PERFORMANCE OF OYSTER MUSHROOM (*PLEUROTUS OSTREATUS* L.) ON DIFFERENT SIZES OF POLYPROPYLENE BAGS GROWN IN RICE STRAW AS A SUBSTRATE

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ABSTRACT: *Performance of oyster mushroom (Pleurotus ostreatus L.) on different sizes of polypropylene bags grown in rice straw as a substrate was conducted at the nursery area of the Plant Science Department, College of Agriculture, Mindanao State University-Main Campus, Marawi City, Lanao del Sur, Philippines from October 14, 2015 to February 29, 2016. The experimental design was laid out in complete randomized design with four treatments and replicated three times. The treatments were T1 (6x12), T2 (7x12), T3 (8x12) and T4 (9x12). The variety used was oyster mushroom (Pleurotus ostreatus L.) with following objectives: (1) to evaluate the performance of oyster mushroom on different sizes of bags, (2) to evaluate the yield of oyster mushroom as affected by different sizes of bags, (3) to analyze the return of investment of oyster mushroom by using different sizes of bags each treatment. The results on the length of mycelia every fifteen days gathering of data from ten data bags, from 15-90 days showed no significance at all treatments. The results on the number of pileus per flushing was, in the first flush no significant difference, second flush no significant difference, third flush and the fifth flush no significant difference from each treatment. But in the fourth flushing of pileus showed highly significant at 5% and 1% level in the tabular F. The result of length of stipe or stem per flushing, the result in first flush was not significant, second flush of the length of stipe or stem no significant difference, third flush no significant difference, fourth flush significant at 5% level, fifth flush the last flushing no significant difference from each treatment. The result of diameter of basidiocarp per flushing, the result in first flush was not significant, second flush no significant, third flush no significant, fourth flush not significant, and the fifth flush the last flushing of diameter of basidiocarp was not significant to each treatment. The result of yield at forty-five days of fruiting period, first, second, third, fourth and fifth flush was showed not significant to each treatment. The return on investment result showed that the treatment 3 (8x12) have the highest return of investment with a value of 4499.09% followed by treatment 1 (6x12) with a value of 4490%, treatment 2 (7x12) with 4011.30% and the lowest return of investment was treatment 4 (9x12) with a value of 3712.86% in 30 bags per treatment and 10 data bags per replication.*

Key words: Pileus, flushing, mycelia, basidiocarp

1. INTRODUCTION

Mushroom can be grown on decaying dead bodies of trees, trunks, Agricultural wastes materials of harvested crops, usually can be seen in rice fields or even in the corn fields and other sources of waste materials that can be utilized as a substrate for growing mushroom. Oyster mushroom can utilize various kinds of waste materials than any other mushrooms like rice straw mushroom, shitake mushroom, etc. The substrates / waste materials from the farm are rice straw, corn stover, banana leaves, sawdust and others. Growing of mushroom is attractive to develop in our country especially, to waste material that can be utilized as a substrate for growing oyster mushroom and recycling the agricultural waste materials instead of burning[11].

The commercial production of oyster mushroom is largely determined by the availability and utilization of cheap and locally organic materials of which agricultural lingo-cellulose waste represent the ideal and most promising substrate for cultivation of Oyster mushroom. Pleurotus can be grown in fruiting bags of indigenous agricultural waste materials such as sawdust and rice straw which is the major substrate used by the growers, Pleurotus grown on sterilized polypropylene bags with agricultural waste materials. Today, Growers all over the world are using polypropylene bags for mother spawn and mushroom production to produce a wide variety of mushrooms, polypropylene bags are tested in mother spawn growing or bags for mushroom production. The advantage of using these materials are gas exchangeable to avoid dehydration of your spawn and it provide a perfect environment for fungi growth, the sizes of bags are available in the market where suited to your needs. Growers can choose their best materials in different types of bags base on their needs in the production. The best choice for their selection depends on several factors: local availability, sterilization methods, gas exchange, price, melting point, size, brittleness and transparency[12].

2. MATERIALS AND METHODS

Location and duration of the study

The study was conducted in the nursery area of Plant Science Department, College of Agriculture, Mindanao State University, Marawi City, from October 14, 2015 to February 29, 2016.

Materials used

The materials used in this study were; 6x12 polypropylene bags, 7x12 polypropylene bags, 8x12 polypropylene bags, 9x12 polypropylene bags, rubber bands, rice straw, steel drum, match/lighter, fire woods, mother spawn (Pleurotus ostreatus L.), denatured alcohol, rubbing alcohol, rubber band, stirrer, alcohol lamp, ruler, tape measure, scissor, weighing scale, ballpeen and notebook.

