DOI :https://doi.org/10.36378/juatika.v4i2.2366
JUATIKA
JURNAL AGRONOMI TANAMAN TROPIKA
VOL.4 NO. 2 July 2022
eissn 2656-1727
pissn 2684-785X
Hal : 158 – 168

Oyster Mushroom (*Pleurotus ostreatus*) Growth And Production On Straw And Brands Substrate Supplied With NASA Liquid Organic Fertilizer (POC)

Marlin Tupa, Abdullah Sarijan, Nurhening Yuni Ekowati*
Program Studi Agroteknologi Universitas Musamus
Jl. Kamizaun Mopah Lama, Rimba Jaya, Kec. Merauke,
Kabupaten Merauke, Papua 99611
*Email : nurhening2@gmail.com

ABSTRACT

This study aims to analyze the effect of adding NASA Liquid Organic Fertilizer (POC) supplements to the substrate on oyster mushroom (*Pleurotus ostreatus*) growth and production. The research design used in this study was a completely randomized design (CRD), with four levels of treatment with the addition of NASA POC. The treatment doses used were 0% NASA POC as control (A), 2.5% NASA POC (B), 3% NASA POC (C), and 3.5% NASA POC (D). Each treatment was repeated four times to obtain 16 treatment units. Each treatment unit consisted of 5 Baglogs, so the total sample observed was 80 Baglogs. Based on the parameters observed in this study, including the length of mycelium spread (LPM), the beginning of the emergence of pinheads (AMP), the number of pinheads (JP), the diameter of the oyster mushroom hood (DTJT), and the weight of the oyster mushroom (BBJT), the addition of NASA POC on the substrate. Growth has no significant effect on the growth and production of oyster mushrooms (*Pleurotus ostreatus*).

Keywords: *Oyster Mushroom, Pleurotus ostreatus, POC NASA, Oyster Mushroom growth, Oyster Mushroom production*

1. INTRODUCTION

Oyster mushroom (*Pleurotus ostreatus*) is a macroscopic mushroom from the Class Basidiomycetes group, order Agaricales which is widely consumed by the public because it has a high nutritional content (Randive, 2012). The part consumed by oyster mushrooms is the fruit body which is known to contain carbohydrates (57.6%), protein (30.4%), fiber (8.7%), fat (2.2%), and ash (9.8 %) (Saifullah et al., 2016). Oyster mushrooms also contain B & C vitamins, high protein, and amino acids. According to Saifullah et al. (2016), Oyster mushroom fruiting bodies (*Pleurotus ostreatus*) contain amino acids equivalent to the amino acid content of meat. In addition, oyster mushroom (*Pleurotus ostreatus*) contains -glucan bioactive compounds that are beneficial for health, including increasing macrophage function, activating non-specific immune responses, and reducing the possibility of cancer and reducing cancer development (Nunes et al., 2012).

Currently, oyster mushrooms (*Pleurotus ostreatus*) are in great demand by people in various countries; apart from their high nutritional content, these mushrooms are also easily cultivated on various substrates and are highly adaptive to various agro-climatic conditions (Nongthombam et al., 2021). Oyster mushroom (*Pleurotus ostreatus*) requires easily absorbed nutrients and a growth medium rich in vitamins and minerals for its metabolic activity. (Ananto, 2021). One type of POC used as a mineral source is NASA POC, a liquid organic fertilizer containing nutrients (minerals) produced from organic materials and is usually applied to plants (Jayanti et al., 2022). Oyster mushrooms (*Pleurotus ostreatus*) can grow on various types of substrates containing lignocellulose with varying temperature ranges. This is because oyster mushrooms (*Pleurotus ostreatus*) can produce lignocellulose enzymes that can degrade lignocellulose into carbohydrates that are beneficial for the growth of oyster mushrooms (*Pleurotus ostreatus*) (Zakil et al., 2019). Referring to Saifullah et al. (2016), The nutritional and nutritional content of oyster mushrooms (*Pleurotus ostreatus*) is influenced by the type and composition of nutrients in the growth substrate of oyster mushroom (*Pleurotus ostreatus*). A good substrate for the growth of oyster mushrooms (*Pleurotus ostreatus*) is a substrate containing cellulose, hemicellulose, calcium, magnesium, potassium, protein, and carbohydrates. Oyster mushrooms (*Pleurotus ostreatus*) can produce cellulase, hemicellulase, and ligninase enzymes to degrade substrates (Saifullah et al., 2016). Adding N sources into the substrate can increase the biomass and productivity of oyster mushrooms (*Pleurotus ostreatus*) (Nunes et al., 2012). According to Carrasco et al. (2018), the addition of supplements to the growth media of oyster mushroom (*Pleurotus ostreatus*) can increase the substrate bioconversion process. The addition of nano urea to various compositions of oyster mushroom growth media increased the content of protein and fiber, total carbohydrates, sucrose, glucose, and fructose, as well as essential amino acids in oyster mushrooms. However, it decreased the content of several minerals, including potassium (K) and sodium (Na).), calcium (Ca), iron (Fe), and copper (Cu) but reduced the content of Zinc (Zn) (Sassine et al., 2021). Another study stated that adding glucose, molasses, and sucrose supplements as a carbon source could increase the growth of oyster mushroom mycelium (*Pleurotus ostreatus*) (Hoa & Wang, 2015).

