Growth and Productivity of Oyster Mushroom (*Pleurotus ostreatus*) on Bagasse-Sawdust Mixed Media

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Abstract: Oyster mushroom (*P. ostreatus*) is a wood fungus that grows in a row sideways on weathered logs. The purpose of this study was to determine the effect of bagasse composition on *P.ostreatus* as a substitute for sawdust and to obtain bagasse composition. Best for growth and production of white oyster mushrooms. This research designed using completely randomized design (CRD) consisting six treatments and five replications. The treatments were 850 grams of sawdust without bagasse, 650 grams of sawdust and 100 grams of bagasse, 550 grams of sawdust and 200 grams of bagasse, 450 grams of sawdust and 300 grams of bagasse, 350 grams of sawdust and 400 grams of bagasse and 250 grams of sawdust and 500 grams of bagasse. The data were analyzed using one way ANOVA and Duncan's test with a significance level of 0.05%. The results showed that mixed media ratio treatment influencing the production of white oyster mushrooms (*P. ostreatus*). Based on harvesting periods 250 grams of sawdust and 500 grams of bagasse produce the fastest harvesting. Bagasse can be used as substitute media for oyster mushrooms

1 INTRODUCTION

Indonesia is megabiodeversity country. Indonesia forests have abundan flora and fauna, while consist of 13% flora and fauna in the world. In Indonesia's forests, various flora species are available which can be used as one of the foods with high nutritional content. One of the food source was white oyster mushrooms (P. ostreatus).

P. ostreatus is known as a fungus that is widely cultivated in wood plastic bags media. Generally, the substrate for oyster mushrooms cultivation is sengon wood sawdust (Paraserianthes falcataria) obtained from processed processing of sengon wood.

Demand for wood is increasing every year. Increasing wood prices also increased the price of wood sawdust. This causes the oyster mushroom farmers to have difficulty in obtaining the raw material for planting media. Multipurpose saws are difficult to obtain at the location of oyster mushroom cultivation, for example the city of Medan. Therefore, for things to look for alternative substrates that are available and easily available, one of them is bagasse. (Ginting et al., 2013).

The agriculture and plantation industries produce by-products which resulted from its processing of products or direct consumption. One of the agricultural wastes is bagasse (*Saccharum officinarum* L.). Waste of bagasse is easily available so that it can be used to reduce waste problems. Sugar cane traders do not use bagasse and every time they are consumed, bagasse is always thrown away and eventually becomes garbage.

2 MATERIALS AND METHOD

The tools used in this study are shovels, sand sieves, wood pieces to compact media, chopper machines, sterilizers, bunsen, baglog with 4 cm diameter, spatulas, cutter, beko, hand sprayers, rulers, scales analytics, calculators and other tools.

The materials for this research were seeds of white oyster mushrooms (P. ostreatus), bagasse, wood sawdust, bran, dolomite CaCO3, Em4 (Effective Microorganisms), PP (Polypropylene) plastic size 30 cm x 18 cm with thickness 0.6 cm as a container for growing oyster mushrooms, rubber bands, sheets of paper measuring 10 cm x 10 cm to cover baglog, alcohol, dogrid paper, and stationery.

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2.1 Observed Parameters

The observed parameter in this research were:

a. Growth of mycelium
The observation periode was starts from the appearance of the mycelium until the mycelium appears on baglog.

b. Harvesting period
Harvesting periode is determined from the beginning of planting or inoculation to the first mushroom harvest.

c. Weight wet harvest (gram)
The measurement of fresh / mushroom weight is done using a scale. Measurement of mushroom weight is carried out on all fungi (clumps) when harvested.

d. Stalk Length (cm)
Measuring the length of the stalk using a slide in units of cm .

e. Number of fruiting body
Oyster mushrooms after being gotten fresh after post-harvest are continued by the calculation of the number of hoods produced by the white oyster mushroom.

f. Area of hood (cm2)
The area of the hood is calculated to see the size of the fungus in each treatment made.

g. Diameter of hood (cm)
Diameter is measured using a slide in centimeters.

