



(RESEARCH ARTICLE)



Growth and production of purple eggplant (*Solanum melongena* L.) with application of chicken manure and liquid organic fertilizer of goat urine

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Abstract

It is feared that the continuous use of inorganic fertilizers at high doses could cause a decrease in soil fertility. Besides that, currently people tend to prefer organic plant products. Efforts that can be made to reduce the use of inorganic fertilizers are using liquid organic fertilizer goat urine and steps to improve soil quality require the application of manure. This study aims to determine the effect of the interaction of dosing chicken manure and the concentration of goat urine liquid organic fertilizer. This study used a factorial completely randomized design consisting of two factors, namely chicken manure with 3 dose levels of 10, 20, 30 t.ha⁻¹ and liquid organic fertilizer (LOF) of goat urine with 3 concentration levels of 10, 20, 30%. The results showed that the interaction between chicken manure and goat urine liquid organic fertilizer did not provide an increase in all observation parameters. Applying several doses of chicken manure can increase plant height and stem diameter in purple eggplant plants with the best growth found at a dose of chicken manure 20 t.ha⁻¹. Application of liquid organic fertilizer goat urine does not improve the entire parameter. Application of chicken manure dose of 20 t. ha⁻¹ and concentration of 20% LOF showed the best growth and production of purple eggplant plants.

Keywords: Chicken manure; Eggplant; Goat urine; Liquid organic fertilizer

1. Introduction

Purple eggplant (*Solanum melongena* L.) is one of the important agricultural commodities in Indonesia and has a fairly high economic value. Generally, purple eggplant fruit is used as food ingredients such as fresh vegetables or processed into various types of dishes. The nutritional content contained from 100 g of eggplant raw materials consists of 26 calories, 1 g protein, 0.2 g charcoal hydrate, 25 IU of vitamin A, 0.04 g of vitamin B, and 5 g of vitamin C [1]. Other uses of eggplant are as traditional medicine, including skin itching medicine, toothache medicine, hemorrhoids, high blood pressure, urine launcher, and is believed to facilitate the labor process if often consumed before labor [2]. Currently, consumers want food crops including vegetables that are cultivated naturally with healthy hygienic results for consumption. This can be achieved through environmentally friendly cultivation techniques, including organic farming.

Organic farming is a way of crop production by avoiding or preventing the use of synthetic chemical compounds (fertilizers, pesticides, and others). Organic farming as much as possible is carried out through crop rotation, the use of plant residues, manure (manure), beans, green manure, off farm organic waste, and maintaining biological pest control. The main goal of organic farming is to use materials and cultivation practices that can promote natural environmental balance. This will increase health and productivity as well as the interdependence between land, plants, animals and humans [3].

The continuous use of inorganic fertilizers will actually cause a decrease in soil fertility [4]. Mansyur et al [5] added that excessive use of inorganic fertilizers causes a decrease in soil organic matter content, soil vulnerability to erosion,

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decreased permeability and soil microbial populations which are indicators of low soil fertility and nutrients. Efforts that can be made to reduce the use of inorganic fertilizers are by using organic fertilizers, one of which is liquid organic fertilizer.

Liquid organic fertilizer is a solution from the decay of organic matter derived from plant residues and animal waste whose nutrient content is more than one element. The advantages of liquid organic fertilizer include being able to quickly overcome nutrient deficiencies, not having problems in nutrient leaching, and providing nutrients quickly [6]. One type of liquid organic fertilizer is goat urine liquid organic fertilizer. Goat urine production per head reaches 0.6 – 2.5 liters / day , while solid manure produced is 1 kg / head / day. Goat urine, one of the liquid organic fertilizers, contains more nitrogen, phosphorus, potassium and water compared to solid goat manure [7]. Liquid organic fertilizer is generally given through plant parts, and steps to improve soil quality require the application of manure as an effort to support the growth of eggplant.

Applying chicken manure can improve soil structure and can strengthen plant roots [8]. Mansyur et al [5] adding chicken manure has a complete nutrient content, increases water holding, soil microbiological activities, cation exchange capacity values, and improves soil structure. In Simatupang [9] the application of chicken manure with a dose of 20 t.ha⁻¹ was proven to be able to optimize plant height, leaf length and leaf width in eggplant plants.

