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Growth Performance of Catfish (Clarias Sp.) Aquaponic System

Ernawati[1)], AgungSetia Abadi[1)], Intanurfemi B.Hismayasari[1)], Asthervina W.Puspitasari[1)], Moh. Sayuti[2)], Achmad Sofian[3)], Saidin[1)], Rike Kagiling[1)], Hudai Manilet[4)], Hajar Sulawesi[4)]

[1]*Aquaculture Study Program, Sorong Polytechnic of Marine and Fisheries, Jl. KapitanPattimura, Tj.Kasuari, West Papua*

[2]*Fish Processing Technology, Politeknik Ahli Usaha Perikanan. Jl. AUP No. 1, PasarMinggu, South Jakarta 12520, Jakarta, Indonesia*

[3]*Aquaculture Study Program, Pangandaran Polytechnic of Marine and Fisheries, Babakan, Kec. Pangandaran, Kab. Pangandaran, Jawa Barat 46396*

[4]*Student, Sorong Polytechnic of Marine and Fisheries, Jl. KapitanPattimura, Tj.Kasuari, West Papua*

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ABSTRACT: The goal of research is to determine the effect of diffferen planting media on the growth of catfish (Clarias sp.) in an aquaponics system for m49 tial days. The research was designed using a completely randomized design (CDR) method whit 3 (three) treatments and 4 (four) replications including : Treatment A: Cocopeat (cc), Burnt Husk (sb), Clay (tl) ratio 3:1:1 and 30 catfish. The test parameters in this study include absolute wightgrowt, absolute length growth, specific growt rate, survival an feed convertion ratio. The result of analysis of variance unsingspss 22 showed that there was no significant effect on each treatment. The best absolute length value in treatment A was 0.92±0.26. the absolute weight value was 1.03±0.30, and the specific growth rate was 14.78±4.35. several factors can increase growth such as the quality and quantity of feed provided and good water quality.

KEYWORDS: Clarias sp., Aquaponic, Growth.

I. INTRODUCTION

Catfish is one type of fishery commodity whose demand has been increasing until now. Cultivating catfish is more accessible, requires lower costs, and contains high nutrition. This supports the community in increasing its production output. Along with the successful economic development, accelerating urbanization, infrastructure, and industrial and commercial products in urban areas have resulted in a further decline in agricultural land. This causes the potential for the development of aquaculture and plants to decrease (Chen, 2007; Naab et al., 2013). However, limited land use can be used as an option to support the development of fisheries and agriculture in urban areas, one of which is aquaponic cultivation. Aquaponics has become a trend in increasing productivity without causing excessive environmental impact, thus increasing public interest drastically in recent years (Palm et al., 2018). This is an effort to increase the intensification of aquaculture systems that can reduce environmental impacts such as pollution caused by the disposal of nutrient-rich sediments into local water bodies.

The aquaponics system simultaneously produces two commodities: fisheries and agriculture (Steve Diver, 2006). The thing that supports the success of plant growth is the use of planting media that matches the needs of plants without causing adverse effects on fish-rearing media. Therefore, the provision of planting media is the essential thing that must be considered in supporting the successful cultivation of both plants and fish. Some planting media that can develop agricultural and fishery businesses include cocopeat (coconut fiber) (Kamauddin et al., 2019), roasted husks (Purba et al., 2021), and clay (Biró et al., 2022). This material helps absorb organic waste left over from feed and fish feces so that it becomes a source of nutrition for plants/vegetables. In addition, it can convert ammonia compounds into nitrates, which are beneficial for aquaculture cultivation so that they can be used as biofilters in ponds. Another advantage of this material is that it is easier to obtain and the price is more economical.

