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# Application of Black Water From Vegetable Waste with Decomposer In Blotong-Based Planting Media on The Growth and Yield of Water Spinach

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ABSTRACT

Many vegetable wastes are not utilized, causing many problems. Vegetable waste can be used as organic fertilizer such as black water. Black water from vegetable waste is used as fertilizer to increase the growth and yield of kale. Making black water using decomposers in the form of Lumbricus sp and EM4 worms to help the decomposition process. Blotong compost planting media as an additional material for soil improvement to support the availability of nutrients in plants . This research used the addition of EM4 decomposer, rumen MOL, and *Trichoderma sp*. This research was carried out from August to November 2022 at the Greenhouse Agroteknopark, Jember University and analytical testing at the Soil Physics and Chemistry Laboratory of the Sukosari Research Center. This research used a two-factor factorial with a completely randomized basic design (CRD) consisting of 2 factors and 3 replications, so there were 27 experimental units . The data obtained will be analyzed using variance testing with the F test carried out in order to determine the effect of the treatment in this research. Data processing uses IBM SPSS Statistics 20 software. The interaction between the application of black water decomposer and filter cake planting media did not have a significant effect on all observed variables. Likewise, the single factor of applying black water does not have a real influence on all observed variables. The single factor of treatment using filter cake growing media had a significant influence on all observed variables. The best treatment for M3 is with a composition ratio of 20% filter cake planting media: 80% soil.

## INTRODUCTION

According to Minister of Agriculture Regulation No.2/Pert./HK.060/2/2006, organic fertilizer in question is fertilizer that consists mostly or entirely of organic material derived from plant or animal remains that have undergone engineering in solid or liquid form. used to supply organic material, improve the physical, chemical and biological properties of soil (Directorate of Production Facilities, 2006). Organic fertilizer is safer to use and does not contain toxic residual *substances* . Using organic fertilizer is more recommended than using synthetic chemical fertilizer and is more optimal if used simultaneously. The role of liquid organic fertilizer can be used as the main fertilizer, but it requires a lot of ingredients so it is often used as a complementary ingredient to the use of synthetic chemical fertilizers (Rasmito et al., 2019). Fertilizer is usually applied to the soil and can also be applied by spraying it onto the leaves. Spraying fertilizer on leaves can increase the efficiency of fertilizer use. Another advantage of using fertilizer through leaves is that the nutrient content is complete, consisting of macro nutrients and micro nutrients (Lintang et al., 2015). According to Manis et al (2017), the use of liquid organic fertilizer has many advantages, including being able to provide nutrients to plants more quickly, the availability of useful microorganisms, minimal problems with leaching of nutrients and the application being easier and more quickly absorbed by plants.

Liquid organic fertilizer is a solution resulting from the decomposition of organic materials originating from plant residues, animal and human waste which contains more than one nutrient element. The advantages of liquid organic fertilizer are that it can quickly overcome nutrient deficiencies, has no problems in leaching nutrients, and is able to provide nutrients quickly. The use of liquid organic fertilizer generally does not damage the soil and plants even if used as often as possible (Mahyuddin et al., 2019). Liquid organic fertilizer provides several advantages, for example this fertilizer can be used in solid planting media by pouring it on the roots or spraying it on parts of the plant body. Applying fertilizer to plants by spraying the leaves has proven to be more effective than treatment by watering the planting medium (Marjenah et al., 2017).

