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Influence of artificial light on vegetative growth of *Pleurotus eous* and *Pleurotus florida*: An oyster mushroom

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Abstract
Pleurotus is considered as the second most popular mushroom after button and are commonly called oyster or dhingri. Worldwide, *Pleurotus* is getting its popularity because of its easy cultivation and fast-growing habit. The growth of *Pleurotus* mushroom is greatly influenced by several factors *viz;* spawn, media, pH, temperature, moisture, and light colour. The influences of light colour on the mycelium growth of oyster mushroom *Pleurotus eous and Pleurotus florida* were investigated under LED light chamber in Mushroom laboratory, GBPUAT, Pantnagar, U.K. The result revealed that all the light colour greatly influences the mycelial growth of both the species. Red light showed maximum radial growth of 88.66 mm (*P. florida*) and 87.33 mm (*P. eous*) over the check. *P. eous* species showed minimum growth of 68.66 mm against green light while *P. florida* impart least growth of 77.33 mm against yellow light over the check, respectively.

Keywords: *Pleurotus eous*, *Pleurotus florida*, light colour, mycelium growth

Introduction
Mushrooms are macrofungi belonging to the class Basidiomycetes having distinctive fruiting bodies that possess nutritional and medicinal qualities (Chang and Miles, 1992) [3]. They are considered a reliable source of good quality protein and vitamin D as well as bio-factories of many elite bio-molecules for the interest of human health. Apart from this mushroom also play a vital role to restore the damaged environment after involving it in the recycling of rather polluting substances. Moreover, it also improves the socioeconomic status of rural people by increasing the opportunities for employment and income generation. Presently, mushrooms are being grown in more than 100 countries. China, Japan, the United States of America, the Netherland, and France are the major mushroom-growing countries. China stood first in the production and consumption of mushrooms (Shen *et al.*, 2002) [13]. Taxonomically, there is about 1.5 million fungal population out of which approximately 2000 fungal flora are considered edible mushrooms. Nowadays, mushroom species *viz; Agaricus*, *Pleurotus*, *Lentinula Auricularia*, *Volvariella*, and *Calocybe indica* are mainly adopted for commercial cultivation (Chang and miles, 1991) [2]. *Pleurotus* is rewarded as the second most popular mushroom after button and are commonly called oyster or dhingri. Worldwide, *Pleurotus* is getting its popularity because of its easy cultivation and fast-growing habit. The word *Pleurotus* was derived from the Greek word "Pleuro" which means "a lateral attachment of pileus to its stipe". The oyster is called after shell-like resemblances of its pileus. The oyster mushroom is mushy in texture with different colours, like dark blue, white, cream brown and pink, yellow, etc. *Pleurotus* are also rich nutritionally and medicinally. It contains 24.99% of protein on a dry weight basis and 3 to 28% carbohydrate, 3 to 32% fiber, and 3-5% lipids on a dry weight basis. Worldwide, there are more than 1000 species of the oyster mushroom have been described, out of these about 40 species are recognized and 20 species *P. australis, P. columbines, P. cystidiosus, P. djamor, P. eryngi, P. flabellatus, P. florida, P. fossulatus, P. levis, P. membranaceus, P. ostreatus, P. opuntiae, P. sajor-caju, P. sapidus, P. cornucopiae, P. platypus, P. purpureo-olivaceus, P. populinus, P. tuber-regium* and *P. yuccae* (Singh *et al*., 2011a) [14] are commercially cultivated**.** The growth of *Pleurotus* mushroom is greatly influenced by several factors *viz;* spawn, growing media, pH of media, temperature, moisture content, light intensity, and light colour (Kadiri and Kehinde, 1999) [7]. The study of mycelial behaviour is also important in studying the life cycle and other cultivation aspects of medicinally important mushrooms.

Therefore, the present study aimed to investigate the effect of different light colours (red, blue, green, and yellow) on the mycelial growth of *Pleurotus eous* and *Pleurotus florida* oyster mushroom species.

Material and Methods

Experimental layout

An experiment was conducted to evaluate the effect of different lights (red, blue, green, and yellow) on the mycelial growth of *Pleurotus eous* and *Pleurotus florida*. The experiment was carried out in a laboratory and crop room at Mushroom Research and Training Centre (MRTC), Department of Plant Pathology, College of Agriculture of G.B. Pant University of Agriculture and Technology, Pantnagar during 2017-2018.

