AGRIUM
Jurnal Ilmu Pertanian
pISSN 0852-1077; eISSN 2442-7306

April 2026 Volume 29 No.1: 1- 10
https://jurnal.umsu.ac.id/index.php/agrium/article/view/26229

The Effect of Rabbit Urine and Cow Manure Application on The Growth and Yield of *Centella asiatica* L.

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Abstract

Gotu kola (Centella asiatica L.) is a medicinal plant with high therapeutic potential, yet its cultivation in Indonesia remains underdeveloped. Excessive reliance on synthetic fertilizers poses risks to environmental sustainability and may negatively affect the quality of bioactive compounds. This study aimed to evaluate the effects of rabbit urine–based liquid organic fertilizer (LOF) and cow manure on the growth and yield of gotu kola, and to identify a sustainable fertilization strategy that supports vegetative development. The experiment was conducted using a factorial randomized group design with two factors: rabbit urine LOF concentrations (0, 100, and 200 ml/L) and cow manure dosages (0, 20, and 40 g/polybag), resulting in nine treatment combinations with three replications. Data were analyzed using analysis of variance. The results showed that rabbit urine LOF significantly influenced stolon length, with the 200 ml/L concentration consistently promoting longer stolon development compared to lower concentrations and the control. This response indicates that nutrients in rabbit urine, particularly nitrogen, enhance vegetative expansion through stolon growth. Other growth and yield parameters were not significantly affected, suggesting that the fertilization treatments primarily influenced early vegetative growth rather than yield formation. These findings demonstrate that integrating rabbit urine LOF with cow manure has potential as an environmentally friendly fertilization approach for sustainable gotu kola cultivation.

***Keywords**: Fertilizer, gotu kola, rabbit urine.*

Received: 07 August 2025; **Revised:** 22 September 2025; **Accepted:** 01 March 2026

INTRODUCTION

Gotu kola (*Centella asiatica* L.) is a herb that has long been known as a traditional medicinal plant in various countries, including Indonesia. The kidney shaped leaves with an inward curving base often make this herb mistaken for a weed (Sadik and Anwar, 2022). Despite its simple appearance, gotu kola offers many health benefits. Widely consumed traditionally as a vegetable, juice, and herbal remedy across Indonesia, gotu kola remains underused in modern medicines, despite its rich active compounds like triterpenoids and essential oils valuable to pharmaceuticals (Sutardi, 2016). Gotu kola contains triterpenoids like asiatic acid, madecassin, asiaticoside, and madecassoside. These compounds aid wound healing through anti-inflammatory, antibacterial, and proangiogenic effects, while also stimulating type I collagen synthesis, which plays a vital role in repairing and regenerating skin tissue. Globally, *Centella asiatica* is also used in Ayurveda in India and Traditional Chinese Medicine (TCM) in China, and has even entered the European pharmacopoeia as a medicinal and cosmetic ingredient.

As a wild plant with promising medicinal potential, gotu kola has actually been known for a long time. Gotu kola has been listed as a traditional medicinal plant since 1884. Traditional medicines themselves are concoctions or preparations made using traditional methods, passed down from generation to generation, and usually based on ancient recipes, community beliefs, and local traditions (Shomad et al., 2024). Another added value is that traditional medicines made from plants such as gotu kola are affordable, easy to obtain, and have minimal side effects due to their low toxicity (Sutardi,

10.30596/agrium.v29i1.26229

2016). As the traditional and herbal medicine industry grows, demand for gotu kola (gotu kola) continues to rise. Besides its local popularity, gotu kola is also listed as one of the 50 main medicinal plants considered important in Indonesia (Sutardi, 2016). National demand for gotu kola (Gotu kola) for herbal medicine production reaches 126 tons annually, ranking 13th among 152 medicinal herbs. In Indonesia, demand for herbal raw materials continues to increase; the Indonesian Food and Drug Authority (BPOM) (2022) recorded a more than twofold increase in phytopharmaceutical products in the last 10 years, yet the availability of gotu kola remains limited. Gotu kola is valued for benefits like treating nervous disorders, bronchitis, fever, hemorrhoids, regulating blood sugar, boosting appetite, and vitality.

