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The Growth of Tilapia Cultured in An Aquaponic System with Different Stocking Densities

Pertumbuhan Ikan Nila Yang Dibudidayakan Pada Sistem Akuaponik Dengan Padat Tebar Yang Berbeda

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ABSTRACT

Aquaponics is a combination of aquaculture technology with hydroponic technology in one system to create a symbiotic relationship between the two. The main component in the aquaponics system is fish, where fish waste and feed residues as a nutrient supply are very dependent on aquatic plants. Stocking density is one of the things that needs to be considered in aquaponic fish farming systems. Inappropriate increase in stocking density can cause adverse effects that are detrimental to farmers. This study aims to determine the best growth and density level of tilapia reared in aquaponics system. The research was carried out for 40 days in April-June 2022 at the Fisheries Laboratory, Faculty of Marine Affairs and Fisheries, Udayana University, Bali. The research design used was a completely randomized design (CRD) with 3 (three) treatments and each treatment consisted of 3 replications. The stocking density used was treatment I with a stocking density of 100 fish, treatment II 150 fish, treatment III 200 fish. The results of the study concluded that different fish stocking densities had an effect on survival, weight growth and specific growth rates. The highest survival rate was found in treatment III with an average of 87.3%, the highest weight growth was found in treatment I with an average of 3.29 grams, and the highest specific growth rate was found in treatment I of 4.67%.

ABSTRAK

Akuaponik adalah gabungan teknologi akuakultur dengan teknologi hidroponik dalam satu sistem untuk menciptakan suatu simbiotik antara keduanya. Komponen utama dalam sistem akuaponik adalah ikan, dimana limbah kotoran ikan dan sisa pakan sebagai pasokan nutrisi sangat bergantung untuk tanaman air. Padat tebar merupakan salah satu hal yang perlu diperhatikan dalam budidaya ikan sistem akuaponik. Peningkatan padat tebar yang tidak sesuai dapat menyebabkan dampak buruk yang merugikan pembudidaya. Penelitian ini bertujuan untuk mengetahui pertumbuhan dan tingkat kepadatan terbaik ikan nila yang dipelihara dalam sistem akuaponik. Penelitian dilaksanakan selama 40 hari pada April-Juni 2022 di Laboratorium Perikanan, Fakultas

Kelautan dan Perikanan, Universitas Udayana, Bali. Rancangan penelitian yang digunakan adalah Rancangan Acak Lengkap (RAL) dengan 3 (tiga) perlakuan dan masing-masing perlakuan terdiri dari 3 kali ulangan. Padat tebar yang digunakan yaitu perlakuan I dengan padat tebar 100 ekor, perlakuan II 150 ekor, perlakuan III 200 ekor. Hasil penelitian disimpulkan bahwa padat tebar ikan yang berbeda berpengaruh terhadap kelangsungan hidup, pertumbuhan bobot dan laju pertumbuhan spesifik. Tingkat kelangsungan hidup tertinggi terdapat pada perlakuan III dengan rerata 87,3%, pertumbuhan bobot tertinggi terdapat pada perlakuan I dengan rerata 3,29 gram, dan laju pertumbuhan spesifik tertinggi terdapat pada perlakuan I sebesar 4,67%.

Kata Kunci	*Akuaponik, Ikan Nila, Laju Pertumbuhan*
Keywords	*Aquaponics, Tilapia, Growth Rate*
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INTRODUCTION

Tilapia (*Oreochromis niloticus*) is one of the most popular freshwater commodities in Indonesia. According to Istiqomah et al., (2018) tilapia is an important commodity in the world freshwater fish business. Tilapia cultivation has economic advantages and is popular among the public, so tilapia is quite promising as a business prospect. According to Arzad et al. (2019), the growth aspects of tilapia include fish that can grow quickly and have a high level of productivity.

Aquaponics is a combination of aquaculture technology with hydroponic technology in one system to create a symbiotic relationship between the two. According to Fariudin et al. (2013), aquaculture is the cultivation of fish, while hydroponics can be interpreted as the cultivation of plants. Aquaponics can reduce the amount of water used for cultivation and reduce water pollution produced by fish cultivation.

