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The Effect of Use of Local Organic Microorganism Fertilizers on Rice Media, Banana Sticks, And Tongol Fish on The Growth of Arabika Coffee Plants (*Coffea arabica* L.) in The Gunung Karang Garden, Pandeglang District

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Abstract

Arabica coffee plants (*Coffea arabica* L.) are plantation commodities with high economic value. Efforts that can be made in farming without using chemicals that will damage the environment is by utilizing local microorganisms (MOL). For farmers who demand the use of cheap and practical fertilizers, they can be directed to use local microorganism organic fertilizers made from rice, banana stems, and tuna. This study aims to determine the effect of using local microorganism organic fertilizers made from rice, banana stems, and tuna on the growth of *C. arabica* plants. The type of research to be carried out is experimental research. This research method uses a Completely Randomized Factorial Design (CRFD) consisting of 2 factors and 3 replications. The first factor is the source material consisting of 3 levels, namely: M1 = stale rice, M2 = banana stem, and M3 = tuna. The second factor is the fermentation period consisting of: H1 = 2 weeks fermentation and H2 = 4 weeks fermentation. The measured parameters of *C. arabica* plants are height, number of leaves, and stem diameter. The results showed that rice, banana stem, and tuna can be made into MOL fertilizers. The use of MOL organic fertilizers (stale rice, banana stem, and tuna) affects the growth of *C. arabica*, which can be seen from the parameters of plant height, number of leaves, and stem diameter. M3H2 MOL organic fertilizer (tuna fermented for 4 weeks) provides optimal growth of *C. arabica* in terms of plant height, number of leaves, and stem diameter.

Keywords: Banana Stem; *Coffea arabica* L.; Tuna; MOL; Rice.

INTRODUCTION

A plantation commodity with high economic value is the coffee plant (Coffea arabica L.), which can provide foreign exchange income for the Indonesian state and support national development. The area of coffee plantations in Indonesia reached 1,243,441 ha (in 2019), with a coffee production capacity of 716,089 tonnes per year and an export value of 279,961 tonnes (815,933,000 US$) (Makmur & Karim, 2020).

Cultivating C. arabica plants to obtain optimal seed production results requires proper fertilization. Many C. arabica farmers still do not pay special attention to good fertilization so that the production of C. arabica seeds is still low, which becomes a problem for C. arabica farmers, namely inappropriate fertilization which has an impact on the low production of C. arabica seeds from cultivation. (Sapurah et al., 2019).

Production of C. arabica plants can increase by increasing the planting area and soil fertility with excellent and appropriate fertilization techniques. In farmers in developing countries like Indonesia, still use synthetic pesticides and fertilizers to cultivate C. arabica plants. This can lead to dependence on the continuous use of synthetic fertilizers and pesticides, which can cause environmental damage, decrease soil fertility, and ultimately reduce soil productivity (Manure, 2014).

Continuous use of synthetic chemicals (pesticides and chemical fertilizers) over a long period will pollute the environment, kill populations of beneficial microorganisms (playing a role in soil biogeochemical cycles), harm non-target pests, the emergence of resistant pests and nutrients in the soil will decrease. Therefore, alternative solutions are needed to replace chemical fertilizers and develop microorganism-based biocontrol that is safer, more effective, has fewer detrimental effects, and is made from natural ingredients (Mursalim et al., 2018).

The use of local microorganisms or MOL for short is an effort made as an alternative to the use of synthetic chemicals (chemical fertilizers) that can damage the environment. MOL can utilize local microorganisms which can be used to improve soil structure, fertilize plants which can be a solution for farmers for organic farming that is environmentally friendly and free from dangerous chemicals. MOL can be made by utilizing household waste, agricultural and livestock waste which can be easily obtained and is widely available in the environment so that using MOL can save cultivation costs by up to 20-25%. MOL is used as a starter in making organic fertilizer in both solid and liquid form (Delfiana et al., 2019).

MOL can improve compost quality and speed up the composting process. MOL contains bacterial microorganisms such as Azotobacter sp., Azospirillum sp., Bacillus sp., Pseudomonas sp., Rhizobium sp., and phosphate solubilizing bacteria which are beneficial for plants and increase soil fertility. MOL can be produced independently from surrounding natural materials such as agricultural waste, livestock waste and even household waste (Rahayu & Tamtomo, 2017).

