**PSM Biological Research**
**2017 | Volume 2 | Issue 1 | 51-55**
**ISSN: 2517-9586 (Online)**

**www.psmpublishers.org**

**Research Article** **Open Access**

# Variation in Patterns of Pinhead and Fruiting Body Formation of *Pleurotus ostreatus* (Jacq. Fr.) upon Different Weeds and Agricultural Waste Substrates

**Waqar Islam[1]*, Asif Riaz[2], Zujian Wu[1]**

[1]College of Plant Protection, Fujian Agriculture & Forestry University, Fuzhou, Fujian 350002, China.
[2]University of Agriculture, Faisalabad, Pakistan.

**Received: 11.Nov.2016; Accepted: 21.Jan.2017; Published Online: 30.Jan.2017**
***Corresponding author: Waqar Islam; Email: ddoapsial@yahoo.com**

**Abstract**
Oyster mushrooms are fleshy edible fungi which acquire huge importance due to their nutritional and medicinal properties. These mushrooms are cultivated upon various substrates which directly affect the pattern and time taken in pin head and fruiting body formations. So the present experiment was designed to study different weeds, agricultural wastes and their mixtures for understanding the different variations in patterns of different growth stages of oyster mushrooms. These patterns were evaluated through time taken to reach the attributed target. Our results illustrated that cotton waste showed better performance as substrate as it took minimum days i.e. 7.5 followed by *Chenopodium album* and mixture of cotton waste + *Chenopodium album* which relatively taken 12.5 and 13.5 days to initiate pinhead formation. These substrates also provided better results regarding pattern of fruiting body formations as compared to all other substrates by recording 14, 19 and 19.5 days respectively. Further experimentation revealed that relatively more number of fruiting bodies was formed when cultivation was based upon cotton waste, *Chenopodium album* and mixture of cotton waste + *Chenopodium* anonymously. The performance of all other substrates was below power. Hence we conclude that *Chenopodium album* anonymously or mixture of particular weed and cotton waste can be utilized for efficient cultivation of oyster mushrooms.
**Keywords:** Oyster mushroom, Substrates, Weeds, Fruiting bodies, Agricultural waste, Pinhead.

**Cite this article:** Islam, W., Riaz, A., Wu, Z., 2017. Variation in Patterns of Pinhead and Fruiting Body Formation of *Pleurotus ostreatus* (Jacq. Fr.) upon Different Weeds and Agricultural Waste Substrates. PSM Biol. Res., 2(1): 51-55.

## INTRODUCTION

Mushrooms are edible and fleshy fungi which are cultivated upon organic substrates (Ashraf *et al.,* 2013). Due to their medicinal and nutritive properties, they acquire a very important place in human food chain (Ng'etich *et al.,* 2013). Their importance is continuously increasing day by day as they acquire valuable vitamins, proteins and minerals. All the edible mushrooms exhibit vitamin A, B1, B5, B6, C and D (Manzi *et al.,* 2001; Ahmed *et al.,* 2009; Islam *et al.,* 2016). Stanely (2011) has reported that *Pleurotus oestreatus* (Oyster mushroom) incorporates 2-5% fats, 7-38%, 8-12% minerals, mycocellulose, 17-47% sugars and 25-50% proteins.

Various agricultural substrates such as paddy straw, vegetable residues, maize stalks and cotton waste are utilized for cultivation of oyster mushrooms (Hassan *et al.,* 2011; Islam *et al.,* 2016a; Salama *et al.,* 2016; Siqueira *et al.,* 2016). The growth of the mushroom is considered to be dependent upon the performance of the substrates (Iqbal *et al.,* 2005). But the substrates which have high levels of nitrogen and carbohydrate contents are categorized as ideal for mushroom growth (Khare *et al.,* 2010; Islam *et al.,* 2016a; Salama *et al.,* 2016; Singh *et al.,* 2016). Several fungal species could be regarded as post-harvest decay of fruits (Abdullah *et al.,* 2016). In developing countries, sever usage of chemicals (Islam *et al.,* 2016b,c) along with recycling and management of the organic wastes has become a challenge but these can be efficiently utilized in cultivation of oyster mushroom which will ultimately reduce the malnutrition problems in these countries and will also reduce the pollution (Eswaran and Ramabadran, 2000). Oyster mushroom has many industrial and medical usages as they possess anti-oxidant, anti-microbial, anti-hypersensitive, anti-inflammatory, anti-tumor and food additive properties (Chang, 2007).