Black water is classified as liquid waste from industrial, fishery, agricultural, domestic and human waste. The majority of *black water* encountered comes from industrial waste and human waste, both feces and urine. This waste is known as *black water* or *gray water* because the waste is classified based on the color and turbidity of the waste water. According to Yazid et al (2012), *black water* is a type of waste water that comes from toilets and generally uses *a septic tank* as a container, while *gray water* is a type of waste water that comes from domestic waste that is not mixed with toilet waste, such as bathing and washing activities which are disposed of directly through public waters or drainage channels (sewers) (Qomariyah et al., 2016). Black water waste processing from human waste can be used as fertilizer in several countries, one of which is China which uses it as fertilizer in plant cultivation and biogas with the condition that the waste processing must be carried out separately based on Raditaningrum (2017), because the difference in feces and urine content can be used as fertilizer. In practice, cultivating these plants also functions to increase nutrients in the soil (Skjelhaugen, 1999). The

use of human urine waste has been carried out in the practice of planting Jatropha curcas, namely by processing it into organic fertilizer (Sundari et al., 2014). The main ingredient in good liquid fertilizer from organic waste is wet organic material or organic material that has a high water content, such as fruit or vegetable remains. This material is rich in nutrients that plants need. The greater the cellulose content of organic material, the longer the bacterial decomposition process will take. The length of the organic material decomposition process can be shortened by using bioactivators such as EM4 to speed up the process of making liquid organic fertilizer (Nur et al., 2016). EM4 or *effective microorganisms* are various types of bacteria that are beneficial and act as starters in breaking down organic materials. The use of EM4 in the fermentation process requires food so that the bacteria in the composter or fermenter container remain alive (Hadisuwito, 2012). The objective of the research was to determine effect of Black water from vegetable waste on the growth and yield of water spinach.

## METHODS

### Materials and Tools

The materials used in research activities are vegetable waste (green vegetables, namely white cabbage leaves and green mustard greens), *lumbricus sp worms* , sausage seedling media, Bangkok LP-1 water spinach seeds (red arrow stamp trademark), sugarcane filter cake compost (Blotong), alluvial soil, raw water, EM4, brown sugar and other supporting ingredients. The tools needed for research are hoses, bricks, *hands sprayer* , jerry can, plastic tub, bucket, clear plastic, scales, thermometer, poly bag measuring 25 x 25 cm, ruler, rice sack, raffia rope, knife, scissors, used mineral water bottles, measuring cup, spatula, cloth, stationery, cellphone cameras and other supporting equipment needed during research activities.

### Preparation of Equipment and Planting Media

The materials prepared include seedling media in the form of sausage seedling media, while the planting media is alluvial soil and composted sugar cane cake. The ratio of planting media used for filter cake compost to alluvial soil includes 0%:100%, 10%:90% and 20%:80%. The soil used in carrying out the research was alluvial soil purchased in Sukowono which was then analyzed for its nutrient content. Sugar cane cakes from the PG Semboro sugar factory, Jember Regency, which had been composted, were also analyzed before being used as a growing medium for kale plants. The polybag used measures 25 x 25 cm or 1 kg plastic which usually contains planting media weighing approximately 2.5 to 3 kg.

### Collecting Data and Analysis

This research used a two-factor factorial with a completely randomized basic design (CRD) consisting of 2 factors and 3 replications, so there were 27 experimental units. The data obtained will be analyzed using variance testing with the F test carried out in order to determine the effect of the treatment in this research. Data processing uses IBM SPSS Statistics 20 *software* ,

if: (i) The P-value is > α (0.05), so the treatment has no real influence on the criteria for length, fresh weight , dry weight and number of leaves; (ii) P-value < α (0.05), then the treatment has a significant effect on the criteria for length, fresh weight , dry weight and number of leaves. Then proceed with *the Duncan's Multiple Range Test.*

## RESULTS AND DISCUSSIONS

### Results of Sugarcane Blotong Compost Analysis

Based on the statement of Sudomo and Santoso (2011), plant growth is greatly influenced by the growing media. The planting medium used in this research was a mixture of sugar cane filter cake compost and alluvial soil. The use of media in the form of a mixture of sugar cane filter cake compost and alluvial soil is expected to add nutrients so that it can support plant growth and yield. The following are the results of elemental analysis of the sugarcane filter cake compost used in this research.

