

## Effect of Different Saw Dust Substrates on the Growth and Yield of Oyster Mushroom (*Pleurotus ostreatus*)

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**Abstract :** Cultivation of *Pleurotus ostreatus* on different saw dust substrates such as *Ficus carica* (Fig tree, T<sub>2</sub>), *Albizia saman* (Rain Tree, T<sub>3</sub>), *Swietenia mahagoni* (Mahogany tree, T<sub>4</sub>), *Leucaena leucocephala* (Ipil ipil tree, T<sub>5</sub>), *Eucalyptus globulus* (Eucalyptus tree, T<sub>6</sub>) and mixture of all five tree sawdust (T<sub>1</sub>) supplemented with 30% wheat bran and 1% lime as basal substrates were investigated. The effects of various saw dust substrates comparative growth and yield of performance oyster mushroom were analyzed. The highest mycelium running rate (0.70 cm/day) and the lowest time from primordial initiation to harvest (3.33 days), were obtained in T<sub>4</sub>. The highest time from stimulation to primordial initiation (8.00 days) were found in T<sub>1</sub>. The highest biological yield (373.4 g/packet), economic yield (371.8 g/packet), dry yield (37.16 g/packet), biological efficiency (213.2%), benefit cost ratio (5.62), the highest average number of primordia/packet (226.3), the highest average number of fruiting body/packet (122.3), the highest average weight of individual fruiting body (4.45 g) and the highest average number of effective fruiting body/packet (21.33) were obtained in T<sub>3</sub>. Among all aspects, T<sub>3</sub> was found as a best substrate with biological yield (373.4 g/packet) and BE (213.2 %) followed by T<sub>1</sub>, T<sub>4</sub>, T<sub>6</sub>, T<sub>5</sub>, T<sub>2</sub> for the production of mushroom

**Keywords:** Growth, Sawdust, Spawn, Substrates, *Pleurotus ostreatus*, Wheat bran, Yield

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### I. INTRODUCTION

Mushrooms are one kind of edible fungi belonging to the genus *Pleurotus* under the class Basidiomycetes. Oyster mushroom (*Pleurotus ostreatus*) is an edible mushroom having excellent flavor and taste. *Pleurotus* species are popular and widely cultivated throughout the world mostly in Asia and Europe owing to their simple and low cost production technology and higher biological efficiency [1]. Cultivation of oyster mushroom has increased tremendously throughout the world because of their abilities to grow at a wide range of temperature and harvested all over the year [2]. *Pleurotus* have the ability to excrete hydrolyzing and oxidizing enzymes [3] which have capable of utilizing complex organic compounds that occurred agricultural wastes and industrial by-products [4] with broad adaptability varied agro-climatic conditions [5]. *Pleurotus ostreatus* demands few environmental controls, and their fruiting bodies are not often attacked by diseases and pests, and they can be cultivated in a simple and economic way [6]. It requires a short growth time in comparison to other edible mushrooms [7]. Mushrooms require carbon, nitrogen and inorganic compounds as their nutritional sources, the main nutrients are less nitrogen and more carbon containing substrate such as most organic matters containing cellulose, hemicellulose and lignin can be used as mushroom substrate (i. e. rice and wheat straw, cottonseed hulls, corncob, sugarcane baggase, sawdust, waste paper, leaves, and so on) which supports the growth, development and fruiting of mushroom [8]. The growths of diverse type of mushrooms require different type of substrates and availability of varied type of materials may dictate which type is used [9]. Large quantity of freely available sawdust of different trees offers a potential substrate source for mushroom cultivation in the tropics [10]. Mushroom cultivation has a special relevance to Bangladesh, because sawdust and other materials are available to the farmers. In India, sawdust is the most popular basal ingredient used in substrates to grow shiitake mushroom compare to the wheat straw and rice or wheat bran [11-15].