2.2 Research Design

The study designed using Completely Randomized Design (CRD) consisting of six treatments and five replications. The formulation of planting media used in each treatment per 1000 grams can be seen in the following table:

Table 1: The planting media formulation used for each treatment.

Treatment	Sawdust (gram)	Bagasse (gram)	Roc bran (gram)	Chalk (gram)
Control	850	0	100	50
P1	750	100	100	50
P2	650	200	100	50
P3	550	300	100	50
P4	450	400	100	50
P5	350	500	100	50

Research design. The research design used is Completely Randomized Design which consists of six treatments, namely
Control : Addition of 0% bagasse or 100% sawdust powder used as a control.
P1: Addition bagasse 10% of the weight of sawdust.
P2: Addition bagasse 20% of the weight of sawdust.
P3: Addition bagasse 30% of the weight of sawdust.
P4: Addition bagasse 40% of the weight of sawdust.
P5: Addition bagasse 50% of the weight of sawdust.

The research data were analyzed using variance with a linear model of

$$Yij = \mu + Ti + \varepsilon ij$$

Information:
Yij : The results of observations from the treatment of various planting media and replications
M : Average value
Ti : Effect of various growing media
Eij : Effect of trial errors from various planting media and replications

2.3 Data Analysis

The obtained data will was analyzed by using ANOVA (with a confidence level of 95%. If there is an influence on the treatment, then proceed with Duncan's Multiple Range Test (DMRT) with a 5% error rate.

3 RESULTS AND DISCUSSION

The observed parameter in this reseach was used for calculated that the success rate of the planting media used. The succes rate were determined by using several parameters such as the rate of mycelium growth (days), diameter of hood (cm), fresh weight of mushroom fruit body (gram), number of fruiting bodies (fruit), stalk length (cm), area of hood (cm2), and age of harvest (days). According to Wijaya (2008), the success of mushroom cultivation is determined by the quality of the growing media. Data from the measurement of all parameters for determining the quality of planting media are presented in Table 2.

Table 2: Results of Measurement of Average All Parameters.

No	Parameter	Treatment					
		Control	P1	P2	P3	P4	P5
1	Growth of mycelium day)	37	37,4	40,4	42,4	43	44,6*
2	Diameter of hood (cm)	11,7	12,3	12,2	12,6	12,62	12,61
3	Wet weight (gram)	144	146	146	146	166	170
4	Number of fruit hood (fruit)	7,4	7,2	5,6	4,6	5	5,6
5	Stlak lenght(cm)	3,56	3,98	3,94	3,86	3,98	4,8
6	Area of hood (cm^2)	127,9	112,6	109	108	131	148
7	Harvest periods (day)	55	50,6	53	57,6	55,8	48,6*

Note (*) : Significant average value

3.1 The Growth of Mycelium

The growth of mycelium in each treatment ranged from 37-44,6 days. The fastest growth average of white oyster mushroom mycelium (*P. ostreatus*) was on 37 days in the control treatmen. Whereas, The longest growth rate of white oyster mushroom mycelium 44.6 days in treatment P5.

Full mycelium growth of treatment commonly on fifth week. The different growth periode can be caused by external and internal factor. Internal factors consist of composting, nutrition, media density and water content. Composting in the media, have the functions to break down complex substances into simpler substances with the help of microorganisms. The good growth of mycelium is due to the growth of fungi decomposed quickly and evenly, so that nutrition is fulfilled (Hermiati, 2010). In the contro treatment the mycelium growth faster because the size of sawdust is smaller so that it is easily decomposed compared to other treatments. In contrary the bagasse planting media is larger in particle size and requires a longer time to decompose.

The variance analysis (ANOVA) showed that the media composition ratio significantly affecting the growth rate of oyster mycelium. The Duncan Multiple Range Test (DMRT) test results showed that the control treatment was significantly different from treatment P5. According to Rudiono (2006) bagasse has porosity properties, due to space of micro and macro pores compared to other media. Bagase also easy to bind water, not easily weathered, has K source which needed by plants and difficult to compact. It may caused the bagasse decompositon takes longer time than sawdust.