Table 1. Results of analysis of sugarcane filter cake compost

| Elemental Analysis | Results | Unit | Blotong Compost Standard |
|---|---|---|---|
| N | 1.20 | % | 2 – 6 |
| $P_2O_5$ | 2.37 | % | 2 – 6 |
| $K_2O$ | 1.88 | % | 2 – 6 |
| C Organic | 31.89 | % | Min 10 |
| C/N Ratio | 26.6 | - | 25 |

The results of the analysis of sugar cane filter cake compost in table 1 show that the sugar cane filter cake compost sample contains 1.20% N, 2.37 % $P_2O_5$ , 1.88% $K_2O$, 31.89% Organic C and 31.89% C/ N Ratio is 26.6. Based on the results of the analysis of sugarcane filter cake compost which is used as a planting medium mixed with alluvial soil, the content of sugarcane cake cakes that have been composted is quite good and meets the standards of Minister of Agriculture Regulation 261/KPTS/SR.310/M/2019 for the content of N, $P_2O_5$ and $K_2O$.

### Black Water Analysis Results from Vegetables

Analysis of black water or liquid organic fertilizer carried out at PT. Perkebunan Nusantara The results of the analysis of black water without the addition of decomposer (B0) after the fermentation process for approximately 21 days showed an N content of 0.47%, $P_2O_5$ of 0.84%, $K_2O$ of 0.68%, C-Organic of 5.50%, pH of 5.85 and C/N Ratio of 11.7. The results of black water with the addition of EM4 with an N content of 0.68%, $P_2O_5$ of 0.68%, $K_2O$ of 0.51%, C-Organic of 5.00%, pH of 5.91 and C /N Ratio 8.1. The results of black water analysis with a worm decomposer showed an N content of 0.61 %, $P_2O_5$ 0.97%, $K_2O$ 0.74%, C-Organic 5.00%, pH 6.47 and C/N Ratio 8.2.

Based on the results of the analysis of the nutrient content of black water categories B0 and B1, it does not meet the minimum technical standards for organic fertilizer, while the pH already meets the standards. The nutrient content and pH in black water with the addition of worm decomposer have met the minimum technical requirements for organic fertilizer. The following is a table of the results of the nutrient analysis that has been carried out:

Table 2. Results of Analysis of Vegetable Black Water Content

| Elemental Analysis | Results | | | POC standard |
|---|---|---|---|---|
| | BW 0 | BW 1 (EM4) | BW 2 (Worm) | |
| $N + P_2O_5 + K_2O$ (%) | 1.99 | 1.87 | 2.32 | 2 – 6 |
| pH | 5.85 | 5.91 | 6.47 | 4 – 9 |
| C Organic (%) | 5.50 | 5.50 | 5.00 | Minimum 10 |
| C/N Ratio | 11.7 | 8.1 | 8.2 | - |

Note: The POC standard value is based on the minimum technical requirements for organic and soil amendments, Minister of Agriculture Decree 261/KPTS/SR.310/M/4/2019.

**Application of Black Water to Plants**

The procedure for applying *black water* to kale plants follows the procedure for applying POC to plants, namely by spraying the underside of the leaves. Application of *black water* to kale plants has no real effect. Based on data that has been analyzed using variance analysis to determine the effect of the application of *black water* and sugar cane cake media on the growth and yield of water spinach plants on all observation variables, it is presented in the following table:

Table 3. Recapitulation of the results of variance analysis of the effect of using black water decomposer with the use of filter cake planting media on the growth and yield of water spinach

| Parameter | Treatment | | |
|---|---|---|---|
| | *Black Water* | Growing media | Black *Water* |
| Plant Length | 0.6262 $^{ns}$ | 0.0002 $^{*}$ | 0.7981 $^{ns}$ |
| Gross weight | 0.4172 $^{ns}$ | 0.0047 $^{*}$ | 0.8564 $^{ns}$ |
| Dry Weight | 0.5267 $^{ns}$ | 0.0102 $^{*}$ | 0.4564 $^{ns}$ |
| Number of Leaves | 0.7919 $^{ns}$ | 0.0003 $^{*}$ | 0.4501 $^{ns}$ |

