

Conference Paper

Application of Composting Technology to Reduce Organic Waste by Utilizing Black Soldier Fly (*Hermetia illucens*) Larvae

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ABSTRACT

The larvae BSF (black soldier fly) can be used as an insect-based organic waste recycling technology. Not only for recycling organic waste, BSF larvae (black soldier fly) can also convert organic waste into a product in the form of compost. With so many waste problems, this technology is the most relevant way to deal with the problem. The purpose of this study was to examine the use of BSF (Black Soldier Fly) larvae in the composting process and to find out how much BSF (Black Soldier Fly) larvae were able to reduce organic waste. This study used an experimental method using 16 reactors containing 10000 larvae eggs in each reactor and using a variety of mixed waste. The variation used is the initial weight, in this study used an initial weight of 3 kg and 4 kg and treatment was carried out 2 times. The frequency of feeding was carried out every 3 days and then the weight reduction of the remaining waste in the reactor was measured after harvesting. The average percentage reduction in treatment 1 with an initial weight of 3 kg of waste is 18.25% while the initial weight of 4 kg of waste is 53.65%, different in treatment 2 the average percentage of waste reduction at an initial weight of 3 kg is 60.25% and at 4 kg by 30.25%. The results of the compost will be compared with the quality standard of SNI 19-7030-2004, the results of the study show that treatment variation 2 at the initial weight of 3 kg of waste is closest to the quality standard based on the value of pH, water content, C-organic, N-organic and C ratio /N.

Keywords: BSF larvae, organic waste, composting technology, organic waste reduction

Introduction

In the era of globalization and technological advances today, environmental problems are precisely the problem of waste which is now increasingly the center of attention, one of the causes of the increase in population and changes in people's consumption patterns which can cause waste generation every day to be even greater. One of them is the city of Surabaya has a very rapid growth rate. Waste is one of the complex problems faced by developing and developed countries in the world, including Indonesia. That way the current handling of waste must continue to be in the spotlight. One of them in the spotlight is organic waste which is difficult to recycle, organic waste usually comes from markets or households.

Meanwhile, minimizing the generation of organic waste is one of the best choices that people can do today. Minimizing organic waste can be done by composting. There are several alternative technologies for processing or reducing organic waste, one of which uses the help of Black Soldier Fly (BSF) larvae. The conversion of organic matter by Black Soldier Fly (BSF) larvae is a very attractive recycling technology and has economic potential (Diener, 2010). The Black Soldier Fly (BSF) species have been investigated to be able to degrade various kinds of household organic waste, such as fruit, vegetables, and food waste. According to Hogsette and Borzonyi (2000) this type of larvae can destroy organic substrates so that it can help the problem of waste that cannot

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be reduced in urban areas. The percentage of organic waste reduction value reaches 68% - 80%. Processing waste into compost is an effort that helps reduce the amount of waste that is thrown into the landfill. Compost is the final product in the waste reduction or degradation process carried out by Black Soldier Fly (BSF) larvae that come from food waste during the composting process (Monita et al.,2017). The relatively fast decomposition process of organic waste is one of the advantages of waste reduction technology using Black Soldier Fly (BSF) larvae. This is because Black Soldier Fly (BSF) larvae have great potential to replace a larger protein source. Meanwhile, the time used to make compost takes an average of 7 to 14 days. But it depends on the type of waste used to make compost. In its natural breeding, the BSF leaves the eggs on organic matter that the BSF matures up to. *Black Soldier Fly* perch in a place with a low sanitary level because it will a lot of organic matter is scattered there (Joseph & Philip, 2009)