2. MATERIAL AND METHOD

Place and Time

This research was conducted in March – July 2021 at the Mycoplant Laboratory of Fungal and Plant Tissue Culture, Merauke Regency and Laboratory 3 of the Agrotechnology Study

Program, Faculty of Agriculture, Musamus University. The oyster mushrooms' incubation temperature in Baglog is ± 27.6^{o}C with a humidity of ± 76%, and the temperature inside Kumbung is between 27.2 – 27.6^{o}C with humidity between 89 -95%.

Material and Equipment

The materials used in this study were bran, dolomite, dry straw, EM 4, and clean water, which were used as growing media for Oyster mushrooms (Ostreatus ostreatus). The oyster mushroom (*Pleurotus ostreatus*) seeds were F2 seeds purchased from the Mycoplant Fungal and Plant Tissue Culture Laboratory, Merauke Regency. POC Nasa, 70% alcohol, spirit, and kerosene are other materials used. The tools used are autoclave, Bunsen burner, syringe (10 ml size), digital scale, hand sprayer, pump, thermohygrometer, mortal and pestle, and spatula.

Research Method

This study used a completely randomized design (CRD), with additional nutrients of Nasa Liquid Organic Fertilizer (POC) applied to the growth medium of oyster mushroom (Ostreatus Pleurotus). The POC used consisted of 4 doses, e.g., 0% (Control), namely planting media without Nasa POC (A), 2.5% Nasa POC, 3% Nasa POC, and 3.5% Nasa POC. Each treatment was replicated four times, so there were 16 experimental units. Each experimental unit consists of 5 Baglogs, so the total Baglog used in this study is 80 Baglogs.