This study aims to determine the effect of the interaction of dosing chicken manure and the concentration of goat urine liquid organic fertilizer, the effect of dosing chicken manure, and the effect of goat urine liquid organic fertilizer concentration, as well as determining the best treatment that can increase the growth and yield of purple eggplant plants.

2. Material and methods

This research was carried out at the Experimental Garden of the Faculty of Agriculture, University of Riau, Pekanbaru, Riau Province, Indonesia. The materials used in this study were eggplant seeds of Mustang F1 varieties, chicken manure, liquid organic fertilizer goat urine, vegetable aesthetics, glio TRICO-g, and water.

This study used factorial completely randomized design of two factors, namely chicken manure with 3 levels of doses of 10, 20, 30 t.ha⁻¹ and liquid organic fertilizer of goat urine with 3 levels of concentration of 10, 20, 30%. There were 9 combinations of treatments with 3 repetitions so that 27 experimental units were obtained, where each experimental unit had 4 plants.

The observations made in this study were plant height, stem diameter, flowering age, harvest age, number of fruits by plant, fruit weight by plant, fruit weight by m². The data obtained from the results of the study continued with Duncan's New Multiple Range Test (DNMRT) at the level of 5% using SAS application version 9.1.

3. Results

3.1. Plant Height

The results of variance showed that the interaction between chicken manure and goat urine liquid organic fertilizer had no significant effect, chicken manure had a significant effect and goat urine liquid organic fertilizer had no significant effect on eggplant plant height. The results of the DNMRT follow-up test level of 5% can be seen in Table 1.

Table 1 shows that the treatment of 20 t.ha⁻¹ chicken manure and 20% concentration goat urine LOF resulted in higher plant height growth compared to other treatments, in marked contrast to the treatment of 10 t.ha⁻¹ chicken manure and liquid organic fertilizer goat urine concentrations of 10% and 20%.

The application of chicken manure of 20 t.ha⁻¹ shows the best planting height and differs markedly from the application of 10 t.ha⁻¹, but differs not markedly from the application of 30 t.ha⁻¹. Application of goat urine liquid organic fertilizer with concentrations of 10%, 20%, and 30% showed unreal different results on the height of purple eggplant plants.

Table 1 Eggplant plant height (cm) with application of chicken manure and liquid organic fertilizer age 6 weeks after planting

Chicken Manure (t.ha ⁻¹)	Liquid Organic Fertilizer (%)			Average
	10	20	30	
10	47.83 a	51.16 bc	53.50 abc	50.83 b
20	54.91 abc	61.58 a	56.33 abc	57.61 a
30	54.50 abc	55.25 abc	57.50 ab	55.75 a
Average	52.41 a	56.00 a	55.77 a	

The numbers in columns and rows followed by the same lowercase letters are not real according to the DNMR test level of 5%.

3.2. Rod Diameter

The results of using variance showed that the interaction between chicken manure and goat urine liquid organic fertilizer had no significant effect, chicken manure had a significant effect and goat urine liquid organic fertilizer had no significant effect on eggplant stem diameter. The results of the DNMR test level of 5% can be seen in Table 2.

Table 2 Diameter of eggplant plant stems (mm) with manure application chickens and liquid organic fertilizer age 6 weeks after planting.

Chicken Manure (t.ha ⁻¹)	Liquid Organic Fertilizer (%)			Average
	10	20	30	
10	11.31 a	11.55 a	11.25 a	11.37 b
20	12.22 a	12.80 a	11.57 a	12.20 a
30	12.66 a	12.24 a	12.37 a	12.42 a
Average	12.06 a	12.20 a	11.73 a	

The numbers in columns and rows followed by the same lowercase letters are not real according to the DNMR test level of 5%.

Table 2 shows that the application of different doses of chicken manure and the concentration of liquid organic fertilizer differs insignificantly with respect to the diameter of the stem of eggplant. The application of chicken manure with a dose of 20 t.ha⁻¹ is given a larger diameter on purple eggplant and differs significantly from the treatment of chicken manure 10 t.ha⁻¹, but differs not significantly from the application of 30 t.ha⁻¹. The application of goat urine liquid organic fertilizer concentrations of 10%, 20%, and 30% differs insignificantly in the diameter of the stem of the purple eggplant.

