	1.53	–

November-February owing to mild winter prevailing in the coastal plain of the state. The biological efficiency varies greatly over the months because of wide variations in temperature and relative humidity. Therefore, paddy straw substrate was soaked in clean and cold water for a period of six hours. Bundles were cut at both the ends to have the required length (0.60m). The excess water was drained out to have 65–70% moisture. Cuboidal beds were prepared (0.60×0.60×0.53 m) with three layers each of 6 thickness. For each bed, 10kg dry straw was required. Spawning was done @ 3% of dry substrate in three layers, first two layers at the periphery only and all over the third layer with a spacing of 7.6 cm between spawn segments. The beds were supplemented with wheat bran @3% of the dry substrate. Beds were covered with transparent polythene sheets till mycellial run was over and then withdrawn. Beds were moistened appropriately. Triplicates were maintained for each treatment in Randomized block Design. Observations on days taken for pin head emergence, number of fruit bodies and weight of bodies were recorded. Biological efficiency in respect of each treatment was calculated using the following formula.

$$\text{Percent biological efficiency (BE)} = \frac{\text{Fresh weight of Mushroom}}{\text{Dry weight of Substrate}} \times 100$$

Results and Discussion

Influence of time spawning on yield of *V. volvacea*

Analysis of data indicated that there was significant variation among the treatments in respect of all the parameters recorded. The significantly highest yield of 1612.67g/bed was obtained from the crop raised in the month of July. Superiority of the treatment was observed in terms of number of sporophores produced (84.67) and average weight of sporophore (19.10) with modest crop duration of 14 days. Further, it was observed that crop raised during the period from June to September (rainy season), recorded comparatively more yields (1121-1612.67g/bed). However, yield levels were considerably low in crops raised in the winter months (October—January). The yields obtained from the summer crops (February—May) was better than the yields realized from winter crops as recorded in the investigation. The lowest yield of 168g/bed was recorded from the crop raised in the month of January. It appeared that the winter months are not at all suitable for raising V.volvacea in outdoor situations (Table 1).

Influence of time of spawning on yield of *V. diplasia*

Analysis of data indicated that there was significant

Table 2. Influence of time of spawning on yield of *V. diplasia.*

Treatments	Days to pinhead emergence	Days to first harvest	Number of sporophore	Average of weight of sporophore (g)	Weight of fruiting bodies (g)	Biological efficiency (%)
T_1 Jan 2011	16.67	22.00	6.67	9.33	85.00	0.85
T_2 Feb 2011	14.00	19.00	23.33	11.00	246.67	2.46
T_3 Mar 2011	11.00	16.00	29.00	12.00	340.00	3.40
T_4 Apr 2011	8.33	13.67	39.67	11.67	530.00	5.30
T_5 May 2011	8.00	14.00	60.00	12.67	770.00	7.70
T_6 Jun 2011	7.67	13.33	68.33	15.67	1026.67	10.26
T_7 Jul 2011	8.00	13.33	82.33	15.00	1223.33	12.33
T_8 Aug 2011	8.33	14.33	89.00	15.00	1273.33	12.73
T_9 Sep 2011	8.67	14.67	86.33	15.33	1196.67	11.96
T_{10} Oct 2011	9.00	15.67	81.33	14.33	1096.67	10.96
T_{11} Nov 2011	9.67	16.00	43.67	11.33	496.67	4.96
T_{12} Dec 2011	17.00	21.67	7.33	10.33	75.00	0.75
CD (0.05)	1.12	0.93	5.81	1.56	42.44	–
CV (%)	6.28	3.40	6.68	7.18	3.60	–

variation among the treatments in respect of all the parameters recorded. The significantly highest yield of 1273.33g/bed was obtained from the crop raised in the month of August. Superiority of the treatment was observed in terms of number of sporophores (89) with a modest crop duration of 14 days. Further, it was observed that crop raised during the period from June to October (rainy season), yield recorded was comparatively more yields (1026.67—1273.33g/bed). However, yield levels were considerably low in crops raised during the winter months (November—February). Summer crops raised during the period of March —May were having yields of 340—770g/bed. The lowest yield of 75g/bed was obtained from the crop raised in the month of December which was at par with the yield level (85g/bed) of crop raised during January. It appeared that both the winter and summer months were ot suitable for raising *V. diplasia* in outdoor conditions (Table 2).

Correlation coefficient studies in *V. volvacea*

The multiple regression analysis was performed to study the impact of independent variables on dependent variables. In the present study, the effect of environmental/climatic conditions such as mean day temperature and mean RH greatly influenced mushroom productivity (Table 3). From the analysis, it was recorded that there exists a positive correlation between mean day temperature and biological efficiency and the correlation coefficient *r* was recorded as 0.769 which was found to be significant statistically at 5% level of significance. Similarly, the mean RH had influenced positively the BE in *V. volvacea* to a great extent and the coefficient *r* was calculated as 0.810 which is statistically significant both at 5% and 1% level of significance. The combined effect of mean day temperature and mean RH on biological efficiency was represented by the predication equation as follows.

$$Y = -23.413 + 0.593\ x_1{}^{*} + 0.224\ x_2{}^{**}$$

Where y = biological efficiency X_1 = mean day temperature, X_2 = mean RH.