Cocopeat (coconut fiber) planting media has a high fiber density of 0.56 µ so that this media can hold 0.98 µ of ammonia (Carvalho et al., 2010) and is relatively rich in macro and micronutrients (Alam et al., 2020). However, the ammonia molecules in the coconut fiber are only retained and do not decompose, making it impossible for the growth of decomposing bacteria N Junita&Muhartini, (2002). Efforts to optimize the physiological mechanism of utilizing N, which bacteria can break down, are combined with roasted husks and soil. Burnt husks have a high carbon content, so they can bind ammonium and nitrate (Miska, 2020), which makes plants grow well. In addition, roasted husks can neutralize soil acidity and toxins, increase soil holding capacity to water, and stimulate beneficial microbial growth. (Alam et al., 2020). Soil is a planting medium that supplies nutrients or nutrients (N, P, K, Ca, Mg, S, Cu, Zn, Fe, Mn, B, Cl). If the organic matter contained in the cultivation media increases, it can cause adverse effects on the health of cultivated fish (Afrianto et al., 2015). Several researchers who have conducted trials of aquaponic fish farming include preventing the induction of excessive microbial growth in plant roots and reducing dissolved organic matter in fish-rearing media (Rakocy, J. E., Bailey, D. S., Shultz, R. C., &Thoman, 2004); effective in producing marine fish growth and providing fertilizer to plants (Boxman et al., 2018); reduce the mortality rate of goldfish that are kept together with leafy vegetables (Maucieri et al., 2019); management of water quality in maintenance media (Blanchard et al., 2022). In addition, aquaponic system fish production from several sources has resulted in increased fishery and agricultural commodity growth. The results of the review of these references encouraged the authors to conduct research related to aquaponics system fish farming which aims to determine the effect of growing media on catfish growth, feed conversion, survival, and growth of vegetables

II. EXPERIMENTATION

Time and Place

Research on the effect of planting media on the growth of catfish in the aquaponics system was carried out from June to October 2021, starting from the preparation of tools and materials, maintenance, data collection, and data analysis. The research location took place at the Freshwater Laboratory, Fishery Cultivation Engineering Study Program, Sorong Polytechnic of Marine Affairs and Fisheries..

Research Materials

The tools and materials used in this study included seedling trays, net pot cups, cocopeat, husk charcoal and clay, aeration equipment, concrete ponds measuring 1x0.7x1 m, styrofoam, Pak Choy seeds and catfish seeds 7 cm long, weighing 3 grams/head, artificial feed (F-999 with 38% protein content), ruler, water quality tools (temperature, pH and DO), test kid (nitrite, nitrate, ammonia).

Research Design

The study was designed using a completely randomized design (CRD) with 3 (three) treatments and 4 (four) replications, including:

Treatment A: Cocopeat (cc), Roasted Husk (sb), Clay (tl) ratio 3:1:1 & 30 catfish

Treatment B: Cocopeat (cc), Fuel Husk (sb), Clay (tl) ratio 3:1:1.5 & 30 catfish

Treatment C: Control (without media) & 30 catfish

Working Procedure

Deployment and Maintenance

The catfish seeds were sown into a pond filled with water as high as 50 cm with a stocking density of 30 fish/pond and equipped with aeration equipment. Feeding is carried out three times a day, namely at 07.00, 12.00 & 16.00 WIT, with a feed dose of 5% of the fish's body weight. According to the research treatment, plant seeds were planted in net pots equipped with planting media. The net pot is inserted into the styrofoam, perforated, and placed on the pool's surface. Maintenance was carried out for 49 days, and every week growth was observed in fish, namely body weight and length, while in plants, namely length, width and number of leaves, and plant height. Water quality observations such as temperature, pH, and dissolved oxygen are carried out daily, while nitrite, nitrate, and ammonia are carried out once a week.

Research Parameters

The data collected in this study included growth in absolute weight, absolute length, specific growth rate, and survival in catfish. Data collection was carried out once a week by taking fish samples from as much as 25% of the total population of each treatment. The fish is taken using a scoop and then placed into a bucket filled with water. Furthermore, length measurements were carried out using a ruler, and body weight using an analytical scale with an accuracy of 0.005 grams. The length of the fish is measured from the tip of the head to the tip of the tail.