Experimental design used

The experimental design used was Complete Randomized Design (CRD) with four (4) treatments and replicated three (3) times. The following treatments were used: treatment 1

(6x12x.03) polypropylene bags, treatment 2 (7x12.03) polypropylene bags, treatment 3 (8x12x.03) polypropylene bags, treatment 4 (9x12x.03) polypropylene bags.

Cultural management and practices

Gather the rice straw from the rice field, it should be fresh, and properly stored. Bagging of the rice straw as substrate of oyster production bags were done by putting the media into polypropylene bags, consisting 30 polypropylene bags each treatment with 10 production bags per replication. Steam sterilization of production bags was done in two (2) hours sterilization period from boiling point. Sterilized the production bags of substrate inside of the steel drum in standing position and tightly cover the steel drum. Steam sterilization was done by two 2 hours' sterilization period. Unload the production bags after 48 hours of cooling. After sterilization and cooling the production bags, the production bags were ready to inoculate the mother spawn. After inoculation of the mother spawn to the production bags, they were placed and well-arranged inside the incubation room for 90 days incubation period or mycelial growth (spawn run). After 90 days of incubation, the production bags were arranged in laying position and opened by using a blade or scraper. Four to five days after the bags were opened, first harvest done and daily harvesting of matured fruits were done until forty five days. After 22 days from opening the production bags, the rear of the production bags were opened also. Harvesting was done if the fruiting bodies were ready to harvest daily until 45 days from the first opening of the matured production bags. Watering the walls, ceiling and floor of growing house were done in three(3) to four(4) times during warm condition (without rain) a day to increase the relative humidity (RH) after opening until the last harvesting of mushroom fruits. The following data were gathered from October 14, 2015 up to February 29, 2016. The gathering of the length of mycelia per bag per treatment was measured from the tip of spawned bags up to the end of mycelia in every fifteen (15) days, until full colonization of mycelia in the bags of substrate, using tape measure in centimeter (cm). The gathering of the number of pileus per flushing was done by counting the number of pileus or fruits of each data bags per flushing per treatment. The gathering of the length of stipe was done by measuring the stipe from the base of the stipe/fruit to the tip of stipe, by the used of the ruler in centimeter (cm) per flushing. The gathering of the diameter of basidiocarp was done by measuring the cross section of the basidiocarp and got the average. Yield Per Flushing in 45 Days (g) was done by the used of weighing scale in grams (g) per treatment.

Was done by the used of this formula:

$$ROI = \frac{net\ income}{Cost\ of\ production}\ x\ 100$$

3. RESULTS AND DISCUSSIONS

Length of mycelia every fifteen (15) days interval for 90 days incubation period (cm).

Table 1. Treatment Mean Of The Length Of Mycelia Every Fifteen Days' Interval In Centimeters.

Treatment	15 days	30 days	45 days	60 days	75 days	90 days
T_1 6x12	10.1	14.4	17.21	18.8	20.45	20.68
T_2 7x12	10.5	14.9	18.23	20.0	21.96	22.78
T_3 8x12	10.4	14.25	16.68	18.1	21.35	20.96
T_4 9x12	10.15	13.7	16.53	18.6	20.98	21.7

Table 1 showed that the result of the treatment means for the length of mycelia in every fifteen days' interval of gathering data from ten (10) data bags per treatment. In the first gathering of data (15 days) after the inoculation of mother spawn, treatment 2 (7x12) has the highest length of mycelia with a mean of 10.5 cm, followed by treatment 3 (8x12) with 10.4

cm, treatment 4 (9x12) with 10.15 cm and treatment 1 (6x12) has the lowest length of mycelia with a mean of 10.1 cm. The result showed no significant difference in every treatment of the length of mycelia in the first gathering (15 days). This results showed that any size of polypropylene bags used in four treatments can be used in mushroom production despite the fact that sizes of polypropylene bags has no significant result for mushroom production. In the second gathering of data (30 days) treatment 2 (7x12) has the highest length of mycelia with a mean of 14.9 cm, followed by treatment 1 (6x12) with 14.4 cm, treatment 3 (8x12) with a mean of 14.25 cm and treatment 4 (9x12) has the lowest length of mycelia with the mean of 13.7cm. The result showed no significant difference of the length of mycelia in the second gathering data (30 days) from inoculation of mother spawn.

In the third gathering of data (45 days) from inoculation of mother spawn, treatment 2 (7x12) has the highest length of mycelia with a mean of 18.23 cm, followed by treatment 1 (6x12) with 17.21 cm, treatment 3 (8x12) with 16.68 cm and treatment 4 (9x12) has the lowest length of mycelia with a mean of 16.53 cm. The result showed that the length of mycelia in the third gathering (45 days) was no significantly difference from each treatment.

