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Optimizing Goat Manure Rates and Liquid Organic Fertilizer Concentrations for *Solanum melongena* L. Physiology and Fruit Output in Surabaya, East Java

Difa Eka Pranoto, Nova Triani(*), Agus Sulistyono

Agrotechnology Department, Faculty of Agriculture,
Pembangunan Nasional "Veteran" Jawa Timur University
Jl. Rungkut Madya, Gn. Anyar, Surabaya, East Java Province Postcode 60294, Indonesia

***Corresponding author:** novatriani.agrotek@upnjatim.ac.id

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Abstract

Background: *Purple eggplant (Solanum melongena L.) is a high-value nutritional crop with significant market demand. However, production in Indonesia fluctuated between 2021 and 2023; after reaching a peak of 551,552 tons, yields dropped to 510,749 tons in 2023. This decline is largely attributed to the excessive use of synthetic fertilizers. This study aims to evaluate the interactions and effects of integrating goat manure with various liquid organic fertilizers (LOF) on purple eggplant growth. Furthermore, this research seeks to establish sustainable cultivation practices that reduce chemical dependency in horticulture.* **Methodology:** *This research followed a Factorial Randomized Block Design (RBD) with two factors and three replications. The first factor was the goat manure dosage at four levels: 0 g/plant (control), 500 g/plant, 750 g/plant, and 1,000 g/plant. The second factor consisted of four types of liquid applications: NPK 16:16:16 (control), eco-enzyme LOF, banana peel LOF, and cabbage waste LOF. Observation data were analyzed using Analysis of Variance (ANOVA), followed by Tukey's Honestly Significant Difference (HSD) test at a 5% significance level where significant effects were detected.* **Findings:** *The results showed that the combined treatment of goat manure dose of 1,000 g/plant and banana peel LOF gave the best results in the parameters of plant height (46.67 cm), number of leaves (16.33 leaves), total fruit number per plant (11.72 fruits), and total harvest weight per plant (1635.94 grams) compared to other organic combination treatments.* **Contribution:** *The combination of goat manure and banana peel liquid organic fertilizer (LOF) emerged as the most effective treatment compared to other organic combinations. This organic treatment resulted in a 28% yield increase over the control. Althought this specific increase was not statistically significant, the study strongly recommends organic fertilizers as a sustainable and eco-friendly alternative to reduce inorganic fertilizer dependency in horticultural farming systems.*

Keywords: *Dosage; Liquid Organic Fertilizer (LOF); Purple Eggplant; Solanum melongena*

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INTRODUCTION

Purple eggplant (*Solanum melongena* L.) is a widely distributed horticultural commodity in Indonesia and a key component of the nation's agricultural sector. Despite rising market demand driven by annual population growth, productivity increases remain insufficient. This gap persists because many farmers continue to rely on inorganic fertilizers, which often results in suboptimal yields (Sahid et al., 2014; Fitrianti., 2018). According to Central Statistic Agency (2022), purple eggplant productivity fluctuated significantly between 2021 and 2023. While production reached a peak of 551,552 tons during this period, it declined to 510,749 tons by 2023.

Another challenge involves the large-scale use of polybags as a growing medium. While polybags improve land-use efficiency, crop yield often remain unstable due to several critical factors (Dayanti, 2017). The limited volume of the growing medium in polybag systems presents a serious challenge for farmers, particularly in purple eggplant cultivation. Continuous use of inorganic fertilizers within this restricted space frequently triggers media quality degradation and accelerates nutrient leaching (Kolaka, 2024; Harahap et al., 2020). Consequently, polybag cultivation is highly susceptible to nutrient imbalances. According to Putri (2022), effective organic strategies are required to addres these issues, such as combining liquid organic fertilizer (LOF) with manure, incorporating biochar (husk charcoal), using organic mulch, and applying mycorrhizae. These methods improve the structure of the growing medium, maintain water availability, and ensure more optimal, healthy, and sustainable eggplant production.

Sustainable alternatives increasingly involve the application of organic fertilizers in both solid and liquid forms. Solid organic fertilizers, such as goat manure, are combined with liquid organic fertilizers (LOF) derived from organic household waste, including *eco-enzymes*, banana peels, and cabbage waste. These organic inputs are essential for plant maintenance as they help meet comprehensive nutrient requirements.