In general edible mushrooms are low in fat and calories, rich in vitamins B, D, K and sometimes vitamins A and C [16], contain more protein than any other food of plant origin and are also a good source of mineral nutrients [17]. Malnutrition is a problem in developing third world countries. Mushrooms with their flavor, texture, nutritional value and high productivity per unit area have been identified as an excellent food source to alleviate malnutrition in developing countries [18]. Currently, high biofuel prices have caused an increase in food prices and food scarcity in many countries (World Bank, 2008). To alleviate hunger and malnutrition in a world of rising food prices, cultivation of mushrooms is a very reliable and profitable option. Oyster mushroom cultivation can play an important role in managing organic wastes whose disposal has become a problem [19]. These wastes can be recycled into food and environment may be less endangered by pollution [20]. Strengthening mushroom production sector could be essential in order to enable the rural economy to keep

its vibrancy and development, increasing and diversifying business and employment opportunities in the rural areas, and providing income opportunities of small family farms. Furthermore, the use of these residues in bioprocesses may be one of the solutions to bioconversion of inedible biomass residues into nutritious protein rich food in the form of edible mushrooms [21]. Apart from food value, its medicinal value for diabetics and in cancer therapy has been emphasized [22]. Many of mushrooms pose a range of metabolites of intense interest to pharmaceutical e.g. antitumour, antigenotoxic, antioxidant, anti-inflammatory, anti-hypertensive, antiplatelet-aggregating, antihyperglycaemic, antimicrobial, antiviral activities and food industries [23].

The present experiment was undertaken to evaluate influence of locally available substrates containing sawdust of different trees with wheat bran and 1% lime on growth and yield of *Pleurotus ostreatus* mushroom. Those experiments were also to find the best sawdust among others as substrate for effective cultivation of oyster mushroom.

## II. MATERIAL AND METHODS

### 2.1. Materials and Measurement

The experiment was carried out at the Mushroom Culture House (MCH), Biochemistry laboratory of the Department of Biochemistry, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh and National Mushroom Development and Extension Center (NAMDEC) laboratory, Savar, Dhaka, Bangladesh during July' 2012 to December' 2012. Fruiting body of oyster mushroom was collected from NAMDEC, Savar, Dhaka, Bangladesh. Oyster mushrooms (*Pleurotus ostreatus*) are characterized by the rapidity of the mycelial growth and high saprophytic colonization activity on cellulosic substrates. The sample was weighted by electric balance (KEY: JY-2003; China) and heated in a muffle furnace (Nabertherm: Mod-L9/11/c6; Germany).

### 2.2. Sterilization Procedure

In the laboratory, all of the apparatuses, equipment, metallic instruments, glassware and culture media were sterilized in the autoclave at 121°C about 1 hour at 1.5 kg/cm<sup>2</sup> pressure strictly for maintaining sterility. The culture room of the laboratory was cleaned by gently washing with detergent followed by 70% ethyl alcohol regularly. Before inoculation, laminar airflow cabinet was sterilized using ultra violet light for 30 minute keeping blower active. All inoculation measures were carried out in the laminar airflow cabinet to avoid contamination. The cabinet was exposed on the UV light for 30 minutes before use. All the instruments and equipment used were sterilized with alcohol before use.

### 2.3. Production of Oyster Mushroom (*P. ostreatus*)

#### 2.3.1. Preparation of PDA Media

At first, 250 g potatoes were washed, peeled and sliced to prepare 1000 mL PDA media. Then peeled and sliced potatoes were boiled in water to make them soft and also filtered through a cheese cloth and further water was added to get 1000 mL media. After adding 18 g agar and 20 g dextrose, it was heated and stirred for about 45 minutes. Then 10 mL media was taken into each of test tube and mouths of the test tubes were plugged with cotton and brown paper. After that all the test tubes were sterilized in an autoclave for 20 minutes at 121°C and 1.5 kg/cm<sup>2</sup> and kept in slanting position for having maximum space for the organism in pure culture to proliferate.

#### 2.3.2. Tissue Culture

To obtain pure culture, a small piece of tissue was collected from the fruiting body of mushroom, *Pleurotus ostreatus* and placed on the sterilized PDA medium under aseptic condition in a laminar air flow cabinet. It was then kept for 7-10 days in an incubator under 25°C for sufficient mycelial growth. These pure cultures were used for the entire experiment.

#### 2.3.3. Preparation of Mother Spawn

Mother culture substrate was prepared by using sawdust. Sawdust was sieved and sun dried. The mother culture substrate was prepared by sawdust and wheat bran in 2:1 ratio with 0.1% calcium carbonate [24]. Then it was mixed thoroughly with hands and maintained 55% moisture content by adding sufficient water. Then 200 g of mixture was packed tightly 18×25 cm polypropylene bags. Each of the bags was prepared by using bamboo neck and plugged the neck with cotton and covered with brown paper placing rubber band to hold it tightly in place. The packets were sterilized for 1 hour at 121°C with 1.5 kg/cm<sup>2</sup> pressures in an autoclave and kept them for cooling. Then inoculums from pure culture were placed aseptically to the mother spawn packets. The packets after inoculation were again plugged with cotton and were kept at 20-22°C for spawn run. The whole packet containing substrate became white due to fungal mycelia proliferation within 15-20 days and thus ready for spawning the substrate [25].

