JBER 2 (1) (2021) 21 - 28

Journal of Biology Education Research (JBER)

https://journal.unpak.ac.id/index.php/jber

BLACK SOLDIER MAGGOT AS PROTEIN ALTERNATIVE FISH FEED IN PRODUCING A GOOD PERFORMANCE OF *Clarias* sp.

Giry Marhento[1*], Mashudi Alamsyah[2]

[1]Student of Biology Education, Universitas Indraprasta PGRI, Jakarta, Indonesia

[2] Lecturer of Biology Education, Universitas Indraprasta PGRI, Jakarta, Indonesia

**Email: girymarhento@gmail.com*

Received: April 5, 2021 Revised: May 15, 2021 Accepted: May 22, 2021

Abstract

Black soldier maggot (*Hermetia* sp.) has a good prospective as protein alternative fish feed. The purpose of this study was to determine the effect of feeding *Black soldier fly* maggot on *Clarias* sp cultivation. The method used in this research was an experimental method with hypothesis testing using a randomized block design. It consisted of two treatments and 5 replications. Moreover, the parameter observed in this study were the length of *Clarias* sp. and weight of *Clarias* sp. Based on the research hypothesis testing using one-way ANOVA calculation, the length of *Clarias* sp. obtained f count 53.4, weight Clarias sp . It was obtained f count 3576.04, while f table 3.88. It states that, f count > f table on length and weight of *Clarias* sp. Based on the average analysis, it is found that giving *Black soldier fly* maggot feed gives the best results because it has the highest average results.

Keywords*: Black Soldier Fly*, maggot, Length, Weight, *Clarias* sp.

INTRODUCTION

Indonesia has enormous potency of fishery resources, both in freshwater (land) and marine. In Indonesia's freshwater, there are about 655 types of native fish, 13 of which have been cultivated. Indonesia as large population country is a potential market for fishery products (Arie, 2009).

Clarias sp. is a freshwater fish that is in great demand by the community. This can be seen from the number of catfish pecel food stalls that have sprung up. For markets in the Jakarta, Bogor, Depok, Tangerang and Bekasi regions, the daily request is not less than 75 tons or 2,250 tons / month with a turnover value of around IDR 20 billion / month. This is what makes *Clarias* sp. becomes the main commodity of aquaculture target. Its productivity is increasing gradually from 2009 to 2014 with an average of 35% or 450 tonnes (Susanto, 2003). In addition, *Clarias* sp. can be cultivated with relatively easy cultivation technology that is controlled by the community, relatively easy marketing, and relatively low business capital (Mahyuddin, 2010).

The level of fish consumption in Indonesian society is still low when compared to other countries. Even though it is known that fish is a source of animal protein which is very necessary and beneficial for the body. Provision of food is a problem that continues to be resolved for human welfare, one of which is through fisheries development. One of the types of consumption fish that has the opportunity to be cultivated is *Clarias* sp.

The *Clarias* sp. farming business is intended to obtain fish consumption size or the size favored by consumers. For this reason, it is certainly not easy to make a good pond for *Clarias* sp. farming. In addition, there are several other factors that support *Clarias* sp. farming (Sihombing, 2018). Among other things, how to maintain it is not complicated, the growth rate is very fast, has a good taste of meat, a good appetite, a relatively high nutritional content, is relatively resistant to disease and the price is quite expensive so it is more profitable (Azizy, 2020).

The provision of quality animal feed is one of the determining factors for the success of *Clarias* sp. farming and is the biggest component in business activities. Protein components have an important role in a *Clarias* sp. feed formula because they are involved in the formation of body tissues and are actively involved in vital metabolism such as enzymes, hormones, antibodies, and so on (Khairuman, 2009). In developing countries, the source of protein for feed relies on animal and vegetable protein. However, protein is the most expensive component of feed compared to others. As a result, economically, the fulfillment of economic resources is quite burdensome for production costs.

Black Soldier Fly or black army fly with the scientific name *Hermetia illucens* is an insect belonging to the fly family group. Black Soldier Fly flies have the ability to remodel organic waste, especially manure or livestock manure (Setiawan, 2020). Black Soldier Fly larva can very quickly convert fresh organic matter into compost and biomass rich in protein and fat. Larvae are rich in protein and fat potential as fresh feed or feed ingredients for livestock. Maggot is found in many organic wastes that have undergone decay such as kitchen waste, vegetable and fruit waste, food processing waste, livestock waste to livestock manure (Hardini, 2021).

