

The Effect of Local Microorganism (MOL) Concentration of Banana Hump and Fruit Waste on the Growth and Yield of Broccoli Plants (*Brassica oleracea*)

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Abstract—Local Microorganisms (MOL) are fermented liquids made from natural ingredients that contain microorganisms that have the potential to transform organic matter, stimulate growth, control pests and plant diseases. Broccoli includes horticultural plants which are a source of vitamins A, B complex, C, calcium, iron and essential minerals for the fulfillment of human nutrition and contain substances that can prevent cancer. In Indonesia the demand for broccoli vegetables increases by 15-20% every year, it is not comparable to the production produced. The purpose of the study was to examine the effect of microorganism local concentrations of banana hump waste and fruit waste on the growth and yield of broccoli plant. The study was conducted in the laboratory and experimental garden of the Faculty of Agriculture and Animal Science, University of Muhammadiyah Malang. Research is a factorial experiment that is arranged randomly block design. The first factors: kind of local microorganism waste (banana hump waste and fruit waste). The second factor: concentration of local microorganisms (50 ml / l; 100 ml / l, and 150 ml / l), each treatments repeated 4 times. Data were analyzed using variance analysis, 5% real different type test. The results showed that the local microorganism (MOL) had significant effect on the observation variable of flower diameter and wet weight of the flower. Local microorganism made from fruit waste is better and significantly different compared to banana hump waste

Keywords—Banana, fruit, hump, local microorganism, waste.

I. INTRODUCTION

Public awareness of the importance of consuming broccoli (*Brassica oleracea*) vegetables, resulting in increased demand for broccoli. Broccoli (*Brassica oleracea*) is the most popular vegetable because it is a source of essential nutrients, vitamins and minerals needed by the body [1]. Broccoli is a horticultural plant which is a source of vitamins A, B complex, C, calcium, iron and essential minerals for the fulfillment of human nutrition and contains substances that can prevent cancer cells [2]. The increasing public awareness of the importance of consuming vegetables in this case broccoli, making the demand for broccoli is increasing as well [3]. Local microorganisms (MOL) are fermented liquids made from natural ingredients that contain microorganisms that have the potential to transform organic matter, growth stimulants, and pest and plant disease control agents so that they are well used as decomposers, biological fertilizers and organic pesticides [4]; [5];[6]. Waste is a source of environmental pollution,

but if it is recycled it can be an organic fertilizer that is beneficial for plant growth [7].

The purpose of the study was to examine the effect of microorganism local concentrations of banana hump waste and fruit waste on the growth and yield of broccoli plant.

II. METHODS

The study was conducted in integrated laboratory of Agriculture-Animal Science Faculty in University of Muhammadiyah Malang, on January 2018 - April 2018. The study was a factorial experiment that was arranged randomly block design, the first factor was local microorganism material : banana hump waste (P1) and fruit waste (P2), the second factor was local microorganism concentration : 50 ml/l (K1) , 100 ml/l (K2) , dan 150 ml/l (K3), each treatment combination contained 4 sample plants and repeated 4 times. Local microorganisms are made from banana hump waste and fruit waste, there were after being cleaned and washed with water then chopped and mixed with rice washing water (*leri*) and molasses with a size of 1000 grams (banana hump waste or fruit waste) + 5 liters of rice washing water (*leri*). All ingredients mixed in the bucket are then fermented for 21 days. Broccoli seeds are sown to grow 3-4 leaves or age 30 days, then transplanted into the field with a spacing of 50 cm x 50 cm and the soil surface covered with straw mulch. Local microorganisms are applied every 2 weeks. Microbial density calculation is done using the pour plate method. Observation of growth variables was done 2 weeks after the application of local microorganism for variables: number of leaves, plant height, stem diameter, flower diameter, wet weight and dry weight of plants.

III. RESULTS AND DISCUSSION

Plant Height

The results of the variance analysis showed that there was no interaction between material of local microorganism (MOL) treatment and MOL concentration treatment on broccoli plant height. Banana hump MOL and fruit waste MOL not significant differences to plant height (Figure 1 A), MOL concentration 100 ml/l is better for plant height compared to MOL concentrations of 50 ml / l and 150 ml / l (Figure 1 B)



Figure 1. Effect of MOL Concentrations of Banana Humps and Fruit Waste on the Height of Broccoli Plants at Every Age of Observation
A. Effect of MOL (Banana Hump and Fruit Waste) on Broccoli Plant Height
B. Effect of MOL Concentration on Broccoli Plant Height

In Figure 1 above, it appears that the treatment of the kind of waste (banana hump and fruit waste) was show differences in the plant height variables of broccoli plants at each age of observation (Figure 1A), while the better concentration treatment on the plant height variable of broccoli plants is a concentration of 100 ml / l (Figure 1B).

