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KELIA, A Liquid Organic Fertilizer Made of Tutut Snails for A Good Tomato Growth

Fika Fatwa Anin Nafis[1], Nur Laili Rahmawati[2], Robiatul A'dawiyah[3], Septa Katmawanti[4], Hartati Eko Wardani[5,*]

[1] *Department of Public Health, Faculty of Sport Science, Universitas Negeri Malang, Malang, Indonesia*
[2] *Department of Public Health, Faculty of Sport Science, Universitas Negeri Malang, Malang, Indonesia*
[3] *Department of Public Health, Faculty of Sport Science, Universitas Negeri Malang, Malang, Indonesia*
[4] *Department of Public Health, Faculty of Sport Science, Universitas Negeri Malang, Malang, Indonesia*
[5] *Department of Public Health, Faculty of Sport Science, Universitas Negeri Malang, Malang, Indonesia*
[*] *Corresponding author Email: hartati.eko.fik@um.ac.id*

ABSTRACT
The failure of tomato harvesting, which happens to some agricultural lands in Indonesia, compels farmers to utilize liquid organic fertilizer (LOF). Liquid organic fertilizer can be applied to escalate tomato immune system against phytophthora, a fungus-like organism which frequently stampedes tomato plants. Existing LOF employed by farmers has not maximally increased the tomato plants growth. KELIA is a LOF composed of Keong tutut (tutut snails), Limbah sayur (vegetable waste), and Arang (charcoal). Tutut snails, recognized better as rice field pests, were chopped and mixed with vegetable waste and charcoal with a proportion of 5: 5: 1. Researchers gave KELIA to tomato plants for 77 days with concentration of 0, 10, 20, 30, 40, and 50%. With a four repetition of complete randomized design, results showed that the best tomato growth (indicated with plant height, leaf length, and leaf numbers) was KELIA LOF with 50% concentration.

Keywords: *Farming, Waste management, Snails.*

1. INTRODUCTION

The failure of tomato harvesting that occur in Batu region are partly due to phytophthora attacks. Phytophthora is a fungal-like organism that often stampedes tomato plants. Tomatoes that have been attacked by phytophthora will make the leaves become curly and wither away, that will result in poor quality tomatoes. It is because the leaves is the center of photosynthesis [1]. This photosynthesis failure will lead to low photosynthate production, which have crucial role in fruit forming [2].

One of the factors causing tomatoes frequently attacked by phytophthora is a weak immune system, which is occasionally evoked by lack of nutrients. Since nutrients in the soil are not enough to fulfill the nutrition need of tomato plants, farmers utilize organic fertilizer [3]. The organic fertilizers that often employed is in a solid form, which is difficult to decompose so that the plant can not absorbed nitrogen, phosphor, and potassium from it.

To solve the problem, farmers start to use a liquid organic fertilizer (LOF). The problem is, many of LOF available on the market are at relatively at high prices. Liquid organic fertilizer actually can be made from materials obtained from the surrounding environment, such as vegetable waste. However, based on Latifa's research, LOF made from vegetable waste still does not meet the need of tomato plants, so that it is still not be able to escalate the vegetative growth of tomato plant [4]. Poor vegetative growth leads to poor generative growth. That's why, additional material that can upgrade the nutrient content of fertilizer is required.

Tutut snail is a rice plants pest that is found in many farming area in Indonesia. Its presence troubles farmers because it gnaws young rice leaves. One hundred grams of Tutut snail contains 79.7% protein, potassium and phosphor [5, 6]. Tutut snail is usually consumed as food, and there has never been an innovation to make tutut snail as a base material for liquid organic fertilizer. In addition, the results of degradation from vegetable wastes or the result of fermentation process may create

toxic substances which may inhibit the breakdown of nutrients. For this reason, more material is needed to absorb poisons produced by LOF. Charcoal is widely used as a toxic absorbent material [7]. The addition of charcoal to the LOF is expected to absorb toxins from vegetable waste and fertilizer fermentation results, so that nutrients can be absorbed optimally.

