Effect of Black Soldier Fly (BSF) Larvae to Market Biological Waste Management, Jombang Regency

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Abstract. Increasing population density makes people's consumption's higher too. This condition makes waste increases. The waste generated in Jombang Regency more than 417,838 m3 per day in 2010. The comparison between biological waste and non-biological waste produced is 61% and 39%. Respectively, that residents of Jombang Regency produce a lot of biological waste compared to non-biological waste. More than 50% biological waste comes from market waste. In general, biological waste can be processed into compost, animal feed and biogas. One alternative to other biological waste decomposition is using maggot Larvae from Black Soldier Fly (BSF) Larvae which can convert waste be a protein and fat, and reduce waste mass by 50% to 60% so that it can be used as a solution to reduce waste pollution. So, this study want to analyze the ability of Black Soldier Fly (BSF) Larvae to degrade market biological waste in Jombang. This study used an experimental quantitative research design. This research used biological waste with 8 different treatments and 3 times repetition and control group. The independent variable is amount of Black Soldier Fly (BSF) Larvae and heavy of biological waste, while the dependent variable is residual biological waste after giving BSF. Data analysis used one-way ANOVA test. The results found that there were differences residual biological waste using Black Soldier Fly (BSF) Larvae in any amount. Judging from the output of the one-way ANOVA statistical test in the Homogeneous Subsets table, the control column does not have an equation for the speed of decomposition from treatment 1 to treatment 8. According to this research, the best way to decompose biological waste is to use Black Soldier Fly (BSF) Larvae. It is recommended to the public to use Black Soldier Fly (BSF) Larvae in an effort to degrade market biological waste.

Keywords: Black Soldier Fly (BSF) larvae · market biological waste · degradation

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1 Introduction

Poor waste management is a serious environmental issues both in local and global levels. We need an effective and sustainable waste disposal system to manage it. Poor waste management is still a problem for people in urban and rural areas [1]. Growing human population has a contribution for increasing food and absolutely this condition be the accumulation of waste both organic and anbiological waste [2]. According to Law No. 18 of 2008 waste is the remains of all human activities in solid form. Waste can cause contaminants that will cause environmental pollution and can also have a direct influence on health, safety and living comfortly [3].

Based on data from the Ministry of Environment and Forestry in Indonesia, amount of waste is dominated by biological waste, which reaches 60% from all the waste. The second highest waste is plastic with approximately 14%, and then paper waste is about 9%, and the last is rubber waste about 5.5% [3]. Other waste consists of heavy metal, wood, glass, and the others. Biological waste that produced major by food waste from biotic waste like animal or product from plants like fruits, leaves, twigs, and the others. It should manage properly because biological waste can be a source of disease or pollution in our environment. Like flood, landslide, water pollution, and soil pollution [4].

Waste generated in Jombang Regency totally high approximately about 417,838 m3 per day in 2010. The comparison between biological waste and non-biological waste produced is 61% and 39%, respectively, the residents of Jombang Regency produces a lot of biological waste compared to non-biological waste. More than 50% biological waste comes from market waste, one of market place in Jombang Regency in Jombang Traditional Market.

Using microorganism like insects, is well known for solving problem linked with amount of biological wastes produced all over the world. It has progressively been employed in treating our environment by managed biological waste cheaper and easier [2]. In general, BSF or Black Soldier Fly Larvae is one of insect which can process biological waste into compost, animal feed, and biogas. Black Soldier Fly (BSF) larvae which can convert waste into protein and fat, and reduce waste mass by 50% to 60% so that it can be used as a solution to reduce waste pollution. Biological waste has low nutritional content, namely: Crude protein by 1–15% and crude fiber by 5–38%. However, this biological waste will be more valuable if it is used as feed through processing [4]. With this condition in mind, data reported on BSF larvae, and absolutely because of so many biological waste produced in Jombang traditional market make us to research about effect of BSF larvae in any amount to degradation biological waste [5].

2 Method

The current research using quantitative research with experimental study design. This research used to find the effect Black Soldier Fly (BSF) larvae macroorganisms to biological waste. We want to analyze differences in the residual of biological waste after eating by any amount of Black Soldier Fly (BSF) larvae. This research used 8 treatment with 3 times repetition and 1 control grup. Every single treatment used different amount of BSF and amount of biological waste. Treatment 1 using 200 BSF and 200 gr biological

waste, second treatment used 200 BSF and 250 gr biological waste, third used 200 BSF and 300 gr biological waste, treatment fourth used 200 BSF and 400 gr biological waste. And then for treatment fifth used 300 BSF and 200 gr biological waste, treatment sixth used 300 BSF and 250 gr biological waste, treatment seventh used 300 BSF and 300 gr biological waste, and the last used 300 BSF and 400 gr biological waste. We analyze about where is the best combination for BSF to degradate biological waste.

