Original Research Article

THE EFFECT OF *BLACK SOLDIER FLY* (*Hermetia illucens*) LARVAE FEEDING ON THE GROWTH OF MUTIARA CATFISH SEEDS (*Clarias gariepinus*)

ABSTRACT

Aims: The purpose of this study was to determine the level of feeding in the form of Bblack soldier fly larvae (*Hermetia illucens*) to increase the growth of the (*Clarias gariepinus*) Mmutiara catfish seeds.

Study design: This study used an experimental method with a completely randomized design (CRD) consisting of four treatments and four replications. The treatments are a combination of commercial feed and dry maggots of *H. illucens*, consisting of A (control, 100% commercial feed), B (75% commercial feed + 25% dry maggot), C (50% commercial feed + 50% dry maggot) and D (100 % dry maggot).

Place and Duration of Study: This research was conducted from August 2022 to September 2022 at the Cipancuh Fish Seed Center, Indramayu Regency. Mutiara catfish seeds were obtained from the Cipancuh Fish Seed Center, commercial feed and dried maggot were obtained from online stores whose quality was guaranteed.

Methodology: The parameters observed in this study were survival rate, specific growth rate and water quality. The combination of commercial feed and dry maggot has an effect on the growth rate of a specific length and survival of mMutiara catfish seeds.Pearl Mutiara catfish fry were reared for 40 days by feeding them three times a day. Observations are made every ten days.

Results: The results showed that the combination of 50% commercial feed and 50% dry maggot resulted in a specific length growth rate of 16.19%, while the best survival rate was in treatment D with feeding 100% dry maggot with a value of 91% with water quality in accordance with SNI.

Conclusion: Giving a combination of 50% commercial feed and 50% dry maggotresulted in thehighest specific length growth rate of 16.19%. The highest survival value of Mmutiara catfish seeds was obtained by feeding 100% dry maggot, which was 91%.

Keywords: Growth; Mmutiara catfish seeds; *Clarias gariepinus*; Black sSoldier fFly larvaemaggot;dry maggot; *Hermetia illucens*

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1. INTRODUCTION

Mutiara catfish (*Clarias gariepinus*) is a type of catfish selected by the Sukamandi Fish Breeding Research Institute (BRPI) which has been set for release based on the Decree of the Minister of Maritime Affairs and Fisheries Number 77 KEPMEN-KP/2015. Mutiara catfish is a product superior results of selection from African catfish crossed with four strains of African catfish in Indonesia, namely catfish Egypt, paiton, sangkuriang and dumbo as their parent populations [1].~~(BPPI 2014)~~. The advantages of mutiara catfish are higher growth, high feed efficiency, uniform size, resistance to disease, resistance to environmental stress conditions, high productivity, and higher cultivation benefits because the proportion of meat is relatively higher [2]~~(Matasina and Tangguda 2020)~~.

According to Mahyudin [3].(2008), M~~m~~utiara catfish included in the ~~clas~~class~~ss~~ of all-eating or omnivorous but tend to eat meat. Catfish is a type of fish that has a habit of eating at the bottom of waters or ponds *(bottom feeder*). Mutiara catfish are *nocturnal*, that is, they have a tendency to be active and look for food at night, but in aquaculture they will adapt as a diurnal. During the day catfish prefer to stay or take shelter in the dark parts of the waters. In maintenance ponds, especially in intensive cultivation, catfish can be used to being fed pellets in the morning or during the day. According to Kordi [4].~~(2010)~~ that catfish is a fish that eats all food ingredients (omnivores), both animal and vegetable ingredients. Mutiara catfish's natural food is small animals, such as water fleas from the *D~~d~~aphnia*, *C~~c~~ladocera*or *C~~c~~opepod groups*.

Cannibalism is the act of killing and consuming all or part of the body of individuals of the same species. The nature of cannibalism in catfish is one of the factors causing death, this is due to the non-uniform size of the fish along with the ongoing rearing process (Sopha *et al.* 2015).

The problem that often arises in the cultivation of S~~s~~angkuriang catfish (*Clarias* sp.) is the high mortality rate its ~~of sangkuriang catfish (Clarias sp)~~ seeds due to cannibalism in hatchery activities. The mortality rate of S~~s~~angkuriang catfish ~~(Clarias sp)~~ fry due to cannibalism under cultivation conditions can range from 15% -90% mortality (Sylvawan 2014 in Sutanmuda 2007). To overcome the problem of cannibalism of M~~m~~utiara catfish seeds, there are several efforts, one of which is by providing highly nutritious feed.