Research on household waste-based MOL has been conducted using stale rice (Arifan et al., 2020); stale rice, banana stems, and tuna fish, which had a significant influence on the growth of mustard greens (Brassia juncea) (wet weight, number of leaves, and plant height (Mursalim et al., 2018).

Utilization of household and agricultural waste or waste such as stale rice, tuna and banana stems as organic fertilizer by utilizing MOL by farmers so that they obtain fertilizer that is cheap, practical and easy to make but very effective and efficient for farmers in increasing plant fertility and improving plant quality so that crop production will increase.

This research aims to determine the effect of using organic fertilizer from local microorganisms on the growth of C. arabica plants rown on rice, banana stems and tuna.

RESEARCH METHODS

This research was conducted in March – October 2022. The research was conducted at Gunung Karang Gardens, Pandeglang Regency.

The tools used in this research were a shovel, a sprayer, a 5 liter bucket, paper (used newspapers), a board container, a glass jar, a plastic bottle, a scale, a 15x20 cm polybag, a handsprayer, a measuring cup, and a caliper.

The materials that will be used in this research include Arabica coffee seeds (Coffea arabica L). water, banana stems, rice washing water, rice, coconut water, brown sugar, NaOH, soil and tuna.

Making MOL Organic Fertilizer

MOL Stale Rice

Put the stale rice in a box-shaped container (20 cm x 15 cm x 7 cm), cover with newspaper and provide an air gap so that air can still enter. The container containing the rice is then placed in a damp and shady place so that mold grows on the entire surface of the rice. Rice that has grown mold or microorganisms is selected by discarding rice that contains black mold. The selected rice is then put into the bucket.

500 mL of coconut water and rice washing water and 1 kg of brown sugar were added to the bucket containing the stale rice, then 1,500 mL was added. The bucket was covered with newspaper and stored for 2 weeks (H1) and 4 weeks (H2).

MOL Banana Stem Media

The banana stems are chopped into small sizes then put into a box-shaped container (20 cm x 15 cm x 7 cm), covered with newspaper and given an air gap so that air can still enter. The container containing the chopped banana stems is then placed in a damp and shady place so that the entire surface of the chopped banana stems grows with mold. Chopped banana stems that have grown fungi or microorganisms are selected by discarding chopped banana stems that contain black fungi. The chopped banana stems that have been selected are then put into the bucket.

Add 500 mL of coconut water and rice washing water and 1 kg of brown sugar to the bucket containing chopped banana stems and then add 1,500 mL. The bucket was covered with newspaper and stored for 2 weeks (H1) and 4 weeks (H2).

MOL Tuna Fish Media

1 kg of tuna is chopped into small pieces and then put into a box-shaped container (20 cm x 15 cm x 7 cm), covered with newspaper and given an air gap so that air can still enter. The container containing chopped tuna is then placed in a damp and shady place so that the entire surface of the tuna is covered with fungus. Tuna fish that have grown fungi or microorganisms are selected by removing pieces of tuna that contain black fungi. The tuna that has been selected is then put into the bucket.

Add 500 mL of coconut water and rice washing water and 1 kg of brown sugar to the bucket containing chopped banana stems and then add 1,500 mL. The bucket was covered with newspaper and stored for 2 weeks (H1) and 4 weeks (H2).

MOL Formulation Design

This research method uses a factorial Completely Randomized Design (CRD) consisting of 2 factors and 3 replications. The first factor is the original ingredients which consist of 3 levels, namely: M1 = stale rice, M2 = banana stems and M3 = tuna.

The second factor is the fermentation time which consists of: H1 = 2 weeks fermentation and H2 = 4 weeks fermentation. These two factors were repeated 3 times to obtain 18 repetitions.

Table 1. Combination of Treatments.