Average Body Weight

The Average body weight of fish is calculated using the formula Effendi (1997) as follows:

ABW = Wt – Wo

Information :

Wm: Average body weight (gram)

Wt: Average weight at the end of the study (grams)

Wo: Average weight at the start of the study (grams)

Average Length Growth

Absolute length growth is calculated using the formula Effendi (1997) as follows:

ALG = Lt – Lo

Information :

Pm: Growth in absolute length (cm)

Lt: Average final length (cm)

Lo: Initial average length (cm)

Specific Growth Rate

The specific growth rate is calculated based on the Zenneveld formula (1991) as follows:

SGR= ((LnWt-LnWo))/T x100

Information :

SGR: Specific Growth Rate (%)

Wt: Average weight on day t (grams)

Wo: Average weight at the start of the study (grams)

T: Length of maintenance (days)

Survival Rate

Survival rate is calculated based on the formula (Muchlisin et al., 2016) as follows:

SR= ((No-Nt))/No x100

Information :

SR: Survival Rate (%)

Nt: Number of Fish at the end of the Research (heads)

No: Number of Fish at the Beginning of Research (heads)

Feed Conversion Ratio

Feed Conversion Ratio is the ratio between the amount of feed given and the weight of the fish produced. The amount of feed consumed by fish is strongly influenced by the feed quality (Wicaksana et al., 2015). According to Djarijah (1995), the feed conversion ratio is calculated using the following formula:

FCR = (F)/((Wt+D)-Wo)

Formula Description:

FCR: Feed Conversion Ratio

F: Weight of feed given (gr)

Wt: Biomass at the end of maintenance (gr)

D: Weight of dead fish (gr)

Wo: Biomass at the beginning of maintenance (gr)

Data Analysis

This research was conducted experimentally with variable observations, including absolute weight growth, absolute length growth, specific growth rate (SGR), feed conversion (FCR), and survival of catfish. The research data were tabulated in tabular form, displayed in graphical form, and then analyzed descriptively. The research data were analyzed statistically using SPSS 22, including tests for normality, homogeneity, and variance (ANOVA) with a 95% confidence level and if the Tuckey test continued the data.

III. RESULTS AND DISCUSSIONS

Growth is one indicator that shows the success of a fish farming business. Observation of growth aims to determine the length and weight of fish at the time of maintenance. The results of observations in research on the effect of growing media on the growth of catfish using the aquaponics system are presented in Table 1.

Table 1. Growth yield data on fish and vegetable rearing

Treatment	Absolute Lenght (cm)	Absolute Weight (gram/day)	Spesific Growth Rate (%)
A (3:1:1)	0,92±0,26[a]	1,03±0,30[a]	14,78±4,35[a]
B (3:1:1,5)	0,58±0,42[a]	0,80±0,30[a]	11,55±4,29[a]
Control	0,88±0,32[a]	0,65±0,28[a]	9,28±4,13[a]

Note: The same superscript letter is not significantly different

Table 1.shows that the results of the analysis of variance (ANOVA) test of fish rearing in the aquaponics system had no significant effect on the growth in absolute length, absolute weight, and specific growth rate between treatments. The average growth in catfish reared for 49 days resulted in the highest absolute length, weight, and specific growth rate obtained in the 3:1:1 planting medium treatment, namely 0.92 cm, 1.03 g/day/head, and 14 .78%. However, the absolute length was more significant in the control than in treatment B, and the absolute weight and specific

growth rate were more significant in treatment B than in the control.