In the fourth gathering (60 days) from inoculation of mother spawn, treatment 2 (7x12) has the highest length of mycelia with a mean of 20.0 cm, followed by treatment 1 (6x12) with a mean of 18.6 cm, treatment 4 (9x12) with 18.6 cm, and treatment 3 (8x12) has the lowest length of mycelia with a mean of 18.1 cm. result showed that the length of mycelia at fourth gathering (60 days) was no significant difference from each treatment.

In the fifth gathering of data (75 days) from inoculation of mother spawn, treatment 2 (7x12) has the highest length of mycelia with a mean of 21.96 cm, followed by treatment 3 (8x12) with a mean of 21.35 cm, treatment 4 (9x12) with a

mean of 20.98 cm, and treatment 1 (6x12) has the lowest length of mycelia with a mean of 20.45 cm. The result of the length of mycelia in (75 days) was showed no significant difference from each treatment.

Last gathering of data at (90 days) from inoculation of mother spawn which was the maturity of the, the highest treatment mean was obtained by treatment 2 (7x12) with a mean of 22.78 cm, followed by treatment 4 (x12) with 21.7 cm, treatment 3 (8x12) with a mean of 20.96 cm, and treatment 1 (6x12) got the lowest length of mycelia with a mean of 20.68 cm. The result in the last gathering of the mycelia (90 days) was showed not significant in each treatment.

Table 2. Treatment Mean Of The Number Of Pileus Per Treatment Per Flushing Number

Treatment	1st flush	2nd flush	3rd flush	4th flush	5th flush
T_1 6x12	8.2	7.4	6.8	6.03[b]	11.83
T_2 7x12	5.4	9.19	7.0	5.26[b]	11.23
T_3 8x12	7.6	9.9	9.7	6.06ab	14.76
T_4 9x12	5.2	9.63	8.2	13.5[a]	18.1

Table 2 showed the results of the number of pileus of oyster mushroom in every nine (9) days of harvesting on every ten (10) data bags per treatment. The highest number of pileus in the first flush is in treatment 1 (6x12) with a mean of 8 pileus per bag per flushing, followed by treatment 3 (8x12) with 7.6, treatment 2 (7x12) with 5.4, and treatment 4 (9x12) has the lowest number of pileus with a mean of 5.2. The result showed no significant difference of number of pileus in the first flushed.

In the second flushed, it showed that treatment 3 (8x12) has the highest treatment with a mean 9.9, followed by treatment 4 (9x12) with a mean of 9.63, treatment 2 (7x12) with 9.19, and treatment 1 (6x12) has the lowest number of pileus with a mean of 7.4. The result showed no significant difference of number of pileus in the second flushed.

In the third flushed showed that treatment 3 (8x12) has the highest number of pileus with a mean of 9.7, followed by treatment 4 (9x12) with a mean of 8.2, treatment 2 (7x12) with 7.0 and treatment 1 (6x12) has the lowest number of pileus with a mean 6.8. The result showed no significant difference of number of pileus in the third flushed.

In the fourth flushed showed that treatment 4 (9x12) has the highest number of pileus with a mean of 13.5, followed by the treatment 3 (8x12) with 6.06, treatment 1 (6x12) with 6.03, and treatment 2 (7x12) has the lowest number of pileus with a mean of 5.26. The result showed highly significant difference of number of pileus in the fourth flushed.

The computed F was valued 9.0 which are highly significantly different at 5% level and 1% level. The treatment means of the number of pileus were further subjected to the Duncan Multiple Range Test (DMRT), it was found out that treatment 1 (6x12), treatment 2 (7x12) and treatment 3 (8x12) is highly significantly difference from treatment 4 (9x12), the same superscript of the letters showed no significant difference from each treatment.

In the fifth flush showed that treatment 4 (9x12) has the highest number of pileus with a mean of 18.1, followed by treatment 3 (8x12) with 14.76, treatment 1 (6x12) with 11.83, and treatment 2 (7x12) has the lowest number of pileus with a mean of 11.23. The result showed no significant difference of the number of pileus in the fifth flushed.

Table 3. Treatment Mean Of The Length Of Stipe Or Stem Per Flushing (Cm).