Treatment	H1	H2
M1	M1H1	M1H2
M2	M2H1	M2H2
M3	M3H1	M3H2

Preparation of Research Areas and Plants

Preparing the research area is by cleaning the research area from weeds, rocks and rubbish with a hoe. Three beds were made of soil and a drainage ditch was made in each bed to avoid waterlogging. A shade is created above the bed to avoid the intensity of sunlight and direct rain exposure to the nursery area. The shelter is made with a bamboo or wood frame measuring 2.5 m x 1.7 m.

The growing medium used is topsoil, which is fine fertile soil that has been sifted with a 20 mesh diameter sieve, where the size of the polybag used is 1 kilo with a ratio of soil to sand of 1:1.

Preparation of Planting Media

Preparing the planting media is by filling the planting media into polybags, filling them one by one by mixing 1 part topsoil with 1 part sand into the polybag.

Selection of C. arabica seeds

C. arabica seeds were selected that were the same size, the seeds were not attacked by disease, were not moldy, the color was uniform, the seed leaves had no holes, were healthy and of good quality.

Planting C. arabica seeds

C. arabica seeds are planted into the planting medium by immersing them, namely the back side up and the belly side down.

Planting C. arabica seeds in polybags

C. arabica planting is done by taking the nursery seeds and transferring them into prepared polybags.

Providing MOL Treatment

MOL liquid fertilizer solution (stale rice, banana stems, and tuna) is made by dissolving organic fertilizer according to a predetermined dose in size (50 ml, 100 ml, 150 ml, 200 ml, 250 ml and 300 ml) in each measuring cup by adding one liter of water each then stirring evenly. The MOL fertilizer solution (stale rice, banana stems, and tuna) is then put into a handsprayer and then sprayed on C. arabica plants when the stomata are open, namely in the morning between 08.00-10.00. MOL is given at 7 weeks after transplanting (MSPT). Subsequent fertilization every week for 8 weeks.

When spraying the C. arabica plants under observation, they were protected using cardboard so that splashes of the solution did not hit other plants with different treatments.

Maintenance

Maintenance by watering C. arabica every morning and evening according to the humidity conditions of the planting medium. Other maintenance is controlling pests and diseases and removing weeds that grow manually using hands or a sickle.

Observation Parameters

Plant Height (cm)

Observations were made by measuring the height of the C. arabica plant, measured from the base of the stem at the ground surface to the tip of the stem, using a meter, which was carried out every week for eight observations.

Number of Leaves (strands)

Observations were made by counting the number of fully formed C. arabica leaves, which was carried out every week for eight observations.

Stem Diameter (cm)

Observations were made by measuring the middle of the C. arabica stem that appeared on the ground using a caliper, which was carried out every week for eight observations.

Data Analysis

Data from observations of C. arabica plants were analyzed using analysis of variance to determine the effect of treatment. If there are differences between treatments, Duncan's Multiple Range Test is carried out with α=1% and α=5%.

RESULTS AND DISCUSSION

Observation of Plant Height

Results of observations of C. arabica plant height at the age of 7 weeks after transplanting (MSPT) during 8 weeks of observation (Table 2).

Table 2. Observation results of C. arabica plant height.

Treatment	Plant Height (cm)								
	0	1	2	3	4	5	6	7	8
M1H1	19,23	21,40	23,87	26,17	28,30	30,63	33,10	35,50	37,70
M1H2	19,23	21,60	24,17	26,40	28,67	31,20	33,47	36,20	38,30
M2H1	19,23	21,80	24,53	27,17	29,70	32,30	34,77	36,50	38,40
M2H2	19,27	22,00	24,80	27,57	30,27	32,90	35,60	37,67	39,50
M3H1	19,27	22,30	25,10	27,93	30,53	33,43	36,20	37,70	39,67
M3H2	19,27	22,40	25,73	28,70	31,77	34,90	38,13	39,30	40,63
Control	19,23	19,73	20	20,27	20,70	21,10	21,30	21,80	22,70

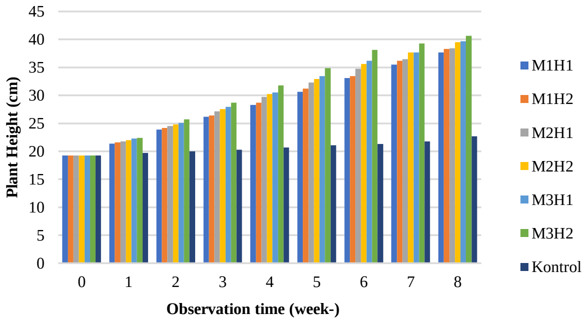

Figure 1. Crop High Response Graph.