Note: The numbers in the table are significant values. * = real treatment at 95% confidence interval with a significant value ( *P-value* ) < 0.05 (α); tn = treatment has no significant effect at the 95% confidence interval with a significant value ( *P-value* ) > 0.05 (α)

Based on the variance results in Table 3, it can be seen that the treatment of composted sugar cane filter cake-based planting media had a real influence on the observed variables of plant length, fresh weight, dry weight and number of leaves at a 95% confidence interval. Meanwhile, the use of *black water decomposer* or the interaction *of black water* with the planting medium did not have a significant effect on the parameters of plant length, fresh weight, dry weight, and number of leaves at the 95% confidence interval.

Growth analysis is needed to measure plant growth without disturbing the plant being measured. The growth and yield of kale plants were observed using four parameters. The growth parameters observed were plant height, plant fresh weight, dry weight, and number of leaves. Analysis of plant dry matter is one of the parameters that is often measured because dry matter is the result of almost all metabolic processes that occur in plants. According to Alsabah *et al*.(2014), this parameter is the most representative indicator to determine the overall performance of the plant.

**Plant Height**

Based on the results of variance analysis (Table 3), it shows that the use of *black water decomposer* and the interaction of the use of *black water* with the planting medium did not have a real effect on the long growth of water spinach plants with a 95% confidence interval. However, the use of planting media can have a real influence on the length of water spinach plants with a confidence interval of 95%. The results of Duncan's test on the effect of using planting media on the length growth of kale plants can be seen in Table 4.

Table 4. Results of Duncan's test on the effect of using planting media on water spinach plant height

| Treatment | Plant Height (cm) | % Change |
|---|---|---|
| M3 | 78.67a | +103.18 |
| M2 | 62.39b | +61.13 |
| M1 | 38.72c | 0.00 |

Based on the results of the Duncan test in Table 4, it shows that the M3 treatment (giving planting media with the composition *Blotong* 20%: *Alluvial* 80%) gave the highest response to the growth of the length of the kale plants (Figure 4.1) with an average height growth of 78.7 cm and percentage change against control +103.18%. This treatment was significantly different from treatment M2 (giving planting media with the composition *Blotong* 10% : *Alluvial* 90%) with an average growth in plant length of 62.4 cm and M1 (giving planting media with the composition *Blotong* 0% : *Alluvial* 100%) as a control with The lowest average height growth was 38.7 cm. Therefore, to get good long growth results for water spinach plants, a comparative composition of 20% filter cake media with 80% *alluvial soil media can be given.*

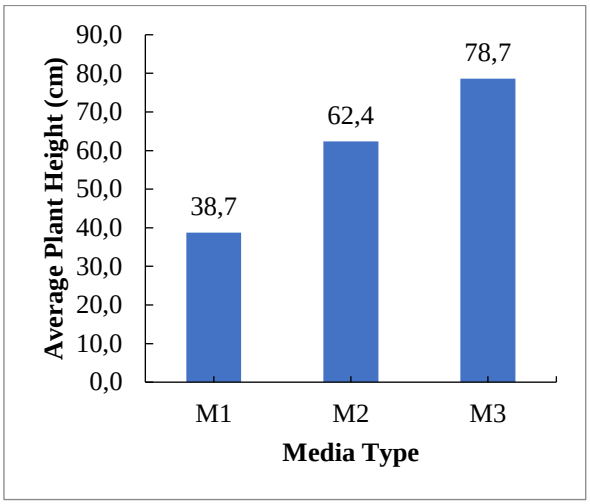


Figure 1. The effect of sugarcane filter cake planting media and alluvial soil on the height of water spinach plants