The aquaponics system utilizes fish waste and leftover feed as nutrients for aquatic plants which can increase business efficiency. In the aquaponics system, fish and plants have different functions, but are mutually dependent on each other (Faozar, 2019). Farmed fish can produce water contaminated with ammonia, water that contains too much ammonia can poison fish. The aquaponics system is able to reduce ammonia compounds and convert them into nitrates with the help of oxygen and bacteria. In cultivation activities using a recirculation system, bacteria have an important role in eliminating ammonia compounds through the nitrification process (Rully, 2011). Plants will grow abundantly, while aquaponic cultivation water will be safer for fish because the plants and media function as water filters (Widyawati, 2013). According to Nugroho et al. (2012), pond water is channeled into a plant growing medium as a vegetation filter that can clean toxic substances in the water so that the water that returns to the pond is clean and suitable for reuse as a medium for cultivating tilapia.

The problem that fish farmers often encounter during the rearing process is the best fish stocking density. Differences in fish stocking density are very important for the functioning of an aquaponic system. Increasing stocking density that is not optimal can slow down fish growth. The stocking density for cultivating tilapia seeds measuring 3-5 cm based on BSN (2009) is 100 m2. Intensive stocking density of tilapia cultivation in the cultivation system according to Zalukhu et al. (2016) is 150 individuals/m^2. Fish that are stocked in dense conditions can cause problems, namely competition for food and space which can affect growth rate and survival (Darwis et al., 2019). Therefore, it is hoped that the use of an aquaponics system in tilapia cultivation can minimize these problems. This research aims to determine the best growth and density level of tilapia fish kept in an aquaponic system.

METHODS

This research was carried out for 40 days from April to June 2022. The research took place at the Fisheries Laboratory, Faculty of Marine Affairs and Fisheries, Udayana University, Bali. Tools and materials used in this research include: containers, scales, PVC pipes, trays, netpots, rulers, stationery, cameras, water pumps, thermometers, pH meters, TDS meters, DO meters, tilapia fish, pak choy plant seeds, pellet feed.

This research used the Completely Randomized Design (CRD) method, 3 different treatments with 3 replications. This research used tilapia fish seeds (*Oreochromis niloticus*) measuring 3-5 cm. The treatment tested was the use of an aquaponic system with different tilapia stocking densities by combining the principles of aquaculture and hydroponics through a water recirculation system. The treatment consists of:

Treatment I : Stocking density is 100 heads /m^2
Treatment II : Stocking density is 150 heads /m^2
Treatment III : Stocking density is 200 heads /m^2

The research procedures are as follows:

Pool Preparation

The pool used in this research was a tarpaulin pool with dimensions of 140 x 70 x 70 cm and prepared 9 pools. The pool is cleaned first, then the inlet and outlet pipes and filter are installed in the pool, and the pool is filled with clean water with a water height of 50 cm in each pool. Each pond is given a treatment and replication label.

Seed Distribution

The fish seeds that were stocked were 3-5 cm long, then kept in ponds according to each treatment with treatment I 100 fish, treatment II 150 fish, and treatment III 200 fish. The tilapia fish were acclimatized to the environment for 30 minutes and the fish were fasted for 2 days. Before spreading the seeds in each pond, 10% of the seeds from the total population in each treatment were taken as weight and length samples to determine the initial size of rearing.

Feeding

Pakan yang diberikan untuk benih ikan nila selama penelitian yaitu berupa pelet Feng Li 3S with 40% protein content. The frequency of feeding is 3 times a day, namely morning, afternoon and evening with an amount of 10% of the fish biomass.

Data collected during the research were absolute weight growth and fish survival rate. This research was carried out for 40 days, data collection was carried out 4 times during the research with a duration of 10 days, by sampling fish as much as 10% of the total population in each treatment. This activity is carried out before feeding the fish. The fish were taken slowly using a filter then placed in a basin filled with water, then the weight of the tilapia fish was measured using a digital scale one by one. Observations of the number of fish are carried out every day so that you can know the number of fish that have died and the number of fish that are still alive.