Results of statistical analysis using Duncan's test on C. arabica plant height parameters (Table 3).

Table 3. Duncan Test Plant Height Parameters.

Treatment	Plant Height (cm)
M1H1	28,43^{ab}
M1H2	28,80^{ab}
M2H1	29,37^{ab}
M2H2	29,95^{ab}
M3H1	30,23^{b}
M3H2	31,20^{b}
Control	20,75^{a}

Note: Numbers followed by different letters indicate a significant difference based on the Duncan test at the 5% level ($P \leq 0.05$)

Plant height is a plant measurement that is often observed as an indicator of growth or as a parameter to measure the influence of the environment or the treatment applied because plant height is the easiest measure of growth to see (Ramli et al., 2017).

The results of observations of C. arabica plant height after analysis of variance showed that there were variations in plant height. The average height of C. arabica plants in the M1H1 treatment was 28.4333 cm, M1H2 was 28.8037 cm, M2H1 was 29.3778 cm, M2H2 was 29.9519 cm, M3H1 was 30.2370 cm and M3H2 was 31.2037 cm. The highest C. arabica plant height in the 8th week occurred in the M3H2 treatment (MOL tuna fermented for 4 weeks) with an average height of 40.3 cm. Various types of MOL react fully and can be utilized by plants where the administration of various MOL begins to show their respective advantages.

The results of statistical analysis using the Duncan test on C. arabica plant height showed that there were significant differences (significantly different) between the M1H1, M1H2, M2H1, M2H2, M3H1 and M3H2 groups and the control. It is suspected that giving MOL contains nutrients that play a role in plant vegetative growth. This is thought to be because the treatment (giving MOL rice, banana stems and tuna) can fulfill the need for macro and micro nutrients for plant height growth.

A plant will grow and develop well if the nutrients the plant needs are in sufficient quantities and are in a form that is ready to be absorbed. Meanwhile, Yudiawati & Kurniawati. (2019) explained that MOL contains a source of nitrogen and phosphorus for plants. Where plants need the elements N and P to be able to grow, develop and produce well and stimulate vegetative growth. Apart from that, the presence of microorganisms contained in MOL is thought to stimulate the media decomposition process, thereby helping to provide nutrients from organic material available in the soil which ultimately can increase nutrient absorption by plants.

Romero (2014) states that the addition of organic matter to the soil can increase the development of soil microorganisms, because there is a supply of carbon as energy for the development of microorganism activity in the soil, thereby helping the absorption of nutrients from the soil and increasing plant production. The addition of useful microorganisms in MOL is thought to have helped supply N for optimal plant growth. MOL added with beneficial microorganisms works better in aerobic soil conditions. Conditions like this support an increase in the population of soil microorganisms which can help provide nutrients for plant growth. These microorganisms are known to have the ability to provide nutrients and contain growth hormones that plants need. These microorganisms are also able to work well in increasing plant growth.

MOL contains 7 microorganisms which are very useful for plants, namely: Azospirillium, Azotobacter, Bacillus, Aeromonas, Aspergillus, phosphate solubilizing microbes and cellulotic microbes. According to Suiatna (2010) Azospirillium sp is a non-symbiotic N-fixing bacteria in the air. Apart from its direct role in increasing plant N content, Azospirililum sp. It is also able to produce phytohormones that can stimulate plant growth, including auxin, gibberellins and cytokinins.

MOL contains Aspergillus niger bacteria which can dissolve the P element in the soil. This P element is very important for the growth of plant leaves. Aspergillus niger which helps growth and soil fertility. A. niger is a microbe that can dissolve phosphate in the soil. If plants lack this element, plant growth will be hampered. A. niger increased stem growth several times higher than the control treatment. It is hoped that giving high doses of nitrogen will also form high levels of protein so that it will increase the width, length and number of leaves which will expand the surface available for photosynthesis (Yuliani, 2015).