3.3. Flowering Age

Table 3 Flowering age of eggplant plants (HST) with manure application chicken and liquid organic fertilizer

Chicken Manure (t.ha ⁻¹)	Liquid Organic Fertilizer (%)			Average
	10	20	30	
10	30.66 a	30.66 a	29.33 a	30.22 a
20	29.33 a	30.00 a	28.66 a	29.33 a
30	28.66 a	29.33 a	29.33 a	29.11 a
Average	29.55 a	30.00 a	29.11 a	

The numbers in columns and rows followed by the same lowercase letters are not real according to the DNMR test level of 5%.

The results of variance showed that the interaction between the treatment of chicken manure and goat urine liquid organic fertilizer, chicken manure and goat urine liquid organic fertilizer had no significant effect on the flowering age of eggplant. The results of the DNMR test level of 5% can be seen in Table 3.

Table 3 shows that the application of various treatments of chicken manure and goat urine liquid organic fertilizer showed different results not significantly on the flowering age of purple eggplant. Applying chicken manure showed different results not significantly with flowering age, but an increase in dose tended to be followed by the speed at which flowers appeared. Application of goat urine liquid organic fertilizer with increased concentrations of 10%, 20% and 30% showed no significantly different results on the flowering age of purple eggplant.

3.4. Harvest Life

The results of variance showed that the interaction between chicken manure and goat urine liquid organic fertilizer, chicken manure and goat urine liquid organic fertilizer had no significant effect on the harvest age of eggplant. The results of the DNMRT follow-up test level of 5% can be seen in Table 4.

Table 4 Harvest age of eggplant plants (HST) with the application of chicken manure and liquid organic fertilizer.

Chicken Manure (t.ha ⁻¹)	Liquid Organic Fertilizer (%)			Average
	10	20	30	
10	50.00 a	47.66 a	47.66 a	48.44 a
20	50.00 a	45.33 a	47.66 a	47.66 a
30	47.66 a	47.66 a	47.66 a	47.66 a
Average	49.22 a	46.88 a	47.66 a	

The numbers in columns and rows followed by the same lowercase letters are not real according to the DNMRT follow-up test level of 5%.

Table 4 shows that the treatment of chicken manure and goat urine liquid organic fertilizer differs not significantly from the harvest age of purple eggplant. The application of chicken manure differs not significantly from the harvest age parameters, but when viewed the harvest age of eggplant plants is already at the optimal age for harvesting. Application of liquid organic fertilizer goat urine showed different results not significantly on the harvest age of purple eggplant.

3.5. Number of Fruits by Plant

The results of variance showed that the interaction between chicken manure and goat urine liquid organic fertilizer, chicken manure and goat urine liquid organic fertilizer had no significant effect on the number of fruits by eggplant plant. The results of the DNMRT follow-up test level of 5% can be seen in Table 5.

Table 5 The number of fruits by eggplant plant (fruit) with the application of chicken manure and liquid organic fertilizer

Chicken Manure (t.ha ⁻¹)	Liquid Organic Fertilizer (%)			Average
	10	20	30	
10	5.72 a	5.94 a	6.16 a	5.94 a
20	6.28 a	8.11 a	7.13 a	7.17 a
30	7.33 a	7.50 a	6.97 a	7.26 a
Average	6.44 a	7.18 a	6.75 a	

The numbers in columns and rows followed by the same lowercase letters are not real according to the DNMRT follow-up test level of 5%.

Table 5 shows that the interaction between chicken manure treatment and goat urine liquid organic fertilizer differs not significantly from the parameter of the number of fruits by plant. Applying chicken manure shows different results are not noticeable. Application of goat urine liquid organic fertilizer showed no different results on the number of fruits by plant.

3.6. Fruit Weight by Plant

The results of variance showed that the interaction between chicken manure and goat urine liquid organic fertilizer, chicken manure and goat urine liquid organic fertilizer had no significant effect on fruit weight by eggplant. The results of the DNMRT follow-up test level of 5% can be seen in Table 6.