The urgency of this research stems from the need to address the limited volume of growing media in polybag systems, which often leads to yield fluctuations in purple eggplants due to soil degradation and rapid nutrient leaching. This study utilizes a combination of goat manure and liquid organic fertilizer (LOF) to create a synergistic nutrient release mechanism. Goat manure serves as a long-term, slow-release nutrient source and a soil conditioner (Nurlailah et al., 2023; Lubis et al., 2023; Dewi, 2016). Conversely, LOF provides immediate, fast-release nutrients that are easily absorbed during critical growth phases. The interaction between these two organic inputs ensures stable nutritional balance and enhances nutrient uptake efficiency within restricted root zones. Furthermore, this approach offers a sustainable alternative to chemical fertilizer dependence by repurposing organic waste (Handayani & Elfarisna, 2021; Delvi et al., 2021; Sianipar et al., 2017).

Limited studies on the combination of solid and liquid organic fertilizers for purple eggplant indicate a research gap that this study aims to address. Therefore, this research evaluates the independent effects and interactions between various doses of goat manure and different types of liquid organic fertilizer (LOF) on the

growth and yield components of purple eggplant. This study seeks to identify the optimal combination for maximizing nutrient absorption efficiency and sustainable productivity in restricted growing media. Furthermore, these findings are expected to provide practical contributions for farmers and expand the literature on optimizing organic agricultural inputs within the context of tropical horticulture.

METHOD

Research Methods

This research was comducted from Augus to December 2024 at the Submarine School (Sekasel) site, Pusdiskus Kodikopsla Kodiklatal, Surabaya, East Java. The site is located at an altitude of 4.6 m above sea level, characterized by an average rainfall of 179.65 mm, a mean temperature of 36 ^{0}C, humidity levels between 60% and 85%, and a light intensity of 70%. The soil profile consists of alluvial and grumosol types with a pH range of 6.5 - 7.5, categorized as neutral to slightly alkaline. The equipment used included cultivation tools (shovels, hoes, watering cans, 40x40 cm polybags, bamboo stakes), fermentation containers, and precision instrument such as analytical balances, digital scales, and vernier calipers. The primary research materials consisted of Antaboga F1 variety purple eggplant seeds, soil, compost, and goat manure. Additionally, various liquid organic fertilizers (LOF) were prepared from *eco-enzymes*, banana peels, and cabbage waste using molasses and EM4 solutions. Supporting inputs included NPK 16:16:16 fertilizer as a control, AC wastewater, and "Nopatek" botanical pesticide for plant maintenance.

This study employed a factorial experiment based on a Randomized Block Design (RBD) featuring two factors. The experimental structure consisted of 16 treatment combination replicated three times, resulting in 48 experimental units. Each unit contained three sample plants, totaling 144 plants. The first factor was the dose of goat manure (P), which comprised four levels as follows: The first factor was the dose of goat manure (P), consisting of four levels: P0, soil only (control); P1, goat manure at 500 g plant^{-1}; P2, goat manure at 750 g plant^{-1}; and P3, goat manure at 1,000 g plant^{-1}. The second factor was the type of liquid organic fertilizer (LOF) (M), which also comprised four levels: M0, NPK 16–16–16 (control); M1, eco-enzyme liquid organic fertilizer; M2, banana peel–based liquid organic fertilizer; and M3, cabbage waste–based liquid organic fertilizer.

Soil Analysis

Soil analysis of the combination treatment involving 1,000 g/plant of goat manure and banana peel liquid organic fertilizer (LOF) revealed a total nitrogen (N-total) content of 0.22% (moderated). Available phosphor (P-available) was recorded at 1,051.0 ppm (very high), while available potassium (K-available) reached 4.7 me/100 g (very high). Additionaly, the combination significantly enhanced the water-holding capacity (WHC), with values ranging from 45% to 60%.

Research Procedure

Planting

Purple eggplant was cultivated in polybags using a growing medium composed of soil and compost in a 1:1 ratio, supplemented with goat manure according to the designated treatment doses. The goat manure contained 1.14% N, 0.264% P, and 0.423% K, with a moisture content of 50.89% and a C/N ration of 19.9. Seedlings were prepared in a nursery tray using a 1:1 soil-compost medium, with seeds sown at a depth of 0.5 cm. Once ready, a single seedling was transplanted into each polybag into a hole 3 - 4 cm deep.

