

The effect of interaction of types and dosages of liquid organic fertilizer on eggplant (*Solanum melongena* L.) growth and yield

Junaidi^{1*}, Nugraheni Hadiyanti¹, Nur Ulfa Turrohmah¹, Windy Sylviana¹

¹Agrotechnology Study Program, Faculty of Agriculture, Kadiri University, Kediri, East Java, Indonesia

*Corresponding author's email: junaidi@unik-kediri.ac.id

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ABSTRACT

The aim of this research was to examine the effect of the interaction between the treatment of type and the dose of liquid organic fertilizer on the growth and yield of eggplant. The design of research was a completely randomized design (CRD) of two factors. The first factor is liquid organic fertilizer types consisting of 2 levels: kitchen waste liquid organic fertilizer (P1), banana weevil liquid organic fertilizer (P2), and factor two is liquid organic fertilizer doses consisting of 4 levels: without liquid organic fertilizer (D0); 10 ml/tan (D1); 20 ml/tan (D2); 30 ml/tan (D3). Observations of growth when the eggplant plants were 10 DAP with an interval of 10 days until the plants were 40 days old. The data obtained were analyzed by variance analysis and a further test by using 5% Least Significance Different (LSD) tests. The combination of type and doses of liquid organic fertilizer does not affect all variables. The liquid organic fertilizer significantly affected the plant height and number of leaves at all observed ages, stem diameters at 20, 30, and 40 days after plant, and fruit weight. Banana weevil liquid organic fertilizer gives better results for eggplant growth and yield than kitchen waste liquid organic fertilizers. The liquid organic fertilizer dose of 30 ml/plant resulted in the best eggplant growth and yield.

Keywords: eggplant, dosage, liquid organic fertilizer

INTRODUCTION

Eggplant (*Solanum melongena* L.) is one of the vegetable crops in Indonesia and is well known to both rural and urban communities. The nutritional content of eggplant fruit is that every 100 grams of raw eggplant contains 26 calories, 1 gram of protein, 0.2 grams of carbohydrate, 25 IU of vitamin A, 0.04 grams of vitamin B and 5 grams of vitamin C (Sunarjono, 2013). In eggplant, high levels of potassium and low sodium are useful for health, especially for controlling high blood pressure (Sakri, 2012), and contain anti-cancer substances and proteases that can fight cancer-triggering substances (Fitrianti et al., 2018).

The market demand for eggplant in Indonesia increases as the population increases. Even though national eggplant production tends to increase every year, eggplant production is relatively low and only contributes to 1% of the world's eggplant needs. The low eggplant production is partly due to the limited area for eggplant cultivation and the cultivation culture is not yet intensive (Alhadi, 2018).

The eggplant business development has good prospects because eggplant prices are high enough (Charlos et al., 2021). The advantage of eggplant cultivation is that it can be harvested within three months, and it doesn't take a long time (Lestari, 2019). Sustainable plant cultivation and increasing plant yield organically, one of which is using organic fertilizers. Organic matter that returns to the soil can maintain the physical, chemical, and biological fertility of the soil (Iswahyudi et al., 2020). Ways to increase the growth and yield of eggplant plants can be done, among others, by using various kinds and dosages of liquid organic fertilizers. Liquid organic fertilizer can maintain the balance

of nutrients in the soil. Organic fertilizers contain macro and micronutrients needed by plants. Liquid organic fertilizer is good for the environment because it does not cause environmental pollution and provides soil microorganisms (Pantang et al., 2021). Liquid organic fertilizers can be processed by simple technology, for example, liquid organic fertilizer from kitchen waste and banana weevils.

Kitchen waste includes wet waste, because it decomposes easily and also contains a lot of water (Setiati & Nurlaila, 2014). Kitchen waste liquid organic fertilizer has several ingredients such as N-Total 0.33%, P₂O₅ 2.98%, K₂O 3.28%, Ca 1.98%, Mg 2.66%, Fe 212 ppm, Mn 0.852 ppm, Na 118 ppm, Zn 169 ppm. and pH 4.54, C-Organic 7.85% (Wahida & Suryaningsih, 2016). Banana weevil contains carbohydrates (66%), protein, water, and minerals (Damanik et al., 2014). The banana weevil has a starch content of 45.4% and a protein content of 4.35%. Banana weevil is known to contain microbes that decompose organic matter. The decomposer microbes are usually the outside and inside of the banana weevil (Suhastyo et al., 2013).