In fish farming activities, feed is very important in increasing production. In intensive aquaculture, almost 70% of production costs are spent only on procuring feed. To increase profits, fish cultivators must make production costs more efficient, one of which is by reducing feed costs by utilizing natural feeds available in the environment (Herlina 2016).

Natural feed is a kind of fish feed in the form of aquatic organisms which are primary producers in the food chain. Natural food is able to breed in waters in accordance with its life tolerance. Several types of natural fish feed that can be mass-produced include *infusoria*, *daphnia*, *chlorella*, *tetraselmis*, *rotifers*, *artemia*, to *tubifex* worms or silk worms. In the cultivation of natural feed is needed because it has a high nutritional content and is complete and easy to digest. Natural food has high protein to support the growth of fish such as silk worms which have high protein. The use of natural feed also aims to cut capital for relatively expensive pellet buyers.

Black soldier fly(BSF) (*Hermetia illucens*)larvae or commonly called maggotas animal feed has direct and indirect benefits. According to Rachmawati *et al.* (2015) that prepupa is ideal for use as a mixture of feed or pellet raw materials because it is able to meet the quantity of production. Prepupae are more suitable for direct fish feed, because their small shape matches

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the size of the fish's mouth. Maggot has potentialas feed because of its high protein content of 44.26% and fat content of 29.65%. The value of amino acids, fatty acids and minerals contained in the larvae is also not inferior to other protein sources, so that BSF larvae are ideal raw materials that can be used as feed. BSF larvaeBlack soldier flyor maggotlarvae can also be used as alternative feed or additional feed for cultivated fish, especially Mmutiara catfish. (Sheppard *et al.* 2005 in Rini Fahmi *et al.* 2009).

According to Habibie *et al.* (2020) states that the best treatment uses a combination of commercial feed and maggot(BSF) at a ratio of 50% + 50% by giving the highest daily growth rate value of 1.86%, a length ratio value of 1.40%, a feed efficiency value of 65.09% and the lowest feed conversion ratio value is 1.54.

According to Irawan and Helmizuryanu (2014) stated that the growth in length and weight of Ssangkuriang catfish (*Clarias sp.)* in the maggotfeeding treatment gave better results than the other treatments (treatment with chicken intestine, golden snail and trash fish) with an average average length reaches 7.87 cm, and weight reaches 78.23 grams.

According to Sepang *et al.* (2021) stated that the provision of alternative feed in the form of BSF maggothad a good effect on the growth of tilapia and the treatment that had the best effect on the growth of Ttilapia seeds was at the dose of giving a combination of 50% pellet + 50% maggot feed, with an absolute growth yield of 5, 5 gr, daily growth of 3.7%, relative growth of 139.4%.

The purpose of this study was to determine the level of feeding in the form of Bblack soldier fly(*Hermetia illucens)* larvae to increase the growth of Mmutiara catfish (*Clarias gariepinus*). It is hoped that by providing feed in the form of Bblack soldier fly larvae *(Hermetia illucens)* it can increase the growth of Mmutiara catfish*(Clarias gariepinus)*.

2. MATERIAL AND METHODS

This research is explorative in nature by taking data from the field. The test fish used in this study were Mmutiara catfish seeds obtained from the Cipancuh Fish Seed Center. The number ofcatfishused during this study was 800 fish, measuring 3-5 cm/head with a stocking density of 50 fish/pond. Pool size 100 x 60 x 40 cm^3totaling 16 pools. The research method used was an experimental method with an experimental design using a completely randomized design (CRD).

This study used 4 treatments with 4 repetitions which were observed for 40 days. The treatment carried out in this study was Treatment A 100% Commercial Feed (Control), Treatment B Combination of 75% commercial feed + 25% dry BSF *black soldier fly* larvae, Treatment C 50%commercial feed combination + 50% dried BSF *black soldier fly* larvae% and Treatment D. Feed in the form of dry BSF larvae was added with dry *black soldier fly larvae* as much as 100%. Feeding is done twice a day.

Observations were made for 40 days with observation parameters including the degree of survival and the specific length increase rate.