Pakistan being agricultural country possess 70% of its population in villages and all this population are directly related with the cultivation of different agricultural crops



 

(Noman *et al.,* 2015, 2016) which lead to the production of huge agricultural waste (Anonymous, 2001). Sarwar (2002) estimated that Pakistan produces around 11.3 and 3.2 million tons of wheat and paddy straw per year. China and Zimbabwe are considered as the largest producer of oyster mushroom and they use bag and tray method for its cultivation (Oei, 2003). Even after the availability of huge amount of agricultural waste, Pakistan has not accelerated the production of mushrooms which may be due to lack of knowledge and awareness (Helrich, 1990). So there is an urgent need to aware the people regarding mushroom cultivation and evaluation of different substrates for the better and efficient production of mushrooms. Keeping in view the importance of substrates in cultivation of oyster mushrooms, we tried to study the variation in patterns of pinhead and fruiting body formation upon different weeds, agricultural substrates and their relative mixtures.

## MATERIALS AND METHODS

### Collection and execution of experiment

Weeds (*Amaranthus viridis, Chenopodium album, Trianthemportula castrum*) and agricultural plants (Wheat straw, rice straw and cotton waste) were collected from industrial area of Faisalabad and Agronomic research area of University of Agriculture, Faisalabad. The experiment was laid out by following completely randomized design with three replications in mushroom experimental room at University of Agriculture Faisalabad, Pakistan.

### Preparation of substrates

Substrates were prepared in the following concentrations and treatment. Where T1= *Amaranthus virdis* (100%), T2= *Chenopodium album* (100%), T3= *Trianthemportula castrum* (100%), T4= *Amaranthus virdis* (50%) + Wheat straw (50%), T5= *Trianthemportula castrum* + Rice straw (50%), T6= *Chenopodium album* (50%) + Cotton waste (50%) and T7= Cotton waste (100%). For this process, all the weeds plants were dried under sunlight, chopped into small (1-2cm) pieces, weighed upon electronic scale and soaked for overnight. Drying out the excessive water, all the weeds were spread upon the clean floor surface. 65% moisture level was achieved through spraying of water and 2% $CaCO_3$ was added for enhancing the fusion of substrates for 24 hours upon the floor surface. After removing any gluts, the substrates were placed into the polypropylene bags (7 x 11 cm) according to above mentioned treatments. All the bags were closed via tying the rubber bands and were autoclaved for an hour for sterilization.

### Spawning of bags and controlled conditions

For all the replications and treatments, spawning of polypropylene bags were done specifically at 7% dry weight and each bag was incorporated with 56 grams of spawn and incubation of these bags was done at $25^0$C in complete darkness. Required temperature was achieved though usage of electrical heater and data was recorded till 100% growth was achieved in all bags. Similarly required humidity i.e. 80-90% was maintained through sprinkling of water upon floor surface. Furthermore, required moisture for bags was achieved by sprinkling the water on the bags thrice a day. Ventilation was maintained by operating the exhaust fan 3-4 times a day for air flushing and fulfilling the oxygen requirements for fructification of mushrooms.

### Data recording

The data regarding pinheads and their primordial formations upon various substrates was recorded in term of days taken for appearance. Furthermore time taken regarding fruiting body maturation and total number of fruiting bodies formation in different treatments was also recorded. All the data was subjected to analysis of variance where P= 0.05 (Steel *et al.,* 1997).

## RESULTS

### Pattern of Pinhead Formation

Statistical data regarding Pinhead formation revealed that all the substrates played a significant role in variation of pattern. Comparison of means explained that Cotton waste (T7) proven to be the most efficient as it took minimum number of days (7.5) for pinhead formations. Afterwards, the performance of *Chenopodium album* (T2) and the mixture of *Chenopdium alum* + Cotton waste (T6) were comparative to each other as they recorded the appearance of pinheads in 12.5 and 13.5 days respectively (Figure 1). All other substrates did not exhibited encouraging results by taking more than 15 days to achieve the same target i.e. T1 (15.50 days), T4 (17.50 days), T3 (19.00 days) and T5 (23.50 days).