The local microorganism of the banana weevil will act as a decomposer for the organic matter to be processed. The opinion (Wulandari & Winarsih, 2022) is that 100 g of dried banana hump contains 66.2 g of carbohydrates, and fresh banana hump contains 11.6 g of carbohydrates. What needs to be considered into account before the application of liquid organic fertilizer is the dosage used. For this reason, it is necessary to research to determine the effect of the interaction between the type of treatment and the dose of liquid organic fertilizer on the growth and yield of eggplant plant.



MATERIALS AND METHODS

The research was conducted from December 2021 to March 2022 in the greenhouse of the Faculty of Agriculture, University of Kadiri, Jalan Selomangleng No. 1 Pojok Village, Mojoroto District, Kediri City, East Java Provinces. The tools used in the study included: sieves, polybags, buckets, tape measure, measuring cups, knives, scissors, plastic, scales, treatment labels, and stationery, while the ingredients were eggplant seeds, liquid organic fertilizer kitchen waste, and banana weevil.

Research using Completely Randomized Design (CRD). The first factor is the type of liquid organic fertilizer (P) which consists of 2 levels, namely: liquid organic fertilizer for kitchen waste (P1) and liquid organic fertilizer for banana weevils (P2). The second factor was the POC dose which consisted of 4 levels, namely: without liquid organic fertilizer (D0); 10 ml/tan (D1); 20 ml/tan (D2); and 30 ml/tan (D3). Each treatment combination was repeated three times.

The research implementation included making liquid organic fertilizer for kitchen waste, banana weevil liquid organic fertilizer, preparation of planting media, planting, application of liquid organic fertilizer aged two weeks after planting by spraying it on the plants once every three days, and plant maintenance. Harvest eggplant at approximately 34 weeks after planting. The observed variables in this study were plant height, number of leaves, fruit length, number of fruit per plant, fruit weight per polybag, leaf area, and fruit dry weight. Observation of growth from the age of 10 days after planting (DAP) at intervals of 10 days. Measurement of leaf area using the constant method. Observational were analyzed by analysis of variance to examine whether there was an effect of treatment on the observed variables. If the results are significantly different, then using to 5% least significant difference (LSD) tests.

RESULT AND DISCUSSION

Plant Height

Analysis of plant height variance showed no

interaction between treatment of types and doses liquid organic fertilizer on plant height at all ages of observation. Eggplant plant height was affected by the treatment of types and the dose of liquid organic fertilizer at all ages of observations (Table 1).

Giving banana weevil liquid organic fertilizer produced higher eggplant plants than plants given kitchen waste liquid organic fertilizer. the banana weevil liquid organic fertilizer contains more N, P, and K elements than the N, P, and K elements in kitchen waste liquid organic fertilizer. According to (Bahtiar et al., 2017), banana weevil contains 3087 ppm NO₃, 1120 ppm NH₄, 439 ppm P₂O₅, and 574 ppm K₂O. Based on the results of the study (Wulandari & Winarsih, 2022), stated that liquid organic fertilizer for kitchen waste contains 0.26% N, 0.14% P, and 0.13% K.

Liquid organic fertilizer dose treatment also significantly affected plant height. The application of liquid organic fertilizer to eggplant plants causes better plant growth, as seen from the height of the eggplant plants. The higher the dose of liquid organic fertilizer given to the plants causes the plants to grow taller. The application of high doses of liquid organic fertilizer has a good effect on meeting the nutrient needs of eggplant plants so that their growth is better.

Number of Leaves

Analysis of the variance in the number of leaves showed that the treatment of type and the dose of liquid organic fertilizer each had a significant effect on the number of leaves at all ages of observation, but there was no significant interaction between the two treatments. The effect of the types and doses of liquid organic fertilizer on the number of leaves in Table 2.

Eggplant plants using liquid organic fertilizer from banana weevils produced more leaves than plants using liquid organic fertilizer from kitchen waste. The content of the elements N, P, and K in banana weevil liquid organic fertilizer is more than that of kitchen waste liquid organic fertilizer. According to (Rina et al., 2020), the element N will accelerate plant growth, including the number of leaves.

Table 1. Effect of liquid organic fertilizer types and doses on plant height.