KELIA is a LOF made from tutut snails (KEong – Indonesian), vegetable waste (Limbah sayur) and charcoal (Arang). This fertilizer is expected to raise tomato growth, as well as to solve the problem of the extraordinary increase of tutut snail populations in rice fields. This research aimed to determine the effect of KELIA LOF on tomato plant growth indicated by plant height, leaf length, and leaf numbers.

2. METHOD

The research was conducted in the year of 2019 at Green House Biology Department Universitas Negeri Malang, Indonesia. It used a complete randomized design with 5 replications. The independent variable in this study was the administration of organic fertilizers with a concentration of 10%, 20%, 30%, 40%, and 50%, respectively with negative control variable (without LOF). The tomato plants growth indicated by parameters of plant height, leaf length and leaf numbers. Tomato seeds were planted in under some controlled variables: rainfall free (roof was covered by glass), planting media (soil: husk = 1: 1), watering frequency and volume (250 ml per 3 days). Liquid organic fertilizer was given to each plant 500 ml per 2 weeks. The light intensity was 100% from sun without paranet, temperature ranged between 15 to 30oC.

KELIA was made from a combination of tutut snails, vegetable waste, and charcoal with a composition ratio of 5: 5: 1. The mixture of them were then fermented by giving of EM4 for 10 days. After fermentation phase, the liquid organic fertilizer was divided into 5 groups, each group was diluted by water with different concentration (10%, 20%, 30%, 40%, and 50%, respectively). Each seed was planted in a polybag of soil-husk media, at a depth of 1-2 cm. Tomato plant growth was observed at 21, 49, and 77 days after planting. The data of plant height, leaf length and leaf numbers were statistically analyzed using the Kruskal Wallis and Friedman test with a 95% confidence level.

3. RESULTS AND DISCUSSION

3.1. Plant Height

The data of tomato plant height is presented in table 1. Based on the Friedman test, the overall treatment produced a significant difference in the growth of tomato plants (p-value = 0.007). However, when viewed from the average growth of plant height, the lowest growth is shown by tomato plants without administration of KELIA (P0). It can be seen from the table, that the optimal growth of tomato plant height is shown by KELIA fertilizer with a concentration of 50%. Based on the data analysis test using Kruskal wallis, the administration of KELIA has a significant effect on plant height at age 49 days after planting (P value = 0.011).

This is possibly due to the nutrient content (N, P, K) of 50% concentration of KELIA which almost approaches the needs of tomatoes. The less dilution, the more nutrient content it gets. The content of nitrogen acts to form amino acids and proteins and to stimulate vegetative growth [8]. The phosphor functions to stimulate cell division and enlarge cell tissue as well as transporting metabolic energy by plants [9]. Whereas Potassium is able to increase plant resistance or immunity to disease, affect photosynthesis, and as a system of transporting assimilation results, enzymes, and minerals including water [10].

Table 1. Average of plant height (cm) in three variations of days after planting

Treatment	Plant Height (cm)			Friedman (p-*value*)
	21 days	49 days	77 days	
P_0 (0%)	4.50	17.20	77.80	0.007
P_1 (10%)	4.50	19.60	89.60	0.007
P_2 (20%)	4.74	20.20	89.60	0.007
P_3 (30%)	4.46	24.60	88.60	0.007
P_4 (40%)	4.56	21.80	89.60	0.007
P_5 (50%)	4.52	22.00	109.00	0.007
Kruskal Wallis (p-*value*)	0.578	0.011	0.056	-

3.2. Leaf Length

It is shown in table 2, the best KELIA application for tomato growth indicated by leaf length, is shown at 50% concentration. This is possibly due to the nitrogen and potassium content of KELIA. Nitrogen plays an important role in vegetative growth of plants including the length of leaves. The longer leaves will produce more photosynthates. These photosynthates will affect fruit formation [2]. Based on Kruskal Wallis test, the administration of KELIA has a significant effect on leaf length at 49 and 77 days after planting (P value 0.002 and 0.006 respectively). While based on the Friedman test, the overall treatment produced a significant difference in the growth of leaf length (P value 0.007 <0.05). However, when viewed from the average growth of leaf length, the lowest leaf length was shown by tomato plants without administration of KELIA.