The results of statistical analysis using the Duncan test on C. arabica plant height showed that groups M1H1, M1H2, M2H1, M2H2 and groups M3H1 and M3H2 were significantly different. The M3H1 and M3H2 groups and the control group were also significantly different. This shows that the M3H1 and M3H2 groups have a greater influence on plant height compared to the

M1H1, M1H2, M2H1, M2H2 groups. This shows that MOL from tuna has the greatest influence on the height growth of C. arabica plants.

The results are the same as research from Mursalim et al (2018) where the MOL treatment of tuna had the most significantly different effect on plant height among the other treatments. According to Suaib (2015), tuna nutrition contains the element nitrogen (N) which functions as a fertilizer for the leaves. The protein content of Tuna fish is 36.10%, equivalent to Nitrogen of 5.78%.

Pamungkas & Supijatno's (2017) research shows that applying nitrogen fertilizer has a significant effect on plant height. It is suspected that the plants have the ability to utilize nitrogen in the soil in the early weeks of observation so that the high yields of the plants are different from other treatments. The availability of nitrogen in the soil is influenced, among other things, by soil organic matter, soil water content, temperature and nitrogen fixation by soil bacteria.

Observation of the Number of Leaves

Results of observations of the number of leaves of C. arabica plants at the age of 7 weeks after transplanting (MSPT) during 8 weeks of observation (Table 4).

Table 4. Observation Results of the Number of C. arabica Leaves.

Treatment	Number of strands								
	0	1	2	3	4	5	6	7	8
M1H1	5,00	5,33	6,33	6,67	7,33	8,00	8,33	9,33	9,67
M1H2	5,33	5,67	6,67	7,00	8,33	9,00	9,67	10,33	10,67
M2H1	5,00	5,67	7,33	8,00	9,33	9,67	10,33	11,00	11,33
M2H2	5,00	6,00	7,67	8,67	9,67	10,67	11,00	11,67	12,33
M3H1	5,33	6,00	8,33	10,33	12,00	12,33	12,67	13,33	14,00
M3H2	5,33	7,00	9,33	11,33	12,33	13,33	14,33	14,67	15,67
Control	5	5	5,33	5,67	5,67	6	6,33	6,67	7

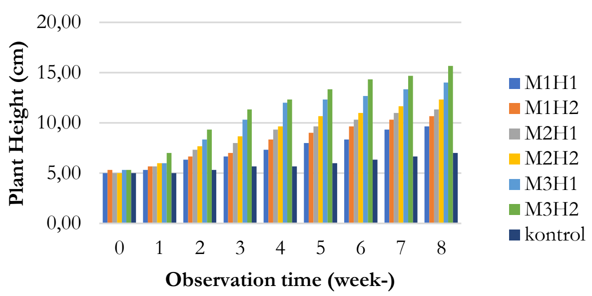

Figure 2. Leaf Count Response Graph.

Results of statistical analysis using the Duncan test on the parameters of the number of leaves of C. arabica plants (Table 5).

Table 5. Duncan Test Parameters for Number of Leaves.

Treatment	Number of Leaves
M1H1	7,33[ab]
M1H2	8,07[abc]
M2H1	8,62[abc]
M2H2	9,18[abc]
M3H1	10,48[bc]
M3H2	11,48[c]
Control	5,85[a]

Note: Numbers followed by different letters indicate a significant difference based on the Duncan test at the 5% level ($P \leq 0.05$)

The second vegetative growth parameter observed was the number of leaves. Observing the number of leaves is very necessary because apart from being an indicator of growth, leaf number parameters are also needed as supporting data to explain the growth process that occurs (Ramli et al., 2017). The results of observations on the number of leaves of C. arabica plants after analysis of variance showed that there was variation in the number of leaves. The average number of C. arabica leaves in the M1H1 treatment was 7.33, M1H2 was 8.07, M2H1 was 8.62, M2H2 was 9.18, M3H1 was 10.48 and M3H2 was 11.48.

The highest number of leaves in the 8th week was M3H2 (Tongkol fish MOL fermented for 4 weeks) with an average of 16 leaves. It is suspected that the increase in the number of leaves is due to leaf formation being influenced by the absorption and availability of nutrients. The nutrients contained in MOL from flying fish waste play a major role in plant growth and development.