Treatment	Plant height (cm) at age (DAP)			
	10	20	30	40
P1	17,17 a	34,42 a	86,58 a	105,33 a
P2	18,54 b	37,08 b	94.25 b	108,42 b
BNT 5%	1,17	3,87	6,61	3,01
D0	14,92 a	29,33 a	72,50 a	92,67 a
D1	16,17 b	32,83 ab	89,67 b	102,67 b
D2	18,50 c	35,67 b	93.75 bc	114,50 c
D3	21,83 d	45,17 c	105.75 c	117,67 c
BNT 5%	1,66	5,47	9,34	4,25

Note: Numbers accompanied by the same letters in the same column are not significantly different on the BNT test at the 5% level

Table 2. The effect of the types and doses of liquid organic fertilizer on the number of leaves.

Treatment	Number of leaves (strands) age (DAP)			
	10	20	30	40
P1	5.50 a	7.83 a	10.33 a	12.25 a
P2	6.25 b	8.92 b	12.08 b	14.17 b
BNT 5 %	0.68	0.98	1.51	1.77
D0	4.67 a	7.00 a	9.17 a	10.83 a
D1	5.67 b	8.00 ab	10.33 ab	12.17 a
D2	6.17 b	8.67 bc	11.83 bc	14.70 b
D3	7.00 c	9.83 c	13.50 c	15.67 b
BNT 5 %	0.97	1.39	2.13	2.49

Note: Numbers accompanied by the same letters in the same column are not significantly different on the BNT test at the 5% level

Element P will activate the growth of plant tissue that forms the growing point of plants. The element K can accelerate the absorption of water and nutrients and help transport photosynthetic results from leaves to plant tissue. Table 2 also shows that the highest number of leaves was produced by the highest liquid organic fertilizer dose treatment, namely 30 ml/plant (D3), although this was not significantly different from the treatment with a liquid organic fertilizer dose of 20 ml/plant (D2). The higher the provision of liquid organic fertilizer, the more N, P, and K elements are available to plants, resulting in faster absorption of water and nutrients, faster tissue growth, and faster plant growth (Rina et al., 2020), so the number of leaves formed more.

Stem Diameter

Analysis of stem diameter variance showed that there was no interaction between types and doses liquid organic fertilizer on stem diameter at all ages of observation. Treatment types and dosage of liquid organic fertilizer affected plant diameter at 20, 30, and 40 DAP, whereas when the plants were ten DAP the show two treatments did not significant differences (Table 3).

Treatment types and doses of liquid organic fertilizer had no significant effect on stem diameter when the plants were 10 DAP. Eggplant plants aged 10 DAP are still

relatively small, so they have not shown a response from the treatment given. After the plants were 20 DAP, the effect of each treatment was evident. Eggplant plants aged 10 DAP are still relatively small, so they have not shown a response from the treatment given. After the plants were 20 DAP, the effect of each treatment was evident. The liquid organic fertilizer application of banana weevil produces plants with a larger stem diameter than the liquid organic fertilizer application for kitchen waste. Banana weevil liquid organic fertilizer contains more elements N, P, and K than kitchen waste liquid organic fertilizer. Element K can increase the absorption of water and nutrients and help transport photosynthetic results from leaves to plant tissues. The P element can increase the growth of tissues that form the growing point of plants, while the N element will accelerate plant growth (Rina et al., 2020).

The higher the liquid organic fertilizer dose, the eggplant plant will have a larger stem diameter. Eggplant plants with the highest liquid organic fertilizer dose of 30 ml/tan (D3) produced a stem diameter of 1.95 cm, while eggplant plants produced a stem diameter of 1.35 cm. eggplant plants that are given liquid organic fertilizer with higher doses, the need for nutrients needed by plants is more available so that plant growth will be better and the stem diameter will be big.

Table 3. Effect of types and doses liquid organic fertilizer on stem diameter

Treatment	Stem diameter (cm) at age (DAP)			
	10	20	30	40
P1	0.73	0.97 a	1.29 a	1.57 a
P2	0.74	1.07 b	1.42 b	1.80 b
BNT 5 %	ns	0.09	0.12	0.2
D0	0.63	0.84 a	1.08 a	1.35 a
D1	0.7	0.98 ab	1.32 b	1.6 ab
D2	0.78	1.06 bc	1.43 bc	1.85 b
D3	0.82	1.18 c	1.58 c	1.95 c
BNT %	ns	0.14	0.16	0.28

Note: Numbers accompanied by the same letters in the same column are not significantly different on the BNT test at the 5% level

Table 4. Effect of types and doses liquid organic fertilizer on fruit length, fruit diameter, fruit number, and fruit weight every plant