The overall contribution of mean day temperature and mean RH on biological efficiency was calculated to the tune of 78.60% and the multiple correlation co-efficient R was calculated as 0.908 which was found to be statistically significant at 5% and 1% of significance.

Correlation coefficient studies in *V. diplasia.*

The data show that the correlation between the mean

Table 3. Correlation coefficient studies in *V. volvacea.* Biological efficiency verses temperature correlation co-efficient r =0.769*, Biological efficiency verses mean relative humidity r =0.810**, Prediction equation Y= 23.413 + 0.593* x_1 + 0.224** x_2 Co efficient of determination Rr = 0.825 Adjusted Rr = 0.786. Multiple regression coefficient R= 0.908**

Treatments		Mean day temperature	Mean relative humidity	Biological efficacy (%)
T_1	Jan 2011	20.99	60.75	1.68
T_2	Feb 2011	25.20	66.75	7.14
T_3	Mar 2011	28.01	66.40	11.67
T_4	Apr 2011	30.12	65.10	9.82
T_5	May 2011	31.66	71.50	9.64
T_6	Jun 2011	30.42	77.00	11.21
T_7	Jul 2011	28.86	87.00	16.12
T_8	Aug 2011	29.05	87.20	12.86
T_9	Sep 2011	29.07	87.30	11.57
T_{10}	Oct 2011	28.62	76.20	9.69
T_{11}	Nov 2011	24.98	64.00	7.75
T_{12}	Dec 2011	22.10	59.50	2.39

Table 4. Correlation coefficient studies in *V. diplasia*. Biological efficiency verses temperature, Correlation co-efficient r = 0.495 NS, Biological efficiency verses mean relative humidity r = 0.864**, Predication equation Y=18.696 + 0.087 x_1 + 0.329 x_2** Co-efficientof determination Rr = 0.750, Adjusted Rr = 0.694. Multiple regression co efficient = 0.866**.

Treatments		Mean day temperature	Mean relative humidity	Biological efficacy (%)
T_1	Jan 2011	20.99	60.75	0.85
T_2	Feb 2011	25.20	66.75	2.46
T_3	Mar 2011	28.01	66.40	3.40
T_4	Apr 2011	30.12	65.10	5.30
T_5	May 2011	31.66	71.50	7.70
T_6	Jun 2011	30.42	77.00	10.26
T_7	Jul 2011	28.86	87.00	12.23
T_8	Aug 2011	29.05	87.20	12.73
T_9	Sep 2011	29.07	87.30	11.96
T_{10}	Oct 2011	28.62	76.20	10.96
T_{11}	Nov 2011	24.98	64.00	4.96
T_{12}	Dec 2011	22.10	59.50	0.75

day temperature and biological efficiency was non-significnt (r=0.495 NS). However, the mean Rh influenced positively the B. E. in *V. diplasia* and the correlation coefficient r was calculated as 0.864 which was statistically significant at 1% level of significance. The combined effect of mean day temperature and mean RH on biologicl efficiency was represented by the prediction equation as follows.

$$Y = - 18.696 + 0.087\ x_1^{NS} + 0.329\ x_2^{**}$$

Where Y = Biological efficiency, X_1 = Mean day temperature, X_2 = Mean RH.

The impact of climatic conditions on mushroom yield showed a positive correlation between yield and both mean day temperature and relative humidity. However, best yield (1612.67g/bed) was obtained in the month of July when the mean day temperature was 28.86°C with relative humidity of 87.0%. Higher yields of *V. volvacea* were recorded (15.9%) in July (25.1-35.1°C and 73-92% RH) [3]. The optimum temperature and humidity for fructification of *V. volvacea* are 28-32°C and 80% respectively under conventional method of cultivation [3]. Findings of the present investigation were in agreement with the findings of several workers [4, 5]. In *V.diplasia*, however, June to October was found to be the appropriate period of cropping with realization of good yields (10.26–12.73%). Winter as well as summer cropping did not fruit well (2.46-7.70%).

The overall contribution of mean day temperature and mean RH on biological efficiency was calculated to the tune of 69.40% and the multiple correlation coefficient R was calculated as 0.866 which was found to be statistically significant at 1% level of significance. Poor performance of *V. diplasia* during summer months. Moderate temperature (25–38°C) and high humidity (>85%) requirement of *Volvariella* spp. was again ascertained from the above investigations.

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