Preparation of Kepok Banana Peel Liquid Organic Fertilizer (LOF)

The preparation of *Kepok* banana peel LOF began by cutting 15 kg of banana peel waste into small pieces. The waste was then washed with water and processed using a blender until smooth. The mixture was placed in a plastic drum with 15 liters of water, 375 ml of EM4 solution, and 375 ml of molasses. All ingredients were stirred thoroughly, and the drum was sealed for 14 days to ensure an optimal fermentation process (Rahayu et al., 2022).

Preparation of Cabbage Waste Liquid Organic Fertilizer (LOF)

The preparation of cabbage waste LOF involved processing 15 kg of cabbage waste using a blender until crushed. The material was then transferred into a plastic drum and mixed with 15 liters of water. Subsequently, 375 ml of EM4 solution and 375 ml of molasses were added to the mixture. All ingredients were stirred thoroughly, and the container was sealed for 14 days to ensure an optimal fermentation process (Septiawan, 2018).

Application of NPK 16-16-16 Fertilizer

NPK 16:16:16 fertilizer was applied to the M_0 treatment (control). An initial dose of 7.5 g/plant was administered at planting using the drill method (side-dressing). Subsequent applications were provided as top-dressing at 14, 21, 28, 35, 42, 49, 56, 63, 70, and 77 days after planting (DAP), with a dose of 2.25 g/plant per application. While the initial fertilization was performed by drilling, all subsequent applications were administered through the fertigation (drenching) method.

Application of Liquid Organic Fertilizer

The liquid organic fertilizer (LOF) was applied after a 14-day fermentation process. Following fermentation, the mixture was filtered to separate the liquid from the unused solid residue. Successful LOF was characterized by a non-pungent odor, a yellowish-brwon color, and pH levels of 6.35 for banana peel LOF and 6.25 for cabbage waste LOF. The fertilizers were stored in sealed containers away from direct sunlight. To maintain microbial activity and nutrient availability for the purple eggplant, molasses was added monthly. Additional, a commercial *eco-enzyme* treatment (*Eco-Enzyme* GMT Super) was utilized, which is composed of 50-70 varieties of fruit and vegetable waste.

Fertilization was carried out using three types of LOF: *eco-enzyme*, banana peel, and cabbage waste. Each LOF was diluted with water prior to application

according to the treatment levels: M_1 (*eco-enzyme* at a recommended dose of 5 ml/l water), M_2 (banana peel at a 1:3 ration, using 75 ml LOF in 225 ml water), and M_3 (cabbage waste at a 1:3 ratio, using 75 ml LOF in 225 ml water). The LOF was applied weekly for a total of ten applications via soil drenching. The dosage was 100 ml/plant at 14 and 21 DAP, which was then increased to 200 ml/plant for subsequent applications from 28 to 77 DAP.

Plant Maintenance

Plant maintenance included irrigantion, weeding, land sanitation, pruning, and pest and disease management. Irrigation was performed twice daily, in the morning and afternoon, except during sufficient rainfall. Weeding was conducted manually by removing weeds from the polybags by hand. Additionally, land sanitation involved clearing overgrown grass around the exterior of the polybags using a brush cutter. These practices ensured optimal growth by minimizing nutrient competition.

To accelerate the generative phase (flowering), pruning was performed weekly. During the vegetative stage, axillary shoots or branches located below the primary "Y" fork were removed. Once the plants entered the generative phase, pruning was restricted to the lowermost water shoots. Pest and disease control involved applying "Nopatek" botanical pesticide starting at 14 DAP. The pesticide was administered weekly in the afternoon at a recommended dose of 3 bottle caps per 15 liters of water.

Data analysis

Observation parameters in the vegetative phase included plant height parameter (cm) and number of leaves (strands). Meanwhile, in the generative observation parameters, there are total fruit number per plant (fruit) and total harvest weight per plant (gram). The data was analyzed using ANOVA statistically, if the treatment experiment gave a real effect then continued with the Honestly Significant Difference (HSD) test at the 5% test level.