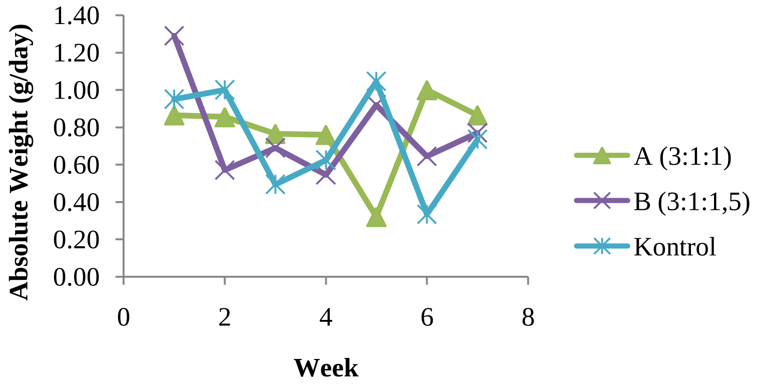

Figure 1. Results of descriptive analysis of absolute weight growth for 49 days of rearing

Figure 1. Shows that catfish reared for 49 days resulted in fluctuating absolute weight growth every week in the three research treatments. The 3:1:1 growing media treatment experienced a decrease in growth in week 5, the 3:1:1.5 growing media treatment in weeks 2, 4, and 6, and the control in weeks 3 and 6. Treatment A showed the highest value even though the test yield was not significantly different, and this indicated that the nutritional needs of the feed and differences in the growing media made the tested fish only able to improve their health of the fish. The inability of fish to utilize the feed indicates that the feed is used for self-care, and the nutritional content of the feed and the environment are not suitable (Abadi et al., 2022). According to Takeuchi (2017), cultivation media with an aquaponic system will help stabilize water quality.

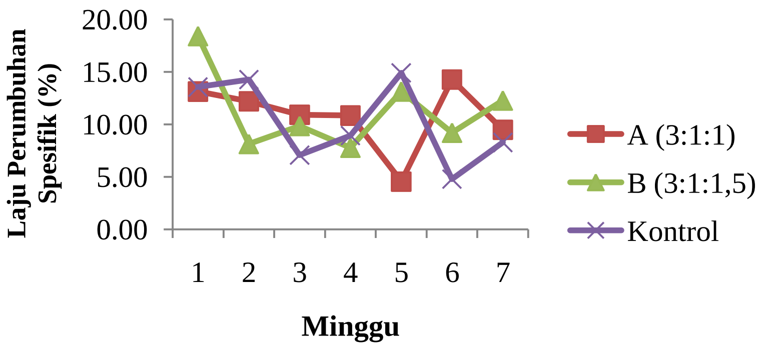

Figure 2. The results of the descriptive analysis of the specific growth rate of catfish for 49 days of rearing

The specific growth rate of catfish showed that the treatment using 3:1:1 media experienced the highest growth in the sixth week at 14.29%, the treatment using media 3:1:1.5 and the highest control in the fifth week at 13.14%. And 14.93%. The specific growth rate of fish in this study had no significant effect, according to Yunus et al. (2014); apart from being influenced by feed, it is also water quality, seed quality, seed size used, and stocking density. The existence of fish growth that is not uniform also affects the growth of other fish. The living environment of fish will increase the growth rate of fish, and the fish-rearing process will produce optimal growth if it routinely controls water quality, such as temperature, water acidity, and light intensity (Lingga&Kurniawan, 2013). Planting media in the aquaponic system in this study has not been proven to increase fish growth significantly. According to Nursandi (2018), the environment's carrying capacity is one of the main things in fish farming. The ability of the media to accept contaminants such as fish feces will significantly affect the growth and survival of fish.

Planting media will support the ability of plants to take up nutrients found in the environment. The available nutrient content will increase the growth and stability of nutrients in the soil while reducing water pollution (Ansar et al., 2020). The content of organic waste in fish rearing is very high, with the provision of feed with high protein levels causing water quality to decline rapidly. The use of aquatic plants in this study could not reduce the level of organic waste, so the growth rate of fish did not experience a significant difference (Effendi et al., 2015). According to G et al. (2021). The use of aquatic plants is one of the factors that can determine the success of an aquaponics system. Water hyacinth (Eichhorniacrassipes) used as a biofilter can improve water quality and the growth and survival of koi fish (Cyprinuscarpio) in an aquaponic system.