### **2.3.4. Preparation of Spawn Packets**

Spawn packets using different saw dust (individual five trees as T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub> and mixture of five trees as T<sub>1</sub>), wheat bran and CaCO<sub>3</sub> in ratio 69:30:1 respectively. The mixed substrates were filled into 10×12 inch polypropylene bag. The spawn packets preparation, sterilization, inoculation and incubation were done using the method described by Sarker *et al.* [26, 27]. The weight of each spawn packet was 500 g. Moisture was measured by using the moisture meter and adjusted the moisture content at 65%. Therefore the packets were sterilized about 1h and then these were kept for cooling. After cooling, 5 g mother spawn were inoculated into the packets in the laminar airflow cabinet and were kept at 20-22°C temperature until the packets become white with the mushroom mycelium. After completion of the mycelium running the rubber band, brown paper, cotton plug and bamboo neck of the mouth of spawn packet were removed and the mouth was wrapped tightly with rubber band. Than this spawn packets were transferred to the culture house.

### **2.3.5. Cultivation of Spawn Packet**

Two ends, opposite to each other of the upper position of plastic bag were cut in "D" shape with a blade and opened by removing the plastic sheet after which the opened surface of substrate was scraped slightly with a tea spoon for removing the thin whitish mycelial layer. Then the spawn packets were soaked in water for 15 minutes and invested to remove excess water for another 15 minutes. The packets of each type were placed separately on the floor of culture room and covered with newspaper. The moisture of the culture room was maintained 80-85% relative humidity by spraying water 3 times a day. The light around 300-500 lux and ventilation of culture house was maintained uniformly. The temperature of culture house was maintained 22-25°C. The first primordia appeared 3-5 days after scribing depending upon the type of substrate. The harvesting time also varied depending upon the type of substrate [26, 27].

### **2.3.6. Harvesting of Mushroom**

Oyster mushrooms matured within 2-3 days after primordia initiation. The matured fruiting body was identified by cural margin of the cap, as described by Ruhul Amin *et al.* [28]. Mushrooms were harvested by twisting to uproot from the base. Mushrooms were harvested 3 times from a packet. After completing the first harvest again the packets were scraped at the place where the 'D' shaped cut had been done and were soaked in a bucket for five minutes and then placed in the culture house and water was sprayed regularly. The primordia appeared 9-10 days after first harvest and 7-8 days after second harvest. Water spraying was continued until the mushrooms were ready to be harvested.

## **2.4. Data Collection**

Data were collecting on the following parameters

*Mycelial Growth (%)*: Mycelial growth was counted by taking the full packet as a full unit and generally the data was taken at every two days intervals.

*Mycelium Running Rate in Spawn Packet (cm)*: Mycelium running rate (MRR) for each type of substrate was measured after the mycelium colony cross the shoulder of the packet. The linear length was measured at different places of packet [27].

$$\text{MRR} = \frac{L}{N} \text{ cm/day}$$

Where,

L= Average length of mycelium running for different places (cm)

N= Number of days

*Days Required for Completing Mycelium Running*: Days required from inoculation to completion of mycelium running were measured.

*Time from Stimulation to Primordia Initiation (days)*: Time required from stimulation to primordia initiation (days) were recorded.

*Time from Primordial Initiation to Harvest (days)*: Time required from primordial initiation to harvest (days) were recorded.

*Average Number of Primordial/Packet*: Number of primordial/packet was recorded.

*Average Number of fruiting Body/Packet*: Number of well-developed fruiting body was recorded. Dry and pinheaded fruiting bodies were discarded but tiny fruiting bodies were included in counting.

*Average Number of Effective Fruiting Body/Packet*: Number of very well-developed fruiting body was recorded. Tiny fruiting bodies were discarded from counting.

*Average Weight of Individual Fruiting Body/Packet*: Average weight of individual fruiting body was calculated by dividing the total weight of fruiting body per packet by the total number of fruiting body per packet.

