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THE EFFECT OF TOPOGRAPHICAL DIFFERENCES ON THE GROWTH OF KOI CARP (*Cyprinus carpio koi*)

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ABSTRACT

Interest in the cultivation of koi carp commodities has increased during the Covid-19 pandemic. Breeders come from various communities. This study aims to determine whether topographic differences have an effect or not on the growth of koi carp. The research was conducted from February to March 2022 for 45 days. The location of the research was carried out in three different places, Kaliangkrik, Tempuran, and Kebumen. The research method used was a Completely Randomized Design (CRD) with 3 treatments and 3 repetitions. The first treatment is an altitude of 1,030 meters above sea level (Kaliangkrik), the second is 323 meters above sea level (Tempuran), and the third is 26 meters above sea level (Kebumen). The data were analyzed using the Analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) further tests. The results showed that topographic differences affect the growth of koi fish both in weight and length growth of koi fish. The altitude that produces the best growth in this study is at an altitude of 26 meters above sea level or located in Kebumen. This is supported by the data showing the highest weight (average 4,1 g), the longest (average 2.5 cm), the lowest FCR (average 2,16), and the highest Survival Rate (SR) high (80%).

Keywords: *Cyprinus carpio koi*, Water Quality, Growth, Topography

1. INTRODUCTION

Ornamental fish aquaculture has good opportunities in the future. This can be seen from the stable and increasing public interest in the last decade. Interest in ornamental fish cultivators penetrated in various circles both young and old, male or female, fishery professionals or beginners, both those living in the lowlands and highlands. The high interest can be seen from the high sales of fish seeds on the market, there is fish pond in front of the house, or an aquarium in the house, and can also be seen from the rampant counseling or training on ornamental fish cultivation and offset by a large number of participants.

The COVID-19 pandemic has made tourist attractions compete to attract tourists, one of which is by making a concept of ecotourism which involves fish used for educational purposes. One of the commodities that farmers and the market are interested in is koi carp (*Cyprinus carpio*). Koi carp is a prima donna ornamental fish in Indonesia. Koi carp production in Indonesia from 2015 to 2020 averaged 30% of the total production of ornamental fish in Indonesia, this makes koi fish dominate among other types of ornamental fish[1].

Attractiveness koi carp are in the beauty of color and elegance. Keeping koi carp that are easy and difficult does not dampen the interest of the keepers. According to the DJPB[1], the demand for koi carp is stable and tends to increase. Data shows that national ornamental fish production has continued in recent years from 1.19 billion in 2017 to 1.22 billion in 2018 to 1.28 billion and 19.81 billion in

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2019. The high interest is because the koi carp cultivation system does not require too much land so anyone can do it. Maintenance constraints exist in differences in cultivation results between places. Like growth between one place and another, some are slower even though the cultivation technique is the same. This difference is found in the results of cultivation in the lowlands and highlands which are different, seen in the growth section. Seeing the conditions in the field like this, it is necessary to research so that we can find out whether height is a factor that affects the growth of koi carp or does not affect the growth of fish.

2. RESEARCH METHOD

Time and Place

The research was carried out from February to March 2022 at three different places. The first place was in Kebonlegi Village, Kaliangkrik District, Magelang Regency, the second place was in Kebonagung Kulon Hamlet, Jogomulyo Village, Tempuran District, Magelang Regency, and the last place was in Penaket Village, Ambal District, Kebumen Regency. The research was conducted for 45 days[2]. The number of days of the study to know the growth of koi carp.

Methods

The experimental design used was a completely randomized design (CRD) with 3 treatments with 3 repetitions so that a total of 9 units. The stocking density of koi carp in one pond uses 5 fish. The following treatment will be carried out:

T1 = Altitude 1,303 m above sea level
T2 = Altitude 323 m above sea level
T3 = Altitude 26 me above sea level

Parameters observed during the study included growth including weight and length, survival rate, water quality, and blood glucose in fish. The treatment in this study was the maintenance of fish in different topography.

The research began with location determination, site preparation, fish procurement, maintenance of test animals, and maintenance evaluation. Determination of the location was chosen by considering the existence of significantly different elevation differences. Maintenance is carried out for 45 days with routine controls such as feeding, checking temperature and pH, as well as siphoning once a week

Data Analysis

Data analysis used a completely randomized design (CRD) experimental method. Research data were analyzed using one-way Analysis of Variance (ANOVA) with an error level of $\alpha = 0.05$. If in the calculation of the analysis of variance the results are significantly different ($P < 0.05$), then proceed with a follow-up test using Duncan's Multiple Range Test (DMRT) to find out the difference between one treatment and another[3]. Data processing is done with SPSS statistical calculations.