Treatment	1st flush	2nd flush	3rd flush	4th flush	5th flush
T_1 (6x12)	2.06	2.65	1.78	0.81b	1.87
T_2 (7x12)	1.95	1.18	1.81	0.55b	1.78
T_3 (8x12)	2.61	3.40	3.14	0.803ab	2.62
T_4 (9x12)	1.49	4.29	3.01	2.08[a]	2.85

Table 3 showed the results of treatment mean for the length of stipe or stem in centimeter at every 8 days 0f harvesting. The highest treatment mean for the length of stipe or stem in the first flush is treatment 3 (8x12) got the highest with a mean of 26.08 cm, followed by treatment 1 (6x12) with a mean of 20.59 cm, treatment 2 (7x12) with 19.50 cm and the lowest treatment mean of length of stipe or stem in the first flushing is treatment 4 (9x12) with a mean of 14.90 cm. The result on the length of stipe or stem showed no significant difference in the length of stipe or stem in every treatment at the first flushing.

In the second flushing of length of stipe or stem the highest treatment was obtained by treatment 2 (7x12) with a mean of 111.82 cm, followed by treatment 4 (9x12) with a mean of 42.86 cm, treatment 3 (8x12) with a mean of 33.98 cm, and treatment 1 (6x12) got the lowest treatment mean with a with a mean of 26.46 cm. The result showed no significant difference in length of stipe or stem in the second flushed.

In the third flushing of the length of stipe or stem the highest treatment was obtained by treatment 3 (8x12) with a mean of 31.36 cm, followed by treatment 4 (9x12) with a mean of 30.10 cm, treatment 2 (7x12) with a mean of 18.07 cm, and treatment 1 (6x12) got the lowest with a mean of 17.80 cm. The result showed no significant difference in length of stipe or stem in the third flushing.

In the fourth flushing of the length of stipe of stem the treatment got the highest treatment mean is the treatment 4 (9x12) with a mea of 20.8 cm, followed by the treatment 1 (6x12) with a mean of 8.1 cm, treatment 3 (8x12) with a mean of 8.03 cm, and the lowest treatment mean was obtained in treatment 2 (7x12) with a mean of 5.5 cm. The result showed significant difference in length of stipe or stem in the fourth flushing. The computed F was valued 7.3 which are significantly different at 5% level. The treatment means of the length of stipe or stem were further subjected to

the Duncan Multiple Range Test (DMRT), it was found out that treatment 1 (6x12), treatment 2 (7x12) and treatment 3 (8x12) is significantly difference from treatment 4 (9x12), common superscript of the letters shows no difference from each treatment.

For the fifth flushing of the length of stipe or stem, the treatment got the highest mean is treatment 4 (9x12) with a mean of 28.47 cm, followed by the treatment 3 (8x12) with a mean of 26.13 cm, next is treatment 1 (6x12) with 18.67 cm, and treatment 2
(7x12) got a lowest mean of 17.83 cm. The result showed no significant difference in length of stipe or stem in the fourth flushing.

Table 4. Treatment Mean Of The Diameter Of Basidiocarp Per Flushing (Cm).

Treatment	1st flush	2nd flush	3rd flush	4th flush	5th flush
T_1 (6x12)	4.59	4.27	3.53	1.87	4.33
T_2 (7x12)	3.71	4.94	3.47	1.21	4.62
T_3 (8x12)	4.26	5.47	4.71	1.63	5..91
T_4 (9x12)	3.08	5.66	4.68	3.02	7.01

Table 4 showed the results of the diameter of basidiocarp in centimeter every 8 days of harvesting from ten (10) data bags per treatment. The highest treatment mean of the diameter in the first flush is treatment 1 (6x12) with a mean of 45.93 cm, followed by treatment 3 (8x12) with 42.56 cm, treatment 2 (7x12) with 37.17 cm and the lowest treatment mean in the first flush is treatment 4 (9x12) with a mean of 30.79 cm. The result showed no significant difference in the diameter of basidiocarp in the first flushed.

In the second flush of diameter of basidiocarp the highest treatment mean was in T4 (9x12) with a mean of 56.62 cm, followed by T3 (8x12) with 54.69 cm, T2 (7x12) with 49.44 cm and T1 (6x12) has the lowest treatment mean with 42.68 cm. The result showed no significant difference in diameter of basidiocarp in the second flushed.

in the third flushed of the diameter of basidiocarp the highest treatment mean is treatment 3 (8x12) with a mean of 47.12 cm, followed by treatment (9x12) with 46.8 cm, treatment 1 (6x12) with 35.30 cm and treatment 2 (7x12) has the lowest treatment mean with a mean of 34.70 cm. The result showed no significant difference in diameter of basidiocarp in third flushed.

In the fourth flushing of diameter of basidiocarp the highest treatment mean is treatment 4 (9x12) with a mean of 30.2 cm, followed by treatment 1 (6x12) with a mean of 18.7 cm, treatment 3 (8x12) with a mean of 16.3 cm, and treatment 2 (7x12) got the lowest mean of 12.1 cm. The result showed no significant difference in diameter of basiocarp in the fourth flushing.