To enhance the potential of gotu kola as a high-value medicinal plant, proper fertilization plays a vital role. Fertilizers enrich plant nutrient content, improving both yield quality and quantity. Organic fertilizers, sourced from animal manure and crop residues, offer abundant macro- and micronutrients essential for plant growth. Available in solid and liquid forms, these fertilizers work complementarily to support healthy development and sustainable cultivation of gotu kola. Cow manure improves soil structure with natural humus, boosts water absorption, and provides microorganisms that produce compounds beneficial for plant growth compared to chemical fertilizers (Mintarjo, 2018). In addition, manure also helps maintain the balance of the soil ecosystem so that it can be used continuously without damaging soil quality.

Meanwhile, liquid organic fertilizer (POC) also has its own advantages. POC is a solution resulting from the decomposition of organic materials such as plant residues, animal waste, and other organic materials. One potential source of POC is rabbit urine and droppings. Using rabbit urine as a liquid fertilizer can improve soil quality and plant growth (Sembiring et al., 2017). This is because the nitrogen and other nutrients in rabbit urine are relatively easily absorbed by plants. Farmers tend to rely on chemical fertilizers because they provide quick results, but they negatively impact long-term soil fertility. A combination of cow manure and rabbit urine offers a cheaper and more environmentally friendly solution. Research conducted by Kusnia, Taryana and Turmuktini (2022) also proved that the provision of liquid organic fertilizer from rabbit urine had an effect on the growth of plant height, number of leaves, leaf area, and harvest yields measured by weight per plant and weight per pak choy plot.

Farmers often use inorganic fertilizers to boost gotu kola yields, but excessive use harms soil and the environment. Though effective short-term, prolonged high doses reduce soil porosity, making it hard in dry seasons and sticky in rainy seasons. This condition also disrupts nutrient balance, worsens the physical condition of the soil, and reduces the presence of soil microbes (Taher, 2021). Chemical fertilizers cannot increase soil organic matter and thus fail to support long-term sustainability. To overcome this, research on organic fertilizers is vital. Using cow manure combined with rabbit urine liquid fertilizer is expected to naturally enhance gotu kola growth and yield. This study seeks optimal dosages to help farmers boost quality, productivity, and environmental sustainability. This study provides a novel approach by evaluating the combined effect of rabbit urine and cow manure on Centella asiatica, which has not been widely studied. The results are expected to offer insight into optimizing organic fertilization strategies for medicinal plant cultivation. This research is unique because it evaluates the combination of two organic fertilizer sources in gotu kola, a relatively understudied area. The findings are expected to support sustainable cultivation and be relevant to SDGs 2 (Zero Hunger), SDG 3 (Good Health), and SDG 15 (Life on Land).

Based on these considerations, this study aimed to evaluate the effects of cow manure and rabbit urine based liquid organic fertilizer on the growth and yield of gotu kola (Centella asiatica L.), and to determine the optimal combination of both fertilizers that supports vegetative development and sustainable cultivation. Specifically, this research examined the response of key growth parameters under different fertilizer dosages to identify an environmentally friendly fertilization strategy that can improve productivity while maintaining soil health and supporting long-term sustainability of medicinal plant production.

MATERIALS AND METHODS

Place and Time

This research was carried out from June to September 2023 in the Jember State Polytechnic Plant Laboratory Greenhouse, at an altitude of 89 meters above sea level.

10.30596/agrium.v29i1.26229

Materials and Tools

In this research, the materials used are soil planting media, compost, rabbit urine LOW, cow manure, and gotu kola seeds. Meanwhile, the tools needed include stationery, rulers, labels, knives, analytical scales, chlorophyl meter, gembor, tape measure, scissors, hoe, and 25 x 25 cm polybag.

