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Influence of Organic Liquid Fertilizer on The Growth and Production of Purple Eggplant (*Solanum melongena*)

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Abstract

Eggplant production in Indonesia is still low and only accounts for 1% of the world's needs, this is because the cultivation culture is still not intensive. Infertile soil is also a factor in low eggplant production. In order for growth to be good, it must look at the ideal growing conditions and nutrients in the soil. This study aims to determine the optimal concentration of liquid organic fertilizer in increasing the growth and production of purple eggplant plants. The research design applied is a non-factorial Randomized Group Design (RGD) consisting of 1 factor, namely Liquid Organic Fertilizer, with 4 experimental levels, namely P0 (0 ml /l water), P1 (50 ml /l water), P2 (100 ml /l water), P3 (150 ml /l water). The results showed that the concentration of liquid organic fertilizer had a very significant effect on all variables observed, except the number of fruits, fruit weight and production weight were not significantly different. LOF treatment with a concentration of 150 ml/l water gave the best results on the parameters of plant height, stem diameter, number of flowers, number of fruits, fruit length, fruit weight, production weight and production ha/ton

Keywords: *Eggplant; Fertilizer; Organic; Production*

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INTRODUCTION

Agriculture is the most important sector in the economic progress of people in Indonesia. In this modern era, there are many new types of commodities that can be cultivated, one of which is eggplant cultivation. This horticultural product is always needed by the community every day and is an important part of efforts to increase agricultural production which is useful as a source of nutrition in supporting public health and increasing community income, especially for farmers (Aisyah et al., 2021).

Eggplant (*Solanum melongena* L) is one of the vegetable plants from the Solanaceace tribe. This plant comes from Asia, namely India. Currently eggplant has spread widely throughout the world both tropical and sub-tropical countries (Triadiawarman, 2019). This eggplant plant can grow in all types of fertile soil at an altitude of 1200 meters above sea level (Jariyah et al., 2022). Eggplants are loved by many people because they taste good and can be used as vegetables or fresh vegetables. Eggplants are also good for heart health, reducing cholesterol and diabetes, and good for digestion (Aisyah et al., 2021). Another use of eggplant is as a raw material for traditional medicine for bone cracks, urine, and fever. The price of eggplant is quite cheap so it is affordable by the community. Its marketing distribution is not only limited to traditional markets, but also to supermarkets or convenience stores (Permadi et al., 2018).

The national production of eggplant in Indonesia in 2022 was 691,738 tons. Based on data from BPS-Statistics Indonesia (2023) the harvest area of eggplant in 2022 was 50,400 ha and in 2023 the harvest area was 49,458 ha and production reached 699,896 tonnes. Judging from the data, it shows that the productivity of purple eggplant plants has increased, this figure shows that purple eggplants provide quite good market opportunities, especially to meet domestic market demand and recently purple eggplants have successfully penetrated foreign markets (Habibie, 2020).When viewed from the value of productivity, the numbers are still relatively low. So it needs efforts to apply maximum cultivation technology so that it can increase its productivity value. One of them is by applying the right fertilization technology. Eggplant plant growth and production will be fast when the nutrients stored in the soil are sufficient (Lestari et al., 2019). Infertile soil is also a factor in low eggplant production. In order for growth to be good, it must look at the ideal growing conditions and nutrients in the soil (Sianturi et al., 2022).

In an effort to meet the needs of nutrients for plants, it can be obtained from inorganic and organic fertilizers, but excessive use of inorganic fertilizers can damage soil quality, reduce soil fertility, reduce biodiversity and contaminate agricultural products by chemicals (Herdiyanto & Setiawan, 2015). Organic Fertilizers, which are fertilizers derived from plant, animal or human residues such as manure, green manure and compost (humus) in the form of liquids or solids which, among others, can improve the physical properties and structure of the soil, can increase water holding capacity, soil chemistry, soil biology (Firmansyah et al., 2017).