Protein sourced from insects is more economical, environmentally friendly and has an important role naturally. The insects are reported to have high feed conversion efficiency and can be maintained and mass produced. In addition, insect cultivation can reduce organic waste that has the potential to pollute the environment (Senlin et al., 2016). As a fish feed, maggot has two functions, namely as a source of protein that can substitute fish meal and as an alternative pellet, namely maggot which can be directly converted into pellets. Maggot production can be done closed and openly. The closed method is for densely populated areas while the open method is carried out in areas that are sparsely populated.

Maggot as fish feed has several functions, namely as a substitute for fish meal and as an alternative feed. This maggot function will ultimately affect the form of processing. As a substitute for fish meal, maggot is processed in the form of flour. This maggot flour is then included in the feed formulation as a source of protein to replace fish meal (Nila, 2019). As an alternative feed, maggot can be given in fresh form to fish, it can also be given in the form of pellets. For processing into maggot pellets, first dry it until the water content reaches 25%, after that it is immediately put into the pellet machine for printing (Gunaria Siagian, 2020).

The growth of *Clarias* sp. will be optimal with pellets containing protein, the price per kg of high protein pellets is indeed more expensive. The presence of the Black Soldier Fly mogot as an alternative protein source for *Clarias* sp. makes a very significant contribution. With its very high protein content, this commodity is increasingly being looked at by small, medium scale breeders as well as breeders with large production capacities.

Based on the background and identification results, the problem can be formulated, namely how to cultivate *Clarias* sp. through Black Soldier Fl feed, and to find out and analyze *Clarias* sp. cultivation through Black Soldier Fly maggot feed.

.

METHOD

The data to be obtained is numerical data described in statistical form. If the research data is in the form of numbers and the analysis uses statistics, the method is called a quantitative method. (Sugiono, 2010). Therefore, the method used by the researcher in this study is an experimental quantitative method, which was compiled based on a Randomized Group Design with one factor, namely maggot black soldier fly and pellets.

The research design used a randomized block design with 2 (two) different treatments. Each treatment was repeated 5 times. The experimental plot design for *Clarias* sp. was as follows:

Table 1. *Clarias* sp Experiment Design

AP1	**AP2**	**AP3**	**AP4**	**AP5**
BP1	**BP2**	**BP3**	**BP4**	**BP5**

Information:
A : *Clarias* sp. uses Black Soldier Fly feed.
B : *Clarias* sp. use pellet feed
P1 : Repetition Square 1
P2 : Repetition Square 2
P3 : Repetition Square 3
P4 : Repetition Square 4
P5 : Repetition Square 5

The materials used to conduct the research were catfish seeds measuring 7-9 cm, Maggot Black Soldier Fly, water. Meanwhile, the tools used to carry out the research are ponds, nets, rulers, ditches, buckets, stationery, and scales.

The following are the stages of sowing *Clarias* sp. seeds until harvest, which is to prepare 8 cm *Clarias* sp. seeds. Sowing catfish seeds, spreading *Clarias* sp. seeds is best done in the morning and evening to avoid the scorching sun. The way to spread *Clarias* sp. seeds is to place the seeds in a plastic container. Then, spread the seeds by tilting the container and removing the *Clarias* sp. seeds bit by bit. The water used in the pond is not recommended to be changed before harvesting. The water conditions must be calm and stagnant. This study used Black Soldier Fly maggot feed, the feed was given 3 times a day. Give food when the sun has risen so that pollution that pollutes the area around the pond can disappear first exposed to sunlight. For harvest on *Clarias* sp., the dose of 1 kg *Clarias* sp. is already 7-8. Use harvesting equipment made of smooth and smooth material so as not to cause blisters on *Clarias* sp. How to harvest it, namely by reducing the pool water first. Then, use a ditch to catch *Clarias* sp. and put it in a plastic container.

Population is a generalization area consisting of objects or subjects that become certain quantities and characteristics applied by researchers and then conclusions are drawn (Sugiyono, 2010). The population used in this study is *Clarias* sp. Sampling of the number of research samples was carried out using a saturated sampling technique which was used to determine the effect of feeding Black Soldier Fly maggot and pellets on *Clarias* sp. cultivation. Saturated sampling is a sampling technique when all members of the population are used as samples. This is often done when the population is relatively small, less than 30 data. (Sugiono, 2010).

To determine the number of replications of an experiment, by using the treatment formula as follows:

$$(n-1)\ (t-1)\ 15$$

Where :
n = number of repetitions
t = number of treatments

This research method is a field experiment based on a Randomized Block Design with one factor, namely feeding maggot Black Soldier Fly and pellets. Variables are characteristics that will be observed from the observation unit (Supriadi, 2016). Data collection was carried out to find out the existing problems by conducting direct observation or research, conducting direct observations of places that cultivate *Clarias* sp.