Treatment	Fruit Length (cm)	Fruit Diameter (cm)	Fruit Number (biji)	Fruit Weight Per Plant (gr)
P1	20.04	4.97	4.00	446.83 a
P2	20.12	5.03	4.33	499.17 b
BNT 5 %	ns	ns	Ns	48.61
D0	19.07	4.67	2.83 a	351.33 a
D1	19.42	4.90	4.00 b	448.33 b
D2	20.75	5.15	4.67 c	511.67 b
D3	21.08	5.30	5.17 c	580.67 c
BNT % %	ns	ns	0.66	68.74

Note: Numbers accompanied by the same letters in the same column are not significantly different on the BNT test at the 5% level

Fruit Length, Fruit Diameter, Fruit Number, and Fruit Weight Every Plant

The results of the analysis of variance showed that there was no interaction between the treatment of type and doses liquid organic fertilizer on fruit length, fruit diameter, fruit number, and fruit weight per plant. Treatment of various types of liquid organic fertilizer did not affect fruit length, fruit diameter, and the number of fruit but did affect fruit weight every plant. Liquid organic fertilizer dose treatment did not significantly affect fruit length and fruit diameter, but the number of fruit and fruit weights every plant showed a significant effect. The effect of type and doses liquid organic fertilizer on fruit length, fruit diameter, number of fruit, and fruit weight served in Table 4.

Treatment types and doses of liquid organic fertilizer did not affect fruit length and fruit diameter at all ages of observation. This was possible because the parameters of eggplant fruit length and fruit diameter were more influenced by genetic factors than factors of type and dose liquid organic fertilizer (environmental). This is in accordance with the opinion (Dwidjoseputro, 1998), that factors affecting plant growth can be divided into two factors, namely genetics and environment.

The treatment of type liquid organic fertilizer had no significant effect on the number of fruits. This means that the growth of eggplant fruit diameter is more influenced by internal factors (genetic) than environmental factors (various liquid organic fertilizer treatments). The essential nutrient content of liquid organic fertilizer for kitchen waste and liquid organic fertilizer for banana weevil is relatively the same, that is, they both contain elements of nitrogen (N), phosphorus (P) and potassium (K). Banana weevil various liquid organic fertilizer treatments contains 3087 ppm NO₃, 1120 ppm NH₄, 439 ppm P₂O₅ and 574 ppm K₂O (Bahtiar et al., 2017), while research (Wulandari & Winarsih, 2022) found that various liquid organic fertilizer treatments kitchen waste contains 0.26% N element, P 0.14%, and K 0.13%.

Plants that were not given treatment liquid organic fertilizer produced fewer eggplant fruit compared to plants that were given treatment liquid organic fertilizer because liquid organic fertilizer contained the essential elements N, P,

and K, which had a good effect on plant growth so that the yield (number of fruits) produced also increased. The treatment of liquid organic fertilizer with dose 30 ml/plant (D3) produced eggplant fruit with the largest diameter, namely 5.17 cm, although it was not significantly different from the D2 treatment (20 ml/tan), namely 4.67 cm. This is possible the liquid organic fertilizer of higher doses causes plants to obtain more nutrients than plants given liquid organic fertilizer treatments at lower doses. In Table 4, it can also be seen that the weight of the fruit planted is affected by the treatment of type liquid organic fertilizer. Plants that were given banana weevil liquid organic fertilizer treatments produced greater eggplant fruit weight than plants that were given kitchen waste liquid organic fertilizer, because the content of elements N, P, and K in banana weevil liquid organic fertilizer was more than that of kitchen waste liquid organic fertilizer. Banana weevil liquid organic fertilizer contains 3087 ppm NO₃, 1120 ppm NH₄, 439 ppm P₂O₅ and 574 ppm K₂O (Bahtiar et al., 2017), while kitchen waste liquid organic fertilizer contains 0.26% N, 0.14% P, and 0 K, 13% (Wulandari & Winarsih, 2022).

CONCLUSION

There was no significant interaction between the treatment of type and dose of liquid organic fertilizer for all observed parameters. The type liquid organic fertilizer treatments affected plant height and number of leaves at all ages of observation, stem diameter at 20, 30 and 40 DAP, and fruit weight per plant. Liquid organic fertilizer dose treatment affected plant height and number of leaves at all ages of observation, stem diameter at 20, 30, and 40 DAP, number of fruit and fruit weight of the plants. The application banana weevil liquid organic fertilizer resulted in better growth, and production eggplant. The recommended dose of liquid organic fertilizer for eggplant plants is 30 ml/plants.

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest regarding the publication of manuscripts.

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