Liquid organic fertilizer (LOF) is an alternative to inorganic fertilizers. The advantage of using liquid organic fertilizer is that if sprayed on the leaves and some of the fertilizer falls to the ground, it can still be utilized by plants (Rajiman, 2019). Efforts to increase the quantity and quality of growth and production of eggplant plants can be done by using liquid organic fertilizer (Marewa, 2020). Liquid organic fertilizer is the weathering of the remaining decay of organic materials derived from plants, animal waste, and human waste processed by biotechnology (Amir & Gusmiatun, 2021). The benefits of using organic fertilizers are that environmental pollution due to pesticides can be reduced. In addition, organic fertilizers can improve soil structure, increase fertility and nutrient availability for plants (Abror & Harjo, 2018).

Liquid organic fertilizer (LOF) is a solution of organic materials derived from crop residues, animal and human waste that contains more than one element. The advantages of liquid organic fertilizer are that it can overcome nutrient deficiencies quickly, has no problem leaching nutrients, and is also able to provide nutrients quickly. Compared to inorganic fertilizers, liquid fertilizers generally do not damage the soil and plants despite frequent use. These fertilizers also have binding agents so that the fertilizer solution applied to the soil surface can be directly Solid organic fertilizers can improve soil structure and the negative effects caused by these fertilizers are not as great as inorganic fertilizers used by plants (Moi, 2015). Organic fertilizers contain humic acid and folic acid as well as growth regulators that can accelerate plant growth. The frequency of fertilizer application with different doses causes different leaf number production results and the right frequency will accelerate the rate of leaf formation (Sembiring & Sebayang, 2020). The purpose of this study was to determine the effect of liquid organic fertiliser application and optimum concentration on the growth and production of purple eggplant plants.

METHOD

This research will be carried out in the research field of Pembangunan Panca Budi University in Dusun 3 Sampe Cita Village, Kutalimbaru District, Deli Serdang Regency, North Sumatra with an altitude of ± 28 meters above sea level. Will be conducted in January 2024 until completion. The materials used in this research are purple eggplant seeds mustang F1 variety, top soil, firewood husks, polybags measuring 30 cm x 30 cm, oil palm empty bunch waste, banana peel waste, gamal leaves, eggshells, papaya skin, rice washing water and moringa leaves. And the tools used in this research are hoes, meters, paddles, stationery and smartphone (camera).

The research design applied is a non-factorial Randomized Group Design consisting of 1 factor, namely Liquid Organic Fertilizer, with 4 experimental levels, namely P0 (0 ml/1 water), P1 (50 ml/1 water), P2 (100 ml/1 water), P3 (150 ml/1 water). Each treatment was repeated 3 times so there were 12 experiments. Observational data were analysed using the Anova test to determine diversity and if there was a significant difference, followed by the DMRT (Duncan Multiple Range Test).

Making of Liquid Organic Fertilizer

Making Liqiud Organic Fertilizer (LOF) by providing materials of empty palm bunches, Moringa leaves, banana and papaya fruit peels, gamal leaves, eggshells of each waste 1 kg, rice washing water, EM4 1 liter, molasses 1 liter, coconut water 2 liters. How to make LOF is to cut the material that has been prepared and then wash it, then the waste pieces are put into the barrel for LOF fermentation. Furthermore, the EM4 solution is made with the composition of coconut water, EM4, and molasses. Then the EM4 solution was stirred for a while, then allowed to stand for several hours. After that, the EM4 solution is mixed with the waste that has been cut earlier, after that stir it evenly, then close the barrel fertilizer tightly and open the barrel 1 time in two weeks, this aims to remove the gas

in the LOF. Let stand for about 3 weeks, to give time for the fermentation process to work after 3 weeks or so, procedure refers to Agustina et al., (2022) research information.

Field Preparation

Before carrying out this research, the land that will be used as a research site is first cleaned of weeds and plant debris and rocks around the area to be used. After the land is cleaned, the next plots is made for laying polybags with a plot size of 80 cm x 80 cm, with a distance of 30 cm between plots and a plot height of about 30 cm which functions to keep plants away from standing water when it rains.

Sowig

Eggplant seed is sown using Mustang seedlings in topsoil mixed with firewood shavings. Water the seedlings at least once a day in the afternoon and after two weeks the seedlings are ready to be transferred to a larger poly bag. The characteristics of the plants ready for planting are the appearance of 3 complete leaves and a height of ± 7.5 cm.