Number of Leaves

The results of the variance analysis showed that there was no interaction between local microorganism (MOL) material treatment and MOL concentration treatment on broccoli leaves number. MOL made from banana hump waste and fruit waste was not significant differences to broccoli leaves number (Figure 2 A), MOL concentration 100 ml/l is better to broccoli leaves number compared to MOL concentrations of 50 ml / l and 150 ml / l (Figure 2 B)

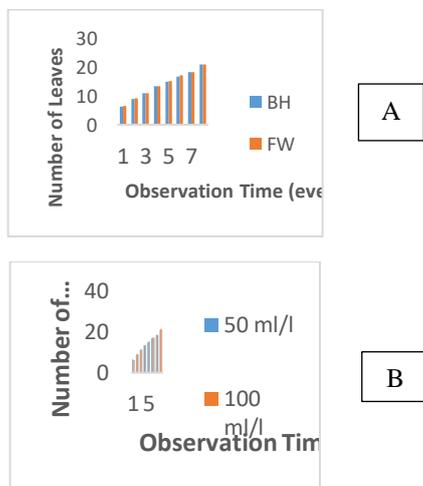


Figure 2. Effect of MOL Concentrations of Banana Humps and Fruit Waste on Broccoli Leaves Number at Every Age of Observation
A. Effect of MOL (Banana Hump and Fruit Waste) on Broccoli Leaves Number
B. Effect of MOL Concentration on Broccoli Leaves Number

In Figure 2, it appears that the treatment of the kind of waste (banana hump and fruit waste) does not show differences in the leaves number variables of broccoli plants at each age of observation (Figure 2A). In MOL concentration treatment did not show differences to the leaves number in the first observation until the third observation, then in the fourth observation shows the better

concentration treatment on the leaves number variable of broccoli plants is a concentration of 100 ml / l (Figure 2B).

Stem Diameter

The results of the variance analysis showed that there was no interaction between local microorganism (MOL) material treatment and MOL concentration treatment on broccoli stem diameter. MOL made from banana hump and fruit waste MOL not significant differences to broccoli stem diameter. (Figure 3 A), MOL concentration 100 ml/l is better to stem diameter compared to MOL concentrations of 50 ml / l and 150 ml / l (Figure 3 B)

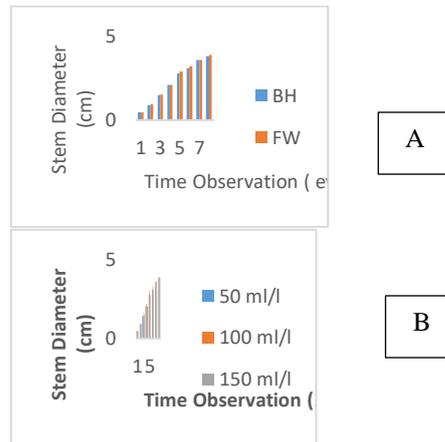


Figure 3. Effect of MOL Concentrations of Banana Humps and Fruit Waste on Broccoli Stem Diameter at Every Age of Observation
A. Effect of MOL (Banana Hump and Fruit Waste) on Broccoli Stem Diameter
B. Effect of MOL Concentration on Broccoli Stem Diameter

In Figure 3 above, it appears that the treatment of the type of waste (banana hump and fruit waste) does not show differences in the stem diameter variables of broccoli plants at each age of observation (Figure 3A). In MOL concentration treatment did not show differences to stem diameter in the first observation and the second observation, then in the third observation until sixth observation shows the better concentration treatment on the stem diameter variable of broccoli plants was 100 ml / l (Figure 3B).