Table 2. Average of leaf length (cm) in three variations of days after planting

Concentration	Leaf Length (cm)			Friedman (p-*value*)
	21 days	49 days	77 days	
P_0 (0%)	2.40	6.60	8.46	0.007
P_1 (10%)	2.40	7.30	11.70	0.007
P_2 (20%)	2.70	7.90	12.64	0.007
P_3 (30%)	3.40	8.70	13.26	0.007
P4 (40%)	3.00	8.70	13.22	0.007
P_5 (50%)	2.60	7.90	13.42	0.007
Kruskal Wallis (p-*value*)	0.228	0.002	0.006	-

3.3. Leaf Number

The number of leaves is one of the determining components of plant productivity because leaves are the place of photosynthesis. If the numbers of leaves are increasing, there will be many photosynthates produced to support the formation of fruit. We can see from table 3, the number of leaves was most optimized at 30% KELIA. This result was contrary to the research of Ifantari and Ardiyanto (2015) which states that the higher the stem of the plant, the more the number of leaves [11]. This is possible because the high content of potassium at 50% concentration can inhibit the work of calsium content which acts as a leaf bud formation [12]. Based on the test of data analysis using Kruskal Wallis, the administration of KELIA has a significant effect on the number of leaves at the age of 77 days after planting (P value = 0.005). Whereas based on the Friedman test, the overall treatment produced a significant difference in the number of tomato leaves (P value = 0.007). However, when viewed from the average growth in the number of leaves, least number of leaves shown by the tomato plants without administration of KELIA

Table 3. Average of leaf number in three variations of days after planting

Concentration	Number of Leaves per stem			Friedman (p-*value*)
	21 days	49 days	77 days	
P_0 (0%)	4.00	19.60	84.00	0.007
P_1 (10%)	4.00	22.20	124.80	0.007
P_2 (20%)	4.00	23.40	145.60	0.007
P_3 (30%)	4.00	28.60	164.20	0.007
P_4 (40%)	4.00	24.80	119.20	0.007
P_5 (50%)	4.00	26.60	156.40	0.007
Kruskal Wallis (p-*value*)	1.000	0.080	0.005	

Vegetative phase in plants is a determinant point of plant productivity, because in this phase there is formation of roots, stems and leaves. If at this stage, a large and healthy root is formed, the plant will be able to achieve high productivity. It will have a large stem and wide leaves. Good leaf growth in the vegetative phase can affect fruit development which is optimal in the generative phase because the good photosynthesis from leaves is able to supply photosynthate. The weight and amount of tomatoes are influenced by the photosynthate produced [13].

KELIA comes to solve the problems of the nutrients lack from soil for tomato plants growth. Nutritional requirements of tomato plants include 4.04% nitrogen, 1% phosphor and 2.05% potassium [14]. With protein content of Tutut snail that will be decomposed into nitrogen, vegetable waste that will supply phosphor and potassium, and charcoal that will absorb toxin coming from the product of fertilizer fermentation, KELIA is expected to be able to maximize the growth of tomato plants and make the plant more resistant to phytopthora. Nitrogen is very important for the growth of stems, leaves, while Phospor can stimulate the growth of flowers, fruit seeds and roots. Potassium is very helpful for photosynthesis, transporting the results of assimilation and increasing plant resistance [15] .

Although the KELIA concentration of 30% indicates the highest number of leaves, in general, the best KELIA concentration to increase tomato plant growth is 50% concentration. It proves that the levels of N, P, K contained in KELIA can be well absorbed by tomato plants to maximize their growth. However, there are some shortcomings of this research which are not yet examined, and it will become recommendation of future research. They are: nitrogen, phosphor, and potassium content in KELIA and absorption ability of plants to KELIA. A good vegetative growth shown in the research results can not guarantee that it will impacts to the good generative growth. In other words, further researches are still needed to determine whether the administration of KELIA lead to better tomato quality.

4. CONCLUSION

This study found that KELIA was one of an alternative Liquid Organic Fertilizer (LOF) that can help optimize tomato growth. Based on four repetition of complete randomized design, KELIA with 50% concentration was the best formula for tomato growth, seen from the plant height, leaf length, and leaf numbers. This organic fertilizer is environmentally friendly so it is safe to use.

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