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PERFORMANCE OF OYSTER MUSHROOM (PLEUROTUS OSTREATUS) GROWN ON COTTON WASTE AND SORGHUM STRAW BASED GROWING SUBSTRATES

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ABSTRACT

Production of oyster mushroom is very low in Pakistan. To estimate growth and yield response of *Pleurotus ostreatus* an experiment was performed in Medicinal and Mushroom Lab, Institute of Horticultural Sciences, University of Agriculture, Faisalabad. Two substrates (cotton waste and sorghum straw) were used alone and with different combinations. There were five treatments T_0 (100 % Cotton Waste), T_1 (100% Sorghum Straw), T_2 (75% Sorghum Straw + 25% Cotton Waste), T_3 (50% Sorghum Straw + 50% Cotton Waste), T_4 (25% Sorghum Straw + 75% Cotton Waste). Data regarding time taken for initiation of spawn run, completion of mycelial growth, initiation of pinheads, total number of pinheads, time taken to harvest 1st, 2nd and 3rd flush, fresh weight of 1st, 2nd and 3rd flush harvested, total yield, pH, total soluble solids, acidity, ascorbic acid contents, total nitrogen, phosphorus, potassium contents, reducing sugars, non-reducing sugars and total sugars was recorded. T_0 (100 % cotton waste) performed well followed by T_4 (75 % cotton waste and 25 % sorghum straw) regarding yield and all the bio chemical attributes.

Keywords: cotton waste, sorghum straw, biochemical, spawnrun, oyster mushroom production.

INTRODUCTION

Oyster mushroom *Pleurotus ostreatus* is popular in many countries of the world. It grows wildly in forests of hilly areas and thrives better at temperature range of 22-28˚C and atmospheric humidity more than 85%. In Pakistan oyster mushroom grows naturally on trunk of trees and stumps in northern areas, Azad Jamu and Kashmir (Sher et al., 2011). Oyster mushroom is an enriched source of protein (20-40 %), vitamins such as B, D, E, K (0.5-1.5%), and fats (0.5-3.5%) etc. Now a days in pakistan oyster mushroom cultivation is gaining popularity because of its high economic returns. Farmers in Pakistan generally cultivate oyster mushroom on cotton waste which is abundently available in pakistan only in summer season. While natural fruiting period of oyster mushroom in Pakistan in plain areas are the autumn and winter months when the temperature range is in between 15-25°C (Kashif et al., 2013). But at that time there is shortage of cotton waste so there is need to seek alternative growing media to ensure year round oyster mushroom cultivation. Sorghum straw is easily available in Pakistan in winter months (October and November). Oyster mushroom (*Pleurotus ostreatus*) is mostly cultivated in these months in Pakistan in plain areas. To the best of our knowledge limited research work is done on sorghum straw for the cultivation of oyster mushroom. So, the objective of this study was to investigate the possibility of oyster mushroom production and growth and yield response on cotton waste and sorghum straw and their different combinations.

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METERIALS AND METHODS

Present research work was accomplished at Medicinal and Mushroom Lab, Institute of Horticultural Sciences, University of Agriculture, Faisalabad during 2013-2014. Standard mushroom growing procedure was followed for cultivation of *Pleurotus ostreatus* on cotton waste,

sorghum straw and their different combinations. Experiment consisted of following treatments and each treatment was replicated five times.

T_0= Cotton waste (100%)

T_1 = Sorghum Straw (100%)

T_2 = Sorghum Straw (75%) + Cotton Waste (25%)

T_3 = Sorghum Straw (50%) + Cotton Waste (50%)

T_4 = Sorghum Straw (25%) + Cotton Waste (75%)

Data regarding different parameters like time taken for initiation of spawn run (days), time taken for completion of mycelial growth (days), time taken for initiation of pinhead formation (days), total number of pinheads, time taken to harvest 1st flush (days), time taken to harvest 2nd flush (days), time taken to harvest 3rd flush (days), fresh weight of 1st flush harvested (g), fresh weight of 2nd flush harvested (g), fresh weight of 3rd flush harvested (g), Total yield (g), pH, Total soluble solids (°Brix), acidity (%) of mushroom (Hortwitz, 1960), Ascorbic acid of mushroom (mg/100ml) (Ruck,1961), reducing sugars, non-reducing sugars, total sugars (Hortwitz, 1960.), notrogen contents of mushrooms, phosphorus contents of mushrooms and potassium contents of mushrooms (Chapman and Parker. 1961) was recorded.