Table 6 Fruit weight by eggplant plant (kg) with the application of chicken manure and liquid organic fertilizer

Chicken Manure (t.ha ⁻¹)	Liquid Organic Fertilizer (%)			Average
	10	20	30	
10	0.84 a	0.92 a	0.97 a	0.91 a
20	1.05 a	1.23 a	1.07 a	1.12 a
30	1.18 a	1.15 a	1.17 a	1.16 a
Average	1.02 a	1.10 a	1.07 a	

The numbers in columns and rows followed by the same lowercase letters are not real according to the DNMR test level of 5%.

Table 6 shows that the application of different doses of chicken manure and the concentration of goat urine liquid organic fertilizer differs not significantly from fruit weight by purple eggplant. Applying chicken manure showed unmarkedly different results to fruit weight by purple eggplant. Application of goat urine liquid organic fertilizer showed no significant different results on fruit weight by eggplant plant.

3.7. Fruit Weight by m²

The results of variance showed that the interaction between chicken manure and goat urine liquid organic fertilizer, chicken manure and goat urine liquid organic fertilizer had no significant effect on fruit weight by m² of eggplant plants. The results of the DNMR test level of 5% can be seen in Table 7.

Table 7 Fruit weight by m² eggplant (kg) with the application of chicken manure and liquid organic fertilizer

Chicken Manure (t.ha ⁻¹)	Liquid Organic Fertilizer (%)			Average
	10	20	30	
10	2.81 a	3.09 a	3.26 a	3.05 a
20	3.52 a	4.12 a	3.57 a	3.73 a
30	3.92 a	3.84 a	3.89 a	3.88 a
Average	3.41 a	3.68 a	3.57 a	

The numbers in columns and rows followed by the same lowercase letters are not real according to the DNMR test level of 5%.

Table 7 shows that the administration of various doses of chicken manure and the concentration of goat urine liquid organic fertilizer differs not significantly from the fruit weight parameter by m². Increased dosing of chicken manure exceeding 10 t.ha⁻¹ does not give markedly different results to the weight of fruits by m² of purple eggplant. Application of liquid organic fertilizer goat urine with increased concentration does not give markedly different results to the weight of the fruit by m² of purple eggplant.

4. Discussion

Overall the interaction of feeding various doses of chicken manure and the concentration of goat urine liquid organic fertilizer showed no increase in the parameters of plant height, stem diameter, flowering age, harvest age, number of fruits by plant, fruit weight by plant, fruit weight by m². This is because organic fertilizers have different properties and characters from inorganic fertilizers. Organic fertilizers are slowly available to plants and the amount of nutrients available in them is low. According to Damanik et al [10] that organic fertilizers are slowly available to plants, low nutrient content, and provide limited amounts of nutrients. The main function of organic fertilizers is to improve the physical, biological and chemical properties of the soil in which plants grow.

The use of a dose of chicken manure 10 t.ha⁻¹ and liquid organic fertilizer goat urine 10% is thought to have been able to play a role in improving the physical and biological properties of the soil and providing nutrients for plant growth so that the increase in dose and concentration did not show a significant increase in the growth and production of purple eggplant. The parameters of plant height (Table 1), flowering age (Table 3) and harvest age (Table 4) show results that match the description of purple eggplant. The application of organic fertilizers plays a role in increasing the organic matter content of the soil. Soil that has high enough organic matter plays a role in improving the physical properties of

the soil then supports microbial activity in the soil. Good soil physical properties will increase the ability to hold water so that it can improve the absorption of nutrients by plants. Sentana [11] said that organic fertilizer serves to improve the physical, chemical and biological conditions of the soil, organic fertilizer can also launch a binding and ion release system in the soil so that it can increase fertility in the soil.

Plants can grow and produce well if the nutrients needed are available in sufficient quantities. Lingga & Marsono [12] said that plant growth and yield are greatly influenced by available nutrients, and growth and yield will be optimal if the available nutrients are sufficient and balanced. Chicken manure and liquid organic fertilizer also contain nutrients that are useful for plants. Organic fertilizers contain macro nutrients such as N, P, K and micronutrients that are needed by plants. Chicken manure contains N: 1.00%, P: 0.80%, and K: 0.40%. Liquid organic fertilizer goat urine contains elements N: 1.35%, P: 0.13%, and K: 2.10% and contains hormones for plant growth. Mansyur et al [5] said that macro nutrients such as N, P, K and microelements are needed by plants to grow and develop optimally. Lakitan [13] stated that element N plays an important role in the formation of green leaf substance which is very useful in the process of photosynthesis, element P is an essential part of various phosphate sugars that play a role in the reactions of photosynthesis, respiration and various other metabolisms and nutrient K plays a role in the formation of proteins and carbohydrates and accelerates fruit ripening.