The results of statistical analysis using the Duncan test on the number of C. arabica leaves showed that groups M1H1, M1H2, M2H1, M2H2 and groups M3H1 and M3H2 were significantly different. The M3H1 and M3H2 groups and the control group were also significantly different. This is thought to be because there are nutrients in MOL.

According to the research results of Suhastyo (2011), MOL contains available N. The benefits of N itself for plants are for the formation or growth of plant parts, such as leaves, stems and roots. Plants that lack phosphorus respond to leaf growth. Soil that lacks phosphorus also has bad consequences for plants. The visible symptom is that the color of the entire leaf changes to become too old, and often appears shiny reddish. On the edges of the leaves of the branches and stems there is a purple red color which gradually turns yellow and will fall off. Lack of phosphorus for plants will have an impact on the number of plant leaves.

MOL contains Aspergillus niger bacteria which can dissolve the P element in the soil. This P element is very important for the growth of plant leaves. The taller the plant, the more leaves it has, the taller the plant will be, this is because the formation of carbohydrates resulting from plant assimilation increases, causing an increase in the fresh weight of the plant. This is thought to be because the MOL treatment can fulfill the needs of macro and micro nutrients for plant growth (Yuliani, 2015).

The M3H2 group and the control group were also significantly different. This shows that the M3H2 group has a greater influence on the number of leaves of C. arabica plants compared to the M1H1, M1H2, M2H1, M2H2 and M3H1 groups. This shows that MOL from tuna has the greatest influence on the number of leaves of C. arabica plants.

The results are the same as research from Mursalim et al (2018) where the MOL treatment of tuna had the most significantly different effect on plant height among the other treatments. This is due to the optimal nutrient content of tuna MOL.

Observation of the Stem Diameter

Results of observations of stem diameter of C. arabica plants at the age of 7 weeks after transplanting (MSPT) during 8 weeks of observation (Table 6).

Table 6. Observation Results of C. arabica Stem Diameter.

Treatment	Rod diameter (mm)								
	0	1	2	3	4	5	6	7	8
M1H1	4,67	4,67	5,00	5,33	5,33	6,00	6,33	6,67	7,33
M1H2	4,33	4,67	5,33	5,67	6,00	6,33	6,67	7,33	7,67
M2H1	4,33	4,67	5,00	5,33	5,67	6,00	6,33	7,00	7,33
M2H2	4,67	4,67	5,67	6,00	6,00	6,33	7,33	7,67	8,00
M3H1	4,33	5,00	6,00	6,33	6,33	8,00	8,67	9,33	9,67
M3H2	4,33	5,33	6,33	6,67	7,33	9,00	9,67	10,67	11,33
Control	4,67	5	5	5,33	5,67	5,67	6	6	6,33

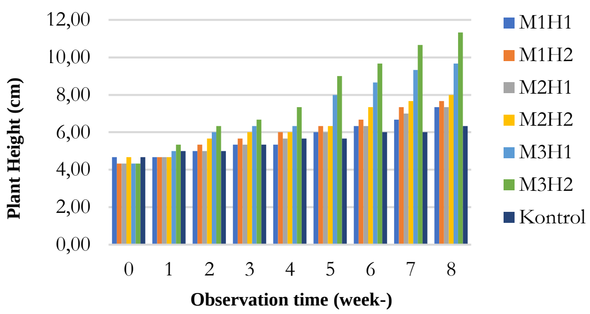

Figure 3. Bar Diameter Response Chart.

Results of statistical analysis using Duncan's test on C. arabica stem diameter parameters (Table 7).

Table 7. Duncan Test for Bar Diameter Parameters.