STATISTICAL PROCEDURE Completely randomized design (CRD) was applied in this experiment. The data collected sequentially was analyzed statistically using LSD test at 5% probability level that provided practical and comprehensive comparison of the treatments for their effectivness (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Time taken for initiation of spawn run was recorded in days. The minimum time for initiation of spawn run was taken by T_0 (1.33±0.35 days) while T_1 took maximum time (2.66±0.33 days) for initiation of spawn run (Table 1). Similarly Time taken for completion of mycelial growth was recorded in days. Treatments showed significant results regarding mycelial growth. T_0 and T_4 performed well and took minimum time (21.33±0.88 days), (30.00±1.55 days) respectively for completion of mycelial growth as compared to other treatments. Time taken for initiation of pinhead formation was also recorded in days. T_0 took minimum time (3.66±.33 days) for initiation of pinheads followed by T_4 (4.66±0.33 days), T_3 (6.00±.01 days), T_2 (6.66±.33) and T_1 (6.66±.33 days) respectively as shown in Table 1. Similarly maximum number of pinheads was also observed in T_0 (80±5.77) followed by T_4 (73.33±4.81), T_3 (71.66±1.66), T_2 (45±2.88) and T_1 (28.33±1.66) respectively. Our findings are supported by the study conducted by Khan et al., 2009. who reported better performance of *Pleurotus* species on cotton waste as compared to other mushroom growing substrates. The variation in above mentioned parameters may be attributed to variation in chemical and lignocellulosic composition of substrates (Iqbal et al., 2005).

Table 1. Effect of cotton waste, sorghum straw and their amendments on growth parameters of oyster mushroom (*Pleurotus ostreatus*).

Treatment	Time for initiation of spawn run (days)	Time for mycelial growth completion (days)	Time for Initiation of pinheads (days)	No. of pinheads
T0	1.33±.35c	21.33±.88e	3.66±.33c	80±5.773a
T1	2.66±.33a	51.33±1.89a	6.66±.33a	28.33±1.66c
T2	2.00±.01b	45.00±1.55b	6.66±.33a	45±2.88b
T3	2.00±.02b	38.00±.57c	6.00±.01a	71.667±1.66a
T4	2.00±.01b	30.00±1.55d	4.66±.33b	73.333±4.81a
LSD value	0.6643	3.0078	0.9395	15.755

Figures not sharing the same letters differ significantly at $P = 0.05$.

Data regarding Time taken to harvest 1st flush, Time taken to harvest 2nd flush and Time taken to harvest 3rd flush is shown in Table 2. T_0 (31±.57) took minimun time for harvesting of 1st flush followed followed by T_4 (42.33±.88), T_3 (46±.57), T_2 (49±.57) and T_1 (51.667±.88) respectively. Similarly T_0 (39.66±.88) took minimun time for harvesting of 2nd flush followed by T_4 (48.67±1.88), T_3 (51.66±1.67), T_2 (54±.57) and T_1 (56.33±1.67) respectively. Likewise T_0 (47±.58) took minimun time for harvesting of 3rd flush followed by T_4 (55.67±1.85), T_3 (58.33±1.87), T_2 (59.35±1.89) and T_1 (62.34±1.88) respectively. The results of present experiment are in agreement with the findings of Dundar and Yildiz. 2009 who reported similar behaviour of mushroom harvesting pattern in their study.