RESULT AND DISCUSSION

Plant Height

Purple eggplant height was measured at weekly intervals. Figure 1 illustrates the plant height trends from 56 to 77 days after planting (DAP). Based on Figure 1, an interaction pattern was observed between the organic fertilizer combinations and plant height across all observation periods. At 77 DAP, the combination of 1,000 g/plant goat manure and banana peel liquid organic fertilizer (P3M2) yielded the highest organic-based result at 46.67 cm. This was significantly different from the 1,000 g/plant goat manure combinations using *eco-enzyme* (P3M1) at 41.61 cm and cabbage waste (P3M3) at 43.50 cm. However, when compared to the chemical control, the combination of 1,000 g/plant goat manure and NPK 16:16:16 (P3M0) produced the overall maximum plant height of 51.89 cm.

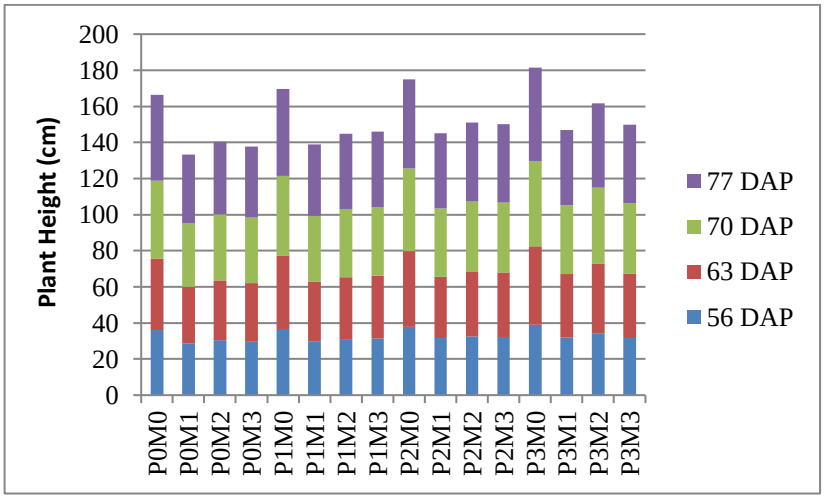

Figure 1. Chart of the Plant Height on Purple Eggplant Plants

Table 1. Average Plant Height of Purple Eggplant in Combination Treatment of Doses of Goat Manure and LOF Ages 56-77 DAP

Age	Dose of Fertilizer Goat Manure Dosage (g/plant)	Purple Eggplant Plant Height			
		Type of Liquid Organic Fertilizer			
		Control (NPK)	*Eco-enzyme* LOF	Banana Peel LOF	Cabbage Waste LOF
56 DAP	Soil (Control)	36.06 ± 0.36 cd	28.72 ± 0.36 a	30.50 ± 0.36 ab	29.64 ± 0.36 ab
	500 g/plant	36.61 ± 0.36 d	29.89 ± 0.36 ab	31.06 ± 0.36 b	31.44 ± 0.36 b
	750 g/plant	37.94 ± 0.36 de	31.50 ± 0.36 b	32.50 ± 0.36 b	32.28 ± 0.36 b
	1,000 g/plant	39.06 ± 0.36 e	31.83 ± 0.36 b	34.44 ± 0.36 c	31.67 ± 0.36 b
	HSD 5%	1.88			
63 DAP	Soil (Control)	39.56 ± 0.30 de	31.33 ± 0.30 a	33.11 ± 0.30 b	32.56 ± 0.30 ab
	500 g/plant	40.61 ± 0.30 e	32.94 ± 0.30 b	34.39 ± 0.30 bc	34.78 ± 0.30 c
	750 g/plant	42.00 ± 0.30 ef	34.17 ± 0.30 bc	36.00 ± 0.30 c	35.72 ± 0.30 c
	1,000 g/plant	43.33 ± 0.30 f	35.28 ± 0.30 c	38.33 ± 0.30 d	35.83 ± 0.30 c
	HSD 5%	1.57			
70 DAP	Soil (Control)	43.33 ± 0.30 de	35.06 ± 0.30 a	36.72 ± 0.30 b	36.17 ± 0.30 ab
	500 g/plant	44.28 ± 0.30 e	36.50 ± 0.30 ab	37.83 ± 0.30 bc	37.89 ± 0.30 bc
	750 g/plant	45.67 ± 0.30 e	37.78 ± 0.30 bc	38.89 ± 0.30 c	38.78 ± 0.30 c