Another research conducted by Dewi (2009), found that the ratio of mycelium growth was fastest in baglog without any additional substitution material (with meranti sawdust) in treatment E0 or control. With the addition of substitutions for mycelium growth rate parameters, it takes longer to decompose the media. In the parameters of the mycelium growth rate (days) it can be concluded that the most optimal treatment is 100% sawdust or control sawdust.

3.2 Diameter of Hood (cm)

Diameter measurement is conducted horizontally from the right side to the left in the center of the hood. The diameter measurements were carried out on the largest hood in one clump at the first harvest of each treatment.

The diameter of oyster mushroom ranges from 11.7-12.62 cm. The diameter size parameters was not significantly different from addition of bagasse. The variance analysis (ANOVA) showed that the composition ratio of bagase addition did not significantly affect the diameter of oyster mushroom hood. Generally, oyster shells size was 5 cm - 15 cm and the lower surface is layered like white and soft gills (Dharijah and Dharijah, 2001). According to this statement, the oyster mushroom size in this research was normal.

The control treatment produces the smallest mushroom diameter for the average. The smallest diameter can be caused by highest number of fruiting bodies of this treatment. The size of the diameter correlates with the number of fruiting bodies. High number of fruiting bodies produce smaller the diameter of the fruit hood. This condition also explained by Purnawanto (2012) that stated fungi grow into clumps where if there is a large number of fruiting bodies, it will affect the diameter of the hood, i.e the diameter becomes smaller because it does not have much space for the fungus hood widens because it coincides with each other another hood.

3.3 Wet Weight Fruiting Bodies (gram)

The fresh weight of the oyster mushroom fruiting body becomes a parameter of physical quality observation of the white oyster mushroom. The weight obtained in one clump of each treatment is influenced by nutrients in the growing media. For the formation of many fruiting body cells can not be separated from the content of the compounds needed by the fungus in the growing media in sufficient quantities in accordance with the statement Abdi (2013).

The size of the fresh weight of the oyster mushroom fruit body for each treatment ranged from 144-170 grams. The variance analysis result (Anova) showed that the media composition by addition of bagasse did not significantly affect the fresh weight of the oyster mushroom fruit body with a confidence interval of 95%. It caused by the more nutrients absorbed by the fungus available in the growing media can increase the wet weight of the fungus. Cellulose and lignin content in bagasse will be degraded to glucose and other compounds. Glucose and these compounds are used as energy reserve nutrients to produce optimal fresh weight. Lignocellulose is needed by oyster mushrooms as a source of carbon that is used to form organic compounds that make up the fungal cells. According to Hidayah (2013) oyster mushrooms have lignocellulose enzymes that are able to remodel cellulose, lignin, and other polysaccharides. as a carbon source. So that it can be seen in the treatment of P5 the amount of cellulose and other content is sufficient so that the growth of fungi for the parameters of the weight of fruiting bodies is greatest.

3.4 Number of Fruiting Bodies

Measurement of the number of fruit bodies is conducted by observed the size of the same hood. The small and newly grown hoods not counted. In addition to providing adequate nutritional needs, the production of white oyster mushrooms is also influenced by the environment, among others: light, media moisture so that it affects the growth and development of white oyster mushrooms. Besides the initial preparation and handling, which is imperfect sterilization, the location and arrangement of the baglog is too tight or dense in the drum or container also affects the production of oyster mushrooms. The number of fruit bodies of oyster mushrooms in one clump can be more than three hoods (Hendritomo, 2002). The number of oyster mushroom fruit bodies ranges from 4.6-7.4 pieces. The variance analysis (Anova) showed that the addition of bagasse on the oyster mushroom growing media did not significantly affect the number of oyster mushroom fruit bodies with a confidence interval of 95%.

This result also in accordance with Wijaya (2008) which stated that lack of an important element in the media will be produce dwarf plants. This condition was occured in controls that resulted in a small diameter of the mushroom hood compared to other treatments. According to Lakitan (2001) carbohydrates are composed of 3 types of elements those were carbon, hydrogen and oxygen. Examples of carbohydrate compounds are sugar, starch and cellulose. Fungi depend on complex carbohydrates as a source of nutrition.