Flower Diameter

The results of the variance analysis showed that there was no interaction between local microorganism (MOL) material treatment and MOL concentration treatment on broccoli flower diameter. MOL made from banana hump and fruit waste were not significant differences to broccoli flower diameter. (Figure 4 A), MOL concentration 100 ml/l is better for plant height compared to MOL concentrations of 50 ml / l and 150 ml / l (Figure 4 B)

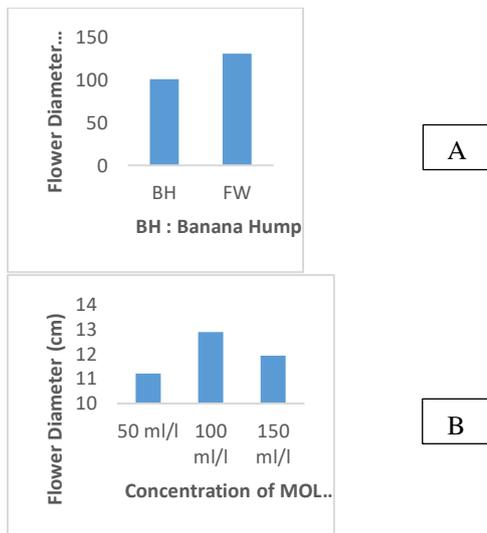


Figure 4. Effect of MOL Concentrations of Banana Humps and Fruit Waste on Broccoli Flower Diameter at Every Age of Observation

- A. Effect of MOL (Banana Hump and Fruit Waste) on Broccoli Flower Diameter
- B. Effect of MOL Concentration on Broccoli Flower Diameter

In Figure 4 above it appears that MOL from fruit waste is better for broccoli flower formation, which is indicated by a larger flower diameter compared to MOL treatment of banana hump waste (Figure 4A), while the better MOL concentration treatment for broccoli flower formation is 100 ml / l (Figure 4A).

Wet Weight of Flowers, Wet Weight of Plants, Dry Weight of Plants

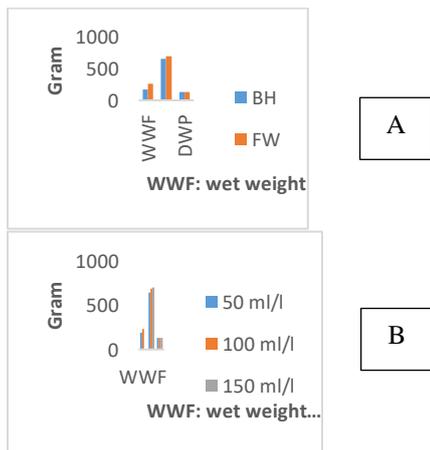


Figure 5. Effect of MOL Concentrations of Banana Humps and Fruit Waste on Wet Weight of Flowers, Wet Weight of Plants, Dry Weight of Plants

- A. Effect of MOL (Banana Hump and Fruit Waste) on Wet Weight of Flowers, Wet Weight of Plants, Dry Weight of Plants
- B. Effect of MOL Concentration on Wet Weight of Flowers, Wet Weight of Plants, Dry Weight of Plants.

The results of the variance analysis showed that there was no interaction between local microorganism (MOL) material

treatment and MOL concentration treatment on wet weight of flowers, wet weight of plants, and dry weight of plants. MOL made from banana hump and fruit waste was not significant differences to dry weight of plants, as while as MOL made from fruit waste is better for the wet weight of broccoli flowers and the wet weight of plants than MOL made from banana hump (Figure 5A). MOL concentration of 100 ml / l was better for wet weight of flowers, concentration of 150 ml / l was better for wet weight of plants, each concentration treatment was not significant for dry weight of plants. (Figure 5B).

In Figure 5 it appears that MOL made from fruit waste shows the better for wet weight of the flower and the wet weight of the plant than MOL made from banana hump waste, while the dry weight of plants, MOL made from fruit waste does not difference compared to MOL made from banana hump waste (Figure 5A). The treatment of MOL concentrations did not show differences to the wet weight plant and dry weight of plants variables, but showed difference in the wet weight of flower variable wet and the best MOL concentration was 100 ml / l (Figure 5B).

Nutrient Content (Nitrogen, Phosphor, Potassium)

The nutrient content test (Nitrogen, Phosphor, Potassium) of each kind of MOL material (banana hump waste and fruit waste) are presented in Table 1.

Table 1. Analysis Result of Each Local Microorganism Nutrient Level (%)

MOL	N-Organic	N-NH4	N-NO3	Total-N	P	K
Banana Hump Waste	0.028	0.000	0.007	0.04	0.0056	0.264
Fruit Waste	0.063	0.007	0.000	0.07	0.0047	0.189

Table 1 shows that MOL made from banana hump waste contains higher organic nitrogen (0.063) than MOL made from fruit waste (0.028). The results of the analysis of MOL nutrient content of fruit wastes did not contain nitrate, whereas the MOL nutrient content of banana hump waste contained 0.007% nitrate. On the contrary, MOL waste of banana hump contains 0.007% ammonium while MOL of fruit waste does not contain ammonium. Phosphate levels and potassium levels of banana hump waste MOL were higher than phosphate levels and potassium levels of fruit waste MOL.