The degree of survival or (Survival Rrate (SR) is calculated using the formula of (Effendie (2002).

$$SR = (Nt/No) \times 100\ \%$$

Information:
SR : Degree of survivalSurvival Rate (%)
Nt : Number of live fish at the end of maintenance (tails)
No : Number of fish at the beginning of rearing (tails)

Calculation ofThe Sspecific Llength Ggrowth Rate (LPPS) is calculated using the formulaas follows:

$$LPPS = (lnLt - lnLo) /t \times 100\ \%.$$

Information:
LPPS : Specific Length Growth Rate (%)
Lt : AverageAverage length of fish at the end of treatment (cm)
Lo : Average length of fish at the beginning of treatment (cm)
t : Maintenance period (days)

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The data obtained was tested with statistical and descriptive analysis. Statistical analysis using Analysis of Variance(ANOVA) at95% confidence interval. To see the difference in treatment, a further test was carried out with the Duncan test (Gaspersz 1991).

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3. RESULTS AND DISCUSSION

3.1 Survival Rate

Based on the Analysis of Variance(ANOVA) test with a 95% confidence level, it showed that the combination of commercial feed and dry maggothad a significant effect (P <0.05) on the survival of Mmutiara catfish seeds with a rearing period of 40 days. For 40 days the maintenance of Mmutiara catfish seeds has a high survival value. According to Habibie *et al*. (2020) in his research the survival value of catfish seeds was above 80% using a combination of artificial feed and maggot. The survival value of catfish seeds at a size of 3-5 cm is said to be good if the value is greater than 80%. Data on the Ssurvival Rate of catfish seeds given a combination of artificial feed and maggot can be seen in Table 1.

Table 11 .Survival of MutiaraCatfish Seeds

Treatment		Survival Rate (%)Life sustainability (%)
A	100% commercial feed	78.50a
B	75% commercial feed + 25% dry maggot	79.50ab
C	50% commercial feed + 50% dry maggot	84b
D	100% dry maggot	91c

In Table 1 it can be seen that the highest survival value was obtained in treatment D, namely feeding 100% dry maggot with a value of 91%, while the smallest survival value was obtained in Ttreatment A, namely feeding in the form of 100% commercial feed with a value of 78.5%. This is influenced by the cannibalism of catfish and the quality of the water.

The death of catfish seeds in this study was caused by the cannibalism of catfish and water quality. According to (Fessehaye *et al*., 2006) cannibalism is influenced by fish density, fish age, fish size and weight ratio of individual predators. Cannibalism can be reduced by the presence of other foods in the rearing medium.Cannibalism can be reduced by the presence of other foods in the rearing medium. Adequate nutrition from feed and the use of natural feed can increase the survival value of pearl catfish fry and reduce the cannibalism rate of pearl catfish fry. With the high survival rate and low cannibalism of pearl catfish seeds, the uniformity of seed size can be well maintained.I recommend including a reference here

In addition to the cannibalism of catfish, the survival rate of catfish seeds can also be affected by water quality. According to Fauzi and Sari (2018) states that maggothas the ability to produce natural enzymes that stimulate fish appetite so that it can increase the digestibility of fish for feed and in the end there is no BSF maggot which is not eaten by fish and does not leave leftover feed which can affect quality water.

3.2 Specific Length Growth Rate

Based on observations of the average Sspecific Llength Ggrowth Rrate (LPPS) of fish fed a combination of commercial feed and dry maggotwith a rearing period of 40 days, different fish LPPS values specific length growth rates were obtained. The graph of the average length of catfish seeds can be seen in Figure 1.

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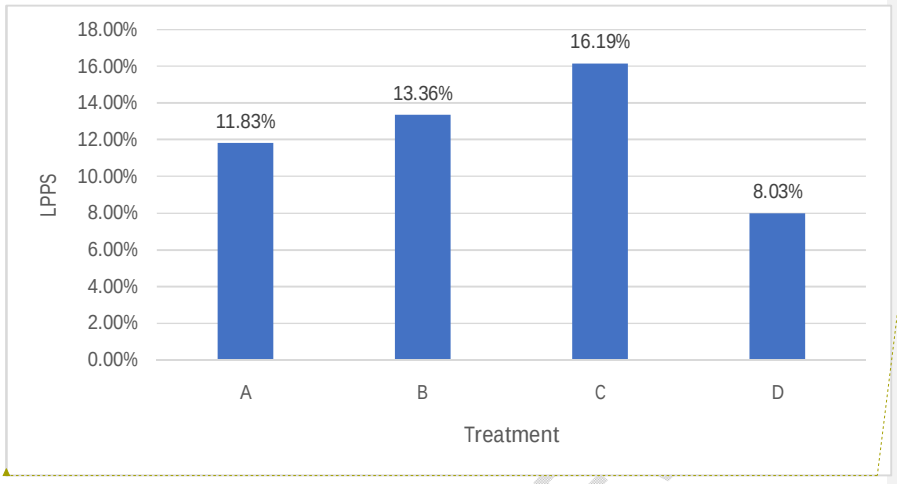