In this study there are two variables, namely one independent variable and one dependent variable, namely the independent variable (χ), is a variable that causes other variables, namely by using maggot black soldier fly and pellets. The dependent variable (Υ), is a variable whose existence is influenced by other variables, namely using the growth of *Clarias* sp. used are *Clarias* sp. length and *Clarias* sp. weight.

Data collection techniques are the main method of gathering information about situations, problems, or phenomena. Parameters observed were the length measurement of *Clarias* sp. measured at 1 month, e month, 3 months after sowing the seeds. This observation aims to determine the growth rate of *Clarias* sp. The part that is measured starts from the mouth to the tail fin of the *Clarias* sp. using a ruler.

Weight measurement in catfish is calculated based on the scales. Weight measurement on fish was carried out at the age of 1 month, 2 months, 3 months after sowing the seeds. Data is a number of information that can provide an overview of a situation or problem, either in the form of numbers or in the form of categories or descriptions (Supardi, 2016). Sources of data in the form of growth of *Clarias* sp. obtained from research conducted by researchers for three months.

RESULT AND DISCUSSION

Length is one of the growth parameters of *Clarias* sp. The height of *Clarias* sp. is measured from the mouth to the tail fin. High treatment of *Clarias* sp. from 1 month, 2 months and 3 months after stocking *Clarias* sp. seeds.

The data on the average length measurement of *Clarias* sp. at the age of 1 month can be seen in the following table:

Table 2. Average Length at 1 Month Age

Repetition	Treatment		Total Group
	A	B	
P1	15	11	26
P2	14	10	24
P3	14	11	25
P4	16	13	29
P5	17	12	29
Total	76	57	133
Average	15,2	11,4	26.6

The length of *Clarias* sp. at the age of 1 month respectively A and B treatment, had a mean of 15.2 cm and 11.4 cm, the highest average was treatment A (*Clarias* sp. with maggot feed) with an average of 15.2 cm and the lowest was treatment B (Treatment *Clarias* sp. feed) with an average of 11.4 cm.

Table 3. Average Length at 2 Months Age

Repetition	Treatment		Total Group
	A	B	
P1	19	15	34
P2	17	14	31
P3	16	15	31
P4	18	17	35
P5	20	16	36
Total	90	77	167
Average	18	15.4	33.4

The length of *Clarias* sp. at the age of 2 months, each treatment A and B, had an average of 18 cm and 15.4 cm. The highest average was treatment A (*Clarias* sp. with maggot feed) with an average of 18 cm and the lowest was treatment B (Treatment of *Clarias* sp. feed) with an average of 15.4 cm.

Table 4. Average Length at 3 Months Age

Repetition	Treatment		Total Group
	A	B	
P1	24	19	43
P2	23	18	41
P3	25	19	44
P4	25	16	41
P5	26	20	46
Total	123	92	215
Average	24.6	18.4	43

Information :
A = Treatment using maggot feed
B = Treatment using pellet feed

The length of *Clarias* sp. at the age of 3 months in treatments A and B, respectively, had an average of 24.6 cm and 18.4 cm. The highest average was treatment A (*Clarias* sp. with maggot feed) with a mean of 24.6 cm and the lowest was treatment B (*Clarias* sp. feed treatment) with a mean of 18.4 cm

The data on the average weight of *Clarias* sp. at the age of 1 month can be seen in table 5 below:

Table 5. Average Weight at 1 Month Age

Repetition	Treatment		Total
	A	B	Group
P1	22	15	37
P2	23	16	39
P3	23	16	39
P4	24	17	41
P5	25	18	43
Total	117	82	199
Average	23.4	16.4	39.8

The weight of *Clarias* sp. in each treatment A and B had an average of 23.4 grams and 16.4 grams. The treatment with the highest average was treatment A (*Clarias* sp. using maggot feed) with an average of 23.4 grams and the lowest was treatment B (control) with an average of 16.4 grams.

Table 6. Average Weight at 2 Months Age

Repetition	Treatment		Total
	A	B	Group
P1	83	43	126
P2	84	44	128
P3	85	46	131
P4	85	45	130
P5	87	47	134
Total	424	223	647
Average	84.4	45	129.4

The weight of *Clarias* sp. in each treatment A and B had an average of 84.4 grams and 45 grams. The treatment with the highest average was treatment A (*Clarias* sp. using maggot feed) with an average of 84.4 grams and the lowest was treatment B (control) with an average of 45 grams.