According to Sutarman & Miftakhurrohmat [14] that the mineralization process of organic matter releases nutrients for plants completely such as N, P, K, and micronutrients and increases water retention and increases cation exchange capacity so that the ability to bind cations becomes higher. Wibowo [15] stated that potassium has a role in preventing flowers and fruits from falling easily, and phosphorus is indispensable in plant generative growth, namely as a fruit former. In line with statement [16] that phosphorus plays a role in flower formation, accelerates fruit ripening and increases yield. Potassium plays a role in the formation of flowers, fruits, and seeds, and helps the seeds / grains contain more and stimulate sweetness in the fruit.

Applying manure is able to increase the vegetative growth of purple eggplant. Increasing the dose of chicken manure to 20 t.ha⁻¹ was able to increase the height growth of purple eggplant (Table 1) and the diameter of purple eggplant stems (Table 2). This is because the use of a dose of chicken manure of 20 t.ha⁻¹ is believed to have increased the availability of macro and micro nutrients needed for plant vegetative growth such as plant height and diameter rod. Plant vegetative growth requires nutrients, especially N and K nutrients, in accordance with opinion [17] N nutrients play a role in increasing plant vegetative growth and K nutrients plays a role in facilitating the process of photosynthesis and accelerating the growth of meristem tissue that divides and enlarges the diameter of the stem.

According to [15] that element N functions on cell division and cell elongation events, element N accelerates plant growth, increases plant height, and stimulates budding. In line with the opinion of [18] that nitrogen is needed especially during the growth of the vegetative phase, element N plays a role in the formation of plant cells, plant tissues and organs. According to [19] element K also plays a role in nitrogen metabolism and protein synthesis, neutralizes organic acids that are important for physiological processes, supervises and regulates various activities of mineral elements, accelerates tissue growth, regulates stomata movement in terms of water-related matters in the process of photosynthesis and increases plant resistance.

The application of chicken manure of 30 t.ha⁻¹ shows the same result as the application of 20 t.ha⁻¹. This is thought to be because the administration of 20 t.ha⁻¹ has met the nutrient needs of plants in a balanced manner so that the increase in dose to 30 t.ha⁻¹ does not show an increase again. In line with opinion Rajiman [17] stated that when conditions are optimal for plant growth, the addition of fertilizer doses will not affect productivity, because of the nutrients that it is needed to be optimal for plant growth. Fertilization will increase plant productivity if plant conditions experience nutrient deficiencies, but when plant growth conditions are optimal fertilization will not affect growth and crop productivity.

Because the pH in the study field is classified as acidic (pH 5.29), this can also affect the process of decomposition (mineralization) of organic matter which causes the organic fertilizer given has not been given fully absorbable by plant roots, even if organic fertilizers are dosed with a view to increasing organic matter in the soil and increasing nutrient availability, But the results have not been able to increase the vegetative growth of plants, this is because the organic fertilizer given requires a long time to react perfectly with low soil pH conditions in the growing medium. According to [20] that the state of soil pH affects the availability of nutrients, especially the solubility of Al and Fe elements. At acidic pH the solubility of some nutrients decreases, while the solubility of Al and Fe increases, so that when absorbed by plant roots can cause less growth good for plants.

Chicken manure is able to increase soil organic matter that is beneficial for biological activity in the soil. In the chemical analysis, the soil used contains high organic C, which is 3.04% so that the soil organic matter contained is also high. Isroi [21] stated that soil organic matter provides nutrients for microbial activity which can also increase the decomposition of organic matter, increase the stability of soil aggregates, and increase soil recoverability. According to [19] chicken manure plays a role in improving the physical, chemical and biological properties of the soil so as to make the soil more friable, air can enter the soil, can hold water and nutrients from being washed away and increase the activity of microorganisms. Good soil structure affects root development in translocating nutrients to all plant organs. According to Advinda [22], if the roots of plants develop well, the growth of other plants will be good, because water as a nutrient transport medium from the soil is absorbed by the roots and then enters the plant tissue.