Planting

After the eggplant seedlings that have been seeded are ± 2 weeks old, and have 3 perfect leaves, then planting is carried out. Eggplant seedlings that were ready for transplanting were then put into polybags that had been placed on the land. Each polybag was planted with one eggplant seedling with a depth of ± 5cm. The observation of plant height and diameter was carried out after 3 weeks after planting, the observation of the number of flowers was carried out after the appearance of flowers on the plant, the calculation of the number of fruits was carried out when the eggplant flowers had produced fruit, and the parameters of fruit length, fruit weight, production weight and production per hectare were carried out after harvest.

RESULT AND DISCUSSION

Plant Height

The results of the analysis of variance explained that the LOF treatment gave a very significant response at the age of 3, 4, and 5 Week after planting (WAT). The results of the average height of eggplants after the DMRT (Duncan Multiple Range Test) test can be seen in Table 1. Table 1 shows that the effect of LOF on the height of purple eggplant plants aged 3, 4, and 5 weeks after planting shows a very real effect, where the highest results of purple eggplant plants are found in the P3 treatment (150 ml/1 Water) which is 49,20 cm and the lowest is in the P0 treatment (0 ml /1 water) which is 39,36 cm. This shows that increasing the concentration of LOF is effective in supporting nutrient absorption so that it can increase the growth of purple eggplant plant height. Giving LOF in addition to adding nutrients also improves soil aggregates, so that the soil becomes loose and can make it easier for plant roots to penetrate the soil and absorb nutrients to meet their needs (Juliansyah et al., 2023).

Tabel 1. Duncant Test Result of Average Plant Height at 3, 4, and 5 Week After Transplanting (WAT)

Treatment	Plant Height (cm)		
	3 WAT	4 WAT	5 WAT
P0 (0 ml/l water)	22,08 cB	30,08 bB	39,36 cB
P1 (50 ml/l water)	24,49AbBc	35,85 aA	44,38 AbB
P2 (100 ml/l water)	25,88 aAbB	37,62 aA	47,11 aAb
P3 (150 ml/l water)	28,43 aA	39,56 aA	49,20 aA

Notes: Numbers in the same column followed by unequal letters indicate significant differences at the 5% level (lowercase letters) and very significant at the 1% level (uppercase letters)

Savitri et al., (2021) stated that the application of oil palm empty fruit bunch compost to the soil can provide nutrients for plants, both macro and micro nutrients. In addition, the application of TKKS compost as organic fertilizer is also thought to improve the physical properties of the soil, so that root penetration to absorb nutrients can be better. Rozy et al., (2018) stated that the improvement of physical properties of the soil has a positive impact on plant root growth and nutrient absorption. Isabella (2016) states that gamal liquid organic fertilizer has an effect on mustard plants, the results of this study show that gamal leaf liquid organic fertilizer with a concentration of 30% gives the greatest response and affects the number of leaves, leaf area and plant height.

Diameter of Stem

The results of the analysis of variance explained that the LOF treatment gave a very significant response at the age of 3, 4, and 5 WAT. The average results of stem diameter of purple eggplant plants after the DMRT (Duncan Multiple Range Test) test can be seen in Table 2.

Tabel 2. Duncant Test Result of Average Diameter of Stem at 3, 4, and 5 Week After Transplanting (WAT)

Treatment	Diameter of Stem (mm)		
	3 WAT	4 WAT	5 WAT
P0 (0 ml/l water)	8,52 cC	11,79 cC	13,62 Cb
P1 (50 ml/l water)	9,49 bBC	12,41 AbBc	14,68 cB
P2 (100 ml/l water)	10,63 aAbB	14,12 aAbB	17,28 bA
P3 (150 ml/l water)	11,66 aA	15,59 aA	18,74 aA

Notes: Numbers in the same column followed by unequal letters indicate significant differences at the 5% level (lowercase letters) and very significant at the 1% level (uppercase letters)

Table 2 shows that the effect of LOF on the diameter of the stem of purple eggplant plants aged 3, 4, and 5 weeks after planting shows a very significant effect, where the highest yield of purple eggplant plants is found in the P3 treatment (150 ml/l water) which is 18,74 mm and the lowest is in the P0 treatment (0 ml /1 water) which is 13,62 mm. It is suspected that rice washing water has many benefits for plants, one of which is an increase in stem, fruit weight, an increase in plant height

and an increase in the number of leaves (Nugroho et al., 2019). Rice washing water contains many components such as carbohydrates, nitrogen, phosphorus, potassium, magnesium, sulfur, iron and vitamin B1 (Hairuddin et al., 2018).