***Absolute Weight Growth* (PBM)**

Absolute weight growth is calculated using the Hopkins (1992) formula, as follows:

$$PBM\ (g) = (Wt - Wo)$$

Information: Wt = Average weight of tilapia at the end of rearing (g)
Wo = Average weight of tilapia at the start of rearing (g)

Survival Rate

The survival rate (SR) is expressed in percent (%) using the Effendie (1997) formula, as follows:

$$SR = \frac{Nt}{No} x\ 100\%$$

Information: Nt = Number of fish at the end of rearing
No = Number of fish at the start of rearing

RESULT AND DISCUSSION

Absolute Weight Growth (PBM)

The absolute weight growth of tilapia fish reared in the aquaponics system for 40 days showed that the weight growth in each measurement treatment ranged from 2.11 to 3.29 grams. The highest average weight of stocking density was in treatment I at 3.29 grams, followed by treatment II at 2.75 grams and the lowest in treatment III at 2.11 grams. Data on the absolute weight growth of tilapia in each treatment can be seen in Figure 1.

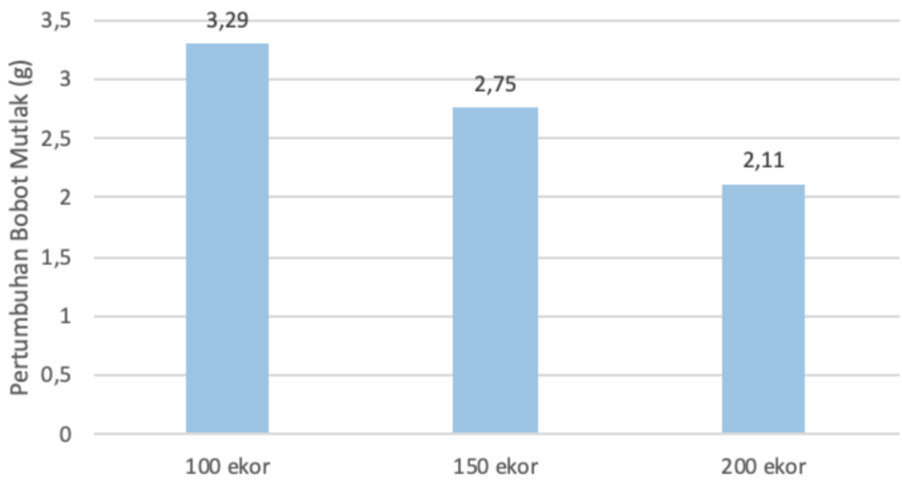
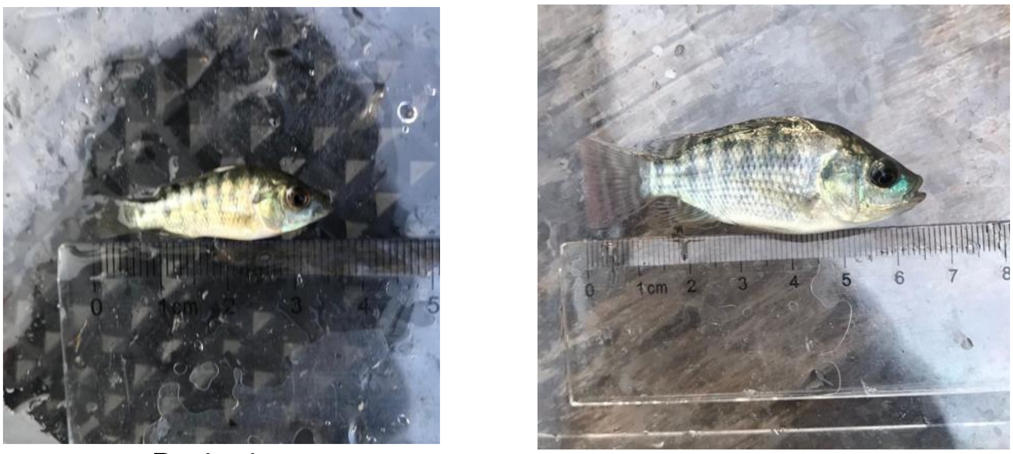


Figure 1. Absolute weight growth



Beginning End

Figure 2. Growth of tilapia fish in treatment I during 40 days of maintenance in an aquaponic system.