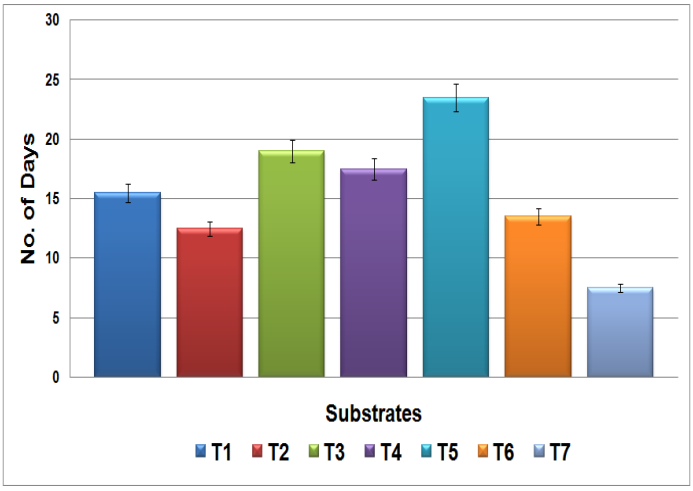


**Fig. 1. Means for pattern of pinhead formation on different weeds, agricultural substrates and their mixture (No. of days).**

**Pattern of Fruiting body formation**

Figure 2 clearly illustrated that once again T7 (Cotton Waste) proven as the best substrate to grow the oyster mushrooms as the fruiting bodies were formed only in 14 days. Other substrates which were satisfactory in this regards were *Chenopodium album* (T2), mixture of *Chenopodium album* + cotton waste (T6) and *Amaranthus viridis* (T1) which recorded 19, 19.5 and 21 days to achieve the fruiting body formation respectively. All other treatments i.e. T4, T3 and T5 were below power in this attribute as they taken 25.50, 26.50 and 30.00 days for fruiting body formations.

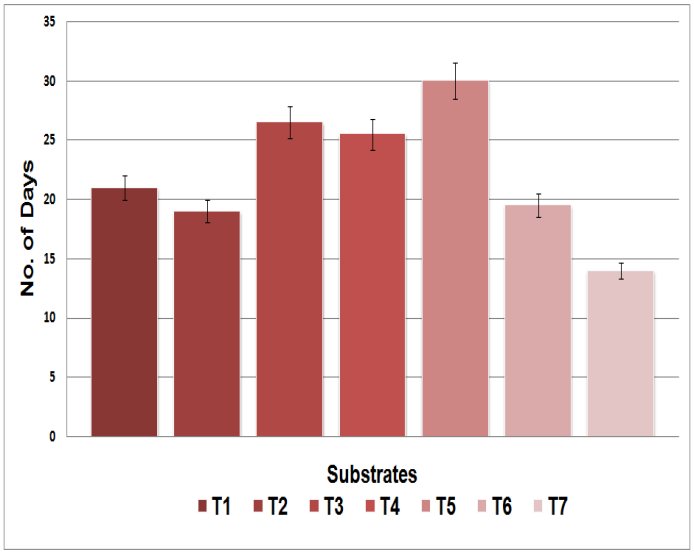


**Fig. 2. Means for pattern of fruiting body formation on different weeds, agricultural substrates and their mixtures (No. of days).**

**Pattern of Total Number of Fruiting body Production**

Comparison of means regarding total number of fruiting body formations revealed that all the weeds, agro substrates and their mixtures showed significant affect. Among all the substrates cotton waste (T7) was categorized as the most efficient as it exhibited 22.5 days to accomplish pattern for formation of total number of fruiting bodies of oyster mushrooms. Comparitive results were shown by T2 (*Chenopodium album*), T6 (mixture of *Chenopodium album* + Cotton Waste) and T1 (*Amaranthus virdis*) by recording 25.00, 28.5 and 29.5 days to achieve the targeted pattern. Rest of substrates (T4, T3, T5) were categorized as un-satisfactory as they recorded 32.50, 33.00 and 37.50 days respectively (Figure 3).