Species Collection and Maintenance

Mushroom species were collected from MRTC, Mushroom Centre at GBPUA&T, Pantnagar, Uttarakhand. *Pleurotus* spp. *viz*; *Pleurotus eous* and *Pleurotus florida* were identified on basis of morphological characteristics in Mushroom Lab (MRTC) and Mycology Lab (Department of Plant Pathology). The pure culture of two species of oyster mushroom *Pleurotus eous* and *Pleurotus florida* was subsequently multiplied on potato dextrose agar (PDA, HiMedia Pvt Lt) media in Petri- plates. The full-grown culture is transferred and preserved in test tubes and Petri plates and was kept in the refrigerator at 4ºC for further use. To impart the experiment of different light colours in the LED chamber, the Petri plates were further poured with 20 ml of the medium and were inoculated with a 10 mm diameter disc of actively growing mycelium of both the species of *Pleurotus* at the center under aseptic conditions (Laminar Flow Chamber). Then the plates were incubated in B.O.D at an optimum temperature of 27±2°C and frequently observed for the growth of colonies. The replications were maintained as per the experiment done to evaluate the relative vegetative growth of *Pleurotus eous* and *Pleurotus florida*. The PDA medium was prepared by using standard methods as described by Ricker and Ricker (1936) [9]. The media was sterilized in an autoclave at 121 ºC (15lbs) for 20 minutes.

Effect of different light intensity

To ascertain the effect of different light intensities on the mycelia growth of tested fungus under laboratory conditions, the inoculated Petri plates with cultures of the *Pleurotus* spp. were placed in the LED chamber having red (620-750 nm), yellow (570-590 nm), green (495-570 nm) and blue (450-495 nm) light for 8th days. In a chamber, no light was taken as a check. The colours of the chamber were developed after wrapping them with red, yellow, green, and blue colored cellphone sheets. A long side inoculated Petri plates were also wrapped by the respective colored sheets for better results before incubation at 24ºC.

LED Growth Chambers

The five growth chambers of 30 cm^3 volume were used as shown in fig.1. Each chamber was precociously wrapped with red, blue, green, and yellow chart papers to produce the red, blue, green, and yellow colour inside. The chambers were also facilitated with the LED bulb of 1 watt each inside at centre to make the double impact of light on the vegetative growth of mushroom mycelium. The distance between the LED bulbs and the samples equalled 15 cm. The inoculated Petri plate of each species was kept in a different light chamber with three replication and the control plate was kept in the chamber without light (no light). The mycelia growth was recorded at 2 days interval till the plate was fully covered with the mycelia growth. The respective data were recorded in the data book. The percent inhibition of growth was calculated by using the formula given by Vincent (1947).

$$\text{Percent inhibition} = C\text{-}T/C \times 100$$

Where
I = Percent inhibition of mycelium
C = Growth of mycelium in control
T = Growth of mycelium in treatment

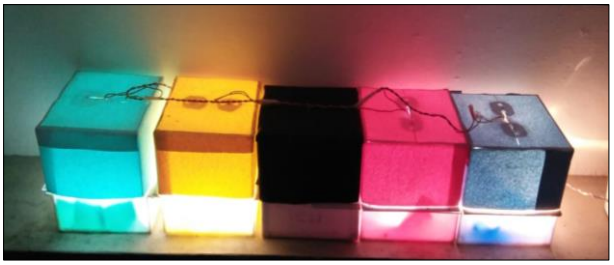


Fig 1: Growth chambers equipped with (a) green (b) yellow (c) no light (d) red (e) blue

Statistical analysis

Statistical analysis of the data was done using ICAR GOA Stat analysis (WASP 2.0) at www.ccari.res.in/wasp 2.0/index. PHP as per the requirement of the experiment. In all the experiments one factorial CRD was used. Critical differences (CD) calculated at a 5 percent level of significance were used for comparison of the difference between the means of treatments.