Overall, the application of liquid organic fertilizer with some concentration showed no increase in the parameters of plant height (Table 1), stem diameter (Table 2), flowering age (Table 3), harvest age (Table 4), number of fruits by plant (Table 5), fruit weight by plant (Table 6) and fruit weight by m² (Table 7). This is suspected because giving liquid organic fertilizer goat urine concentration of 10% has met the nutrient needs of plants so that it does not show significant different results on increasing its concentration. Optimal plant growth and production must be supported by the availability of adequate and balanced nutrients for plants.

Liquid organic fertilizers contain macronutrients needed by plants. Liquid organic fertilizer of goat urine contains elements N: 1.35%, P: 0.13%, and K: 2.10%. According to [19] that three elements of six macronutrients that are absolutely needed by plants, namely N, P, and K, if they are sufficient, then plant growth and production levels are higher. Rajiman [17] stated that fertilization will increase plant productivity if plant conditions experience nutrient deficiencies, but during optimal plant growth conditions fertilization will not affect plant productivity and growth.

In vegetative growth of plants such as plant height growth and stem diameter requires nutrients, especially nitrogen. Kustono [23] said that nitrogen works to help the growth of roots, stems, branches and leaves, and helps the formation of leaf green matter. Plants that have sufficient nitrogen will also be able to use water optimally. According to Wahidah [18], nitrogen has the main function as a synthesis material for chlorophyll, proteins and amino acids, therefore nitrogen is needed especially when growth enters the vegetative phase, this nitrogen is used in regulating overall plant growth. Goat urine liquid organic fertilizer also contains plant growth hormones, one of which is auxin. According to Wiraatmaja [24], auxin plays a role in cell elongation by affecting cell wall stretching, auxin stimulates the pumping of plasma membrane protons in the bud elongation area. Auxins will increase membrane potential and lower pH inside the cell wall, which will affect plant height growth.

When plant growth enters generative phases such as flowering age (Table 3), harvest age (Table 4), number of fruits per plant (Table 5), and fruit weight, plants need nutrients especially P and K. Wibowo [15] stated that phosphorus is needed because it plays a role in the process of respiration, photosynthesis, nucleic acid constituents, and the formation of flowers and fruits. According to Samekto [25], element P is influential in the growth and formation of yield, where phosphorus elements function in energy transfer and photosynthesis processes. In addition to element P, the availability of element K is also very important in improving the quality of fruit, potassium element will increase the movement of photosynthesis from the leaves to the storage part, namely fruits and seeds.

Optimal plant growth and production must be supported by the availability of adequate and balanced nutrients for plants. The fulfillment of nutrient needs for plants, both during vegetative growth and plant generative growth and the ability of plants to absorb good nutrients that have an impact on the growth and production of purple eggplant plants. Liquid organic fertilizer goat urine contains elements N: 1.35%, P: 0.13%, and K: 2.10%, so that the application of liquid organic fertilizer can provide adequate nutrients for eggplant plants, one of which is for fruit formation. According to Hardjowigeno [20], P function is related to generative development, such as the formation of flowers, fruits and seeds and accelerating maturation. Munawar [26] stated that potassium has a role in transporting the results of photosynthesis in the form of assimilate to storage parts such as fruits and seeds.

5. Conclusion

Based on the research that has been done, it is concluded that:

- The interaction of chicken manure and goat urine liquid organic fertilizer does not provide an increase in plant height, stem diameter, flowering age, harvest age, number of fruits by plant, fruit weight by plant, fruit weight by m².
- Applying several doses of chicken manure can increase plant height growth and stem diameter in purple eggplant with the best growth found at a dose of chicken manure 20 t.ha⁻¹.

- Application of goat urine liquid organic fertilizer does not increase plant height growth, stem diameter, flowering age, harvest age, number of fruits by plant, fruit weight by plant, fruit weight by m².
- Application of chicken manure dose of 20 t.ha⁻¹ and liquid organic fertilizer with concentration of 20% shows the best growth and production of purple eggplants.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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