Based on the results of the analysis of solid and liquid organic fertilizers from kepok banana peel conducted by Akbari (2015) there is Corganik 0.55 %; N-total 0.18 %; P2O5 0.043 %; K2O 1.137 %; C/N 3.06 % and pH 4.5. From the analysis above, banana peel contains nutrients that are much needed by plants, namely nitrogen. Nitrogen is an important constituent element in protein synthesis, in stimulating the growth of stems, branches and leaves in plants as well as in the formation of leaf green substances (chlorophyll) and plays a role as a form of protein, fat, and various other organic compounds. Banana peel is a fresh organic material that contains potassium, if used as fertilizer directly in a fresh state, the organic complex in banana peel cannot be used directly by plants for growth. The content of eggshells consists of potassium of 0,121 %, calcium of 8,977 %, phosphorus of 0,394% and magnesium of 10,541 % (Sundari et al., 2023). The provision of eggshell LOF contains nitrogen and potassium nutrients that affect the formation of stem diameter growth of tomato plants. Nitrogen is part of proteins and protoplasm, enzymes, biological catalysts that function to accelerate metabolic processes. While potassium plays a role in forming proteins, hardening plant stems, increasing plant resistance from disease (Hakim et al., 2022).

Total of Flowers

The results of the analysis of variance explained that the LOF treatment gave a very significant response at the age of 7, 8, 9 and 10 WAT. The average results of the number of flowers of purple eggplant plants after the DMRT (Duncan Multiple Range Test) test can be seen in Table 3.

Tabel 3. Duncant Test Result of Average Total of Flowers at 7, 8, 9, and 10 Week After Transplanting (WAT)

Treatment	Total of Flowers (Flowers)			
	7 WAT	**8 WAT**	**9 WAT**	**10 WAT**
P0 (0 ml/l water)	2,73 bB	5,83 bB	6,67 cB	8,67 cC
P1 (50 ml/l water)	3,50 aAB	12,67 aA	10,00 AbBc	12,00 bB
P2 (100 ml/l water)	3,97 aA	13,5 aA	11,83 aAbB	13,00 aAB
P3 (150 ml/l water)	3,97 aA	16,17 aA	13,83 aA	16,00 aA

Notes: Numbers in the same column followed by unequal letters indicate significant differences at the 5% level (lowercase letters) and very significant at the 1% level (uppercase letters).

Table 3 shows that the effect of LOF on the number of flowers of purple eggplant plants aged 6, 7, 8 and 9 WAT shows a very real effect, where the highest yield of purple eggplant plants is found in the P3 treatment (150 ml/l water), namely 16,00 flowers and the lowest is in the P0 treatment (0 ml /1 water), namely 8,67 flowers. This is in accordance with the research of Hisani & Mallawa (2020) which states that banana peel liquid organic fertilizer and eggshells are able to increase the number of flowers on peanut plants due to the phosphorus and kalim content in

LOF. Phosphorus is also very important in fruit formation as stated by Hisani & Mallawa (2020) that phosphorus stimulates the formation of flowers, fruits and seeds and can even accelerate fruit ripening. In addition to the phosphorus element of banana peel LOF, eggshells also have a fairly high potassium content where the potassium element is also needed for pod filling.

Fruit Total

The results of the analysis of variance explained that the LOF treatment gave a real effect response at the age of 8, 9, 10 WAT and had no real effect at the age of 10 WAT. The average results of the number of fruits of purple eggplant plants after the DMRT (Duncan Multiple Range Test) test can be seen in Table 4.