Research Methods

This research used a factorial Randomized Block Design (RBD) with two factors. The first factor was the concentration of liquid organic fertilizer (LOF) from rabbit urine, with levels U0 (0 ml/L), U1 (100 ml/L), and U2 (200 ml/L). The second factor was the dose of cow manure, with levels K0 (0 g/polybag), K1 (20 g/polybag), and K2 (40 g/polybag).

The second factor was the dose of cow manure, consisting of three levels: 0, 20, and 40 g per polybag. These doses were equivalent to 0, 5, and 10 t ha^{-1}, respectively, assuming that one polybag represented a planting area of 0.04 m^2, which is comparable to a planting density of 20 × 20 cm under field conditions. This conversion was used to facilitate comparison with field-scale fertilization practices and to ensure the agronomic relevance of the experimental treatments.

This research consisted of 9 treatment combinations arranged in a factorial randomized block design, with three replications, resulting in 27 experimental units. Each treatment combination consisted of two polybags, giving 54 observation units, and each polybag contained two plants, resulting in a total of 108 plants. Each polybag was filled with approximately 5 kg of growth medium, consisting of a soil and rice husk mixture (2:1). Cow manure was applied once as a basal fertilizer by thoroughly mixing it into the growth medium according to the assigned treatment dose before planting. Planting material consisted of vegetatively propagated gotu kola seedlings, which were planted directly into the polybags without prior seed sowing. Rabbit urine liquid organic fertilizer (LOF) was applied by soil drenching at concentrations of 0, 100, and 200 ml L^{-1}. Each application delivered 100 ml of LOF solution per polybag (50 ml per plant). The LOF was applied every two weeks, starting at 2 weeks after planting and continued until 8 weeks after planting, resulting in four applications during the growing period. All plants were maintained under uniform greenhouse conditions.

For the observed parameter of leaf number, counts were taken every two weeks from 2–8 WAP on fully expanded leaves. For stolon length and stolon number, measurements were carried out at two-week intervals, with stolon length measured from the base to the tip of the longest runner. For tiller number, observations were conducted every four weeks (4–8 WAP) by counting new shoots, while for petiole length, the longest petiole was measured at 4 and 8 WAP. For fresh and root weights, measurements were taken at harvest (10 WAP) using a digital balance after cleaning the plants. For chlorophyll content, measurements were made on three leaves per treatment using a SPAD chlorophyll meter, and all data were averaged per treatment.

Data Analysis

The data obtained were then analyzed using variance (ANOVA). If there were significant differences in the observed variables, the test was continued using Duncan's Multiple Range Test (DMRT) with a significance level of 5%.

RESULT AND DISCUSSION

Based on the results of analysis of variance, it was found that LOF treatment of rabbit urine and cow manure had a significant effect on several parameters. The cow manure treatment increased the number of leaves in the 2nd week after planting and had a significant effect on increasing stolon length in the 8th week after planting. Furthermore, the interaction of rabbit urine LOF treatment and cow manure had an effect on increasing the number of stolons in the 8th week after planting. Apart from that, rabbit urine treatment also had a significant effect on increasing stolon length in the 2nd week after planting (Table 1).

10.30596/agrium.v29i1.26229

Table 1. Recapitulation of Test Results F on All Parameters

It	Observation Variables	Sources of Diversity		
		U*	K	UxK
1	Number of leaves.21WAP*	ns*	*	ns
2	Number of leaves.41WAP*	ns*	ns	ns
3	Number of leaves.61WAP*	ns*	ns	ns
4	Number of leaves.81WAP*	ns*	ns	ns
5	Number of Stolons.21WAP*	ns*	ns	ns
6	Number of Stolons.41WAP*	ns*	ns	ns
7	Number of Stolons.61WAP*	ns*	ns	ns
8	Number of Stolons.81WAP*	ns*	ns	*
9	Stolon length 21WAP*	**	ns	ns
10	Stolon length.41WAP*	ns*	ns	ns
11	Stolon length.61WAP*	ns*	ns	ns
12	Stolon length.81WAP*	ns*	*	ns
13	Number of Cubs.41WAP*	ns*	ns	ns
14	Number of Cubs.81WAP*	ns*	ns	ns
15	Longest stalk.4.WAP*	ns*	nss	nss
16	Longest stalk.81WAP*	ns*	nss	nss
17	Chlorophile*	ns*	nss	nss
18	Wet weight.Plant*	ns*	nss	nss
19	Weight$root.Plant*	ns*	ns*	ns*