Research Implementation

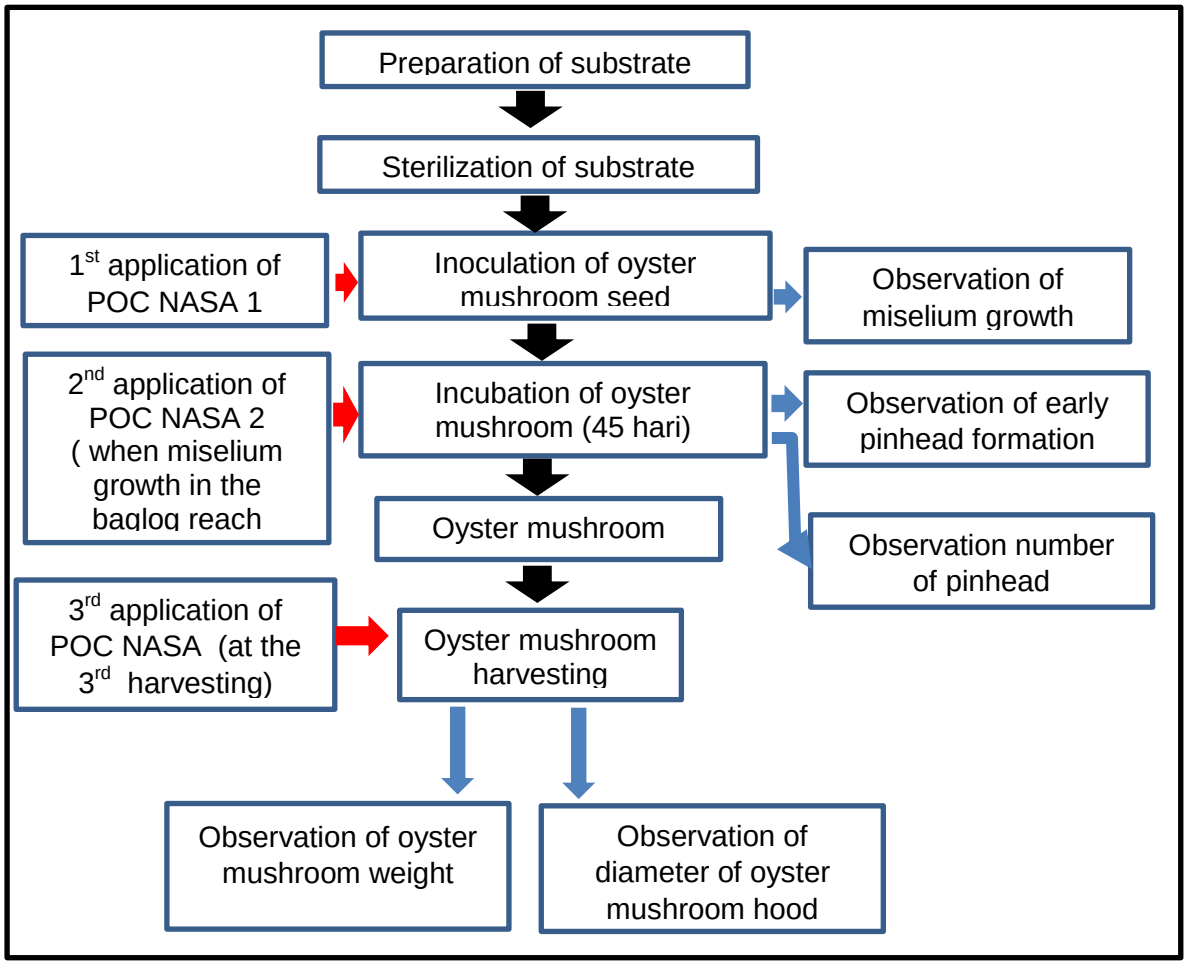

Figure 1. Research Workflow

Making Oyster Mushroom (Pleurotus ostreatus) planting media

The materials used for the planting media are bran, dolomite, dry straw, and clean water mixed until the mixture is moist but not wet. In the media mixture then, EM4 was added as a starter. Furthermore, composting was carried out for six days, and the media looked brownish and odorless. Planting media that has been composted is then put into Baglog as much as 1.3 kg per Baglog, then compacted. Then the media was sterilized using an autoclave for 60 minutes at 121oC. After sterilization, the media is cooled, followed by inoculation of F2 oyster mushroom seeds into the growing media.

Oyster Mushroom (Pleurotus ostreatus) seeds inoculation

Oyster mushroom (*Pleurotus ostreatus*) seedlings were inoculated after sterilizing the growing medium. Fungal seed inoculation was carried out aseptically. After inoculation, further incubated for 45 days. During this incubation, observations were made on the spread of oyster mushrooms in the growing media.

Oyster Mushroom Nursery

After incubation for 45 days, Baglog was transferred to Kumbung (oyster mushroom house). The temperature of the oyster mushroom (*Pleurotus ostreatus*) ranged from 27.2-27.6^{o}C with a humidity of 89-95%. During the growth of oyster mushrooms in Kumbung, Kumbung sanitation must always be maintained from all kinds of dirt. In order to maintain the humidity in the mushroom Kumbung, watering is done with water every day. Furthermore, the early emergence of pinheads was observed. Harvesting oyster mushrooms is done five days after the pinhead appears and after the fruit body is formed.

POC Nasa Application

Nasa POC was applied to the Baglog 3 times at the time of inoculation of oyster mushroom seeds for the first application, the second application was carried out when the mycelium had spread 100% in the Baglog, and the third application was given after the third harvest. Each application was given as much as 10 ml according to the concentration of POC Nasa, namely 0%, 2.5%, 3%, and 3.5%. So the total Nasa POC added to each baglog is 30 ml.

Observation Parameter

Parameters observed in this study included the length of mycelium spread (LPM), the emergence of pinheads (AMP), the number of pinheads (JP), and the diameter of the oyster mushroom cap (DT), and the weight of the oyster mushroom (BB). The length of the mycelium spread was calculated after inoculation of the oyster mushroom seedlings, while the initial appearance of the oyster mushroom pinheads was calculated after incubation.

Data Analysis

The data obtained is transformed using $\sqrt{x} + 1$ Next, the researcher analyzed variance (ANOVA) using the Microsoft Excel application.

3. RESULT AND DISCUSSION

Based on the results of the analysis of variance (ANOVA) showed that the addition of POC to the growth medium of oyster mushrooms had no significant effect on growth and production parameters, including the length of mycelium spread (LPM), the early emergence of pinheads (AMP), number of pinheads (JP), diameter of Oysters mushroom caps (DT).

Oyster Mushroom** (Pleurotus ostreatus) **Growth

The growth parameters of oyster mushroom (*Pleurotus ostreatus*)

observed in this study (Figure 2.) were the length of mycelium spread (LPM) and the early emergence of pinheads (AMP). The duration of mycelium spread (LMP) was observed during the incubation period of oyster mushrooms to see the growth and spread of the oyster mushroom mycelium in the growing medium, while the early emergence of pinheads (AMP) was observed after Baglog was transferred to Kumbung mushrooms.