Material and Methods

This research was conducted at TPS Jambangan Surabaya in April 2022 – May 2022. A product quality test (compost) was carried out at the Environmental Management Laboratory at ITS Surabaya. In the process of collecting organic waste, it is taken from the houses of residents around the Jambangan area which is then held at the Jambangan TPS. After sorting, then the counting process is carried out. Then prepare 16 reactors for waste degradation with Black Soldier Fly (BSF) larvae, after that prepare organic waste that has been chopped and put into the reactor with an initial weight variation of 3 kg and 4 kg, this study was carried out in 2 treatments. After 10 days and 12 days, after the organic waste is placed in the reactor, put the Black Soldier Fly larvae eggs in each reactor weighing 25 grams. From the decomposition process using Black Soldier Fly (BSF) larvae, it can be seen the percentage of waste reduction remaining in the reactor. The result of decomposition with Black Soldier Fly (BSF) larvae is in the form of compost, which will then be analyzed for the quality of the compost according to SNI 19-7030-2004.

Results and Discussion

This research was conducted using different variations in the initial weight of the waste and also treated 2 times. Then determine the percentage of waste reduction in the two treatments, which are then compared with the results of the waste reduction. With the initial weight variation of 3 kg in treatment 1, the harvest period was slowed, meaning that on the 10th day it could not be harvested, while in treatment 2 the harvest was accelerated. In the initial weight variation of 4 kg of waste in treatment 1, the harvest period was on schedule, namely on the 12th day, while in treatment 2 the harvest period was also on the schedule. The high percentage value of mixed organic waste reduction cannot be used as a benchmark for product quality in the form of compost, this is because the growth and development of larvae depend on optimal environmental conditions, so that waste reduction activities that have a very high value do not always support good growth for the community Black Soldier Fly (BSF) larvae.

Table 1. Comparison of the percentage of waste reduction in variations in the initial weight of waste

Reactor	Percentage of Household Waste Reduction (Mixed Waste)			
	Treatment 1 (%)		Treatment 2 (%)	
	*3 Kg	**4 Kg	*3kg	**4 Kg
Reactor 1	15	22,5	47	4
Reactor 2	10	55	60	25
Reactor 3	32	63	58	15
Reactor 4	12	66	72	37,5
Average	18,25	53,65	60,25	30,25

Source: Analysis Results, 2022

Information:

*Waste Variation 3kg day 10:

1. Treatment 1: With slowed harvest period, without feeding 3
2. Treatment 2: With accelerated harvest period, without feeding 3

**Waste Variation 4kg day 12:

1. Treatment 1: With the harvest period on schedule, without feeding 3
2. Treatment 2: With the harvest period on schedule, there are feeding 3