Treatment	Bar Diameter
M1H1	5,70[a]
M1H2	5,74[ab]
M2H1	6.00[a]
M2H2	6,26[ab]
M3H1	7,07[ab]
M3H2	7,85[b]
Control	5,51[a]

Note: Numbers followed by different letters indicate a significant difference based on the Duncan test at the 5% level (P≤0.05)

The results of observations of the stem diameter of C. arabica after analysis of variance showed that there were variations in stem diameter. The average stem diameter of C. arabica in the M1H1 treatment was 5.70 mm, M1H2 was 5.74 mm, M2H1 was 6.00 mm, M2H2 was 6.26 mm, M3H1 was 7.07 mm and M3H2 was 7.85 mm. According to Julita et al (2013), apart from containing bacteria which have the potential to degrade organic matter, MOL solution also acts as a growth stimulant to control pests and plant diseases.

The results of statistical analysis using the Duncan test on C. arabica stem diameter showed that the M1H2, M2H2, M3H1, M3H2 groups and the control group were significantly different. This is thought to be because there are nutrients in MOL.

It is suspected that the nutrients contained in the various types of MOL provided can be fully utilized to increase stem diameter and it is suspected that environmental factors are more dominant in stem diameter, such as the intensity of sunlight. In the relationship between sunlight and plants, there is always a connection between sunlight and the process of photosynthesis. Photosynthesis is the process of making food that occurs in green plants with the help of sunlight and enzymes. The results of photosynthesis are used to support plant growth and development. The stem is an area of accumulation of plant growth, especially in younger plants, so the presence of nutrients can encourage plant vegetative growth, including the formation of chlorophyll in the leaves, which will increase the rate of photosynthesis. The higher the rate of photosynthesis, the photosynthate produced will provide a greater increase in stem girth. Stem diameter growth is faster in open areas than in shaded areas so that plants planted in open areas tend to be short and stocky, whereas plant diameter growth is closely related to the rate of photosynthesis which will be proportional to the amount of sunlight intensity received and respiration (Yudiawati & Kurniawati, 2019).

The M3H2 group and the control group were also significantly different. This shows that the M3H2 group greatly influences the stem diameter of C. arabica compared to the M1H1, M1H2, M2H1, M2H2 and M3H1 groups. This shows that the MOL of tuna has the greatest influence on the stem diameter of C. arabica. The nutrient content in MOL is thought to be able to support plant stem diameter. MOL from mackerel is usually rich in nutrients such as nitrogen, phosphorus, and potassium, which are important for plant growth and development. Apart from that, MOL from tuna fish also contains enzymes and amino acids which can help increase soil microbial activity and optimize nutrient availability for plants. Therefore, the use of MOL organic fertilizer from tuna can help increase plant productivity and quality, including the diameter of plant stems.

Organic fertilizer from MOL mackerel fermented for 4 weeks provides optimal growth of C. arabica in terms of plant height, number of leaves and stem diameter. This is because fish contains many nutrients, namely N (Nitrogen), P (Phosphorus) and K (Potassium), which are components of organic fertilizer. The main role of nitrogen (N) for plants is to stimulate overall growth, especially stems, branches and leaves. Apart from that, nitrogen also plays a role in the formation of green leaves which is very useful in the photosynthesis process. Another function is to form proteins, fats and various other organic compounds. Apart from that, the role of nitrogen in plants can also increase plant weight, leaf diameter and plant height.

The work of bacteria in breaking down proteins and amino acids into simpler compounds so they can grow and reproduce produces waste compounds such as NH3. Fungus on tuna causes the fish to smell rancid. This odor arises due to the production of ammonia (NH3). The ammonia produced from decomposing mackerel is decomposed by soil microorganisms so that plants can obtain nitrogen properly. Fish silage has high levels of N nutrients which are obtained from protein. It is hoped that the use of fish waste will be useful in the plant cultivation process because it has quite good nutritional content and amino acid content. In addition, organic matter in fish can affect growth.

CONCLUSION

Based on the results of the research and discussion, it can be concluded as follows: 1). Rice, banana stems and tuna can be made into MOL fertilizer. 2.) The use of MOL organic fertilizer (stale rice, banana stems, and tuna) influences the growth of C. arabica, namely the parameters of plant height, number of leaves and stem diameter. 3). MOL M3H2 organic fertilizer (MOL tuna fermented for 4 weeks) which provides optimal growth of C. arabica in terms of plant height, number of leaves and stem diameter.

Competing Interests: The author declares there is no conflict of interest.

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