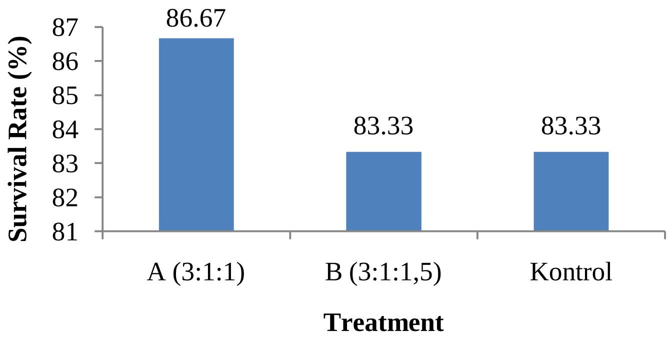

Figure 3. The results of the descriptive analysis of catfish survival for 49 days of rearing

Based on the results of descriptive analysis, the highest survival rate for catfish was obtained in the 3:1:1 planting media treatment, which was 86.67%, while the 3:1:1.5 growing media treatment and the same control, namely 83.33% each. The high survival rate of fish in the growing media treatment was 3:1:1.5 compared to 3:1:1.5, and the control is likely that the growing media supports the growth of plant roots which can filter toxic organic matter so that the water quality for fish rearing is always optimal. Yep & Zheng (2019) stated that the aquaponic system is a process of symbiotic growth of aquatic organisms and plants where in cultivation that creates waste will undergo a microbial transformation which is used as a source of nutrients in plant growth while absorption of nutrients from plants mediates fish culture water. Diver (2006) states that raising plants with fish will produce nutrients that will dissolve in the fish-rearing medium. Therefore, water as a living medium for fish must be of good quality to promote growth. Internally, water is used by fish as a chemical reactor in the body to transport the results of burning nutrients, and externally it is used as a place to live, a place to eat, a place to spawn, and a place to care for children (Elpawati et al., 2015).

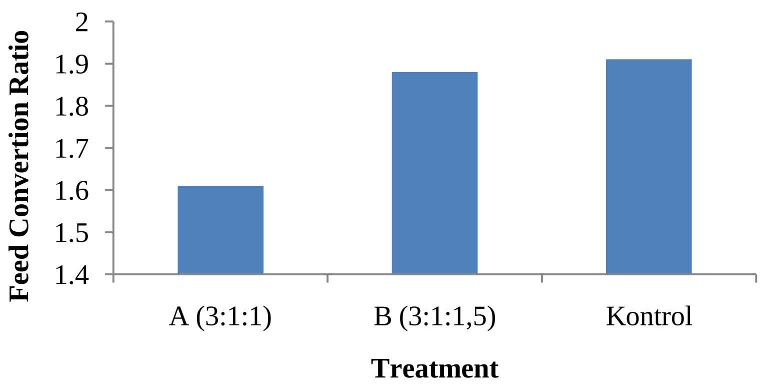

Figure 4. Results of descriptive analysis of catfish feed conversion ratio for 49 days of rearing

The quality and quantity of feed strongly influence growth in tilapia. The efficiency of the utilization of nutrients in feed is an essential factor in increasing growth. Under these conditions, catfish seeds require feed that has a high protein content. Figure 4 shows that the efficiency of feed use in each treatment has no significant effect, but of the three types of treatment, the lowest FCR is obtained, namely the use of 3:1:1 growing media of 1.61 followed by 3:1:1.5 treatment of 1.88 and control of 1.91. Consumption of catfish feed during maintenance is relatively low, possibly influenced

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by the addition of nutritious natural feed. The presence of plants in the rearing pond can convert nitrifying bacteria into nitrates, producing nitrogen as a fertilizer element for the growth of plankton. The digestibility of the test fish for the presence of plankton resulted in a reduced level of artificial feed consumption. This, in addition to reducing the low FCR but still produces optimal growth. The contribution of digestive enzymes by bacteria can increase the digestive process resulting in an increased growth rate (Noviana et al., 2014). Increased nutrition in the form of protein content in feed can support increased growth (Putri et al., 2012).