Tabel 4. Duncant Test Result of Average Total of Fruit at 8, 9, and 10 Week After Transplanting (WAT)

Treatment	Total of Fruit (Fruit)		
	8 WAT	**9 WAT**	**10 WAT**
P0 (0 ml/1 water)	2,07 bB	3,67 bB	4,87 aA
P1 (50 ml/1 water)	3,03 aA	3,97 bB	5,00 aA
P2 (100 ml/1 water)	3,10 aA	4,60 bB	5,33 aA
P3 (150 ml/1 water)	3,37 aA	6,03 aA	6,30 aA

Notes: Numbers in the same column followed by unequal letters indicate significant differences at the 5% level (lowercase letters) and very significant at the 1% level (uppercase letters).

Table 4 shows that the effect of LOF on the number of fruits of purple eggplant plants aged 9 weeks after planting showed no significant effect, where the highest yield of purple eggplant plants was found in the P3 treatment (150 ml/1 water), namely 6,30 fruits and the lowest was in the P0 treatment (0 ml /1 water), namely 4,87 fruits. According to Tomia & Pelia, (2021) that moringa leaf liquid organic fertilizer with a concentration of 150 ml / water has no effect on the number of purple eggplant fruits, so it can be assumed that in addition to the nitrogen element, the availability of P nutrients contained in moringa leaf fertilizer can also process fruit formation on purple eggplant.

Fruit Length

The results of the analysis of variance explained that the LOF treatment gave a very significant response. The average fruit length of purple eggplant plants after the DMRT (Duncan Multiple Range Test) test can be seen in Table 5. Table 5 shows that the effect of LOF on the fruit length of purple eggplant plants showed a real effect, where the highest results of purple eggplant fruit length were found in the P3 treatment (150 ml/1 water) which was 17,21 cm and the lowest was in the P0 treatment (0 ml/1 water) which was 12,41 cm. Wasis & Badrudin (2019) The availability of nutrients in sufficient and balanced amounts supported by a favorable environment, plant growth will be better and the photosynthesis process runs smoothly so as to increase the assimilate which is then used by plants for growth and

fruit formation. Therefore, the more assimilate that is used for growth and as a supply material for fruit formation, the growth increases and the fruit formed becomes more and has a greater weight.

Tabel 5. Duncant Test Result of Average Fruit Length of Purple Eggplant

Treatment	Length of Fruit (cm)		
	Harvest I	Harvest II	Harvest III
P0 (0 ml/l water)	12,77 cC	13,18 cC	12,41 cB
P1 (50 ml/l water)	13,17 BcC	12,09 bBcC	12,74 cB
P2 (100 ml/l water)	15,56 AbB	14,37 bB	14,18 bB
P3 (150 ml/l water)	17,89 aA	18,09 aA	17,21 aA

Notes: Numbers in the same column followed by unequal letters indicate significant differences at the 5% level (lowercase letters) and very significant at the 1% level (uppercase letters).

Fruit Weight

The results of the analysis of variance explained that the LOF treatment gave a very real effect response. The average fruit weight of purple eggplant plants after the DMRT (Duncan Multiple Range Test) test can be seen in Table 6. Table 6 shows that the effect of LOF on the fruit weight of purple eggplant plants showed no significant effect, where the highest results of purple eggplant fruit length were found in the P3 treatment (150 ml/l water) which was 138,27 g and the lowest was in the P0 treatment (0 ml/l water) which was 129,23 g. This is because the nutrients in the soil used as planting media for eggplant plants have low nitrogen nutrients. This is because the nutrients in the soil used in eggplant planting media have low nitrogen nutrients. Therefore, plant weight affects the number of leaves. The more the number of leaves, the heavier the plant will be and can provide maximum production. According Junia (2017) that by increasing the number of plant leaves it will automatically increase plant weight, because leaves are zinc for plants.

Tabel 6. Duncant Test Result of Average Weight of the Purple Eggplant Fruit

Threatment	Weight of Fruit (g)		
	Harvest I	Harvest II	Harvest III
P0 (0 ml/l water)	118,20 aA	134,43 aA	129,23 aA
P1 (50 ml/l water)	122,40 aA	134,90 aA	132,20 aA
P2 (100 ml/l water)	125,20 aA	135,93 aA	135,00 aA
P3 (150 ml/l water)	28,67 aA	137,43 aA	138,27 aA

Notes: Numbers in the same column followed by unequal letters indicate significant differences at the 5% level (lowercase letters) and very significant at the 1% level (uppercase letters).