3. RESULT AND DISCUSSION

Growth

Parameters of fish weight and length are used as a reference to determine whether fish are growing or not. The absolute weight is obtained from the weight of the fish at the end of the research minus the weight of the fish at the start of the research. Likewise, the absolute length data was obtained from the results of measuring the length at the end of the research minus the length at the beginning of the research. The following is data from absolute weight and absolute length measurements during the research (Table 1).

The highest absolute weight in this study with an average of 4.1 g was found in Kebumen while the lowest average was 1.74 g in Tempuran. The highest initial weight gain was in treatment 3 replicates 2 with an added value of 4.3 g and the lowest absolute weight gain was in treatment 2 replicates 1 with a value of 1.4 g.

The highest absolute length gain measurement results were found in the 3rd

treatment with 3 repetitions with a value of 3 cm. While the lowest was in treatment 1 repetition 1 with a value of 0.7 cm. The highest average absolute length was in treatment 3 or Kebumen with a value of 2.5 cm and the lowest was in Kaliangkrik with a value of 0.96 cm. Absolute length growth data for more clarity can be seen in the following Table 2.

Table 1. Measurement of absolute weight growth

Treatment	Repetition (g)			average (g)
	1	2	3	
T1	3	2	2,2	2,4
T2	1,4	1,8	2	1.74
T3	4	4,3	4	4,1

Note: T1 (altitude 1,303 masl), T2 (altitude 323 masl), T3 (altitude 26 masl).

Table 2. Absolute length growth measurement results

Treatment	Repetition			Average (cm)
	1	2	3	
T1	0.7	1	1,2	0.96
T2	1	2,2	1,2	1.46
T3	2	2,5	3	2,5

Note: T1 (altitude 1,303 masl), T2 (altitude 323 masl), T3 (altitude 26 masl).

Overall, the average absolute weight and absolute length were highest in treatment 3. The high absolute weight and length were thought to be due to optimal environmental conditions to support koi carp growth. The environmental conditions in question are relatively stable temperatures not experiencing significant fluctuations, optimal pH, and sunny weather and rarely rains compared to other research locations. According to Supono[4], optimal environmental conditions support the growth of cultivated fish. The data obtained was then analyzed to answer the research objectives, whether or not the topographical differences had an effect on the growth of koi carp.

Growth is closely related to feed requirements. If feed requirements are met and proper utilization then growth will also increase. Although efforts have been made to meet the feed requirements for each treatment, there are differences in the absolute weight and absolute length results. This is presumably due to differences in environmental conditions such as temperature which affect metabolism in fish. According to Goddard *in* Supono[4], temperature, and dissolved oxygen are the main factors affecting appetite, metabolism, and fish growth.

By obtaining the results of the real effect of topographical differences on the growth of absolute weight and absolute length of koi carp, further tests are needed with the Duncan Multiple Range Test (DMRT) to determine differences between one treatment and another. The DMRT test results for the growth of absolute weight and absolute length of koi carp are presented in the following Table 3 and Table 4.

Table 3. Absolute weight DMRT test for koi carp

Treatment	N	Subset for alpha = 0.05	
		1	2
T2	3	1.7333	
T1	3	2.4000	
T3	3		4.1000
Sig.		068	1,000

Table 4. Absolute length DMRT test for koi fish

Treatment	N	Subset for alpha = 0.05	
		1	2
T1	3	.9667	
T2	3	1.4667	
T3	3		2.5000
Sig.		.260	1,000

Based on the DMRT test results in Table 3 and Table 4, it can be seen that the absolute weight and absolute length in Treatment 3 were significantly different from Treatment 2 and Treatment 1. Meanwhile, treatment 1 was not significantly different from treatment 2 and conversely treatment 2 was not significantly different from treatment 1.

Treatment 3 was significantly different from other treatments thought to be due to environmental factors that supported fish growth. These factors, such as changes in temperature that do not fluctuate every day, allow fish to utilize feed optimally. According to Nikolsky *in* Aisyah et al.[5] states the growth of fish depends on environmental conditions and the availability of food because food is the most important factor in supporting growth. It can be seen in the feed conversion calculation results table which shows different results between treatments.