Data regarding Fresh weight of 1st flush harvested (g), Fresh weight of 2nd flush harvested (g), Fresh weight of 3rd flush harvested (g) and Total yield (g) is shown in

Table 3. In case of fresh weight of 1st flush harvested T_0 yielded best (77.66±1.21g) followed by T_4 (65±5.13 g), T_3 (47.66±6.17 g), T_2 (40±2.88 g) and T_1 (25.34±.88 g) respectively. While, in case of fresh weight of 2nd flush harvested T_0 yielded best (55.33±6.49 g) followed by T_4 (39.99±3.12 g), T_3 (30.67±2.33 g), T_2 (22.33±1.45 g) and T_1 (18.34±.88 g) respectively. Similarly, in case of fresh weight of 3rd flush harvested T_0 yielded best (37.71±3.72 g) followed by T_4 (28.73±1.90 g), T_3 (21.67±2.88 g), T_2 (15±1.57 g) and T_1 (15.34±.88 g) respectively. On the other hand in case of total yield T_0 performed best (170.5±10 g) followed by T_4 (133.72±4.72 g), T_3 (100±5.30 g), T_2 (77.34±6.86 g) and T_1 (55.67±5.57 g) respectively. Gradual decrease in yield was observed from 1st flush to 3rd flush in case of all treatments which might be attributed to gradual decrease in nitrogen contents of substrates with passage of time (Mandeel et al., 2005).

Table 2. Effect of cotton waste, sorghum straw and their amendments on harvest parameters of oyster mushroom (*Pleurotus ostreatus*).

Treatment	Time to harvest 1st flush (days)	Time to harvest 2nd flush (days)	Time to harvest 3rd flush (days)
T0	31±.57e	39.66±.88d	47±.58d
T1	51.667±.88a	56.33±1.67a	62.34±1.88a
T2	49±.57b	54±.57b	59.35±1.89ab
T3	46±.57c	51.66±1.67b	58.33±1.87bc
T4	42.33±.88d	48.67±1.88c	55.67±1.85c
LSD value	2.2528	2.3487	3.4836

Figures not sharing the same letters differ significantly at $P = 0.05$.

Table 3. Effect of cotton waste, sorghum straw and their amendments on yield of oyster mushroom (*Pleurotus ostreatus*).

Treatment	Fresh weight of 1st flush harvested (g)	Fresh weight of 2nd flush harvested (g)	Fresh weight of 3rd flush harvested (g)	Total yield harvested (g)
T0	77.66±1.21a	55.33±6.49a	37.71±3.72a	170.5±10a
T1	25.34±.88d	18.34±.88d	15.34±.88d	55.67±5.57e
T2	40±2.88c	22.33±1.45cd	15±1.57d	77.34±6.86d
T3	47.66±6.17c	30.67±2.33bc	21.67±2.88c	100±5.30c
T4	65±5.13b	39.99±3.12b	28.73±1.90b	133.72±4.72b
LSD value	12.204	10.932	4.4855	17.662

Figures not sharing the same letters differ significantly at $P = 0.05$.

Data regarding pH of mushroom, Total soluble solids of mushroom (°Brix), Acidity of mushroom (%) and Ascorbic acid contents of mushroom (mg/100ml) is shown in Table 4. Highest pH value was observed in case of T_2 (7.9±.05) followed by T_3 (7.86±.06), T_1 (7.83±.032), T_4 (7.63±.07) and T_0 (7.23±.08) respectively. In case of total soluble solids of mushroom maximum total soluble solids were observed in case of T_0 (3.66±.33) and T_4 (3.66±.16) followed by T_1 (3.04±.39) and T_2 (3.03±.39) and T_2 (3.00±.01) respectively.

Table 4. Effect of cotton waste, sorghum straw and their amendments on biochemical parameters of oyster mushroom (*Pleurotus ostreatus*).

Treatment	pH of mushroom	Total soluble solids of mushroom (Brix)	Acidity of mushroom (%)	Ascorbic acid of mushroom (mg/100ml)
T0	7.23±.08c	3.66±.33a	0.04±.06a	18±.03a
T1	7.83±.032ab	3.04±.39a	0.03±.01a	11±1.41b
T2	7.9±.05a	3.03±.39a	0.03±.01a	12±.01b
T3	7.86±.06a	3.00±.01a	0.03±.03a	14±1.15b
T4	7.63±.07b	3.66±.16a	0.03±.03a	14±3.60ab
LSD value	0.2043	0.9431	0.0105	4.23

Figures not sharing the same letters differ significantly at $P = 0.05$.

