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EFFECT OF LOCAL MICROORGANISMS (MOL) OF MORINGA LEAVES ON THE GROWTH AND YIELD OF PAKCOY MUSTARD (*Brassical rapa L.)*

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ABSTRACT

To support sustainable vegetable cultivation, the use of organic fertilizers is essential for improving soil quality and minimizing pest disturbances. Pak choi is a widely cultivated horticultural crop due to its high nutritional value and strong economic potential, creating a need for more environmentally friendly cultivation practices. One such approach is the use of Local Microorganisms (MOL), produced through the fermentation of natural materials containing active microorganisms from plants or plant parts. These include *Rhizobium* sp., *Azospirillum* sp., *Azotobacter* sp., *Pseudomonas* sp., *Bacillus* sp., and phosphate-solubilizing bacteria that support soil fertility and plant growth. Moringa leaves (*Moringa oleifera*) are a potential source of MOL due to their growth-promoting properties. This study aimed to evaluate the effect of moringa leaf MOL on pak choi growth and to identify the most effective concentration. Conducted at the Bali Agricultural Technology Study Center, the results showed that the treatment had a highly significant effect on plant height, number of leaves, leaf area, total fresh weight, above-ground fresh weight, and total oven-dry weight, but no significant effect on fresh and dry root weight. The highest leaf number was observed at the P3 concentration.

Keywords: *Local microorganism, kelo leaves, cultivation, mustard greens*

INTRODUCTION

Scotch Mustard (*Brassica rapa* L.*)* is a type of rain-resistant vegetable. This annual plant is also known as spoon mustard. Pakcoy mustard has the genus or genus Barassica so it is included in the type of mustard green. Mustard pakcoy has green leaves with a nutritional content of grams of carbohydrates, 105 milligrams of calcium, 252 milligrams of potassium, 223 micrograms of vitamin A, 19 milligrams of magnesium, In addition, pakcoy also contains fiber, folic acid, antioxidants, and vitamins C, K, and B6 (Sienny, 2022). Pakcoy mustard plant (*Brassical rapa* L.*)* is one of the vegetables that is in great demand among the public. According to data (BPS, 2020) it is stated that the production of mustard (*Brassica rapa* L.*)* in Bali is included in the highest production of horticultural products, which is 29,052.00 tons. In Indonesia, the production of pakcoy mustard (*Brassical rapa* L.*)* It is also relatively high, which is around 667,473.00 tons in 2020. This increase in production figures is not uncommon in Bali, as well as on a larger scale, namely Indonesia. In 2018 and 2020 production has increased. Pakcoy plant cultivation can be done organically or inorganically, but to get the yield of pakcoy mustard (*Brassical rapa* L.*)* Of course, organic cultivation must be carried out immediately, considering the increasing residue produced from the use of inorganic fertilizers and inorganic pesticides. According to (Arum, Setiawan, 2020) The excessive and untargeted use of inorganic fertilizers and pesticides can cause various problems including plant

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poisoning, the occurrence of pest resistance, soil and water pollution, as well as having a negative impact on humans and other living things. Therefore, there is a need for efforts to develop efficient organic fertilizers to be able to increase soil fertility and pest and disease control.

Environmentally friendly cultivation practices can be implemented by replacing chemical inputs with the application of Local Microorganisms (MOL). Plant breeders use MOL as a solution towards environmentally friendly agriculture and free from fertilizers and chemical drugs. MOL materials are easy to obtain and easy to process. MOL is an active microorganism that is located somewhere, which is obtained from plants or plant parts. MOL solution is a fermented solution made from various locally available resources that contain micro and macro nutrients and also contains bacteria that have the potential to be an organic matter remodeler, growth stimulant, and as a pest and disease control agent. Therefore, MOL can be used both as a decomposer, biofertilizer and as an organic pesticide especially as a fungicide. (Arum, Setiawan, 2020).

Produced from locally available natural materials, MOL is a self-made liquid containing beneficial microorganisms that support plant growth and soil fertility, including *Rhizobium* sp., *Azospirillum* sp., *Azotobacter* sp., *Pseudomonas* sp., *Bacillus* sp., and phosphate-solubilizing bacteria (Rahayu and Tamtomo, 2017). Moringa leaves are one of the natural materials that have the potential to serve as a source of MOL and growth stimulants. The presence of chemical compounds such as calcium, magnesium, phosphorus, iron, sulfur, and cytokinin hormones enables moringa leaves to be utilized in the production of liquid organic fertilizers.