Figure 2. Baglog not overgrown with mycelium (A) Mycelium growth inside baglog (B)

The results of observations of oyster mushroom LMP with Nasa POC treatment as additional nutrients in oyster mushroom (*Pleurotus ostreatus*) growing media are presented in Figure 3. as follows:

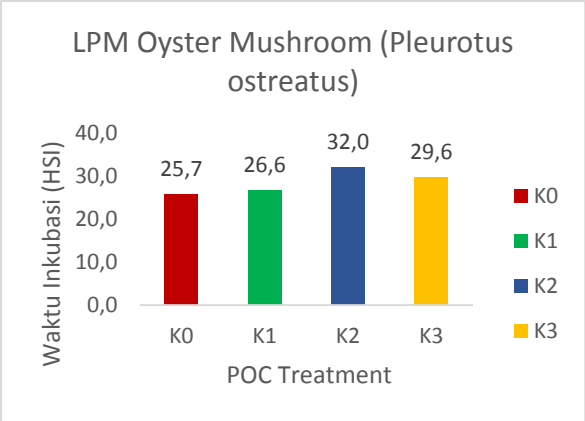

Figure 3. The average duration of mycelium spread (LMP) of oyster mushroom (*Pleurotus ostreatus*) with POC treatment (K0 = POC concentration 0%; K1 = POC concentration 2.5%; K2 = POC concentration 3%; K3 = POC concentration 3.5%). HSI = Days After Inoculation.

The results of the Anova test showed that the NASA POC treatment added to the growth substrate had no significant effect on the duration of mycelium spread (LMP) of oyster mushroom (*Pleurotus ostreatus*) at a significance level of 5%. The concentration of POC 3% (K2) showed the longest LMP compared to other POC treatments, while the fastest LMP was the POC 0% (K0) treatment, which was 25.7 HSI.

In addition to LMP, the observed growth parameter was the emergence of pinheads (AMP). The time it takes for the first pinhead to appear can be seen in Figure 4. below:

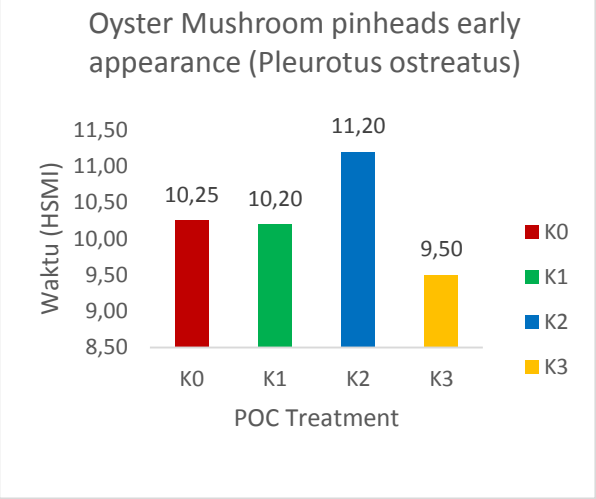

Figure 4. Initial Mean of Pinhead Appearance (AMP) of oyster mushroom (*Pleurotus ostreatus*) with POC treatment (K0 = 0% POC concentration; K1 = 2.5% POC concentration; K2 = 3% POC concentration; K3 = 3.5 % POC concentration). HSMI = Days After Incubation Period.

Based on the results of the Anova test, POC treatment on the growth medium of oyster mushroom (*Pleurotus ostreatus*) did not significantly affect the emergence time of pinhead (AMP) of oyster mushroom (*Pleurotus ostreatus*) at a significance level of 5%. The fastest time for pinhead emergence was in oyster mushroom (*Pleurotus ostreatus*), which was treated with NASA POC with a

concentration of 3% (K3), while the one that took the longest time for pinhead emergence was K3 treatment, namely the addition of NASA POC as much as 3.5% (Fig. 4).

Oyster Mushroom Production (*Pleurotus ostreatus*)

The production parameters observed in this study included the number of pinheads (JP), the diameter of the Oyster Mushroom Hood (DTJT), and the weight of the Oyster Mushroom (BBJT). The following is a picture of the pinhead and fruiting body of the Oyster Mushroom (*Pleurotus ostreatus*):

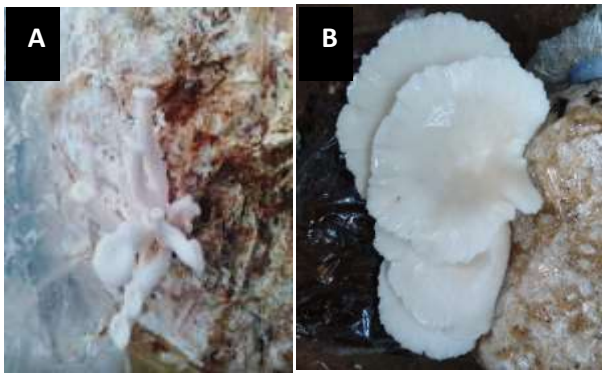

Figure 5. Oyster mushroom (*Pleurotus ostreatus*) pinhead (A) Oyster mushroom (Pleurotus ostreatus) fruiting body (B)