*Dimension of Fruiting Body (pileus and stripe)*: Diameter of pileus (cm), thickness of pileus (cm) and length of stripe (cm) of three randomly selected fruiting bodies was measured using a slide calipers

**Biological Yield (g):** Biological yield per 500 g packet was measured by weighing the whole cluster of fruiting body without removing the lower hard and dirty portion.

**Economic Yield:** Economic yield per 500 g packet was recorded by weighing all the fruiting bodies in a packet after removing the lower hard and dirty portion.

**Dry Yield:** About 50 g of randomly selected mushroom sample was taken in a paper envelop and was weighed correctly. The mushroom was oven dried at 72°C temperature for 24 hours and weighed again. The weight of blank envelop was subtracted from both the weight [27]. The dry yield was calculated using the following formula.

$$\text{Dry Yield (g/500g Packet)} = \text{Economic Yield} \times \frac{\text{Oven Dry Weight of Sample (g)}}{\text{Fresh Weight of Sample (g)}}$$

**Drying of Mushrooms:** The collected fruiting bodies of the mushroom are transferred to the laboratory. Therefore data are collected on different parameter. After collection of the data the fruiting bodies are dried in the sun separately treatment wise. In the time of drying the stipe and the pileus are separated for better drying.

**Biological Efficiency:** Biological efficiency was determined by the following formula [29].

$$\text{Biological Efficiency} = \frac{\text{Total Biological Weight (g)}}{\text{Total Weight of Substrate used (g)}} \times 100$$

**Benefit Cost Ratio:** The benefit cost ratio for different low cost substrate were computed based on present market price of mushroom and cost of different inputs in the markets [27].

### III. RESULTS AND DISCUSSION

#### 3.1. Effect on Mycelium Growth

##### **Effect of Different Sawdust Substrates on Mycelium Running Rate in Spawn (cm)**

Mycelium running rate per day (MRR) for each type of substrates was measured after the mycelium colony crossed the shoulder of the packet. The highest running rate was observed in **T<sub>4</sub>** (0.70 cm) followed by **T<sub>3</sub>** (0.66 cm) which was statically similar to **T<sub>5</sub>** (0.62 cm), **T<sub>6</sub>** (0.59 cm) and **T<sub>2</sub>** (0.58 cm) treatment and the lowest mycelium running rate of mycelium was observed in **T<sub>1</sub>** (0.54 cm) as shown in Table 1. The result of the present study corroborates with the study of previous workers (Khan *et al.*, 2001; Kalita *et al.*, 2001) [30, 31] they were reported that time taken for completion of spawn running may require to 17 days from 22 days by use of different substrates. Sarker *et al.* (2004) found that the mycelium running rate of oyster mushroom greatly influenced with the supplement of wheat brans in different levels [27]. Royse *et al.* (2002) found, as the spawn rate increased the number of days to production decreased [32]. The result of the present study is similar to the Bhuyan (2008) experiment result [33].

##### **Effect of Different Sawdust Substrates on Time from Stimulation to Primordia Initiation (Days)**

The time from stimulation to primordia initiation ranged from 6.0-8.0 days. The lowest time from stimulation to primordia initiation was observed in **T<sub>3</sub>** and **T<sub>2</sub>** (6.0 days). The highest time from stimulation to primordia initiation was observed in **T<sub>1</sub>** (8.0 days). Statically similar stimulation primordia initiation was shown in the treatment to **T<sub>6</sub>** (7.6 days), **T<sub>4</sub>** (7.33 days) and **T<sub>5</sub>** (6.67 days) treatments as shown in Table 1. The results varied with the findings of Patra and Pani (1995)[34] who found that oyster mushroom took 4-8 days for initiation of fruiting bodies but in the present study, it was ranged from 6.0-8.0 days. The difference among the findings may be due to the difference in cultural environment, substrates or the varieties.