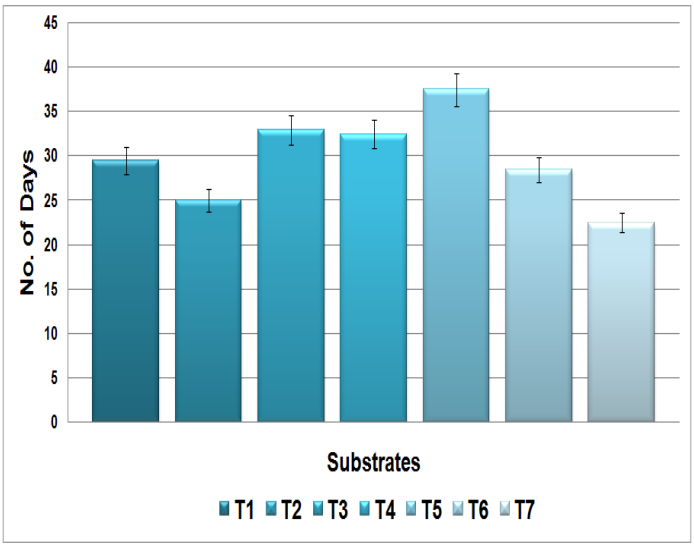


**Fig. 3. Means for pattern of total no. of fruiting body formation on different weeds, agricultural substrates and their mixtures (No. of days).**

## DISCUSSION

Different substrates and their mixtures can be utilized for the better cultivation of oyster mushroom which may include various crop residues, weeds, agricultural wastes and supplements like synthetic fertilizers (Ashraf and Noman, 2006; Zafar *et al.,* 2016). These substrates directly affect the time frame to attain the maximum mycelial growth and also take part in the yield attribute for oyster mushrooms. Previous reports of better yield of oyster mushrooms via utilization of different agricultural substrates attracted our mind towards it (Mendez *et al.,* 2005; Kalmis *et al.,* 2008; Onyango *et al.,* 2011; Islam *et al.,* 2016a; Salama *et al.,* 2016; Singh *et al.,* 2016; Siqueira *et al.,* 2016). So we tried to evaluate various agricultural substrates, Weeds and their mixtures for their effect upon pattern of pinhead appearance and fruiting body formation of the oyster mushrooms. Our results illustrated that cotton substrate relatively proven better as it recorded 7.5 days for pinhead appearance which are well supported by the findings of Khan et al. (2010) who documented that oyster mushrooms taken 7-8 days for this attribute. Furthermore we recorded 23.5 days to exhibit the pinheads of mushrooms upon mixture of Rice straw and *Trianthemaportula castrum* which are coordinating with the findings of Naeem et al. (2014) who mentioned that relatively 6.66 and 6.77 days were taken by paddy straw and cotton waste substrates. The results are further strengthened by the experiments of Ragunathan and Swaminathan (2003) who listed that *P. sajor*-caju utilized 21-30 days upon paddy straw to achieve the pinhead formation. Further continuing our observations, we have observed that regarding pattern of total no. of fruiting bodies formation, cotton waste was proved to be a better substrate by recording 22.50 days to

achieve the set target. Our results are well supported by the findings of Jahangir et al. (2015) who noted the performance of cotton substrate by mentioning that it takes 21.33 days. Arguments of Khan et al. (2009) also support our findings as he concluded cotton waste as a better substrate to grow oyster mushrooms.

## CONCLUSION

The results explain that the selection of better substrate not only initiate the pinheads earlier but also shows variation of patterns in formation of fruiting bodies leading towards the enhanced production of *Pleurotus ostreatus*. We further conclude that Cotton waste, *Chenopodium album* or the mixture of Cotton waste and *Chenopodium album* are better substrates for the cultivation of oyster mushroom.

## ACKNOWLEDGEMENT

We are thankful to anonymous reviewers for their value able suggestions to execute the experiment.