The results of observing the number of pinheads of oyster mushrooms are presented in Figure 6. as follow :

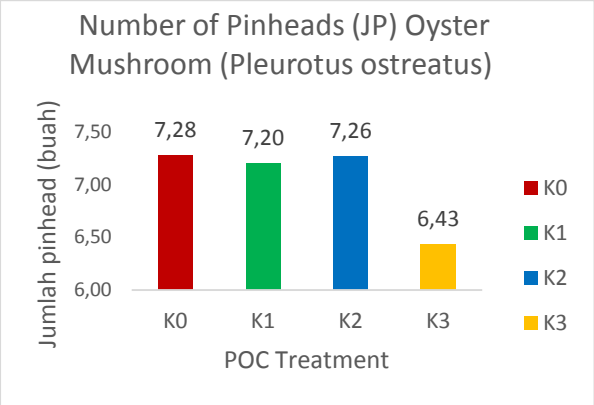

Figure 6. Number of pinheads (JP) of oyster mushroom (Pleurotus ostreatus) with POC treatment (K0 = 0% POC concentration; K1 = 2.5% POC concentration; K2 = 3% POC concentration; K3 =Concentration POC 3,5%.

Based on the results of the Anova test on a large number of pinheads (JP) produced by Oyster Mushroom (*Pleurotus ostreatus*) who were given NASA POC supplements, it showed that NASA's POC treatment had no significant effect on the number of pinheads of oyster mushroom (*Pleurotus ostreatus*) at a significance level of 5%. In Figure 6. it can be seen that the NASA POC treatment with a concentration of 3.5% produced the least number of pinheads compared to other treatments, namely 6.43 pieces.

In this study, the Diameter of the Oyster Mushroom Hood (DTJT) was also observed to see the size of the fruit body of the oyster mushroom produced. Figure 7. below shows the results of DTJT measurements treated with various NASA POC concentrations:

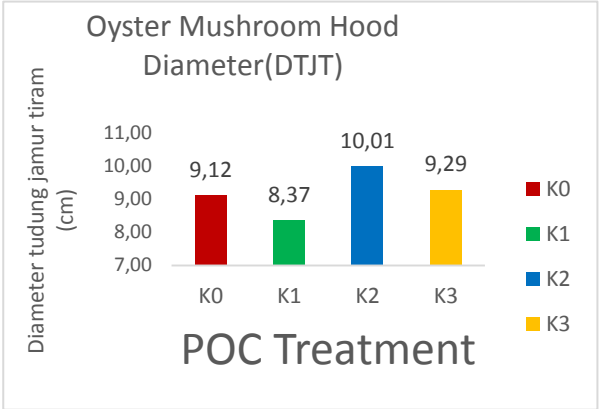

Figure 7. Oyster Mushroom Cap Diameter (DTJT) from oyster mushroom (Pleurotus ostreatus) treated with POC (K0 = 0% POC concentration; K1 = 2.5% POC concentration; K2 = 3% POC concentration; K3 = POC concentration 3 ,5%).

The results of the ANOVA DTJT test for oyster mushrooms (*Pleurotus ostreatus*) showed that the addition of POC as an additional nutrient to the growth substrate of oyster mushrooms (*Pleurotus ostreatus*) had no significant effect on the diameter length of oyster mushrooms (*Pleurotus ostreatus*) at a significance level of 5%. In Figure 7. it

can be seen that the 3% POC treatment produced oyster mushrooms with the longest hood diameter compared to other treatments.

In addition to observing JP and DTJT, the production observation also measured the weight of the oyster mushroom (*Pleurotus ostreatus*). The results of BBJT measurements can be seen in Figure 8. as follows:

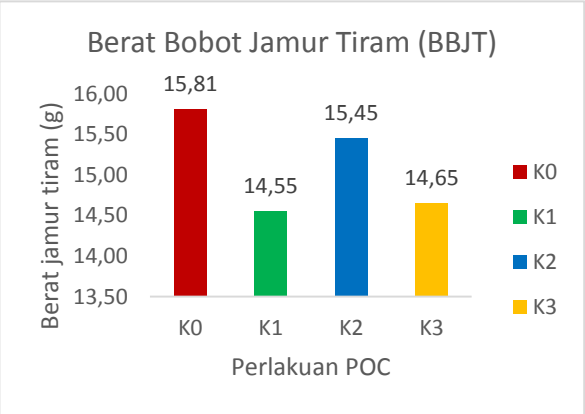

Figure 8. Weight of Oyster Mushroom (BBJT) from oyster mushroom (Pleurotus ostreatus) treated with POC (K0 = POC concentration 0%; K1 = POC concentration 2.5%; K2 = POC concentration 3%; K3 = POC concentration 3 ,5%).