##### **Effect of Different Sawdust Substrates on Time from Primordia Pnitiation to Harvest (Days)**

All the treatments were statistically similar but numerically vary to each other as shown in Table 1. Numerically the lowest time from primordia initiation to harvest was in the treatment **T<sub>4</sub>** (3.33 days) followed by **T<sub>5</sub>** and **T<sub>6</sub>** (3.67 days) and the highest time from primordia initiation to harvest was observed in the treatment **T<sub>1</sub>** and **T<sub>3</sub>** (4.33 days) in Table 1. The findings of the present experiment are in conformity with Shah *et al.* (2004) who found that fruiting bodies of oyster mushroom became suitable for harvest within 3-6 day of primordia initiation in the spawn packet [9]. Khan *et al.* (2001) reported that after spawn running pinhead formation took 7-8 days and fruiting body formed after 3-5 days, sporocarps may be harvested after 10-12 days [30]. Dhoke *et al.* (2001) found significant effect of different agro-wastes on yield of oyster mushroom [35]. The days required for first picking varied from 11.25-12.00 and the final picking complete from 42.25-43.50 days depending on different substrates.

Table 1. Effect of sawdust substrates on mycelial growth of oyster mushroom (*P. ostreatus*)

Treatments	Mycelium running rate in spawn packet (cm)	Time from stimulation to primordial initiation (days)	Time from primordia initiation to harvest (days)
T <sub>1</sub>	0.54c	8.00a	4.33a
T <sub>2</sub>	0.58bc	6.00b	4.00a
T <sub>3</sub>	0.66ab	6.00b	4.33a
T <sub>4</sub>	0.70a	7.33ab	3.33a
T <sub>5</sub>	0.62abc	6.67ab	3.67a
T <sub>6</sub>	0.59bc	7.6ab	3.67a
CV (%)	6.54%	13.58%	16.04%
LSD (0.05)	0.081	1.72	1.14

Means followed by same letter significantly different at 1% or 5% level of significance

### 3.2. Effect on Yield Contributing Characters and Yield

#### Effect of Different Sawdust Substrates on Average No. of Primordia/Package

All the treatments were statistically similar but numerically vary to each other as shown in Table 2. Numerically the highest average number of primordia/package was observed in the treatment T<sub>3</sub> (226.3) followed by T<sub>1</sub> (210.3) and T<sub>4</sub> (210.0) treatments and the lowest average number of primordia/package was in the treatment T<sub>2</sub> (196.3). Ahmed *et al.* (1998) reported significantly different number of primordia on different substrates [29]. Dey *et al.* (2006) found that the number of primordia and the average yield significantly varied with the substrates used in production of oyster mushroom [36]. Bhuyan (2008) found similar findings growing oyster mushroom on sawdust supplemented with different levels of cow dung [33].

#### Effect of Different Sawdust Substrates on Average No. of Fruiting Body/Package

The highest average number of fruiting body/package was observed in the treatment T<sub>3</sub> (122.3) and the lowest average number of fruiting body/package was in the treatment T<sub>2</sub> (76.0) followed by T<sub>5</sub> (82.33). The other treatments were statistically and significantly varied over control in terms of average number of primordia/package as shown in Table 2. Yoshida *et al.* (1993) reported that the number of fruiting bodies was lower, but increased when the substrates was mixed with different supplements [37]. Amin *et al.* (2007) reported that the number of primordia grown on different substrates differed significantly [24]. Sarker (2004) found that the number of primordia increased with the levels of supplement and continued up to a certain range [27]. Bhuyan (2008) in a same type of experiment found similar results [33].

#### Effect of Different Sawdust Substrates on Average No. of Effective Fruiting Body/Package

Numerically the highest average number of effective fruiting body/package was observed in the treatment T<sub>3</sub> (21.33) followed by T<sub>1</sub> (19.67) treatment and the lowest average number of effective fruiting body/package was in the treatment T<sub>2</sub> (15.67). The other treatments differed significantly in terms of average number of primordia/package as shown in Table 2. The findings of the present study matches with the study of Yoshida *et al.* (1993) who reported that the number of effective fruiting bodies was lower, but increased when the substrates was mixed with different supplements [37]. The comparative similar findings were also found by Ruhul Amin (2007) and Ahmed (1998) [24, 29].

#### Effect of Different Sawdust Substrates on Average Weight of Individual Fruiting Body (g)

Effect of different sawdust substrates had great effect on average weight of individual fruiting body. The average weight of individual fruiting body in different treatment ranged from 4.45-2.95 g. The highest average weight of individual fruiting body was observed in the treatment T<sub>3</sub> (4.45 g) followed by T<sub>1</sub> (4.30 g) treatment and the lowest average weight of individual fruiting body was in the treatment T<sub>2</sub> (2.95 g) The other treatments varied significantly over control in terms of average weight of individual fruiting body as shown in Table 2. Sarker *et al.* (2007) reported the individual weight of fruiting body ranged from 1.33-1.59 g, which was more or less similar to this study [26]. Bhuyan (2008) found significant effect of supplementation on the weight of fruiting body but he found comparatively higher weight of individual fruiting body ranged from (5.02-7.01 g), which may be due to environmental conditions or growing season [33].