Table 7. Average Weight at 3 Months Age

Repetition	Treatment		Total
	A	B	Group
P1	146	85	231
P2	145	86	231
P3	147	86	233
P4	147	87	234
P5	148	90	238
Total	733	434	1167
Average	146.6	86.8	233.4

Information :
A = Maggot feed treatment
B = Pellet feed treatment

The weight of *Clarias* sp. for each treatment A and B has a mean of 146.6 grams and 86.8 grams. The treatment with the highest average was treatment A (*Clarias* sp. using maggot feed) with an average of 146.6 grams and the lowest was treatment B (control) with an average of 86.8 grams.

The results of variance with feeding experiments with maggot on the weight of *Clarias* sp. showed an effect of treatment. The effect of treatment can be seen from the weight of *Clarias* sp. by providing maggot feed to help gain weight faster.

The results showed that feeding maggot Black Soldier Fly with different concentrations had a significant difference on the growth of *Clarias* sp. as a reference f table in this study with = 5%, dk1 = 1, and dk2 = 8 was 5, 32.

From the measurement results, it was found that the average length of *Clarias* sp. at the age of 3 months respectively FA and FB treatment was 24.6 cm, 18.4 grams. After performing the analysis requirements test in the form of normality and homogeneity tests, the FA sample (feeding maggot Black Soldier Fly) was normally distributed, the sample FB (feeding pellets) was normally distributed. In the homogeneity test the 2 samples were homogeneous. Then the sample is calculated to determine the statistical hypothesis with the one-way ANOVA test, obtained Fcount 53.4 and F table 5.32. Because F count is more than F Table, Ho is rejected, where there is an effect of feeding maggot Black Soldier Fly on the growth of *Clarias* sp.

The results showed that feeding Black Soldier Fly maggot with different concentrations had a significant difference in the growth of *Clarias* sp. as a reference for Ftable in this study with α = 5%, dk1 = 1, and dk2 = 8 was 5.32. . Maggot Black Soldier Fly contains high protein which functions to accelerate the growth of *Clarias* sp., so that the growth of *Clarias* sp., especially in the length of *Clarias* sp. can grow well.

The results showed that feeding maggot Black Soldier Fly with different concentrations had a significant difference in the weight of *Clarias* sp. as a reference ftable in this study with = 5%, dk1 = 1, and dk2 = 8 was 5, 32. From the measurement results, the average weight of *Clarias* sp. at the age of 3 months each FA and FB treatment was 146.6 grams and 86.8 grams. After performing the analysis requirements test in the form of normality and homogeneity tests, the FA sample feeding Black Soldier Fly was normally distributed, the FB sample (feeding pellets) was normally distributed. In the homogeneity test the two samples were homogeneous.

Then the sample was calculated to find out the statistical hypothesis with the one-way ANOVA test, obtained Fcount 3576.04 and F table 5.32 because F count is more than F table then Ho is rejected, where there is an effect of feeding maggot black soldier fly on the growth of *Clarias* sp. Maggot black soldier fly also affects the growth and weight of *Clarias* sp. because of its content.

The growth of carp fed with maggot feed from PKM media, market waste and fish waste shows better growth (Fahmi, 2015). Another study also tested quail (*Coturnix coturnix japonica*) by replacing fish meal with BSF meal, including doing several combinations of fish meal and BSF meal with different percentages (Widjastuti T, Wiradimadja R, 2014).

CONCLUSION

Based on the research I did, it was concluded that there was an effect of feeding maggot black soldier fly on *Clarias* sp. Cultivation which was strengthened from the results of statistical analysis, on feeding black soldier fly maggot. *Clarias* sp has an average length of 24.6 cm, *Clarias* sp. weight 146.6 grams. In feeding *Clarias* sp pellets, it has an average length of 18.4 cm, weight of *Clarias sp* is 86.8 grams. The results of one-way ANOVA calculations, on the growth of *Clarias* sp. with different feeding, the length of *Clarias* sp. can be Fcount (53.4), the weight of *Clarias* sp. is obtained Fcount (3576.04). While Ftable (5.32) it states that Fcount > Ftable on the length and weight of *Clarias* sp. So reject Ho and accept H1. This means that there is an effect of feeding Black Soldier Fly maggot on catfish. Giving Black Soldier Fly maggot feed shows better results than, pellet feeding can be seen from the length of the *Clarias* sp., and the weight of the catfish. Based on the results of the study, the implications of the research results of giving Black Soldier Fly maggot affect the growth of *Clarias* sp. Feeding maggot Black Soldier Fly in *Clarias* sp. farming can accelerate growth when compared to pellet feed. *Clarias* sp. fed with Black Soldier Fly maggot feed has better fish quality compared to *Clarias* sp. that are only given pellet feed.