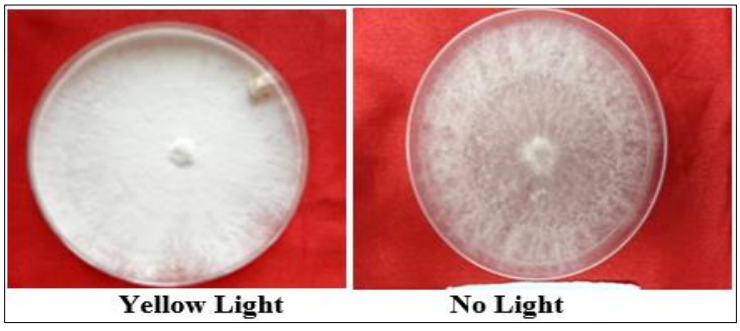
Results and Discussion

In this experiment, radial mycelial growth of *Pleurotus eous* and *Pleurotus florida* was evaluated with a different light colour such as red, blue, green, and yellow on PDA medium along with a check. The data revealed that lights with all the different colours (red, blue, green, and yellow) significantly influence the mycelium growth of both the *Pleurotus* species on the 8thDAI. Table. 1, Plate 1(a, b) & fig. 2 illustrated that the maximum radial growth of *Pleurotus eous* (87.33 mm) was recorded in red light followed by blue (84.66 mm) and yellow light (80.66 mm) while the minimum radial growth was recorded in green (68.66 mm) over the control (81.33), respectively. However, in the case of *Pleurotus florida* the maximum radial growth was recorded in red (88.66 mm) followed by blue, green, and yellow light respectively.

Apart from the mycelium growth of both the species, light also shows great variations in their colony character (Table.1, Plate 1, a). A thin mat like mycelium with a powdery appearance on the upper surface of the media was observed in red light. Blue light gives a spongy appearance with irregular periphery while creamish thick crusty layer at the centre and white smooth thick growth at the periphery with clear regular margins was seen in green light. Meanwhile, yellow light shows smooth mycelia growth with a regular periphery. However, white cottony growth of *Pleurotus eous* appeared in control (without light).

Pleurotus florida also impart variation in colony characters when influenced by different lights as mentioned in Table 1, Plate1, (b). The species impart whitish powdery growth with regular margins in presence of red light while the dotty surface of mycelia at the periphery with a thread-like appearance was recorded in blue light. Green light showed dense powdery growth with regular margins. Yellow light produced a smooth powdery surface and cottony growth with regular margins was produced by check, respectively. The effect of different light colours on the vegetative growth of *Pleurotus* species has been reported by many researchers. Gyurko (1972) [6] studied different colours of light and reported that blue light was the most suitable for the growth of *Pleurotus*. However, green coloured light was found most suitable for the radial mycelial growth of *P. columbinus* followed by yellow light colour (Chaurasia, 1997) [4]. Zadrazil (1976 and 1978) [16-17] concluded that *Pleurotus* species need a daily light for 15 minutes during cropping and in absence of light, sporophores have long and thin stripes with reduced pileus. Although, light is not essential for vegetative growth. Though, require for the formation and maturation of reproductive structures of wood-rotting fungi (Eger, 1978). Cayrol (1978) [5, 1] recommended neon light for 12 hours and 8 hours per 24 hours for *P. ostreatus* and *P. pulmonarius* cultivation, respectively. A three-five minutes exposure of light per 24 hours stimulates the primordial number and yield of *Pleurotus eryngii* when compare to the absolute darkness in which pileus was poorly developed with long and thin stipes (Sharma 1984) [11]. According to Mehta (1985) [8], light exposure of at least an hour to the bags increased the yield of *P. sapidus*. The growth of some mushrooms like *Suillus sibiricus is* inhibited in the presence of light (Sagar *et al*., 1994) [10].

(a)



(b)

Plate 1: (a) Radial growth of *Pleurotus eous* and (b) *Pleurotus florida* in a different light