#### Effect of Different Sawdust Substrates on Average Length of Stripe

The highest average length of stripe was observed in the treatment T<sub>4</sub> (1.63 cm) followed by T<sub>1</sub> (1.3 cm), T<sub>2</sub>, T<sub>3</sub> and T<sub>5</sub> (1.30 cm) treatments and the lowest average length of stripe was in the treatment T<sub>6</sub> (1.17 cm). The other treatments differed significantly over control in terms of average weight of individual fruiting body as shown in Table 2. The findings of the present study were matched with the study of Sarker *et al.* (2007)

and Habib (2005) they were reported that the stripe length of *Pleorotus spp.* on different substrate varied from 1.93-2.97cm and the diameter ranged from 0.74-1.05cm [26, 38].

**Effect of Different Sawdust Substrates on Average Thickness of Pileus**

Effect of different sawdust substrates had great effect on average thickness of pileus. The average thickness of pileus in different treatment ranged from 0.90-0.70 cm. All the treatments were statistically similar as shown in Table 2. The findings of the present study matches with the study of Habib *et al.* (2005) who found that the diameter of pileus ranged from 4.85-8.95 cm and thickness of the pileus ranged from 0.45-0.70 cm due to different substrates [38] and Sarker *et al.*, 2007 reported that the thickness of pileus ranged from 0.50-0.80 cm in case oyster mushroom [26].

**Table 2.** Effect of sawdust substrates on mushroom yield attributes of oyster mushroom (*P. ostreatus*)

Treatments	Average No. of primordia/packet	Average No. of fruiting body/packet	Average No. of effective fruiting body/packet	Average weight of Individual fruiting body	Average length of stripe (cm/ stripe)	Average thickness of pileus (cm/pileus)
T <sub>1</sub>	210.3a	106.7ab	19.67a	4.30ab	1.33ab	0.70a
T <sub>2</sub>	196.3a	76.00b	15.67a	2.95b	1.30ab	0.80a
T <sub>3</sub>	226.3a	122.3a	21.33a	4.45a	1.30ab	0.90a
T <sub>4</sub>	210.0a	101.0ab	17.33a	3.87ab	1.63a	0.80a
T <sub>5</sub>	197.7a	82.33b	16.33a	3.34ab	1.30ab	0.70a
T <sub>6</sub>	207.7a	93.0ab	18.00a	3.75ab	1.17b	0.77a
CV (%)	8.60%	22.60%	19.39%	20.08%	16.68%	16.21%
LSD(0.05)	32.54	39.83	6.37	1.38	0.40	0.23

Means followed by same letter significantly different at 1% or 5% level of significance

**3.3. Effect of Different Sawdust Substrates on Biological Yield, Economic Eield (g), Dry Yield, Biological Efficiency, Benefit Cost Ratio**

All the treatments were statistically similar but numerically vary to each other as shown in Table 3. Effect of different sawdust substrates had great effect on biological yield. Numerically the highest biological yield was counted under treatment T<sub>3</sub> (373.4 g/packet) followed by T<sub>1</sub> (356.2 g/packet) treatment and the lowest biological yield was counted under T<sub>2</sub> (327.3 g/packet). The other treatments varied significantly as compared with control in terms of biological yield (Table 3). Chowdhury *et al.* (1998) examined the effects of adding different supplements to substrates for growing oyster mushrooms (*Pleurotus sajor-caju*) and found adding 5% supplements gave the highest yield of oyster mushroom [39]. Baysal *et al.* (2003) found the highest yield of *P. ostreatus* with the substrate composed of 20% rice husk in weigh [10]. Ruhul Amin *et al.* (2007) found the highest biological yield 247.3g/packet [24]. He also found that the trend of economic yield corresponded with different supplements at different level.