Age	Dose of Fertilizer Goat Manure Dosage (g/plant)	Purple Eggplant Plant Height			
		Type of Liquid Organic Fertilizer			
		Control (NPK)	*Eco-enzyme* LOF	Banana Peel LOF	Cabbage Waste LOF
77 DAP	1,000 g/plant	47.28 ± 0.30 f	38.22 ± 0.30 bc	42.28 ± 0.30 d	38.89 ± 0.30 c
	HSD 5%	1.58			
	Soil (Control)	47.44 ± 0.28 e	38.28 ± 0.28 a	40.00 ± 0.28 b	39.39 ± 0.28 ab
	500 g/plant	48.11 ± 0.28 ef	39.44 ± 0.28 ab	41.44 ± 0.28 bc	42.00 ± 0.28 cd
	750 g/plant	49.44 ± 0.28 f	41.61 ± 0.28 c	43.50 ± 0.28 d	43.44 ± 0.28 d
	1,000 g/plant	51.89 ± 0.28 g	41.61 ± 0.28 c	46.67 ± 0.28 e	43.50 ± 0.28 d
	HSD 5%	1.50			

Notes: The numbers followed by the same letter at the same time observation age show no significant difference in the 5% HSD test.

The application of goat manure significantly supports the growth of purple eggplant, particularly during the vegetative phase, Its high nitrogen (N), Phosphorus (P), and Potassium (K) content fulfills the essential nutrient requirements for plant development. This align with Alrasid (2022), who states that goat manure provides additional nutrients that improve the physical, chemical, and biological properties of the soil, leading to stable and enhanced vegetative groeth, especially plant height. Furthermore, goat manure improves soil structure and texture, increasing the fertility and availability of macronutrients. This nutrient abundance ensures that essential elements are efficiently absorbed, allowing the eggplant to reach an optimal and stable vegetative phase (Harahap et al., 2018; Abdillah et al., 2023).

The application of banana peel liquid organic fertilizer (LOF) produced higher average plant heights compared to *eco-enzyme* and cabbage waste LOF. This difference is attributed to the varying concentrations of macro and micronutrients within each fertilizer. Since LOF composition varies based on raw materials and production methods, its nutrient quality directly influences its effectiveness across different crops and soil types (Pebriawan et al., 2025; Indrajaya & Suhartini, 2018). However, the NPK 16:16:16 treatment yielded superior results overall. This is due to its balanced and readily available N, P, and K content, which supports more stable growth and development of plant organs (Risnawati et al., 2023; Lase et al., 2023).

Number of Leaves

The number of leaves was recorded weekly by counting all fully expanded leaves per plant. Figure 2 illustrates the leaf count trends from 28 to 77 DAP. Based on Figure 2, an interaction was observed between the organic fertilizer combinations and the number of leaves across all observation periods. At 77 DAP, the combination of 1,000 g/plant goat manure and banana peel liquid organic fertilizer (P3M2) yielded the highest organic-based result with 16.33 leaves. This result was significantly different from the 1,000 g/plant goat manure combinations using *eco-*

enzyme (P3M1) at 13.44 leaves and cabbage waste (P3M3) at 13.56 leaves. However, the combination of 1,000 g/plant goat manure and the NPK 16:16:16 control (P3M0) produced the overall maximum leaf count of 18.44 leaves.

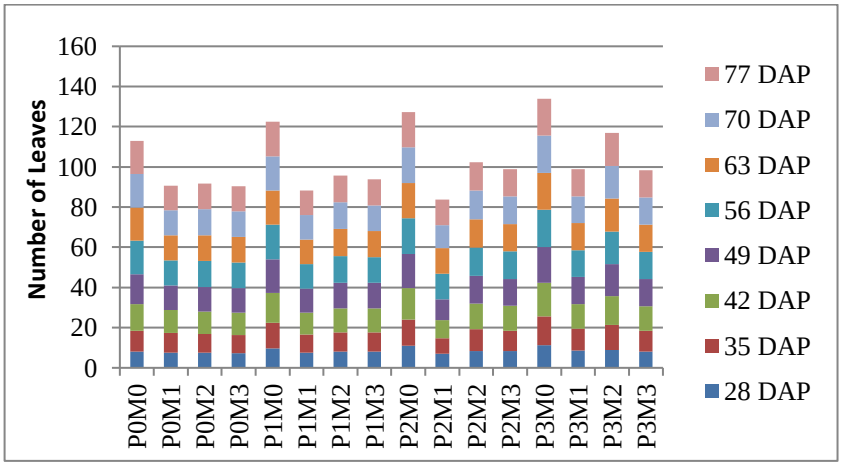

Figure 2. Chart of the Number of Leaves on Purple Eggplant Plants

Table 2. Average Number of Purple Eggplant Leaves in the Combination Treatment of Goat Manure Doses and Types of LOF at 28-77 DAP