**Fresh Weight**

Based on the results of the Duncan test in table 5, it shows that the M3 treatment (giving planting media with a composition of 20% sugar cane filter cake and 80% soil) gives the best fresh weight results. with an average fresh plant weight of 36.56 grams or providing changes to M1 (giving 100% soil composition) of +71.40%, but the M3 treatment was not significantly different from the M2 treatment (giving planting media with a composition of 10% sugar cane filter cake and soil 80%). This indicates that through the use of planting media with a composition of 10% and 80% soil, the growth and yield of water spinach plants is quite good and provides changes to M1 (giving the composition of 0% filter cake compost: 100% soil) by +49.51%. The lowest results for plant fresh weight parameters were found in treatment M1 (giving 100% soil composition) with plant fresh weight results of only 21.33 grams.

Table 5. Duncan's test results on the effect of using planting media on the fresh weight of kale plants

| Treatment | Plant Fresh Weight | % Change |
|---|---|---|
| M3 | 36.56a | +71.40 |
| M2 | 31.89a | +49.51 |
| M1 | 21.33b | 0.00 |

**Dry Weight**

Based on the results of the Duncan test in table 5, it shows that the M3 treatment (giving planting media with a composition of 20% sugar cane filter cake and 80% soil) gives the best dry weight results. with an average plant dry weight of 3.22 grams or providing a change in M1 (giving 100% soil composition) of +49.07%. Treatment M2 (10% filter cake compost composition: 90% soil) was not significantly different from treatment M1 (100% soil

composition), there was only a slight difference. Treatment M2 had an average dry weight of 2.27 grams and treatment M1 had an average dry weight of 2.16 grams, while the change in treatment M2 to treatment M1 was only +5.09%.

Table 6. Duncan's test results on the effect of using planting media on the dry weight of kale plants

| Treatment | Plant Dry Weight | % Change |
|---|---|---|
| M3 | 3.22a | +49.07 |
| M2 | 2.27b | +5.09 |
| M1 | 2.16b | 0.00 |

**Number of Leaves**

Table 7. Results of Duncan's test on the effect of using planting media on the number of leaves of kale plants

| Treatment | Number of Plant Leaves | % Change |
|---|---|---|
| M3 | 25.22a | +35.88 |
| M2 | 20.44b | +10.13 |
| M1 | 18.56b | 0.00 |

Based on the results of the Duncan test in Table 7, it shows that the M3 treatment (giving planting media with a composition of *Blotong* 20%: *Alluvial soil* 80%) gave the highest response to the growth of the number of leaves of kale plants with an average growth in the number of leaves of 25.22 pieces and the percentage change in control +35.88%. This treatment was significantly different from treatment M2 (giving planting media with a composition of 10% *Blotong* compost : 90% *Alluvial soil* ) with an average number of leaves of 20.44 and M1 (giving planting media with a composition of 0% *Blotong compost :* 100% *Alluvial* soil ) as a control with the lowest average growth in the number of leaves of 18.56 pieces. Therefore, to get good results in the number of leaves of kale plants, you can give a comparative composition of 20% filter cake compost media with 80% *alluvial soil media* .

Based on the results of research that has been carried out, there is no interaction between the use of planting media and the application of black water. The single factor that influences all observed variables is the use of sugarcane filter cake compost planting media with alluvial soil. The influencing factor of the use of planting media is in accordance with the analysis results in table 1. because the nutrient content, especially in sugarcane cake cake compost, is in accordance with the Ministry of Agriculture standards, namely with a total N, P and K content of 5.45. The single factor of the planting medium that had the most influence on the M3 treatment ( 20% sugarcane filter cake compost composition: 80% alluvia soil) included the variables of plant height, fresh weight, dry weight and number of leaves of the kale plants. The black water usage factor has no real effect on all observation variables based on table (3) of

variance results but shows different results if seen from figure 2 of the black water single factor bar diagram.