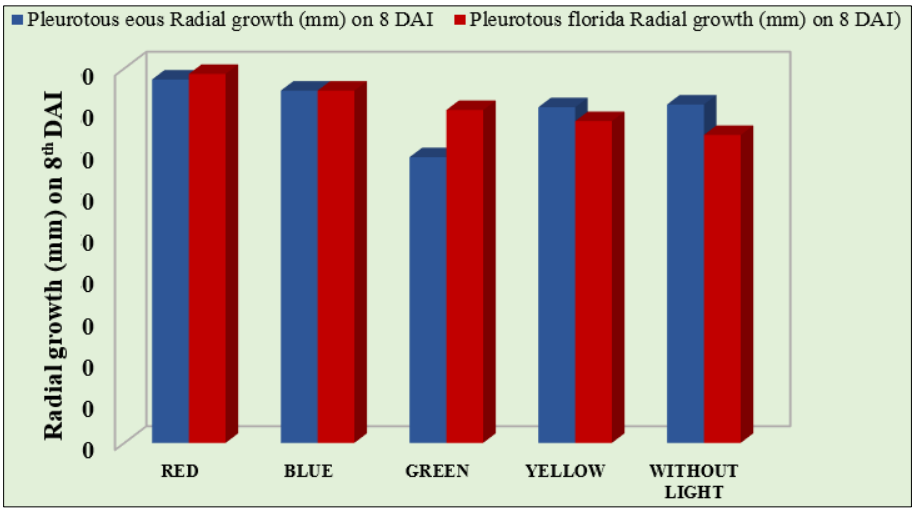


Fig 2: Graphical representation of *Pleurotus* mycelium growth against different light colour

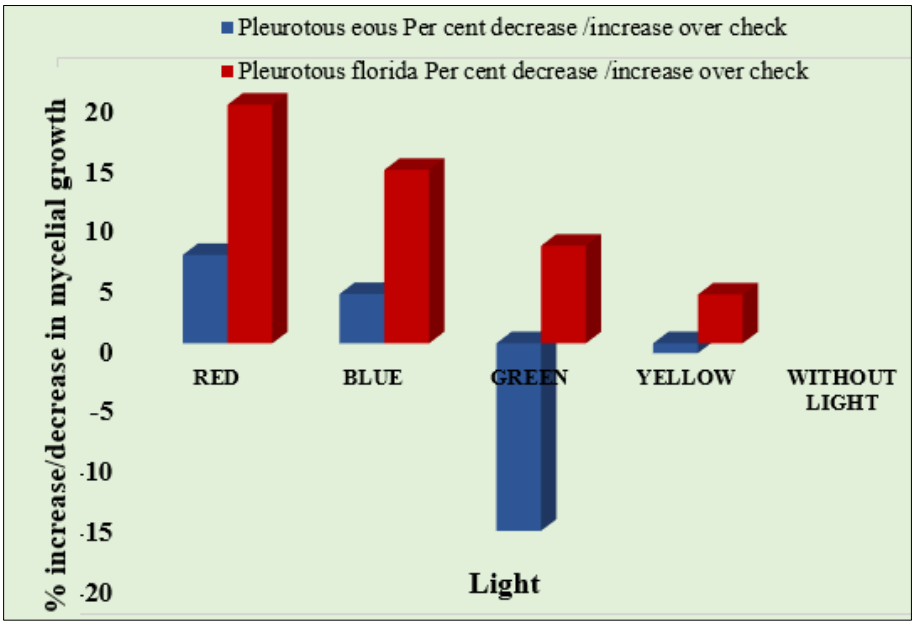


Fig 3: Percent increase or decrease in mycelial growth of *Pleurotus eous* and *Pleurotus florida* against different light colour

Table 1: Effect of different light colour on the mycelium growth of *Pleurotus* spp.

Light	*Pleurotus eous*			*Pleurotus florida*		
	***Radial growth (mm) at 8th DAI**	**% Increase/decrease over check**	**Colony character**	***Radial growth (mm) at 8th DAI**	**% Decrease over check**	**Colony character**
Red	87.33[a]	7.33	A thin mat like mycelium with a Powdery appearance on the upper surface of mycelium and fruiting formation	88.66[a]	19.81	Whitish powdery growth with regular margins
Blue	84.66[b]	4.09	Spongy appearance with the irregular periphery and fruiting on the periphery	84.66[b]	14.40	Mycelium nods at the periphery. Periphery is threaded Three secondary cream-coloured cottony growth
Green	68.66[d]	(-)15.57	Creamish thick crusty layer at the centre and white smooth thick growth at the periphery. Clear and regular margins	80.00[c]	8.10	Dense powdery growth with regular margins
Yellow	80.66[c]	(-)0.82	Smooth mycelia growth with the appearance of a small regular periphery	77.33[d]	4.05	Smooth whitish surface
Without light(Check)	81.33[c]	-	Whitish cottony growth with regular margin	74.00[e]	-	Cottony growth with regular margins
CD at 5%	1.93	-		1.40	-	
CV	1.32	-		0.95	-	

Conclusion

Light of different colour (red, blue, green, and yellow) with respective wavelengths significantly influence the mycelium growth of both *Pleurotus* species (*P. eous* and *P. florida*) under the LED light chamber. Among all the light treatments, red light encouraged the radial growth of *P. eous* and *P. florida* over the check.

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