The results of the ANOVA test of oyster mushroom (*Pleurotus ostreatus*) BBJT with POC treatment showed that NASA's POC treatment on oyster mushroom (*Pleurotus ostreatus*) growth media had no significant effect on BBJT at a significance level of 5%. Figure 8. shows that the 0% POC treatment or the substrate not added with NASA POC produced the highest average BBJT compared to other treatments, namely 15.81 g.

The growth and production of oyster mushrooms are influenced by many factors, including the type of substrate, substrate composition, temperature, light, humidity, substrate fermentation process, and the possibility of contaminants in the growth media of oyster mushrooms. The choice of substrate type greatly affects the productivity of oyster mushrooms (*Pleurotus ostreatus*) to produce optimal growth and development of oyster mushrooms and the yield or production of good quality oyster mushrooms (*Pleurotus ostreatus*). In this study, the addition of NASA POC was carried out as an additional supplement to the straw plus rice bran substrate. Liquid Organic Fertilizer (POC) containing N, P, K, and other minerals resulting from the decomposition of organic matter, is usually applied as a liquid fertilizer on plants (Mangera & Ekowati, 2022). The results of this study showed that the addition of NASA POC supplements up to 2 - 3.5% on the substrate of straw plus rice bran had no significant effect on the growth of oyster mushroom mycelium in Baglog (LPM), the time required for pinhead emergence (AMP), pinhead number, diameter oyster mushroom hood, and weight of oyster mushroom.

Mycelium spread time (LMP) is required for mycelium growth to fill the entire Baglog. This study's spread of the mycelium of oyster mushroom (*Pleurotus ostreatus*) ranged from 25.7-32 days. The results of this study indicate that mycelium growth takes a relatively longer time than the results of previous studies. According to Onyeka & Okehie (2018), Oyster mushroom (*Pleurotus ostreatus*) mycelium growth on various substrates takes 12-24 days. Other studies say that mycelium growth takes between 21-24 days (Assan et al., 2014). Shalahuddin et al. (2018) research implies that the mycelium growth of the oyster mushroom (*Pleurotus ostreatus*) on straw media that was given NPK supplementation ranged from 16.20 to 20.40 days. The growth of mycelium in the substrate is influenced by the type of substrate in the growth medium, the humidity of the substrate (Onyeka & Okehie, 2018); room temperature and conditions (Nongthombam et al., 2021); and levels of

C/N substrate ratio (Assan et al., 2014). The right composition of the medium is necessary for the growth of mycelium. The composition of the medium affects the lignocellulolytic enzymes, which are responsible for degrading the substrate (Shalahuddin et al., 2018). Nitrogen is the main factor affecting enzymes' formation to degrade oyster mushroom growth substrate (Sassine et al., 2021). Nitrogen will be transported into cells in the form of amino acids. Protein in the substrate will be degraded into amino acids by extracellular enzymes secreted by the fungal mycelium, and then the amino acids will be assimilated for fungal protein synthesis. According to Shalahuddin et al. (2018), The formation of lignocellulolytic enzymes in basidiomycetes class fungi is influenced by several factors, including the composition of the medium, pH, temperature, and also the rate of aeration. In addition, the proportion between the content of alpha-cellulose, hemicellulose, pectin, and lignin with the C/N ratio in the substrate affected the growth of the mycelium of oyster mushroom (*Pleurotus ostreatus*) (Assan et al., 2014). The content of the C/N ratio in the substrate affects the growth of mycelium as well as the growth and development of fruit bodies ((Zakil et al., 2019). Substrates with high C/N ratio content are preferred for mycelium growth (Muswati et al., 2021). The addition of organic nitrogen to the growth substrate of oyster mushroom (*Pleurotus ostreatus*) can increase the energy efficiency required for N absorption so that the oyster mushroom (*Pleurotus ostreatus*) has more energy for mycelium growth (Nunes et al., 2012).