Numerically the highest economic yield was recorded under treatment T<sub>3</sub> (371.8 g/ packet) followed by T<sub>1</sub> (354.6 g/packet) treatment and the lowest economic yield was counted under T<sub>2</sub> (324.8 g/ packet). The other treatments varied significantly over control as shown in Table 3. Payapanon *et al.* (1994) mentioned that suitable amount of supplements added to rice straw medium maximized economic yield of oyster mushroom at optimum production cost. Sarker (2004) found appreciable variations in economic yield also observed at different levels of supplements under different substrate-supplement combinations [27]. Bhuyan (2008) observed that the yield of *P. ostreatus* responded with the levels of supplements used with sawdust and increased with the level of supplementation and declined thereafter [33].

The dry yield of the oyster mushroom, grown on different sawdust substrates responded significantly in terms of dry yield with supplement. Numerically the dry yield of mushroom was maximum under the treatment T<sub>3</sub> (37.16 g/ packet) followed by T<sub>1</sub> (35.46 g/packet) treatment and the lowest dry yield was counted under T<sub>2</sub> (32.48 g/ packet). The other treatments varied significantly over control (Table 3). The result of the present study corroborates with Ahmed (1998) who observed significant effects of various substrates on diameter and length of stalk also diameter and thickness of pileus [29]. He also found that lower diameter of pileus produced the lowest yield and concluded that the diameter of pileus increased the quality and yield of mushroom and highest dry yield from mango sawdust. Sarker *et al.* (2007) found the range of dry yield from 4.28-29.98, which was more or less similar to this study [26].

Numerically the highest biological efficiency of 213.2% was calculated in treatment T<sub>3</sub> and the lowest biological efficiency of 187.0% was calculated from T<sub>2</sub> as shown in Table 3. The other treatments varied significantly over control. The present findings keep in with the findings of previous workers; Biswas *et al.* (1997) found supplementation of substrate promoted biological efficiency (125.75%) [40]. Patrabansh and

Madan (1997) reported the similar result in growing *Pleurotus sajor-caju* [41]. Kalita *et al.* (1997) observed biological efficiency for different substrates ranged from 35.2-60.9% [31]. Obodai *et al.* (2003) found biological efficiency (BE) followed a pattern and ranged from 61.0-80.0% [42].

The highest cost benefit ratio was calculated in treatment T<sub>3</sub> (5.62) and the lowest cost benefit ratio 4.87 was calculated from T<sub>2</sub> followed by T<sub>4</sub> 5.24. The other treatments differed significantly in terms of cost benefit ratio as shown in Table 3. Ahmed (1998) also observed the benefit cost ratio of 73.2, 23.78 and 16.23 in case of *Pleurotus sajor-caju* [29]. The cause of these variations between the results of this study might be due to consideration of other costs involved in the production of oyster mushroom or might be due to measuring system. Sarker *et al.* (2007) mentioned the performances of substrates were significantly differed based on benefit cost ratio. They reported the highest cost benefit ratio of 6.50 with wheat straw [26].

**Table 3.** Effect of sawdust substrates on yield of oyster mushroom (*P. ostreatus*)

Treatments	Biological yield (g)	Economic yield (g)	Dry yield (g)	Biological efficiency (%)	Benefit cost ratio
T <sub>1</sub>	356.2a	354.6a	35.46a	203.5a	5.32ab
T <sub>2</sub>	327.3a	324.8a	32.48a	187.0a	4.87b
T <sub>3</sub>	373.4a	371.8a	37.16a	213.2a	5.62a
T <sub>4</sub>	350.8a	349.5a	34.95a	200.5a	5.24b
T <sub>5</sub>	334.6a	333.0a	33.30a	191.2a	4.99ab
T <sub>6</sub>	349.2a	347.8a	34.81a	199.5a	5.22ab
CV (%)	7.42%	7.47%	7.45%	7.42%	7.47%
LSD <sub>(0.05)</sub>	47.06	47.15	4.703	26.90	0.707

Means followed by same letter significantly different at 1% or 5% level of significance

#### IV. CORRELATION STUDY

The highest average no of fruiting body was recorded under treatment T<sub>4</sub> (122.3) and the highest economic yield was recorded under treatment T<sub>3</sub> (371.8 g). The lowest average no of fruiting body was recorded under treatment T<sub>2</sub> (76.00) followed by T<sub>5</sub> (82.33) and lowest economic yield was under T<sub>2</sub> (324.8 g) as shown in fig.1.