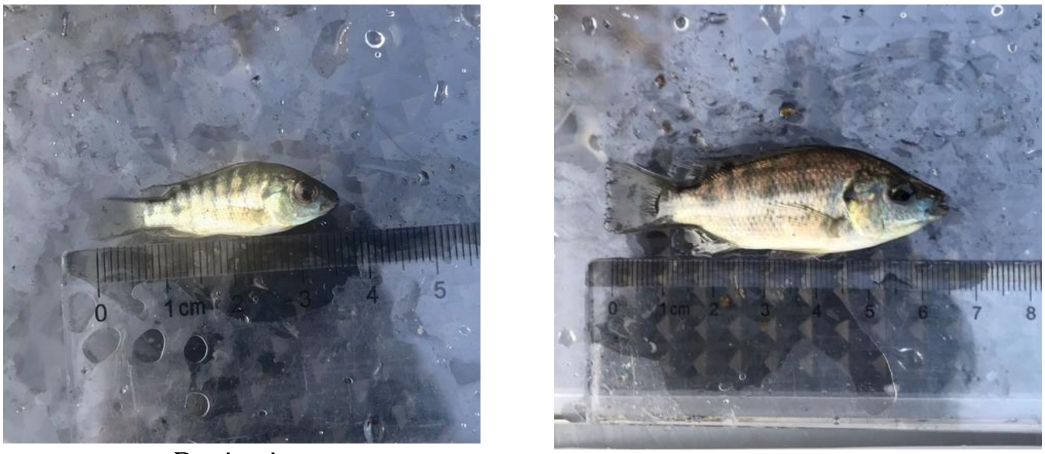


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Figure 3. Growth of tilapia fish in treatment II for 40 days of maintenance in an aquaponic system.

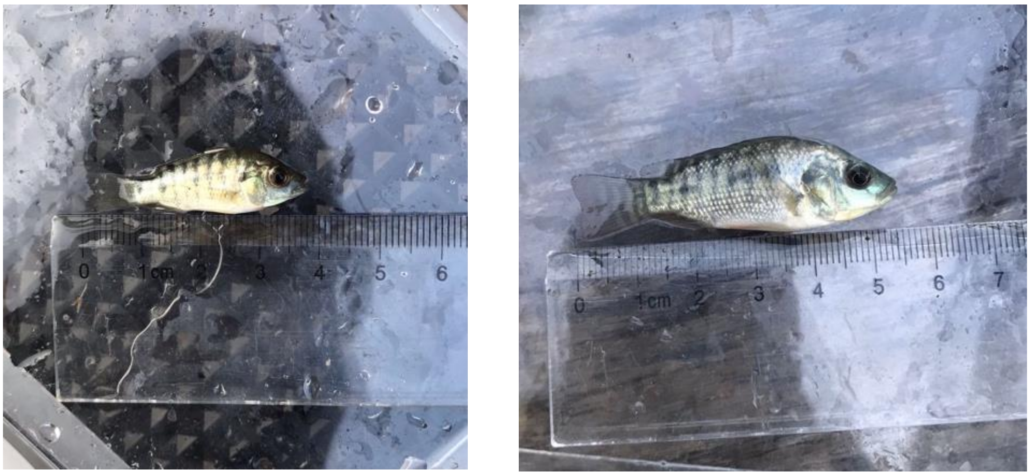

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Figure 4. Growth of tilapia fish in treatment III for 40 days of maintenance in an aquaponic system.

Raising tilapia (*Oreochromis niloticus*) with different stocking densities in an aquaponic system resulted in good cultivation productivity in all treatments. The sustainable performance of an aquaponic system is greatly influenced by fish stocking density. Fish that are stocked in dense conditions can affect the growth rate and survival of the fish. According to Yulianti et al. (2003), stocking density is a limiting factor that can affect survival rates, larval quality, production costs and unit production time.