RESULTS AND DISCUSSION

Based on the outcomes of statistical analysis of the design used, the effect of giving moringa leaf moles on the growth and yield of pokcay mustard (*Brassica rapa* L.*) plants was obtained.* as a result of the treatment given has a very a significant effect on plant height, leaf number, leaf area, total fresh biomass, above-ground fresh biomass, and total oven-dry biomass and the unreal influence on the parameters of the fresh weight of the plant roots and the dry weight of the plant roots Table 1.

RESEARCH METHODOLOGY

The design used was a random group design (RAK) with 6 treatments that were repeated 4 times, so that 24 treatments were obtained each treatment using a polybag with a diameter of 25 cm. So that the number of polybags needed is 6 x 4 = 24 polybags The treatment used in this experiment is as follows: P0: control (without treatment), P1: MOL concentration of moringa leaves 100 ml + water 200 ml, P2: MOL concentration of moringa leaves 200 m l + water 200 ml, P3: MOL concentration of moringa leaves 300 ml + water 200 ml, P4: Moringa leaf MOL concentration 400 ml + water 200 ml, P5: Moringa leaf MOL concentration 500 ml + water 200 ml

Making MOL Moringa Leaves How to make liquid fertilizer from moringa leaves according to Putri (2018). The ingredients of Moringa leaves are : 2.5 kg ; 16 fresh moringa leaves; 5 liters of rice water ; 0.25 kg Molasses; 0.50 liters EM4; strainers, small plastic hoses and plastic bottles. How to make MOL moringa leaves is as follows: 2.5 kg of moringa leaves that have been cut into small pieces are pounded in a container with a size of 10 liters. Next, 0.25 kg of molasses is added to the container that has been filled with moringa leaves, stirring until well mixed. then 0.25 liters of Em4 and 5 liters of rice washing water (1 kg of washed rice with 5 liters of water) were added. After all the ingredients are put into the container is done stir until mixed, then close the container tightly. Every 2 days the container is opened and stirring is carried out. Fermentation is carried out for approximately 14 – 20 days or until it smells good then filtered and stored in bottles.

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Table 1. Significance of the effect of applying MOL concentration of moringa leaves on the growth and yield of the pokcoy mustard (*Brassica rapa* L.*) plant*

No.	Variable	Significance
1	Plant Height (cm)	**
2	Number of Leaves (strands)	**
3	Leaf Area (cm²)	**
4	Total Fresh Plant Weight (g)	**
5	Fresh Weight of Plants on Soil (g)	**
6	Total Oven Dry Weight (g)	**
7	Wet Weight of Plant Roots (g)	ns
8	Plant Root Gravity (g)	ns

Description : ns (no real difference)
** (very real difference)

Table 2 Average effect of moringa leaf MOL administration on plant height parameters, number of leaves, leaf area, total fresh weight of plants, fresh weight on the ground

Treatment	Parameters				
	Plant height (cm)	Number of leaves (strand)	Leaf area (cm²)	Total fresh weight Plants (g)	Fresh weight on the ground (g)
P0	15.10 c	9.00 d	181.01 d	66.20 c	59.52 c
P1	15.10 c	10.25 c	199.82 c	70.07 bc	62.42 bc
P2	18.98 b	10.75 c	215.72 c	74.27 b	66.46 b
P3	20.35 b	12.50 to	284.93 a	82.10 a	73.22 a
P4	24.23 a	12.00 ab	268.29 a	81.65 a	72.81 a
P5	24.13 a	11.25 bc	235.72 b	80.65 a	71.92 a
BNT 5%	1,7469	1,0142	18,5914	4,9378	4,5209

Remarks: The average value followed by the same letter in the same column, means that the difference is not real at the level of the 5% BNT test

Table 3. Average effect of moringa leaf MOL administration on plant height parameters, leaf count, leaf area, total fresh weight of plants, fresh weight on the ground

Treatment	Parameters		
	Total dry weight of the plant	Wet weight of plant roots	Dry weight of plant roots
P0	6.02 c	6.69 a	0.34 a
P1	6.87 b	7.65 a	0.38 a
P2	7.03 b	7.81 a	0.40 to
P3	8.00 a	8.88 a	0.46 a
P4	7.96 a	8.83 a	0.44 a
P5	7.90 a	8.73 a	0.43 a
BNT 5%			