Lastly in the fifth flushed of diameter of basidiocarp the highest treatment was obtained by treatment 4 (9x12) with a mean of 70.1 cm, followed by treatment 3 (8x12) with a mean of 56.91 cm, treatment 2 (7x12) with a mean of 46.17 cm, and the lowest treatment was got by treatment 1 (6x12) with a mean of 43.35 cm. The result showed no significant difference in diameter of basiocarp in the fifth flushing.

Table 5. Treatment Mean Of Yield/S Per Bag In 45 Days Of Fruiting Period (G).

Treatment	1st flush	2nd flush	3rd flush	4th flush	5th flush
T_1 (6x12)	41.9	39.66	29.6	16.66	28.3
T_2 (7x12)	47.3	52.66	31.83	9.33	48.00
T_3 (8x12)	69.3	66.66	48.83	17.00	51.16
T_4 (9x12)	40.3	66.00	38.00	31.6	50.33

Table 5 showed the results of the treatment means of yield in grams every 8 days of harvesting from ten (10) data bags per replication. The highest treatment mean of the yield in the first flushing was obtained in treatment 3 (8x12) with a mean of 69.3 grams, followed by treatment 2 (7x12) with 47.3 grams, treatment 1 (6x12) with 41.9 grams, and the lowest treatment mean in the first flushed was treatment 4(9x12) with a mean of 40.3 grams. The result showed no significant difference in yield of the first flushed.

In the second flushing, the highest yield was obtained in treatment 3 (8x12) with a mean of 66.66 grams, followed by treatment 4 (9x12) with 66 grams, treatment 2 (7x12) with 52.66 grams and treatment 1 (6x12) has the lowest treatment mean of 39.66 grams. The result showed no significant difference in yield of second flushed.

In the third flushing, the highest treatment yield from ten data bags was obtained in treatment 3 (8x12) with a mean of 48.83 grams, followed by treatment 4 (9x12) with a mean of 38.0 grams, treatment 2 (7x12 with 30.16 grams and treatment 1 (6x12) has the lowest treatment mean of 29.6 grams. The result showed no significant difference in yield of third flushed.

In the fourth flushing, the highest treatment mean was obtained in Treatment 4 (9x12) 31.6 grams, followed by the treatment 3 (8x12) 17.0 grams, treatment 1 (6x12) with a mean of 16.6 grams, and the lowest was obtained in treatment 2 (7x12) with a mean of 9.33 grams. The result showed no significant difference in yield on the fourth flushing.

Lastly, the fifth flushing in terms of yield, the treatment obtained highest yield was treatment 3 (8x12) with a mean of 51.16 grams, followed by treatment 4 (9x12) with a mean of 50.33 grams, treatment 2 (7x12) with 48.0 grams, and the lowest yield was obtained by the treatment 1 (6x12) with a mean of 28.3 grams. The result showed no significant difference on yield in the fifth flushing.

Table 6. Return On Investment Of Oyster Mushroom (*Pleurotus Ostreatus* L.) For 1000 Bags On Different Sizes Of Polypropylene Bags Used As Grown In Rice Straw.

Treatments	Gross Income in Peso	Cost of Production in Peso	Net Income in Peso	Return on Investment
T_1 6X12	46,818.0	1,020.0	45,798.0	4490%
T_2 7X12	56,736.0	1,380.0	55,356.0	4011.%
T_3 8X12	75,885.0	1,650.00	74,235.0	4499.%
T_4 9X12	67,869.0	1,780.00	66,089.0	3712.86%

Table 6 showed that in T3 (8x12) had the highest return of investment (ROI) with a value of 4,499.% followed by T1 (6x12) with a value of 4,490%, T2 (7x12) with 4,011.30% and the lowest return of investment was in T4 (9x12) with a value of 3,712.86% in 1000 production bags each treatment.

4. CONCLUSION

Based on the results on the performance of oyster mushroom (Pleurotus ostreatus L.) using rice straw as substrate on different sizes of polypropylene bags used, treatment 3 which is (8x12) polypropylene bags with a thickness of point zero three (.03) was obtained the highest yield in 30 bags per treatment with 10 bags per replication. and the return on investment(ROI), the treatment 3 which was the 8x12.03 thickness got the highest return on investment(ROI) with 4,499% and followed by followed by treatment 1 (6x12) with a value of 4,490%, treatment 2 (7x12) with 4,011.30% and the lowest return of investment was found in treatment 4 (9x12) with a value of 3,712.86%.

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