In case of acidity of mushroom there was non-significant difference among various treatments Maximum acidity of mushroom was observed in case of T_0 (0.04±.06) followed by T_4 (0.03±.03) T_3 (0.03±.03) and T_2 (0.03±.01) and T_1 (0.03±.01) respectively.

In case of ascorbic acid contents of mushroom, maximum ascorbic acid contents were observed in case of T_0 (18±.03 mg/100ml) followed by T_4 (14±3.60 mg/100ml), T_3 (14±1.15 mg/100ml), T_2 (12±.01mg/100ml) and T_1 (11±1.41mg/100ml) respectively. pH, total soluble solids, acidity and ascorbic acid contents are important indicators of mushroom quality (Eissa, 2008).

Data regarding nitrogen contents of mushroom (%), phosphorus contents of mushroom (%) and potassium contents of mushroom (%) is shown in Table 5. In case of nitrogen contents of mushroom (%), maximum nitrogen contents were observed in case of T_0 (0.71±.08 %) followed by T_4 (0.68±.02%), T_3 (0.64±.03%), T_2 (0.53±.03%) and T_1 (0.51±.01%) respectively. Similarly in case of phosphorus contents of mushroom (%), maximum phosphorus contents were observed in case of T_4 (0.45±.08 %) followed by T_0 (0.45±.01%), T_3 (0.32±.09%), T_1 (0.24±.03%) and T_2 (0.24±.01%) respectively. Likewise in case of potassium contents of mushroom maximum potassium contents were observed in case of T_0 (0.76±.03 %) followed by T_4 (0.73±.05%), T_3 (0.67±.02%), T_2 (0.57±.02%) and T_1 (0.57±.01%) respectively. phosphorus, potassium and sodium are some important minerals present in mushrooms and constitute about 70% of total minerals present in mushrooms (Chang and Miles, 1989).

Table 5. Effect of cotton waste, sorghum straw and their amendments on Nitrogen, Phosphorus and Potassium contents of oyster mushroom (*Pleurotus ostreatus*).

Treatment	Nitrogen contents of mushroom (%)	Phosphorus contents of mushroom (%)	Potassium contents of mushroom (%)
T0	0.71±.08a	0.45±.01a	0.76±.03a
T1	0.51±.01b	0.24±.03c	0.57±.01c
T2	0.53±.03b	0.24±.01c	0.57±.02c
T3	0.64±.03a	0.32±.09b	0.67±.02b
T4	0.68±.02a	0.45±.08a	0.73±.05a
LSD value	0.0744	0.0438	0.0490

Figures not sharing the same letters differ significantly at $P = 0.05$.

Data regarding reducing sugars contents of mushroom (%), non-reducing sugars of mushroom (%) and total sugar contents of mushroom (%) is shown in Table 6. In case of reducing sugars contents of mushroom (%), maximum reducing sugars contents were observed in case of T_0 (3.56±.16%) followed by T_3 (3.5±.18%), T_4 (3.41±.04%), T_2 (3.07±.06%) and T_1 (3.06±.06%) respectively. Similarly In case of non-reducing sugars contents of mushroom (%), maximum non reducing sugars contents were observed in case of T_0 (6.63±.14%) followed by T_4 (6.43±.17%), T_3 (6.42a±.16%), T_2 (6.07±.06%) and T_1 (6.07±.06%) respectively. Likewise in case of total sugars contents of mushroom (%), maximum total sugars contents were observed in case of T_0 (10.19±.04%) followed by T_3 (9.92±.14%), T_4 (9.84±.22%), T_2 (9.14±.49%) and T_1 (9.13±.32%) respectively.

Table 6. Effect of cotton waste, sorghum straw and their amendments on reducing sugars, non-reducing sugars and total sugars of oyster mushroom (*Pleurotus ostreatus*).