Feed conversion can be used as a reference to find out how efficient the allocation of feed utilization for growth is. The smaller the FCR value the better the feed conversion. In line with Sutiana[2] which states that if the feed conversion is small, the efficiency level of feed utilization is better and vice versa if the feed conversion is large, the efficiency level of feed utilization is not good. Good feed conversion is supported by optimal environmental conditions so that metabolic processes run optimally.

Feed Conversion Ratio

Feed is a source of energy for the growth of organisms. The feed given is not necessarily optimally absorbed by the fish. So it is necessary to measure feed conversion in fish. This calculation is called the Food Conversion Ratio. With good feeding management to support successful cultivation[4]. The following is the FCR table obtained during the study (Table 5).

Table 5. Feed conversion calculation

Treatment	Repetition			Average
	1	2	3	
1	3.67	4.57	3,36	3.866667
2	3.71	4,44	8,19	5.446667
3	2,13	1.85	2.52	2.166667

Note: T1 (altitude 1,303 masl), T2 (altitude 323 masl), T3 (altitude 26 masl)

A low FCR value indicates a good feed conversion value. This is evidenced by the results of the highest absolute weight and length measurements in treatment 3 or Kebumen. The smaller the feed conversion value, the better the efficiency of feed utilization. Conversely, if the feed conversion is large, the efficiency level of feed utilization is not good. So this feed conversion illustrates the efficiency level of feed utilization achieved. According to Mudjiman[6], food conversion in koi carp seeds ranged from 1.5-8, so the FCR during the study was relatively good.

The results of the analysis showed that topographical differences did not significantly affect the growth of koi fish. According to Fahrizal & Nasir[7], factors that affect FCR include fish conditions, environment, feed, and feed management. Efforts are made to suppress these factors equally during the research. The test fish used came from one lineage with the same size, quality, and genetics. The feed given between treatments was the same as the management of feeding twice a day in the morning and evening. Emphasizing the influence factor makes the FCR value not significantly different in each treatment. After the results were not significantly different, a follow-up test was not carried out using the DMRT Test.

Survival Rate

The survival rate in each place of research is different. From Kaliangkrik, Tempuran, and Kebumen respectively, it was 46%, 66%, and 80%. Good survival in koi carp seeds is 70-100%[8] (Figure 1).

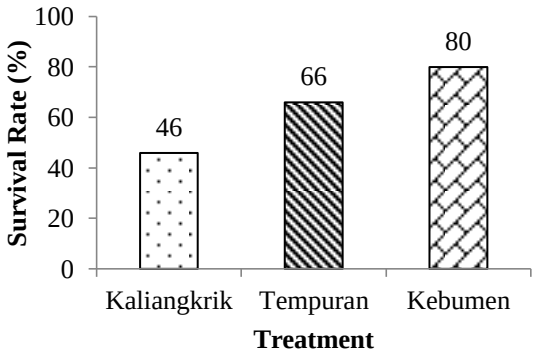

Figure 1. Survival rate koi carp

It is suspected that there are external factors such as the environment and parasites that affect the success rate of fish survival. These external factors include the influence of weather changes where it rained for some time during the study. This is in line with the statement of Ambarwati et al.[9] which states that a low survival rate of around 4-56% is one of the causes, namely the erratic weather factor. The data obtained was then carried out by survival ANOVA test. The test was carried out to find out whether or not there was a significant difference in survival in each treatment.

The results obtained were not significantly different, presumably due to the adaptability of koi fish. As Effendi *in* Ricky et al.[10], states that competitors, population density, age, and the ability of organisms to adapt to the environment are factors that affect survival. In addition to these factors, the quality of the water is still good for the survival of koi fish so the results of the analysis have no significant effect. This is shown by the pH range which is classified as optimal and temperatures that can still be tolerated for koi fish farming. Supono[4], states that water quality parameters that affect survival rate are temperature, pH, dissolved oxygen, and water salinity

Water Quality

Water quality parameters measured in this study were pH and temperature. Measurements were made every day using a pH meter and thermometer. The pH parameter indicates whether the water is alkaline or acidic. The results of pH measurements during the study are presented in the following Table 6.