A significant and positive correlation between average number of effective fruiting body and biological yield was observed when different sawdust was supplemented with wheat bran. That could be expressed by the equation  $y = 7.405x + 214.8$  ( $R^2 = 0.930^{**}$ ) where  $y$  = biological yield and  $x$  = average number of effective fruiting body. The  $R^2$  value indicated that 93% of biological yield of oyster mushroom (*P. ostreatus*) was attributed to the average number of effective fruiting body (Fig. 2).

A significant and positive correlation between average number of primodial/packet and biological yield was observed when different sawdust was supplemented with wheat bran. That could be expressed by the equation  $y = 1.485x + 39.50$  ( $R^2 = 0.969^{**}$ ) where  $y$  = biological yield and  $x$  = average number of primodial/packet. The  $R^2$  value indicated that 96.9% of biological yield of oyster mushroom (*P. ostreatus*) was attributed to the average number of primodial/packet (Fig. 3).

A significant and positive correlation between average weight of individual fruiting body and economical yield was observed when different sawdust was supplemented with wheat bran. That could be expressed by the equation  $y = 2815x + 240.5$  ( $R^2 = 0.933^{**}$ ) where  $y$  = economical yield and  $x$  = average weight of individual fruiting body. The  $R^2$  value indicated that 93.3% of economical yield of oyster mushroom (*P. ostreatus*) was attributed to the average weight of individual fruiting body (Fig. 4).

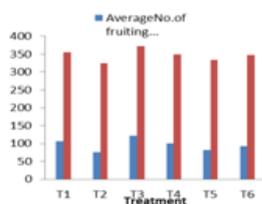


Fig. 1. Effect of different sawdust on relation between average no of fruiting body/packet and economic yield (g)

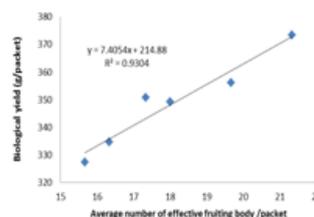


Fig. 2. Functional relationship between average numbers of effective fruiting body with biological yield as influenced by different sawdust substrates.

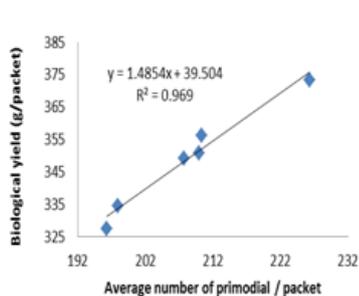


Fig. 3. Functional relationship between average numbers of primordia/packet and biological yield as influenced by different sawdust substrates

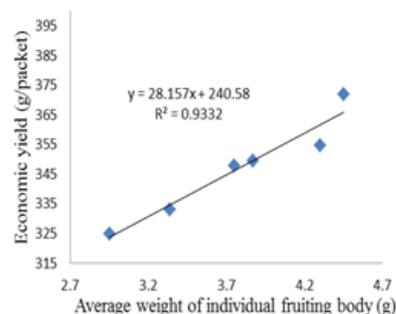


Fig. 4. Functional relationship between average weights of individual fruiting body and economical yield of oyster mushroom influenced by different sawdust substrates.

## V. CONCLUSION

Oyster mushroom presents a promising potential for treatment of sawdust waste those generated in the saw mill. Different saw dust substrates such as *Ficus carica* (Fig tree,  $T_2$ ), *Albizia saman* (Rain Tree,  $T_3$ ), *Swietenia mahagoni* (Mahogany tree,  $T_4$ ), *Leucaena leucocephala* (Ipil ipil tree,  $T_5$ ), *Eucalyptus globulus* (Eucalyptus tree,  $T_6$ ) and mixture of all five tree sawdust ( $T_1$ ) supplemented with 30% wheat bran and 1% lime as basal substrates were cultivate *P. ostreatus* mushroom. Since they were increased the mushroom yield and those sawdust substrate is better mushroom substrate compare to the previous scientist research work. It may also offer economic incentives for agribusiness to examine these residues as valuable resources and develop new enterprises to use them to produce nutritious mushroom products. Therefore, the mushroom cultivation may become one of the most profitable agribusiness that could produce food products from different substrates and help to dispose them in an environment friendly manner. Among all aspects,  $T_3$  was found as a best substrate with biological yield (373.4 g/packet) and BE (213.2 %) followed by  $T_1$ ,  $T_4$ ,  $T_6$ ,  $T_5$ ,  $T_2$  for the production of mushroom.

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