Environmental factors, namely light, determine the growth of mycelium and pinhead formation of oyster mushrooms (*Pleurotus ostreatus*). Optimal mycelium growth in Baglog requires dark conditions because mycelium growth is very susceptible to light. On the other hand, optimum pinhead formation requires sufficient light to stimulate the formation of primordia (pinheads) of oyster mushrooms (*Pleurotus ostreatus*). In this study, pinhead emergence time ranged from 9.50 to 11.20 days. The fastest pinhead formation was 9.50 days in the K3 treatment (3.5% POC), while the slowest was in the K2 treatment (3% POC). While the number of pinheads produced was 6.43 – 7.28 per Baglog, the highest pinhead yield was 7.28 in the K0 treatment (without the addition of NASA POC), and the least was 6.43 in the K3 treatment (3.5% POC). NASA). Several studies have shown that the time required for pinhead formation varies depending on the type of substrate and the composition of the substrate (Muswati et al., 2021), as well as the addition of chemical NPK supplements ((Shalahuddin et al., 2018). According to Muswati et al. (2021), the Pinhead formation of oyster mushroom (*Pleurotus ostreatus*) on various substrate types takes 23 – 31 days. While the research results by Shalahuddin et al. (2018) showed that adding NPK to the oyster mushroom (*Pleurotus ostreatus*) straw substrate could accelerate the pinhead formation time, which ranged from 2.70 to 3.20 days, with 3.50 days on the straw substrate without NPK added. Research result Muswati et al., (2021), Oyster mushroom with the slowest mycelium growth produced the fastest pinhead compared to other treatments.

The number of pinheads produced in this study was 6.48 – 7.20 pieces, while the diameter of the oyster mushroom hood ranged from 8.7-10.01 cm. This study's results differ from previous research conducted by Shalahuddin et al. (2018); on straw medium with the addition of inorganic NPK produced the number of pinheads between 63.40 – 74.40 pieces, and the diameter of the oyster mushroom hood ranged from 6.51 to 6.87 cm. Pinhead formation requires different environmental conditions from those required for mycelium formation. One of the factors that determine the formation of pinheads is light. Oyster

mushroom (*Pleurotus ostreatus*) mycelium growth requires dark conditions, while pinhead formation requires light conditions.

The type of substrate and the composition of the substrate are factors that affect the growth and production of oyster mushrooms (Muswati et al., (2021); Adebayo & Oloke, (2017), but in this study, the type of substrate and the composition of the substrate used were the same so that the results were not significantly different. In addition, substrate moisture is one factor determining the growth of mycelium and fruiting bodies of oyster mushrooms (*Pleurotus ostreatus*). Oyster mushroom fruit body weight produced in this study ranged from 14.55-15.81 g. One of the factors that can affect the weight of oyster mushrooms (*Pleurotus ostreatus*) is the level of substrate humidity which can also be affected by the frequency of watering (Saputera et al., 2020) and temperature. The growth of fruit bodies requires high humidity, which ranges from 80-90%, and moderate temperatures, which is between 25-30oC during the incubation period, while the period of fruiting body formation requires a lower temperature of 18-25^{o}C. (Dhakal et al., 2020). According to Saputera et al. (2020), Oyster mushroom fruit weight is influenced by water content in the fruit body of oyster mushroom (*Pleurotus ostreatus*). In this study, watering was only done once a day, so the humidity level was much lower. Watering 4 times a day results in faster growth of oyster mushrooms and the best production (Saputera et al., 2020). However, substrate humidity that is too high also impacts negatively on the growth of mycelium and fruiting bodies of oyster mushrooms (*Pleurotus ostreatus*). According to Zakil et al. (2019), Substrate humidity that is too high can inhibit mycelium aeration, perspiration, and fruit body development and can result in the growth of unwanted organisms such as bacteria and nematodes.

4. CONCLUSION

Based on the results of this study, the administration of NASA POC on the growth medium of oyster mushroom (*Pleurotus ostreatus*) derived from straw and bran did not affect the duration of mycelium spread, pinhead emergence time, pinhead number, oyster mushroom cap diameter, and oyster mushroom weight.

ACKNOWLEDGMENT

Our thanks go to Ms. Mariana Lusia Resubun, SP., MSi. as Head of the Agrotechnology Laboratory, Faculty of Agriculture, Musamus University, and Mr. Imam at the Mycoplant Fungal and Plant Tissue Culture Laboratory in Merauke Regency for the facilities and assistance during the implementation of this research.

REFERENCE

Adebayo, E. A., & Oloke, J. K. (2017). Oyster mushroom (Pleurotus species); A natural functional food. *Journal of Microbiology, Biotechnology, and Food Sciences*, *7*(3), 254–264. https://doi.org/10.15414/jmbfs.2017/18.7.3.254-264

Ananto, A. (2021). Supply of Coconut Water As a Nutritional Supplement CornCob Media on Growth White Oysters (*Pleurotus ostreatus*). *Jurnal Agronomi Tanaman Tropika*, *3*(1), 12–17.