Table 6. Measurement results pH

Treatment	Week Average						average
	1	2	3	4	5	6	
T1	6,5	6,7	6,5	6,7	6,6	6,5	6,5
T2	6,8	7	7	7	7	7	6,9
T3	7	7	7	6,8	7	7	6,9

Table 7. Temperature measurement

Treatment		Average Temperature Measurement						Average (^oC)
		1	2	3	4	5	6	
1	Morning	19,1	18,7	18.5	18.5	18,7	19	18,7
	Evening	20,2	20,1	20,1	20,2	20,3	20,6	20,3
2	Morning	23,3	23,8	23,3	23,6	23.5	23,6	23.5
	Evening	28,6	28,8	28.5	28,7	28,7	28.5	28,6
3	Morning	26,4	26.5	26,7	26,2	26,4	26,3	26,4
	Evening	28.5	28,8	28,6	28,7	28,6	28.5	28,6

This range is still quite good for aquaculture. The good pH conditions were proven by the results of survival measurements and feed conversion which were good and did not differ significantly between treatments. This is following Swingle *in* Supono[4] which states that fish will grow well if the water pH is around 6.5-9, whereas at pH 4-5 it will experience slow growth and die at pH 10.

Temperature is an important parameter in aquaculture. High and low temperatures affect fish metabolism it can affect fish growth. In this study temperature data collection was carried out 2 times a day in the morning and evening (Table 7).

The most drastic temperature changes are in Tempuran. The changing conditions are suspected because the surrounding environment is a factory environment. However, the temperature in the study was

included in the optimum and could still be tolerated. Another source in SNI 7734:2017 the appropriate temperature for koi fish is 20-26^{o}C. Temperatures that change drastically make the fish adapt every time. Days so that growth is slightly disturbed. This is indicated by the lowest absolute weight among the three treatments. Conversely, if the water quality is good, the growth of fish will be fast and the survival rate is high so that the biomass will increase[4].

Blood Glucose

Blood glucose levels in this study were used to determine stress levels in test fish. According to Midihatama et al.[11], the stress response can be observed in increasing blood glucose levels in fish. The normal range of glucose levels in fish is 40–90 mg/dL. The following are the results of blood glucose measurements (Figure 2).

The results of blood glucose measurements in the study were within the normal range except for treatment 2 which reached 91 mg/dL.

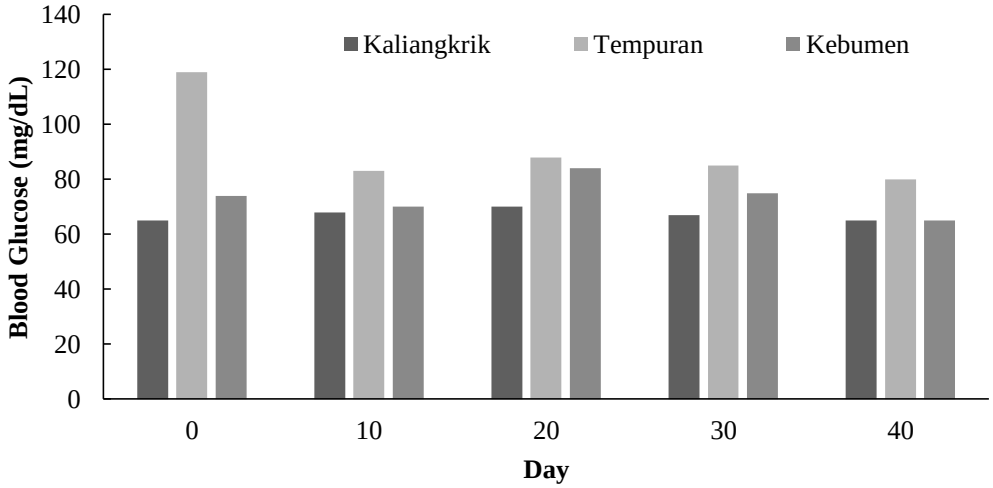

Figure 2. Blood glucose measurement

These levels are an indication that the fish in treatment 2 are experiencing stress. One of the factors that trigger stress is environmental conditions. When the research was taking place there were often sudden changes in weather such as sunny weather during the day and then rainy in the afternoon. This is in line with Adams[12] who stated that one of the causes of fish stress is temperature changes. Significant temperature fluctuations in Tempuran also require fish to continue to adapt every day which requires a lot of energy.

4. CONCLUSION

Topographical differences affect the growth of koi fish both the growth of koi car weight and length. However, it has no significant effect on the feed conversion ratio and survival of koi carp. The altitude that produces the best growth in this study is an altitude of 26 m above sea level or located in Kebumen. This is supported by data showing the highest weight (average 4.1 g), longest (average 2.5 cm), lowest feed conversion ratio (average 2.16), and survival rate the highest (80%).

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