These carbohydrates are broken down into monosaccharides with extracellular enzymes and can then be absorbed by fungi to be assimilated. Carbon sources are needed for energy needs and fungal cell structure. Addition of 100 grams of bagasse to each treatment can absorb and save more water so as to increase the growth of the number of fruiting bodies. Hood area is the surface area of the oyster mushroom hood. Measuring the area of the hood is done by measuring the largest area of the hood. The area of the hood is obtained by drawing a hood on dotgrid paper.

The area of oyster mushroom fruit caps ranges from 108-148 cm^2. The results of variance analysis (ANOVA) showed that media composition using the addition of sugarcane bagase on the oyster mushroom growing media did not significantly affect on growth of oyster mushroom. Media compostion affects the area of the white oyster mushroom hood.

Mushrooms are plants that do not have chlorophyll, so they cannot carry out photosynthesis to produce their own food. Mushrooms need a growing medium that is rich in nutrients for food. P5 treatment have the highest number of fruiting bodies so that the amount of nutrients. In accordance Cahyana (2002) which explains that nutrition plays an important role in the process of mushroom cultivation. Nutrition added raw materials must be in accordance with the needs of oyster mushrooms. Mushroom stalk length (cm) is measured using a ruler. The length of the oyster mushroom stem ranges from 2-15 cm. Cellulose content in bagasse is the main substrate needed as a carbon source to obtain growth energy and stem formation as one of the oyster mushroom productivity parameters.

The average number of lengths of the white oyster mushroom stalks is between 3.56 - 4.8 cm. In general, the length of the mushroom stalk ranges from 2-15 cm. In the composition of the planting media the control treatment has a smaller stalk length than the treatment given the substitution medium. The variance analysis (Anova) showed bagasse did not significantly affect the length of stalks with a confidence interval of 95%.

Cellulose content in bagasse is the main substrate needed as a carbon source to obtain growth energy and mushroom fruit bodies formation. In fungi growth there are two important components those were oxygen and carbon dioxide. The influence of excessive carbon dioxide on growth causes the lenght of stalk stems and the abnormal formation of the hood.

In the same study Dewi (2009) stated the longest oyster mushroom fruit stalk in obtained by substituted 50% media. With the addition of substitutions during the growth period, the nutrients obtained from the growing media are used for the growth of stalk lengths and hoods, so that the amount of nutrients contained in the bagasse planting media is more fulfilled and spurs growth.

3.5 Harvest Periods (days)

Harvesting periods measurement begins when baglog is inserted into the kumbung (incubation) until the baglog period is ready to be harvested with a sign that the hood is already developing. Harvesting periods of oyster mushrooms ranging from 48.6 to 57.6 days. The average number of period starting from harvesting the smallest white oyster mushroom was 48.6 days in treatment P5, while the average periods of harvesting the largest body of white oyster mushroom was 57.6 days in P3 treatment. In accordance with Abdi's research (2013) that the highest number of nutrients (50%) from the amount of baglog added will actually accelerate the age of harvest. The adequacy of nutrition in the fungus accelerates the harvest day. The treatment of different substitution planting media has a significant effect on mushroom harvest periods. The fastest fungus harvests is on P5 which is for 40 days. This is in accordance with Abdul (2002) that the cellulose and lignin content in bagasse will be degraded to glucose and other compounds. The results of variance analysis (ANOVA) showed that the addition of sugarcane bagasse addition on oyster mushroom growing media significantly affected the length of the oyster mushroom stalks with a confidence interval of 95%. The Duncan Multiple Range Test (DMRT) test results showed that treatment P5 was significantly different from P3 treatment. In the measurement of age parameters starting from harvest, it can be concluded that 50% addition of sugarcane bagasse is optimal for the diameter of the oyster mushroom hood.

4 CONCLUSIONS

Sugarcane bagasse added to the white oyster mushroom growing media (*P. ostreatus*) significantly affected the mycelium growth rate parameters and harvest periods. The fastest harvest period obtained on P5 treatment. The bagasse can be used as sawdust substitution for growing oyster mushrooms.

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