Description: U = LOF of rabbit urine, K = cow manure, UxK = Interaction of LOF administration of rabbit urine and cow manure (*) = Significanteffect; (**) = Very real influence; (ns) = No real effect

Table 2. Stolon Length in Several Rabbit Urine (Liquid Organic Fertilizer) LOF Concentrators and Cow Manure Dosage

Treatment Data	Stolon Length (cm)			
	2 WAP	4 WAP	6 WAP	8 WAP
Rabbit Urine LOF Concentration				
0 ml/l	1.45 b	19.01	51.83	75.32
100 ml/l	1.51 b	26.47	51.25	73.80
200 ml/l	2 a	22,58	51.81	80.67
F Count U	5.19	0.94	0.01	1.21
	*	ns	ns	ns
Dosage of Cow Manure				
0 g/polybag	1.76	18.45	43.39	67.41 b
20 g/polybag	1.64	26.78	54.69	81.62 A
40 g/polybag	1.57	22.82	56.81	80.76 A
F Count K	0.53	2.83	3.37	5.89
	ns	ns	ns	*

Description: WAP = weeks after planting, (ns) shows no noticeable difference, (*) indicates significant difference, and (**) shows a significant difference in the 5% and 1% ANOVA tests, notation (a) shows a significant difference with notation (b)

10.30596/agrium.v29i1.26229

Table 3. Number of Leaves in Several Rabbit Urine LOF Concentrators and Cow Manure Dosage

Treatment Data	Number of leaves (blades)			
	2 WAP	4 WAP	6 WAP	8 WAP
Rabbit Urine LOF Concentration				
0 ml/L	4.64	11.06	20.94	35.92
100 ml/L	4.25	9.67	19.75	30.83
200 ml/L	4.39	10.11	20.17	30.64
F Count U	0.62	1.16	0.20	3.03
	nst	nst	nst	nst
Dosage of Cow Manure				
0 g/polybag	4.92 A	9.58	19.83	31.06
20 g/polybag	4.44 b	1061	20.66	34.11
40 g/polybag	3.92 c	10.64	20.36	32.22
F Count K	4.01	0.83	0.10	0.81
	**	ns	ns	ns

Description: WAP = weeks after planting, (ns) shows no real difference, (*) shows real difference and (**) shows very different in the ANOVA test of 5% and 1% level, notation (a) shows a real difference with notation (b), notation (b) shows a real difference with notation (c) in the DMRT follow-up test.

Plant Growth Response to Rabbit Urine Treatment

In the treatment of LOF administration of rabbit urine at a concentration of 200ml/L, it was able to significantly increase the length of stolon at the age of 2 weeks after planting (Figure 1). This is in line with Leksono (2021) stating that the more fertilizer concentration is given, the more nutrients the plant receives. The more frequent the level of fertilizer application intervals on plants, the higher the nutrient content in them. However, it also pays attention to the concentration given, because if it is too excessive, it will cause wilting in plants.