The use of black water did not have a significant effect on all observed variables because based on laboratory results the nutrient content was classified as not meeting POC standards. The lack of nutrients available to plants during the vegetative period of kale plants causes metabolic processes to be disrupted during their growth period because the application of black water is carried out on the underside of the plant leaves. This is different from sugar cane filter cake compost planting media, which is based on nutrient needs in the root area. The nutrient content in sugarcane filter cake compost is higher and in accordance with the Ministry of Agriculture's standards so that it can help in the photosynthesis process, supporting the growth of plant roots, stems and leaves (Shobayar et al., 2018).

Based on figure 2, the bar diagram related to the application of black water with the best treatment is in treatment B1 (using EM4 as a decomposer) for the variables of plant height, fresh weight and dry weight, while the best treatment for number of leaves is in B2 (using *Lumbricus sp worms* as a decomposer ). Based on the results of the single factor in figure 2 which influences the treatment using EM4 (B1) with an average plant height of 64.1 cm. The lowest results for the single factor black water were in the treatment without the addition of decomposer (B0) with an average plant height of 57.1 cm. Black water has no real effect based on table 3 of the variance results and in accordance with table (4.2) of the analysis results of the nutrient content N, P and K because it does not meet the minimum POC standard, namely less than 2%. Based on table 2, the results of the analysis of black water content are in accordance with the minimum POC standards, namely in the treatment using *Lumbricus sp worms* as a decomposer (B2) with a total content of N, P and K elements of 2.32%.

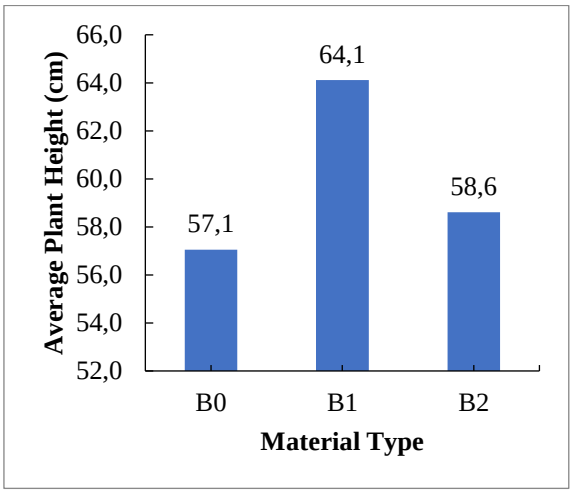


Figure 2. The influence of a single factor of blackwater on the height of water spinach plants

Based on the results of research conducted on water spinach plant height, there were differences in the treatment of filter cake planting media, especially in the M3 treatment (20 % rice cake: 80% soil) and the M1 treatment (100% soil). Based on the treatment that has been

carried out, the high content of filter cake with a composition percentage of 20% can increase the growth of all observed variables such as plant height, fresh weight , dry weight and number of leaves. The results of fresh weight at the time of observation and harvest decreased due to leaf fall during the harvesting process, in this case a technical error in harvesting activities. This affects the dry weight of the plant.

The growth of kale plants is hampered due to exposure to disease. White rust disease that attacks kale plants is characterized by white spots on the two plants that are attacked (Mulana, 2018). The factor that causes white rust disease is the fungus *Albugo Ipomoe panduratae* and also the humidity of the media and growing environment. Planting kale during the rainy season is the cause of the rapid spread of white rust disease. Control of white rust disease is carried out using the trademark fungicide Dithane. Dilution of dithane fungicide in a ratio of 5 grams of dithane powder to 1000 ml water. spraying is carried out once a day in the morning for three days (Muzuna et al., 2021).

## CONCLUSION

1. The interaction between the application of black water decomposer and filter cake planting media did not have a significant effect on all observed variables . Likewise, the single factor of applying black water does not have a real influence on all observed variables .
2. The single factor of treatment using filter cake growing media had a significant influence on all observed variables. The best treatment for M3 is with a composition ratio of 20% filter cake planting media : 80% soil.

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