Production Weight

The results of the analysis of variance explained that the LOF treatment gave a response that had no real effect. The average weight of purple eggplant plant production after the DMRT (Duncan Multiple Range Test) test can be seen in table 7. Table 7 shows that the effect of LOF on the production weight of purple

eggplant plants showed no significant effect, where the highest production weight of purple eggplant plants in the first harvest was found in the P3 (150 ml/1 water) treatment, namely 723,83 g and the lowest was found in the P0 (0 ml/1 water) treatment, namely 589,70 g. The second harvest was found in the P3 treatment (150 ml/1 water) which was 723,83 g and the lowest was found in the P0 treatment (0 ml/1 water) which was 646,73 g. The third harvest was found in the P3 treatment (150 ml.1 water) which was 939,30 g and the lowest was found in the P0 treatment (0 ml/1 water) which was 939,30 g.

Tabel 7. Duncant Test Result of Average Production Weight of Purple Eggplant

Treatment	Production Weight (g)		
	Harvest I	Harvest II	Harvest III
P0 (0 ml/1 water)	589,70 bC	646,73 aA	675,13 aA
P1 (50 ml/1 water	662,63 aAB	685,37 aA	729,93 aA
P2 (100 ml/1 water)	670,20 aAB	806,70 aA	778,90 aA
P3 (150 ml/1 water)	723,83 aA	1156,57 aA	939,30 aA

Notes: Numbers in the same column followed by unequal letters indicate significant differences at the 5% level (lowercase letters) and very significant at the 1% level (uppercase letters).

Production Per Hectare

The results of the analysis of variance explained that the LOF treatment gave a very significant effect response. The average results of the number of flowers of purple eggplant plants after the DMRT (Duncan Multiple Range Test) test can be seen in Table 8.

Table 8. Duncant Test Result Of Average Production Per Hectare of Purple Eggplant

Treatment	Production per Hectare (tons/ha)
P0 (0 ml/1 water)	21,54 Ba
P1 (50 ml/1 water)	21,62 bA
P2 (100 ml/1 water)	23,58 aAb
P3 (150 ml/1 water)	26,57 aA

Notes: Numbers in the same column followed by unequal letters indicate significant differences at the 5% level (lowercase letters) and very significant at the 1% level (uppercase letters).

Table 8 shows that the effect of LOF on the fruit weight of purple eggplant plants showed no significant effect, where the highest results of purple eggplant fruit length were found in the P3 treatment (150 ml/1 water) which was 26,57 tons/ha and the lowest was in the P0 treatment (0 ml / 1 water) which was 21,54 tons/ha. Priangga (2024) stated that the application of liquid organic fertilizer (LOF) has many advantages, including being able to save energy and can maintain soil moisture because this fertilizer can be poured directly onto plant roots or sprayed onto plants. In addition, LOF has a solubility rate of 100% so that its use can be more evenly distributed and there is no accumulation of fertilizer concentration in one place, thus the use of LOF can overcome nutrient deficiencies quickly, has no problem in

leaching nutrients and is able to provide nutrients needed by plants quickly. Rosa & Bustami (2017) Nutrients obtained by plants become essential nutrient supplies that are used in the process of photosynthesis in eggplant plants to produce organic compounds in the form of ATP.

Juliansyah et al., (2023) suggests that if the plant lacks nitrogen the plant will show stunted growth. The data shows that P0 (0 ml/l water) stunted growth and production. In addition to the above factors, the interaction of various internal growth factors (i.e. genetic control) and climatic, soil and biological elements also affect the absence of plant height increase. This is because the height of eggplant plants is also influenced by the environment including: climate, soil and biotic conditions.

CONCLUSION

Liquid organic fertilizer (LOF) with the composition of palm empty fruit bunch waste, banana peel waste, gamal leaves, eggshells, papaya skin, rice washing water and moringa leaves can increase the growth and production of purple eggplant plants. LOF treatment with a concentration of 150 ml/l water gave the best results in the parameters of plant height, stem diameter, number of flowers, number of fruits, fruit length, fruit weight, production weight and production ha/ton. The concentration of liquid organic fertilizer has a very significant effect on all observation variables, except the number of fruits, fruit weight and production weight.

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