Figure 1. Graph of Specific Length Growth Rate Values

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The average value of the LPPS specific length growth rate in each treatment has a different values. This is because the nutritional components in the feed for each treatment are different. Data on the value of the LPPS specific elongation rate of Mmutiara catfish seeds can be seen in Table 2.

Table 2. Value of Specific Length Growth Rate (LPPS) Growth Rate of Specific Length of Mutiara Catfish Seeds

Treatment	LPPBS(%)
D (100% dry maggot)	8.03a
A (100% commercial feed)	11.,83b
B (75% commercial feed + 25% dry maggot)	13.,36c
C (50% commercial feed + 50% dry maggot)	16.,19d

All treatments had significant differences between treatments on Duncan's test. These differences are influenced by differences in the type and combination of feed given.

The highest LPPS growth rate for specific length of Mmutiara catfish seeds was found in treatment C by providing a combination of feed in the form of 50% commercial feed + 50% dry maggotwith a value of 16.19% and the lowest treatment was treatment D by providing feed in the form of 100% dry maggot with a value8.03%. All treatments had significant differences between treatments on Duncan's test. These differences are influenced by differences in the type and combination of feed given.

Treatment D with feeding in the form of 100% dry maggot had the lowest specific length growth rate. This is due to the limiting factor in maggot, namely chitin, which is difficult for fish to digest because it is not dissolved by strong acids, which interferes with fish growth (Suarjuniarta *et al.* 2021).

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3.3 Water Quality

Table 3. Water Quality Value During Maintenance

Treatment	Observed observations			
	Temperature	pH	DO	Aammonia
A	25-26	7	7.0-7.6	<0.03-0.1 mg/l
B	25-26	7	6,8-7,2	<0.03-0.1 mg/l
C	25-26	7	6.5-7.1	<0.03-0.1 mg/l
D	25-27	7	6.4-7.0	<0.03-0.05 mg/l

The temperature and pH observations of each treatment showed an almost the same range, namely 25-27 ^{o} C and 7 respectively (Table 3). According to SNI (2014) states that catfish can live and grow well in the temperature range of 25-30 ^{o} C and pH 6.5-8. Temperature and pH values can affect the growth and survival of Mmutiara catfish seeds, because if the temperature and pH values are not appropriate, it will interfere with appetite and can result in death.

In observing the value of dissolved oxygen(DO) in each treatment showed relatively the same value, namely the range of 6.4-7.96. This value is affected because the fish rearing container is given sufficient aeration to increaseDO in each maintenance container. According to SNI (2014) states that catfish can live and grow optimally if the DO value is > 3 mg/l.

The value of Aammonia levels is one of the important factors in the growth and survival of catfish, if the value is too high from the optimal limit it will cause death. Value of Aammonia levels in each treatment range <0.03-1 mg/l. This value is still in the optimal range for live catfish. Catfish are able to live in waters with ammonia levels <0.1 mg/l (SNI 2014).

Feeding in the form of a combination of commercial feed and dry maggot does not affect the water quality in the rearing container. This is shown by the values of temperature, pH, DO and Aammonia levels which are in accordance with SNI so that fish can maintain their survival and their growth can run optimally.

4. CONCLUSIONS

The Giving a combination of 50% commercial feed and 50% dry maggot resulted inthe highest Sspecific Llength Ggrowth Rrate of (16.19%) of Mutiara catfish at the end of the experiment.

The highest survival value of Mmutiara catfish seeds was obtained by feeding 100% dry maggot, which was 91%.

In addition to this synthesis of the results, I recommend including a couple of paragraphs commenting on what conclusions may emerge from this.

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