Age	Dose of Fertilizer Goat Manure Dosage (g/plant)	Number of Purple Eggplant Leaves			
		Type of Liquid Organic Fertilizer			
		Control (NPK)	*Eco-enzyme* LOF	Banana Peel LOF	Cabbage Waste LOF
28 DAP	Soil (Control)	8.00 ± 0.43 ab	7.67 ± 0.43 ab	7.56 ± 0.43 ab	7.33 ± 0.43 a
	500 g/plant	9.78 ± 0.43 b	7.67 ± 0.43 ab	8.11 ± 0.43 ab	8.00 ± 0.43 ab
	750 g/plant	10.89 ± 0.43 b	7.11 ± 0.43 a	8.33 ± 0.43 ab	8.33 ± 0.43 ab
	1,000 g/plant	11.33 ± 0.43 b	8.56 ± 0.43 ab	9.00 ± 0.43 ab	8.11 ± 0.43 ab
	HSD 5%	2.28			
35 DAP	Soil (Control)	10.44 ± 0.45 b	9.78 ± 0.45 ab	9.22 ± 0.45 ab	9.00 ± 0.45 ab
	500 g/plant	12.67 ± 0.45 bc	9.00 ± 0.45 ab	9.56 ± 0.45 ab	9.67 ± 0.45 ab
	750 g/plant	13.11 ± 0.45 c	7.67 ± 0.45 a	10.89 ± 0.45 b	10.22 ± 0.45 b
	1.000 g/plant	14.33 ± 0.45 d	10.89 ± 0.45 b	12.33 ± 0.45 bc	10.44 ± 0.45 b
	HSD 5%	2.37			
42 DAP	Soil (Control)	13.22 ± 0.44 bc	11.22 ± 0.44 ab	11.11 ± 0.44 ab	11.00 ± 0.44 ab
	500 g/plant	14.89 ± 0.44 ab	10.89 ± 0.44 ab	11.78 ± 0.44 b	11.89 ± 0.44 b

Age	Dose of Fertilizer Goat Manure Dosage (g/plant)	Number of Purple Eggplant Leaves			
		Type of Liquid Organic Fertilizer			
		Control (NPK)	*Eco-enzyme* LOF	Banana Peel LOF	Cabbage Waste LOF
49 DAP	750 g/plant	15.67 ± 0.44cd	9.00 ± 0.44 a	12.67 ± 0.44 bc	12.33 ± 0.44 bc
	1.000 g/plant	16.78 ± 0.44 d	12.33 ± 0.44 bc	14.44 ± 0.44 c	12.11 ± 0.44 b
	HSD 5%	2.31			
	Soil (Control)	15.00 ± 0.37 c	12.33 ± 0.37 b	12.33 ± 0.37 b	12.44 ± 0.37 b
	500 g/plant	16.67 ± 0.37 cd	11.89 ± 0.37 ab	12.89 ± 0.37 b	12.67 ± 0.37 b
	750 g/plant	17.00 ± 0.37 d	10.33 ± 0.37 a	13.89 ± 0.37 bc	13.33 ± 0.37 bc
	1,000 g/plant	17.78 ± 0.37 d	13.33 ± 0.37 bc	15.78 ± 0.37 cd	13.44 ± 0.37 bc
	HSD 5%	1.97			
56 DAP	Soil (Control)	16.56 ± 0.27 c	12.44 ± 0.27 ab	12.89 ± 0.27 ab	12.67 ± 0.27 ab
	500 g/plant	17.11 ± 0.27 cd	12.22 ± 0.27 a	13.33 ± 0.27 ab	12.89 ± 0.27 ab
	750 g/plant	17.67 ± 0.27 cd	12.67 ± 0.27 ab	14.11 ± 0.27 b	13.67 ± 0.27 b
	1,000 g/plant	18.44 ± 0.27 d	13.44 ± 0.27 ab	16.33 ± 0.27 c	13.56 ± 0.27 ab
	HSD 5%	1.42			
63 DAP	Soil (Control)	16.56 ± 0.27 c	12.44 ± 0.27 ab	12.89 ± 0.27 ab	12.67 ± 0.27 ab
	500 g/plant	17.11 ± 0.27 cd	12.22 ± 0.27 a	13.33 ± 0.27 ab	12.89 ± 0.27 ab
	750 g/plant	17.67 ± 0.27 cd	12.67 ± 0.27 ab	14.11 ± 0.27 b	13.67 ± 0.27 b
	1,000 g/plant	18.44 ± 0.27 d	13.44 ± 0.27 ab	16.33 ± 0.27 c	13.56 ± 0.27 ab
	HSD 5%	1.42			
70 DAP	Soil (Control)	16.56 ± 0.32 c	12.44 ± 0.32 ab	12.89 ± 0.32 ab	12.67 ± 0.32 ab
	500 g/plant	17.11 ± 0.32 cd	12.22 ± 0.32 ab	13.33 ± 0.32 b	12.89 ± 0.32 ab
	750 g/plant	17.67 ± 0.32 cd	11.56 ± 0.32 a	14.11 ± 0.32 b	13.67 ± 0.32 b
	1,000 g/plant	18.44 ± 0.32 d	13.44 ± 0.32 b	16.33 ± 0.32 c	13.56 ± 0.32 b
	HSD 5%	1.68			