## CONFLICT OF INTEREST

The authors declare that they don't have any conflicts of interest and are also not interested in competing with anyone.

## REFERENCES

Abdullah, Q., Mahmoud, A., Al-harethi, A., 2016. Isolation and identification of fungal post-harvest rot of some fruits in Yemen. PSM Microbiol., 01(1): 36-44.

Ahmed, S.A., Kadam, J.A., Mane, V.P., Patil, S.S., Baig, M.M., 2009. Biological effeciency and nutritional contents of *Pleurotus florida* (Mont.) Singer cultivated on different agro-wastes. Nat Sci., 7: 44-48.

Anonymous., 2001. Agriculture in Pakistan, Online available from http: // www. pakistaneconomist.com/ issue 2001 / issue37/ i&e 4.

Ashraf, M., Noman, A., 2006. The effect of applied nitrogen on the growth and nutrient concentration of ajwain *trachysprmum ammi.* Aus. J. Exp. Agric., 45: 425-428.

Ashraf, J., Ali, M.A., Ahmad, W., Ayyub, C.M., Shafi, J., 2013. Effect of different substrate supplements on Oyster Mushroom (*Pleurotus* spp.) production. Food Sci. Tech., 1(3): 44-51.

Chang, S.T., 2007. Mushroom cultivation using the "ZERI" principle: potential for application in Brazil. Micol. Aplic. Int.,19(2): 33-34.

Eswaran, A., Ramabadran. R., 2000. Studies on some physiological, cultural and post harvest aspects of oyster mushroom, *Pleurotus ostreatus.* Trop. Agri. Res. J., 12: 360-374.

Hassan, S., Mohammad, A.Y., Kiramat, K., 2011. Cultivation of the oyster mushroom (*Pleurotus ostreatus* (Jacq.) P. Kumm.) in two different agro ecological zones of Pakistan. Afr. J. Biotech., 10: 183-188.

Helrich, K.C., 1990. Official methods of Analysis of the AOAC. Association of Official Analytical Chemists Inc., 2: 15.

Iqbal, S.M., Rauf, C.A., Sheikh, M.I., 2005. Yield performance of oyster mushroom on different substrate. Int. J. Agri. Biol., 7(6): 900-903.

Islam, W Riaz, A, Zaynab, M., Zujian Wu., 2016a. Efficacy of different weeds and agricultural substrates for cultivation of *Pleurotus ostreatus* (Jacq. Fr.). Asian. J. Agri. Biol., 4(4): 108-113.

Islam, W., Ahmed, M., 2016b. Inhibitory Effects of Organic extracts against *Aspergilus flavus* and their comparative efficacy upon germination of infested rice seeds. PSM Microbiol., 01(2): 79-84.

Islam, W., Awais, M., Noman, A., Wu, Z., 2016c. Success of bio products against bacterial Leaf Blight disease of rice caused by Xanthomonas oryzae pv. oryzae. PSM Microbiol., 01(2): 50-55.

Jahangir, M.M., Samin, G., Khan, N.A., Rehman, A., Aslam, Z., Amjad, M., Ziaf, K., Qadri, R.W.K., Khan, I., Atiq, M., 2015. Performance of oyster mushroom (pleurotus ostreatus) grown on cotton waste and sorghum straw based growing substrates. Pak. J. Phytopathol., 27(01): 77-81.

Kalmis, E., Azhar, N., Yildiz, H., Kalyonus, F., 2008. Feasibility of using olive mill effluent (OME) as a wetting agent during the cultivation of oyster mushroom, *Pleurotus ostreatus*, on wheat straw. Biores. Tech., 99: 164-169.

Khan, N.A., Haq, M.I., Khan, M.A., 2009. Growth Comparison of Local and Exotic Strains of Oyster Mushrooms on Different Agricultural Wastes. Pak. J. Phytopathol. 21(2): 139-143 mushroom (Pleurotus ostreatus) Pak. J. of Nutri. 7(2): 349-351.

Khan N.A., Rehman, H.U., Rehman, A., Arif, J.A., 2010. Screening of different exotic strains of oyster mushroom for yield production using cotton waste and combined with rice husk. Pak. J. Phytopathol., 22(1): 40 -44.