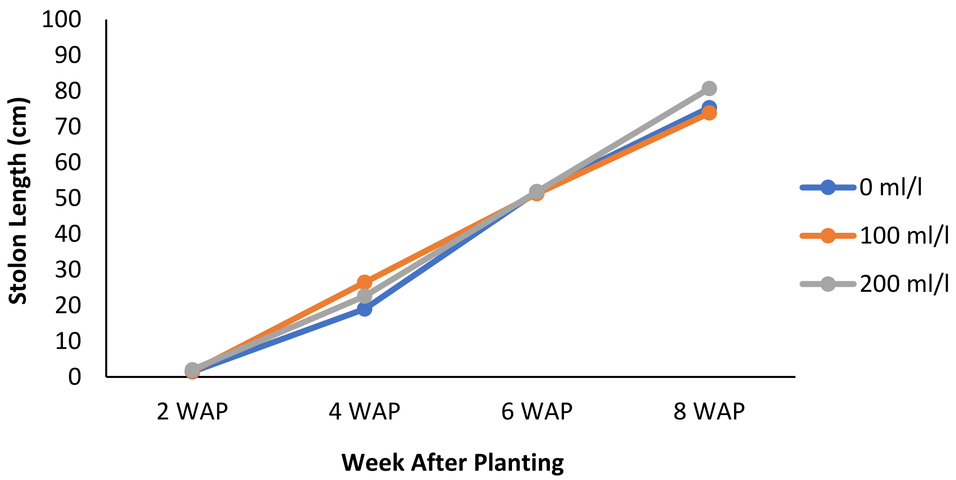

Figure 1. Stolon Length of Rabbit Urine Concentration Treatment.

The method of applying fertilizer itself also affects the absorption of nutrients by plants so that it is more effective and efficient. In this case, the efforts made also aim to increase the N content and improve the structure and quality of the soil. Because, Organic materials are suitable for plant growth because they supply essential macro- and micronutrients and can reduce the mobility and bioavailability of toxic metals through complexation and immobilization processes associated with organic matter (Yacine et al., 2025). Rabbit urine contains nutrients N, P, and K, but the most abundant element in rabbit urine is nitrogen. N nutrients are needed by plants during the growing season for the formation of leaves, branches, roots, and the formation of green leaf material that plays a role in the photosynthesis process. In addition to being an organic nutrient compared to other grass-eating animals, rabbit urine has a higher nitrogen content due to its habit of drinking less water and eating more (Sukrianto & Munawaroh, 2021).

10.30596/agrium.v29i1.26229

Figure 2. Fertilization of Rabbit Urine LOF.

However, based on the results of the F test on the parameters observed, it showed that the LOF of rabbit urine was not significantly different (ns) on the parameters number of leaves, number of stolons, number of tillers, longest leaf stalks, chlorophyll content, root weight and wet weight (Tables 2, 3 and 4). This is inversely proportional to the statement by *(*Firgiyanto *et al*., 2023) that the higher the dose given, the longer the leaf stalk. It is possible that this could happen due to the low level of uptake of nitrogen elements. Because of the importance of the nitrogen element in the formation of plant organs, nitrogen intake affects plant growth rate (Cholisoh & Budiyanto, 2018). The nitrogen element itself is the main factor that influences plant height. Lack of maximum nitrogen uptake results in lower plant growth. However, this response may also be attributed to the incomplete fermentation of rabbit urine, which results in nitrogen being present predominantly in unstable forms such as urea or free ammonia. These forms are prone to volatilization and are not readily converted into plant available nitrogen (NH_4^+ and NO_3^-), thereby reducing nitrogen uptake efficiency by plants (Muhammad Subhan Nuruddin, 2026). The results of fermentation also affect the absorption of nutrients by plants, and the temperature during the decomposition process is not high enough to kill all pathogens in liquid fertilizer, so plants cannot absorb nutrients properly (Sutardi, 2016).

The application of Liquid Organic Fertilizer (LOF) made from rabbit urine on gotu kola (*Centella asiatica*) showed a decreasing trend in both wet weight and root weight as the concentration increased. The highest wet weight (46.05 g) and root weight (4.38 g) were observed in the control treatment (0 ml/L), while the 100 ml/L treatment showed a decline to 40.47 g and 4.36 g respectively, and further decreased to 40.83 g and 3.76 g at 200 ml/L. These results indicate that higher concentrations of rabbit urine LOF did not promote growth in gotu kola and may even have an inhibitory effect. This finding is consistent with several studies in other plant species. In mung bean (*Vigna radiata* L.), the application of rabbit urine LOF at 200 ml/L in combination with NPK significantly improved plant growth, but growth declined at higher LOF concentrations (Ariani *et al*., 2025). Similarly, Zheng *et al.*, (2018) found that pak choi showed the highest fresh weight at 200 ml/L, but this response may differ due to species-specific nutrient sensitivity.