REFERENCES

Azizy, Mohammad Qawarir. (2020). *Pengaruh Konsentrasi Maggot Hermetia Illucens Terhadap Pertambahan Berat Badan Ikan Lele Dumbo (Clarias Gariepinus) Sebagai Kajian Sumber Belajar Biologi.* Undergraduate (S1) Thesis, Universitas Muhammadiyah Malang.

Arie, Usni. (2009). *Panduan lengkap Benih Ikan konsumsi*. Jakarta : Penebar Swadaya.

Fahmi, M. R. (2015). *Optimalisasi proses biokonversi dengan menggunakan mini-larva Hermetia illucens untuk memenuhi kebutuhan pakan ikan*. (March 2015). https://doi.org/10.13057/psnmbi/m010124

Gunaria Siagian. (2020). Pengaruh Pemberian Larva Black Soldier Fly (*Hermetia Illucens*) Terhadap Pertumbuhan Ikan Lele Dumbo (*Clarias Gariepinus*). *International Journal of Natural Sciences and Engineering*. Volume : 4 Nomor : 2, pp 83-91 http://dx.doi.org/10.23887/ijnse.v4i2.29369

Hardini, Sri Yuniati Putri Koes. (2021). Budidaya Lele Menggunakan Pakan Tambahan Maggot. Malang : Ahlimedia Press.

Khairuman. (2009). *Buku pintar Budidaya 15 ikan konsumsi*. Jakarta : Agromedia Pustaka.

Mahyuddin. K. (2010). *Panduan Lengkap Agribisnis Lele*. Jakarta. Penebar Swadaya.

Nila, Yuli Tya. (2019). *Substitusi Fermentasi Tepung Maggot (Hermetia Illucens) Pada Pakan Komersial Terhadap Nilai Kecernaan Protein Dan Energi Ikan Bawal Air Tawar (Colossoma Macropomum). Skripsi Thesis, Universitas Airlangga.*

Senlin, Hong, Zhang, Tian, Zhou, & Haibo. (2016). *Influence of black soldier fly (Hermetia illucens) larvae oil on growth performance, body composition, tissue fatty acid composition and lipid deposition in juvenile Jian carp (Cyprinus carpio var. Jian)*. *Journal Aquaculture, 465*, 43-52. https://doi.org/https://doi.org/10.1016/j.aquaculture.2016.08.020.

Setiawan, Muhammad Nur. (2020). *Pemanfaatan Magot (Hermetia Illucens) Sebagai Pakan Alternatif Untuk Benih Ikan Gabus (Channa Striata) Yang Dikombinasikan Dengan Pakan Komersial.* Undergraduate Thesis, Sriwijaya University.

Sheppard DC, Tomberlin JK, Joyce JA, Kiser BC, Sumner SM. (2002). *Rearing methods for the Black Soldier Fly (Diptera: Stratiomyidae)*. J Med Entomol.

Sihombing, Roberto Mittun. (2018). *Efektivitas Penggunaan Maggot (Hermetia Illucens) Sebagai Pakan Terhadap Pertumbuhan Budidaya Ikan Lele Dumbo (Clarias Gariepinus Burchell)*. Skripsi(S1) Thesis, FKIP Universitas Pasundan.

Sugiyono. (2010). *Metode penelitian kuantitatif kualitatif dan R & D.* Bandung: Alfabeta.

Supardi. (2016). *Apliksi Statistik Dalam penelitian.* Jakarta : Ufuk Press.

Susanto, H. (2003). *Budidaya Ikan di Pekarangan*. Jakarta : Penebar Swadaya.

Tomberlin JK, Sheppard DC. (2002). *Factors influencing mating and oviposition of Black Soldier Flies (Diptera: Stratiomyidae)* in a colony. J Entolomogy Sci.

Tomberlin JK, Adler PH, Myers HM. (2009). *Development of the Black Soldier Fly* (Diptera: *Stratiomyidae*) in relation to temperature. Enviromental Entomol.

Widjastuti T, Wiradimadja R, R. D. (2014). *The effect of substitution of fish meal by Black Soldier Fly (Hermetia illucens) maggot meal in the diet on production performance of quail (Coturnix coturnix japonica)*. Retrieved from : http://animalsciencejournal.usamv.ro/index.php/scientific-papers/235-the-effect-of-substitution-of-fish-meal-by-black-soldier-fly-hermetia-illucens-maggot-meal-in-the-diet-on-production-performance-of-quail-coturnix-coturnix-japonica