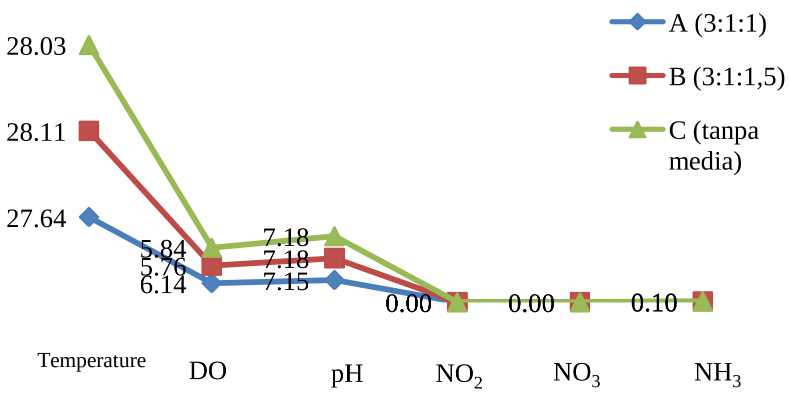

Figure 5. The results of the descriptive analysis of measuring water quality parameters for 49 days of maintenance

Water quality is one of the factors supporting the success of the fish farming business. Optimal water quality parameter conditions support the ongoing metabolic process in the fish's body. Figure 5.shows that during the maintenance treatment of fish, the aquaponic system produces temperatures of 27.64 – 28.11oC, dissolved oxygen 5.76 – 6.14 mg/L, pH 7.15 – 7.18, which results in growth and optimal survival life. Ernawati&Hamsir (2019) stated that the temperature range of 27 – 30.70^{o}C, dissolved oxygen 4.8 – 6.9 mg/L, and pH 6.8 – 8.5 is optimal for the continuity of fish farming, so it does not result in mortality. The existence of planting media is one of the things that can help the nitrification process of organic waste. Adding cocopeat as a planting medium can reduce the decay of leftover feed and fish feces.

Cocopeat contains lignocellulose which is high enough so that its use as a planting medium can reduce the occurrence of decay in the rearing medium (Barlianti& Wilson, 2008). Dahan et al. (2014) stated that water physics parameters influence the occurrence of metabolic processes, thereby increasing the productivity and survival of fish. The ammonia content produced 0.10 mg/L during 49 days of maintenance but did not cause significant mortality. This is probably influenced by the quality of the tested fish, which have high resistance to environmental changes. The presence of waste in the fish-rearing medium is filtered by plant roots which are then recycled to produce nutrients. The ability of Nitrobacter bacteria to convert ammonium into nitrate to produce fertilizer that is useful for the growth of plankton and plants. Yep & Zheng (2019) stated that the transformation of ammonia (NH_3) into nitrate (NO_3) results in the conversion of nutrients through nitrifying bacteria. The application of cultivation technology will increase productivity, and high stocking densities can actively increase changes and decrease water quality. Adjusting water conditions or the fish's living environment to increase survival and the ability of fish to metabolize the nutrients provided. Some fish will experience stress and get sick to death if the water quality gets worse (Augusta, 2016).

IV. CONCLUSION

The use of watercress plants in different growing media was not significantly able to increase fish's growth rate and survival during rearing. However, various factors can increase fish growth, such as feeding, the nutritional content of the feed, and optimal water quality. This study also revealed that using an aquaponics system can minimize water pollution caused by nitrogen content in water.

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