In the case of gotu kola, the reduction in biomass at higher application rates may be associated with excessive nitrogen and soluble salt content in rabbit urine, which can increase osmotic stress and reduce water and nutrient uptake efficiency by plant roots (Aisyah & Basuni, 2023). In gotu kola, biomass declines at excessive LOF concentrations may result from excess nitrogen or salts in rabbit urine, causing nutrient imbalance, osmotic stress, or root toxicity. Similar negative effects have also been observed in broccoli, where moderate doses of liquid organic fertilizer improved growth, while higher levels reduced performance, for instance, Doklega and Abd El-Hady (2017) reported that applying liquid organic fertilizer at appropriate rates enhanced vegetative growth and yield in broccoli. Given that gotu kola is a medicinal herb with different nutrient requirements compared to fast-growing leafy vegetables, the results suggest that it may be more sensitive to nutrient excess. Therefore, lower concentrations of LOF (e.g., below 100 ml/L) or a combination with reduced synthetic fertilizer could be more appropriate for this plant.

Plant Growth to Cow Manure Treatment

The provision of cow manure in this study generally did not have a significant effect on most of the parameters observed, including the number of leaves, number of stolons, stolon length (2, 4, and 6 WAP), number of tillers, length of the main stem, chlorophyll content, plant wet weight, and root weight. In the treatment, giving cow manure at a dose of 0g/polybag had a significant effect on the leaf number parameters in the 2 week and a dose of 20g/polybag had a significant effect on the stolon length parameters in the 8 week (Tables 2).

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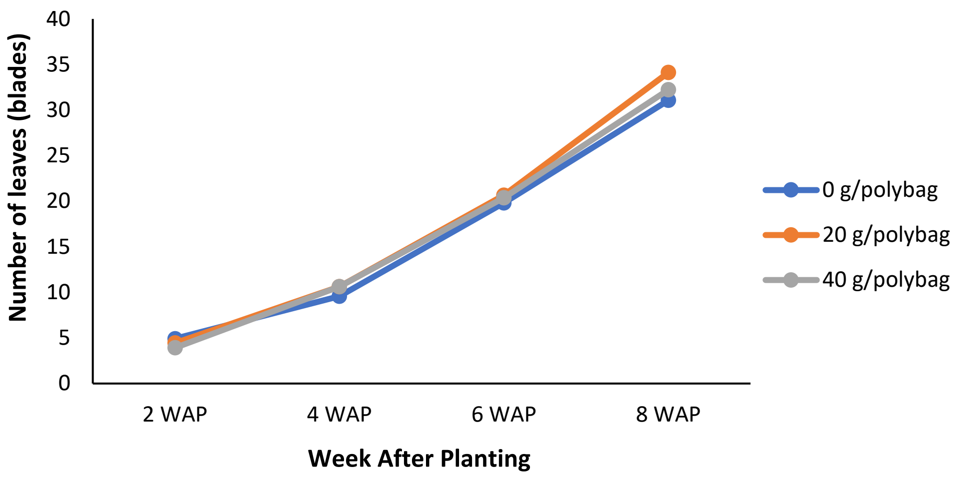

Figure 4. Number of Leaves of Cow Manure Treatment.

This is influenced by the provision of cow manure which is sufficient to provide nutrients in the soil and also supports the growth of gotu kola plants. Cow manure itself contains quite high levels of nitrogen which functions to help vegetative growth in plants (Rosadi, 2019). Apart from the nitrogen element, cow manure also contains the potassium element which is needed for the growth of gotu kola plants. This is in line with Mintarjo (2018) statement that cow manure has advantages compared to other fertilizers, namely that it has a high proportion of fiber such as cellulose, provides macro nutrients and micro nutrients for plants, as well as increasing soil water absorption and encouraging plant growth. As an organic fertilizer, cow manure does not damage the soil; instead, it enriches it with a wide range of essential nutrients, including macro elements (nitrogen, phosphorus, potassium, calcium, sulfur) and micro elements (iron, zinc, boron, cobalt, molybdenum). Cow manure also contains organic substances which play a special role in supplying carbon dioxide to the plant canopy, reducing the negative impact of aluminum and increasing the availability of phosphorus and trace elements, especially in plants with dense canopies with limited air circulation (Rakhmawati *et al*., 2019).