Remarks: The average value followed by the same letter in the same column, means that the difference is not real at the level of the 5% BNT test

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DISCUSSION

The growth of Pakcoy Mustard (*Brassica rapa* L) with the MOL concentration treatment of moringa leaves has a discernible variation in plant height, duan count, leaf area, total fresh weight of plants, fresh weight of plants on the ground, and total oven dry weight of plants, and there is no significant difference between the parameters of fresh plant root weight and dry weight of plant root oven. The application of liquid organic fertilizer by adding 40% moringa cycle extract has an effect on the growth of okcoy plants. This is affected by the administration of several MOL of moringa leaves in the P3 treatment giving the best results compared to other treatments. In this treatment, there was an increase in the results from the P3 to P0 treatment, the lowest results were obtained in the P0 treatment, the administration of moringa leaf MOL during growth always increased. This relates to the findings of the Jama study (2021) which conducted research on planting mustard green plants and using moringa leaf MOL with the best treatment at 2 weeks before planting by giving MOL with a volume of 500 ml (300 ml moringa leaf solution + 200 ml water/plant), getting the best growth result.

Moringa leaf mole contains N, P, and K which are somewhat balanced, this is supported by the results of the analysis of moringa leaf MOL which is good for vegetative growth of plants because it contains carbohydrates found in rice washing water, glucose from brown sugar and EM4 as a source of microorganisms. According to the Swamp Land Agricultural Research Institute, nitrogen (N) is one of the main nutrients in stimulating growth and giving color to leaves (Balatra, 2021)

In addition, MOL enhances the availability of nutrients required for growth in the soil so as to support plant growth. Microbes in the soil stimulate the process of environmental decomposition to extract nutrients from the organic matter in the soil, which can ultimately increase the plant's nutrient intake for healthier and better plant growth. Moringa leaves wilt and break easily, indicating that the protein content is high, indicating that the nitrogen element is also high. As is known, this nitrogen element is the dominant element needed by plants during the planting season. In this study, the soil medium used with moderate nutrient content, this is proven by the results of the soil analysis lab N, P and K while motelage leaves are needed to provide nutrients to the soil.

Growth as defined as an increase in size (usually in dry weight) that is *irreversible*. Development, on the other hand, involves the process of differentiation, and is indicated by higher changes, concerning anatomical and physiological specialization. Differentiation is one of the important processes in plant cultivation. However, the change from simple cells to complex multicellular organisms cannot be fully understood. Research Results (ariambawa 2016) Growth is the process by which an organism's protoplasmic cell count increases along with its size, weight, and number of cells that are unable to revert to their initial state, while the definition of development in theory is the stages of progressive change that occur in the life span of the organism, regardless of the aspects contained in the organism.

The high growth parameter value supports both the yield and the high growth parameter value which reflects the increase in dry weight of plant spots and the wet weight of tan on the soil which reflects the economic results. Economic value of pokcoy mustard plants (*Brassica rapa* L.) found in the fresh weight parameters above the ground is able to give the best results in the P3 treatment. According to (Mursalim et al., 2018) It is seen from the more leaves, the heavier the wet the plant, the bigger it is, as well as the height of the plant, the higher the wet heavy plant.

CONCLUSION

Based on the outcomes of the research and discussions that have been carried out, it can be inferred as follows:

1. The effect of applying moringa leaf MOL on plant growth and the yield of pakcoy mustard (*Brassical rapa L.*) gives very real different results on the height parameters of the plant, Number of leaves, leaf area, total fresh weight of plants, fresh weight of plants above ground, total oven dry weight of plants and no noticeable difference to the parameters of fresh weight of plant roots, dry weight of plant roots
2. The best MOL dose concentration of moringa leaves for the growth and yield of pakcoy mustard (*Brassical rapa L.*) plants is in P3 treatment or at

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300 ml moringa leaf MOL concentration plus 200 ml of water. Applying MOL of moringa leaves to P3 or at a concentration of MOL of moringa leaves of 300 ml plus 200 ml of water on pokcoy mustard plants gives a plant height yield of 24.23 cm, the number of leaves 12.50 pieces, the area of dun 284.93 cm2, the total fresh weight of the plant 82.10 g, the fresh weight on the ground 73.22 g, the total dry weight of the oven of the plant 8.00 g, The fresh weight of plant roots was 8.88 g, and the dry weight of the plant root oven was 0.46 g. The highest compared to the results of other treatments.

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