Treatment	Reducing sugar contents of mushroom (%)	Non reducing sugar contents of mushroom (%)	Total sugar contents of mushroom (%)
T0	3.56±.16a	6.63±.14a	10.19±.04a
T1	3.06±.06b	6.07±.06b	9.13±.32ab
T2	3.07±.06b	6.07±.06b	9.14±.49b
T3	3.5±.18a	6.42a±.16b	9.92±.14ab
T4	3.41±.04ab	6.43±.17ab	9.84±.22ab
LSD value	0.3801	0.4087	0.9120

Figures not sharing the same letters differ significantly at $P = 0.05$.

Regarding reducing sugars, non-reducing sugars and total sugars of mushroom function to provide support and expansion of the fruit body of mushrooms and determine nutritional quality of mushrooms (Barros et al., 2007).

CONCLUSION

It can be concluded from observed results of this research trial that T0 (cotton waste 100%) and T_4 (75% cotton waste + 25% sorghum straw) performed better in case of growth and biochemical parameters for growing of *Pleurotus ostreatus*. So in oyster mushroom cultivation areas shortage of cotton waste substrate can be partially fulfilled by sorghum straw witout compromising nutritional quality, mostly in those areas where there is less availability of cotton waste.

REFERENCES

Barros, L., P. Baptista, D.M. Correia, J.S. Morais and I.C.F.R. Ferreira. 2007. Effects of conservation treatment and cooking on the chemical composition and antioxidant activity of Portuguese wild edible mushrooms. J. Agric. Food Chem. 55: 4781–4788.

Chang, S. T. and Miles, P. G. 1989. Edible Mushrooms and Their Cultivation. CRC Press, Boca.

Chapman, D.H and F. Parker. 1961. Determination of NPK. In: Methods of analysis for soils, plants and water. 1st Ed. California University, Agriculture Division, USA. pp: 150-179.

Dundar, A. and A. Yildiz. 2009. A comparative study on Pleurotus ostreatus (jacq.) P. kumm. cultivated on different agricultural lignocellulosic wastes. Turk. J. Biol., 33: 171-179.

Eissa, H.A.A. 2008. Effect of chitosan coating on shelf-life and quality of fresh-cut mushroom. Pol. J. Food Nutr. Sci. 58(1): 95-105.

Hortwitz, W. 1960. Official and tentative method of analysis. Association of the Official Agriculture Chemist. Washington D.C. 9: 320-341.

Iqbal, M.S., C.A. Rauf and M.I. Sheikh. 2005. Yield performance of oyster mushroom on different substrates. Int. J. Agric. Biol. 7: 900-903.

Kashif, M. M. A. Ali, N. A. Khan, Q. S. Anjum and A. Rehman.2013. Effect of low and high quality cotton waste on yield of oyster mushroom (*pleurotus ostreatus*). Pak. J. Phytopathol. 25 (01) – 91-94.

Khan, N.A., M.I. Haq and M.A. Khan. 2009. Growth comparison of local and exotic strains of oyster mushrooms on different agricultural wastes. Pak. J. Phytopathol. 21(2): 139-143.

Mandeel, Q. A., A. A. Al-Laith, and S. A. Mohamed. 2005. Cultivation of oyster mushrooms (*Pleurotus* spp.) on various lignocellulosic wastes. World. J. Microb. Biot. 21 (4): 601-607. Raton. pp:1-38.

Ruck, J.A. 1969. Chemical methods for analysis of fruits and vegetables. No. 1154. Research Station Summerland, Research Branch Canada, Department of Agriculture, Canada.

Sher, H., M.A. Yemeni and K. Khan. 2011. Cultivation of the oyster mushroom (*Pleurotus ostreatus* jacq.) p. Kumm.) in two different agro ecological zones of Pakistan. Afr. J. Biotechnol. 10: 183-188.

Steel, R.G.D. and J.H. Torre. 1984. Principles and Procedures of Statistics. McGraw Hill Book Co., Inc., New York: 173-191.