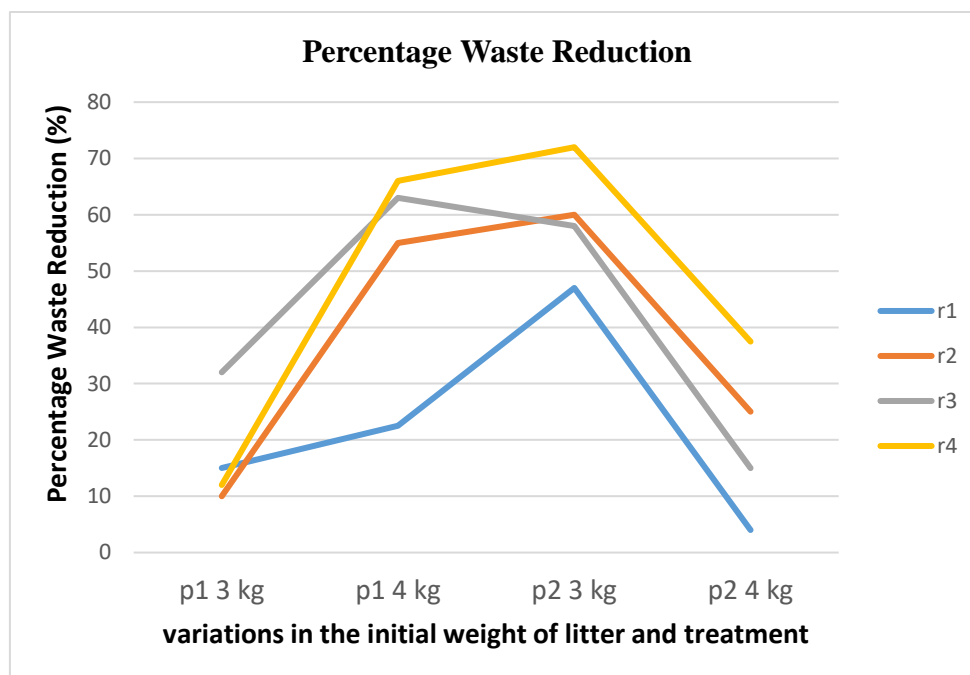


Figure 2. Comparison of waste reduction percentages on variations in the initial weight of litter and treatment

Figure 2. We can see that in the data there is an increase in the percentage of waste reduction in reactor 4 treatment 2 with variations in the initial weight of 3 kg of waste which reaches 72%. This was due to the accelerated harvest period and the absence of feeding frequency 3, so BSF larvae could reduce waste optimally or quickly. This percentage increase became the highest percentage level among all reactors. While in treatment 2 with a total weight variation of 4 kg has a low percentage value of 4% this is due to the frequency of feeding 3 this is due to the high water content. Giving feeding frequency 3 means giving more bait with the same weight as the starter bait, which is 4 kg, this is what causes the Black Soldier Fly larvae to not be able to reduce the amount of bait or waste given because the larvae portion has been reduced and the *Black Soldier Fly (BSF)* larvae will look for a place dry. The ability of BSF larvae to reduce waste has also decreased. In research with various types of vegetable and fruit waste, the waste reduction value reached 63.90%. Meanwhile, the lowest organic waste reduction was 18.87% (Yuwono & Mentari, 2018).

From the process of decomposition or degradation of organic waste carried out by BSF larvae, the final product in the form of compost has different physical qualities between all treatments and variations in initial weight. The parameters tested on the compost were water content, pH, c-organic, n-total and C/N ratio. The following are the results of product quality testing (compost) from the composting process using Black Soldier Fly (BSF) larvae:

Table 2. Comparison of compost quality results with SNI 19-7030-2004

No.	Parameters	*SNI 19-7030-2004	<i>Black Soldier Fly Larvae Compost</i>			
			P1(3 kg)	P1(4 kg)	P2(3 kg)	P2 (4 kg)
Physical Parameters						
1.	Color	Blackish	Fulfill	Fulfill	Fulfill	Fulfill
2.	Odor	Earthy Smell	Fulfill	Fulfill	Fulfill	Fulfill
3.	Moisture Content	50 %	26,81%	17,50%	15,62%	20,32%
4.	pH	6,80 – 7,49	7,65	7,10	7,05	7,45
Chemical Parameters						
5.	C-organic	9,80 – 32 %	38,70%	40,72%	38,76%	42,67%
6.	N-Total	Min 0,40 %	3,75%	3,57%	4,86%	4,86%
7.	C/N Ratio	10 – 20%	10,33%	11,41%	7,97%	8,79%

Source: Laboratory Test, 2022

It can be seen in the composting using BSF (Black Soldier Fly) larvae on the physical parameters of all treatment variations for the color and odor parameters that have met the quality standards, then the water content and pH parameters in all treatments have also met the quality standards, nothing has changed. exceeds the quality standard. The water content parameter has a yield of 26.81%; 17.50%; 15.62%; 20.32% which have met the quality standard of SNI 19-7030-2004 and other parameters. But the most satisfying is in treatment 2 with an initial weight variation of 3 kg. According to Lu et al. (2009), the water content and organic carbon have an inverse relationship, where the water content increases, then the organic carbon content will decrease.

Conclusion

Based on the results of the study, it can be concluded that using BSF larvae as an alternative technology to help reduce organic waste in the area is very appropriate. This is because BSF larvae can degrade organic waste up to 72%. And also the results of the compost are very good, and the maturity of the compost is also very precise.

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