DISCUSSION

The results showed that there was no interaction between the treatment of MOL material and MOL concentration. Each MOL ingredient showed a different response to the growth variable of broccoli because based on the results of the nutrient content test, each MOL presented in Table 1 was also different. Fruit waste MOL material produces the diameter of the flower, the wet weight of the flower, and the wet weight of the broccoli plant because MOL of fruit waste containing total nitrogen is higher than the MOL of banana hump waste. Nitrogen is important for plant growth as stated by Wasnowati, 2009 [1]

that nitrogen is a basic fertilizer for broccoli seedling growth.

The use of organic waste is one way to reduce environmental pollution [6], That is by fermenting organic waste from food waste and plant waste because in this process chemical changes will occur in the organic substrate by microbial activity [8];[9]. In this process is determined by the type of organic material, kinds of microbes, pH, temperature, and certain ingredients that play a role to increase the activity of microorganisms so that the fermentation process runs quickly [10]. Fruit waste that is processed into MOL can stimulate generative growth of plants and there are several bacteria that can act as components of probiotics [11]. Both types of moles can still be used for decomposers or speed up the composting process. MOL solution contains macro, micro, and microorganisms which have the potential to transform organic matter, and pest and plant disease control agents so that they are well used as biological fertilizers and organic pesticides [6].

Local Microorganisms (MOL) are fermented liquids made from natural ingredients [12] that contain microorganisms that have the potential to transform organic matter, stimulate growth, and control pests and plant diseases so that they are used as decomposers, biological fertilizers and organic pesticides [8]. MOL (local microorganisms) is a collection of microorganisms that can be farmed, which functions as a starter in making liquid organic fertilizer [13]. That is an organic fertilizer in liquid form derived from the decomposition of organic materials derived from crop residues, animal waste, and humans whose ingredients contain more than one element [14];[15]. The advantage of this organic fertilizer is that it can quickly overcome nutrient deficiency, is not a problem in nutrient leaching, and is able to provide nutrients quickly. One type of effective liquid organic fertilizer is local microorganism [16]. Microbes contained in MOL solution do not only contain one type of microorganism but there are several microorganisms in them, such as *Rhizobium* sp., *Azospirillum* sp., *Azotobacter* sp., *Pseudomonas* sp., *Bacillus* sp., and phosphate solubilizing bacteria [17].

Banana hump and fruit waste are one of the materials used as the main material for making local microorganism, because bananas hump contain Gibberellin and Cytokinin Growth Regulatory Substances [18]. In addition, in the mole of banana weevil waste also contains 7 microorganisms that are very useful for plants, namely: *Azospirillum*, *Azotobacter*, *Bacillus*, *Aeromonas*, *Aspergillus*, phosphate microbial solvents and cellulose microbes [19]. Fruit waste that is processed into MOL can stimulate generative growth of plants and there are several bacteria that can act as components of probiotics [20]. Both types of local microorganism can still be used for decomposers or speed up the composting process [3]. *Leri* or rice laundry water contain many vitamins and minerals commonly used by plants. Molasses are sugar factory waste that can be used by microbes as a source of carbohydrates. These materials are places that are favored by microorganisms as a medium for living and developing microorganisms that are useful in accelerating the destruction of organic materials (decomposers) or as additional nutrients for plants [7]. Phosphate solvent microorganisms are microorganisms that

can dissolve phosphate so that it can be absorbed by plants [16]. This Microorganism is also known to produce amino acids, vitamins and growth-promoting substances such as Indole Acetyl Acid (IAA) and gibberellins which can stimulate plant growth [8].

IV. CONCLUSION

Based on the research results can be concluded as follows:

1. There is no interaction between the treatment of local microorganism material (banana hump waste and fruit waste) and the local microorganism concentration on broccoli growth and production variables.
2. MOL fruit waste shows a better response to the variable diameter of the flower, the wet weight of the flower and the wet weight of the broccoli plant compared to the banana hump MOL
3. The optimum MOL concentration for growth and broccoli yield is 100 ml / l

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