Assan, N., Assan, N., & Mpofu, T. (2014). The influence of the substrate on mushroom productivity-A Review. *Scientific Journal of Crop Science*, *3*(7), 86–91. https://doi.org/10.14196/sjcs.v3i7.1502

Carrasco, J., Zied, D. C., Pardo, J. E., Preston, G. M., & Pardo-Giménez, A. (2018). Supplementation in mushroom crops and its impact on yield and quality. *AMB Express*, *8*(146), 1–9.

https://doi.org/10.1186/s13568-018-0678-0

Dhakal, P., Pokhrel, Amrit. Bista, A., Shah, K., Acharya, B., & Shrestha, J. (2020). Supplementation in mushroom crops and its impact on yield and quality. *Agriways*, *08*(2), 1–8. https://doi.org/10.38112/agw.2020.v08i01.001

Hoa, H. T., & Wang, C. L. (2015). The effects of temperature and nutritional conditions on mycelium growth of two oyster mushrooms (*Pleurotus ostreatus* and Pleurotus cystidiosus). *Mycobiology*, *43*(1), 14–23. https://doi.org/10.5941/MYCO.2015.43.1.14

Jayanti, A. S., Pribadi, D. U., & others. (2022). The Effect Of Paclobutrazol Concentration And Types Of Organic Liquid Fertilizer On The Growth And Production Of Tomató (Solanum Lycopersicum L.). *Jurnal Agronomi Tanaman Tropika (Juatika)*, *4*(1), 48–60.

Mangera, Y., & Ekowati, N. Y. (2022). *Analysis of the Nutrient Content of Liquid Organic Fertilizer (POC) Household Organic Waste in Rimba Jaya Village, Merauke Regency Using the Stacked Bucket Method*. *4*(1). https://doi.org/DOI :https://doi.org/10.36378/juatika.v4i1.1833

Muswati, C., Simango, K., Tapfumaneyi, L., Mutetwa, M., & Ngezimana, W. (2021). The Effects of Different Substrate Combinations on Growth and Yield of Oyster Mushroom (*Pleurotus ostreatus*). *International Journal of Agronomy*, *2021*, 1–10. https://doi.org/https://doi.org/10.1155/2021/9962285

Nongthombam, J., Kumar, A., Ladli, Manikanta, B., Madhushekhar, M., & Patidar, S. (2021). A review on study of growth and cultivation of oyster mushroom. *Plant Cell Biotechnology and Molecular Biology*, *22*(5), 55–65.

Nunes, M. D., Maria, J., Paes, S. A., Júlio, J., Ribeiro, O., Silva, M. de C. S. da, & Kasuya, M. C. M. (2012). Nitrogen Supplementation on the Productivity and the Chemical Composition of Oyster Mushroom. *Jornal of Food Research*, *1*(2), 113–119. https://doi.org/10.5539/jfr.v1n2p113

Onyeka, E. U., & Okehie, M. A. (2018). Effect of substrate media on growth, yield and nutritional composition of domestically grown oyster mushroom (*Pleurotus ostreatus*). *African Journal of Plant Science*, *12*(7), 141–147. https://doi.org/10.5897/ajps2016.1445

Randive, S. D. (2012). *Cultivation and study of growth of oyster mushroom on different agricultural waste substrate and its nutrient analysis*. *3*(4), 1938–1949.

Saifullah, S., Shah, B., Iqbal, B., Khan, H., Khan, I., Naeem, A., Ullah, W., Khan, N., Adnan, M., Rizwan Ali Shah, S., Junaid, K., Ahmed, N., & Iqbal, M. (2016). Substrates evaluation for the quality, production and growth of oyster mushroom (Pleurotus florida Cetto). *Article in Journal of Entomology and Zoology Studies.*, *4*(3), 98–107. https://www.researchgate.net/publication/302412246

Saputera, A., Sofyan, A., Saputra, R. A., & Sari, N. (2020). Effect of Watering Frequency on the Growth and Yield of Oyster Mushrooms (*Pleurotus ostreatus*). *Agrosainstek*, *4*(2), 155–160. https://doi.org/https://doi.org/10.33019/agrosaintek.v4i2.91

Sassine, Y. N., Naim, L., Sebaaly, Z. El, Alsanad, M. A., & Yordanova, M. H. (2021). Nano urea effects on *Pleurotus ostreatus* nutritional value depending on the dose and timing of application. *Scientific Reports*, *11*(5588), 1–11. https://doi.org/10.1038/s41598-021-85191-9

Shalahuddin, A. K. M., Ahmed, K. U.,

Miah, N. M., Rashid, M. M., & Haque, M. M. (2018). Effect of different chemical nutrients (NPK) on growth and yield of oyster mushroom (*Pleurotus ostreatus*). *American-Eurasian Journal of Agricultural & Environmental Sciences*, *18*(1), 1–7. https://doi.org/10.5829/idosi.aejaes.2018.01.07

Zakil, F. A., Shafiq, M., Sueb, M., & Isha, R. (2019). *Growth and yield performance of Pleurotus ostreatus on various agro-industrial wastes in Malaysia Growth and Yield Performance of Pleurotus ostreatus on Various Agro-Industrial Wastes in Malaysia*. *020055*(September). https://doi.org/https://doi.org/10.1063/1.5125559