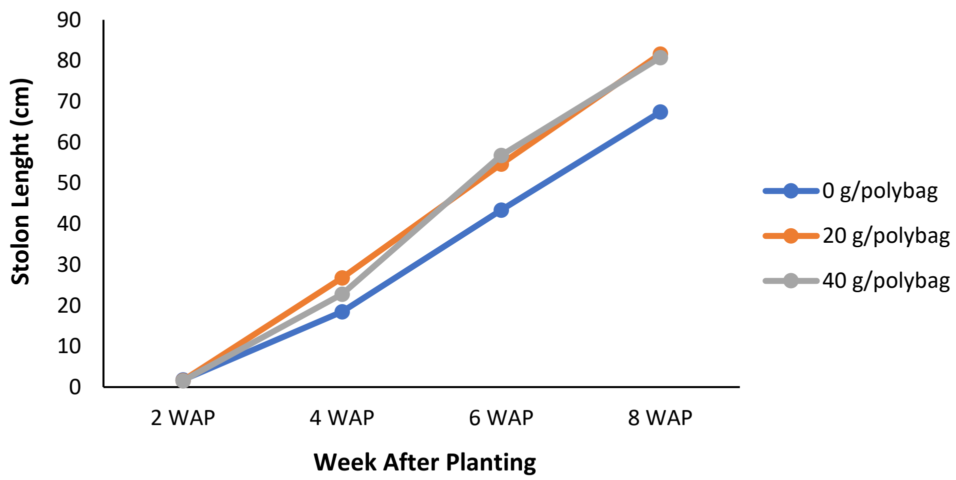

Figure 5. Stolon Lenght of Cow Manure Treatment.

However, based on the F test, giving cow manure had no significant effect on the parameters of number of stolons, number of tillers, longest leaf stalks, chlorophyll content, root weight and wet weight. On the stolon length parameter at 8 weeks after planting (WAP), cow manure showed a significant effect. This indicates that cow manure, as an organic nutrient source rich in organic matter and macronutrients such as P and K, tends to have a slow and gradual effect. Its effects are only apparent in the later growth phase when mineralization of organic compounds begins and nutrients are available in a form that can be absorbed by plants. The dose given to plants also greatly influences the growth of the plant itself. If the concentration is too low, growth and height increase will take longer, whereas if the concentration is too high it will cause poisoning of plant seeds and inhibit their growth and development (Kamaludin, 2018).

10.30596/agrium.v29i1.26229

Apart from that, cow manure has slow release properties, which means the solubility of nutrient elements is relatively slow over a long period of time (Farikhah, 2017). Basically, the growth rate tends to be slower, but the higher the dose, the better the plant growth will be (Gole *et al*., 2019). Lack of availability of nutrients can cause metabolic processes in the plant body to be hampered, and this situation ultimately inhibits the formation of roots, stems and leaves. The growth and development of leaves is greatly influenced by plant roots. If root growth is hampered, upper plant growth will also be hampered (Kamaludin, 2018).

Although it did not show a significant effect on most parameters, cow manure still played a role in improving the physical and biological properties of the soil, such as increasing cation exchange capacity, improving soil structure, and stimulating the activity of microorganisms that support root growth. However, due to the limited observation time and the slow-release nature of this fertilizer, its benefits may not have been fully observed in this study. The application of organic fertilizers based on rabbit urine and cow manure aligns with the sustainable development agenda. This strategy supports SDG 2 (Zero Hunger) by increasing the productivity of medicinal plants, SDG 3 (Good Health and Well-Being) by providing herbal raw materials, and SDG 15 (Life on Land) by naturally improving soil quality.