3 Results

3.1 Differences Speeding of Decomposition Biological Waste Using Black Soldier Fly (BSF) Larvae and Without Using Black Soldier Fly (BSF) Larvae

Based on Table 1, it shows that the control column does not show any reduction equation with treatment 1 to treatment 8. So it can be concluded that there is a difference in the reduction of biological waste decomposition using Black Soldier Fly (BSF) larvae. Based on Table 1 Treatment 6 with an average (0.9333) is a reduction using effective Black Soldier Fly (BSF) larvae. Due to the small amount of waste, BSF larvae are favored so that it does not require a long time for waste reduction.

3.2 Effect of Decomposition of Biological Waste Using Black Soldier Fly (BSF) Larvae Macroorganisms

Based on Table 2. ANOVA test results obtained a significance value (sig.) of 0.000 or $<$ 0.05. So it can be concluded that there is an effect of feeding on the rest of the feed and reducing the decomposition of biological waste.

Table 1. Homogeneous subsets test results differences in biological waste reduction

Treatment	N	Subset for alpha = 0.05				
		1	2	3	4	5
control	3	,1033				
BSF Larvae 200 + 400 g biological waste	3		,5000			
BSF Larvae 200 + 300 g biological waste	3		,6667	,6667		
BSF Larvae 300 + 400 g biological waste	3		,6833	,6833	,6833	
BSF Larvae 200 + 250 g biological waste	3			,7533	,7533	,7533
BSF Larvae 300 + 300 g biological waste	3				,8897	,8897
BSF Larvae 300 + 200 g biological waste	3				,8917	,8917
BSF Larvae 200 + 200 g biological waste	3					,9300
BSF Larvae 300 + 250 g biological waste	3					,9333
Sig.		1,000	,156	,896	,076	,171

Table 2. Analysis results of One Way Anova Test of Black Soldier Fly (BSF) larvae as an effort to decompose biological waste with the SPSS

		Sum of Squares	df	Mean Square	F	Sig.
Biological waste	Between Groups	137001.333	8	17125.167	437.032	.000
	Within groups	705.333	18	39.185		
	Total	137706.667	26			
Residual biological waste	Between Groups	1.740	8	.218	36.058	.000
	Within groups	.109	18	.006		
	Total	1.849	26			

4 Discussion

4.1 Differences in Speed of Degradation of Biological Waste Using BSF Larvae and Without Any Treatment

The results of the study concluded that there was a difference in the speed of degradation of biological waste using Black Soldier Fly (BSF) larvae and without any treatment. Judging from the results of the one-way ANOVA statistical test, it shows that the control column does not have an equation for the speed of degradation with treatment 1 to treatment 8 [5].

This is because the BSF larvae have a better decomposition ability than other organisms and microorganisms. In addition, BSF larvae store fat and protein reserves until they are sufficient for them to pupate into flies, then find a partner, mate, and lay eggs (for females) before finally dying. Therefore, this larval stage is the stage of high feed consumption so that it affects the speed of decomposition of biological waste. Meanwhile, the decomposition of biological waste without Black Soldier Fly (BSF) larvae or natural decomposition is influenced by temperature, pH, color, odor, texture and volume decrease so that it requires a long decomposition time, which is about 1 week - 1 month [6].

4.2 Effect of Degradation of Biological Waste Using BSF Larvae Macroorganisms

The results of the study concluded that there was an effect of decomposition of waste using BSF larvae macroorganisms. Judging from the results of the one-way ANOVA statistical test output in the ANOVA table, it shows a significance value (sig.) of 0.000 or < 0.05. So it can be concluded that there is an effect of feeding on the rest of the feed and the speed of degradation from biological waste.

This is because the small amount of feed causes the efficiency of the larvae in eating garbage or waste to be high. The more the amount of feed, the lower the efficiency of feed consumption. The small amount of waste is very favored by BSF larvae because it does not take a long time to finish it. In addition, the efficiency of large feed consumption can reduce the occurrence of waste decomposition which can result in high water content

for the given waste. The large amount of waste will make it difficult for larvae to reduce it [7, 8].

If the amount of given waste is higher, then the value of waste reduction tends to be low. This is because the larvae are no longer able to consume the feed given because the feed is too much, so the percentage value of the feed consumed to the total feed is lower.

5 Conclusion

There is a difference in the reduction of biological waste decomposition using Black Soldier Fly (BSF) larvae and without treatment. It shows that the control does not have a decomposition reduction equation compare with treatment 1 to treatment 8. There is different of amount of BSF larvae with reduction of the decomposition of biological waste. This condition happen because of the amount of waste given is higher, then the value of waste reduction tends to be low. This is because the larvae are no longer able to consume the feed given because the feed is too much, so the percentage value of the feed consumed to the total feed is lower. BSF larvae are an effective way to decompose biological waste.

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