The highest absolute weight growth of tilapia during 40 days of rearing was 3.29 grams in treatment I, namely with a stocking density of 100 fish/m2. Meanwhile, the lowest was 2.11 grams found in treatment III with a stocking density of 200 individuals/m2. According to Effendi (1997), growth is a change in fish size in terms of weight, length or volume over a certain period of time which is caused by changes in tissue due to the division of muscle and bone cells which are the largest part of the fish's body, causing an increase in the weight or length of the fish. According to Hidayat et al. (2013), growth is influenced by several factors, namely internal and external factors, while internal factors include hereditary characteristics, resistance to disease and the ability to utilize food. Fish grow because of success in getting food. The amount of feed given to each treatment is the same or homogeneous, namely 10% of the fish's body weight at the start of stocking. This is in accordance with research from Lasena et al. (2017) that the best feeding dose for sustainable growth of tilapia fry is 10% of the biomass weight. According to Hakim (2019), growth will be faster if the food provided is in accordance with the fish's needs, whereas if it is given excessively into the rearing pond it will result in a decrease in water quality.

Survival Rate

The survival rate (SR) of fish is the percentage of the number of live fish at the end of the study compared to the number of fish at the start of rearing. To find out, use a simple formula proposed by Baktiar, 2006 in (Fahrizal & Nasir, 2017), namely the number of living fish populations divided by the number of fish populations at the start of rearing multiplied by one hundred percent.

The results of the 40 day study showed that treatment III had the highest average survival rate, namely 90.5%, followed by treatment II, namely 78.7%, while treatment I had the lowest average survival rate compared to the two treatments. others, namely 74%. The survival rate (SR) obtained from the research results for each treatment is shown in Figure 5.

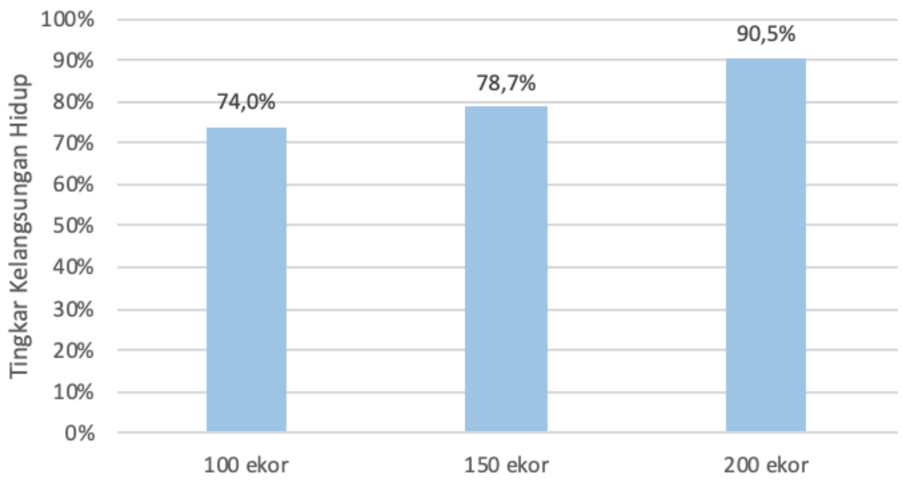

Figure 5. Survival Rate

The survival rate of tilapia during 40 days of rearing ranged from 74% – 90.5%. Treatment III in the study showed the highest survival rate during maintenance, namely 90.5%. This is in accordance with Sharly's (2020) research that high density is good for use in aquaponic systems because it is able to support high survival. This value is included in the good category according to the Ministry of Agriculture (1999) in Fahrizal & Nasir (2018) which states that the value of a good fish survival rate has an average value of 63.5 – 86.0. In almost every treatment there were fish that died during maintenance. More dead fish occurred at the start of stocking the fish into the rearing ponds until the next ten days. This is thought to be due to stress due to transfer to the maintenance pond. According to Effendie (1997) in Hakim (2019), the survival rate is influenced by biotic factors, namely competition, parasites, age, predators, density and human handling, while abiotic factors are the physical and chemical properties of waters. The decline in water quality due to high stocking density affects the dissolved oxygen content and ammonia concentration, where if there is a decline in water quality that exceeds the tolerance limit it will result in death.

CONCLUSSION

The growth of tilapia fish with a high stocking density can be used in an aquaponic system. The best stocking density for the survival of tilapia fish is treatment III stocking density with a density of 200 individuals and a SR level of 90.5%.

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