Khare, K.B., Mutuku, J.M., Achwania, O.S., Otaye, D.O., 2010. Production of two oyster mushrooms, *Pleurotus sajor-caju*and *P. florida* on supplemented and un-supplemented substrates. Bots. J. Agri. Appl. Sci., 6: 4-11.

Manzi, P., Aguzzi, A., Pizzoferrato, L., 2001. Nutritional value of mushrooms widely consumed in Italy. Food. Chem., 73(3): 321-325.

Mendez, L.A., Castro, C.A.S., Casoo, R.B., Leal, C.M.C., Effect of substrate and harvest on the amino acid profile of Oyster mushroom (*Pleurotus ostreatus*), J. Food Comp. Ana., 18: 447-450.

Naeem, S.M., Ali, M.A., Ali, S., Sardar, H., Liaqat, R., Shafiq, M., 2014. Growth and yield performance of oyster

mushroom ondifferent substrates. Mycopath., 12(1): 9-15.

Ng'etich, O.K., Nyamangyoku, O.I., Rono, J.J., Niyokuri, A.N., Izamuhaye, J.C., 2013. Relative performance of Oyster Mushroom (*Pleurotus florida*) on agro industrial and agricultural substrate. Int. J. Agron. Plant Prod., 4(1): 109-116.

Noman, A., Ali, S., Naheed, F., Ali, Q., Fareed, M., Rizwan, M., Irshad, M.K., 2015. Foliar application of ascorbate enhances the physiological and biochemical attributes of maize (Zea mays L.) cultivars under drought stress. Arch. Agron. Soil. Sci., 1: 1659-1672.

Noman, A., Bashir, R., Aqeel, M., Anwer, S., Iftikhar, W., Zainab, M., Zafar, S., Khan, S. Islam, W., Adnan, M. 2016. Success of transgenic cotton (*Gossypium hirsutum* L.): Fiction or reality? Cogent OA., 2: 1207844

Oei, P., 2003. Mushroom cultivation-Appropriate Technology for Mushroom Growers 3rd Ed. Backhuys Publishers, Netherland.

Onyango, B.O., Palapala, V.A., Arama, P.F., Wagai, S.O., Gichimu, B.M., 2011. Suitability of selected supplemented substrates for cultivation of Kenyan native wood ear mushrooms (*Auricularia auricula*). American J. Food Tech., 6: 395-403.

Ragunathan, R., Swaminathan, K., 2003. Nutritional status of *Pleurotus* spp. grown on various agro-wastes.J. Agric. Food Chem., 80: 371- 375.

Salama, A.N.A., Abdou, A.A.K., Helaly, A.A., Salem, E.A., Zhanxi, L., 2016. Cultivation of *Pleurotus ostreatus* L. on different substrates based on JuNCAO technology in Egypt. Nat. Sci., 14(4): 59-66.

Sarwar, M., Khan, M.A., Iqbal, Z., 2002. Feed Resources for Livestock in Pakistan. Int. J. Agric. Biol., 4(1): 186-192.

Singh, P., Vishwakarma, R., Bhartiya, P., Shrivastava, R., Shrivastava, P., 2016. Pleorotus sps. mushroom cultivation with dripping system in odd seasons. World J. Pharma. Res., 5(6): 1663-1667.

Siqueira, O.A.P.A., Zanon, A.R., Martins, O.G., Andrade, M.C.N.D., 2016. New substrates for the cultivation of *Pleurotus ostreatus* using exhausted compost. Afr. J. Agric. Res., 11(26): 2295-2301.

Stanley, R.P., 2011. Enumerative combinatorics*,* Vol. 1. Second edition. Cambridge Studies in Advanced Mathematics, 49. Cambridge University Press, Cambridge.

Steel, R.G.D., Torrie, J.H., 1997. Principles and procedures of statistics: A Biometrics Approach, 2nd ed. McGraw-Hill, New York.

Zafar, S., Ashraf, M.Y., Anwar, S., Ali, Q., Noman, A., 2016. Yield enhancement in wheat by soil and foliar fertilization of K and Zn under saline environment. Soil Env., 35 (1): 46-55.