Response of Yield and Plant Growth to the Interaction of Rabbit Urine LOF Application and Cow Manure

The interaction between the administration of LOF in rabbit urine and cow pukan was significantly different at the highest number of stolons of 3,25 stolons at 8 weeks of age after planting. However, in other interactions, the dose and concentration did not differ significantly, which showed that the combination of rabbit urine LOF and cow pudding did not meet the needs for plant growth so that it did not provide a significant different effect. Insignificant effects can also be caused by the concentration of LOF in rabbit urine or the administration of cow manure at inappropriate doses that cause suboptimal plant growth and development. These findings suggest that combining 20 g of cow manure per polybag with 200 ml/L of rabbit urine LOF has the potential to be a practical recommendation for gotu kola farmers. This combination can improve several growth parameters, such as stolon number and length, while reducing dependence on chemical fertilizers. With its relatively low cost, this method can support gotu kola productivity while preserving the environment.

Table 4. DMRT Test Results Interaction Between Rabbit Urine LOF Concentration and Cow Feed Dose on Stolon Count at 8 WAP

Cow Feed	Rabbit Urine LOF		
	U0	**U1**	**U2**
K0	3.25 a A	1.92 b C	2.58 a B
K1	2.42 b B	3,00 a A	2.75 a AB
K2	2.58 b A	2.83 a A	2.33 a A

Description: U0 = (no treatment), U1 = (rabbit LOF concentration 100ml/l water), U2 = (rabbit LOF concentration 200ml/l water), K0 = (no treatment), K1 = (cow poop dose 20g/polybag), K2 = (cow poop dose 40g/polybag). Numbers followed by the same lowercase letters in the same column showed no significant difference in the DMRT test at the 5% level. The number followed by the same capital letter on the same line did not differ significantly in the 5% DMRT test.

Manure can increase soil looseness and can also add nutrients that are needed for plant growth. Loose soil has the ability to support plant growth, provide good growth space and adequate nutrients. Therefore, manure can also improve the properties and condition of soil damaged by the negative impact of inorganic fertilizers (Sakti & Sugito, 2019). In addition, organic fertilizers generally contain relatively small amounts of nutrients in the soil and are usually available slowly in the soil, resulting in a slow nutrient release process. Slow release of nutrients means that the availability of nutrients in the soil cannot support plant growth (Firgiyanto *et al*., 2023).

Overall, the results indicate that gotu kola exhibits a limited and variable response to the application of rabbit urine liquid organic fertilizer and cow manure, depending on dosage and timing. Rabbit urine primarily promoted early vegetative growth, whereas cow manure, either alone or in combination, tended to support more sustained growth over longer observation periods. These findings suggest that organic fertilization effects on gotu kola are stage-dependent and may require balanced nutrient availability. However, this study was limited by its pot-scale experimental setting and relatively short observation period. Therefore, further research is recommended to evaluate a wider range of

10.30596/agrium.v29i1.26229

fertilizer dosages, including combinations with reduced levels of inorganic fertilizers, to identify an optimal and sustainable fertilization strategy. In addition, multi-location field trials and assessment of key secondary metabolites, such as asiaticoside and madecassoside, are necessary to better link fertilization practices with the pharmacological quality of gotu kola.

CONCLUSION

The study demonstrated that the application of 200 ml/L rabbit urine LOF significantly increased stolon length, indicating its potential role in enhancing vegetative growth of gotu kola. Cow manure at 20 g/polybag was found to improve leaf number and stolon growth, highlighting the importance of organic inputs in supporting plant development. Interestingly, the combination of 0 ml/L LOF and 0 g/polybag cow manure resulted in a higher stolon count, suggesting that gotu kola may respond differently to nutrient limitations compared to other growth traits. To strengthen these findings, further studies are recommended to evaluate the long-term effects of organic fertilizers and to determine the most appropriate dosage combinations for sustainable and efficient gotu kola cultivation.

ACKNOWLEDGMENTS

The authors would like to thank Jember State Polytechnic for providing facilities and support for the completion of this research.

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