Age	Dose of Fertilizer Goat Manure Dosage (g/plant)	Number of Purple Eggplant Leaves			
		Type of Liquid Organic Fertilizer			
		Control (NPK)	*Eco-enzyme* LOF	Banana Peel LOF	Cabbage Waste LOF
77 DAP	Soil (Control)	16.56 ± 0.27 c	12.44 ± 0.27 ab	12.89 ± 0.27 ab	12.67 ± 0.27 ab
	500 g/plant	17.11 ± 0.27 cd	12.22 ± 0.27 a	13.33 ± 0.27 ab	12.89 ± 0.27 ab
	750 g/plant	17.67 ± 0.27 cd	12.67 ± 0.27 ab	14.11 ± 0.27 b	13.67 ± 0.27 b
	1,000 g/plant	18.44 ± 0.27 d	13.44 ± 0.27 ab	16.33 ± 0.27 c	13.56 ± 0.27 ab
	HSD 5%	1.42			

Notes: The numbers followed by the same letter at the same time observation age show no significant difference in the 5% HSD test.

Table 2 indicates that the combination of 1,000 g/plant goat manure and banana peel liquid organic fertilizer (LOF) produced the highest leaf count. This result is attributed to the ability of both organic fertilizers to provide sufficient essential nutrient during the vegetative phase. These nutrient enhance chlorophyll formation and optimize photosynthesis, thereby stimulating leaf production. This align with Saputri et al., (2024) and Badar et al., (2021), who state that essential nutrients significantly influence vegetative growth and development, leading to stable (linear) plant growth.

The application of goat manure ensures optimal plant growth and high productivity, provided that the required nutrients are sufficiently available and balanced in the soil. Nitrogen (N), Phosphor (P), and Potassium (K) in goat manure are essential; the absence of any of these elements can significantly hinder plant development (Rosfani et al., 2023). Among the liquid organic fertilizers (LOF), banana peel LOF produced the highest leaf count compared to *eco-enzyme* and cabbage waste LOF. Although NPK 16:16:16 yielded more leaves, the difference was not statistically significant compared to the banana peel LOF treatment. Consequently, banana peel LOF is a preferable alternative as it is more environmentally friendly and reduces household waste. Furthermore, the high potassium content in banana peel LOF (up tp 560 mg/L) enhances photosynthesis, thereby stimulating leaf production (Cahyawati et al., 2022; Eddy et al., 2019).

Total Number of Fruits per Plant

The total number of fruits per plant was determined by accumulating all harvested fruits from the first to the fifth week of harvest. Figure 3 illustrates the total fruit count trends for the purple eggplant.

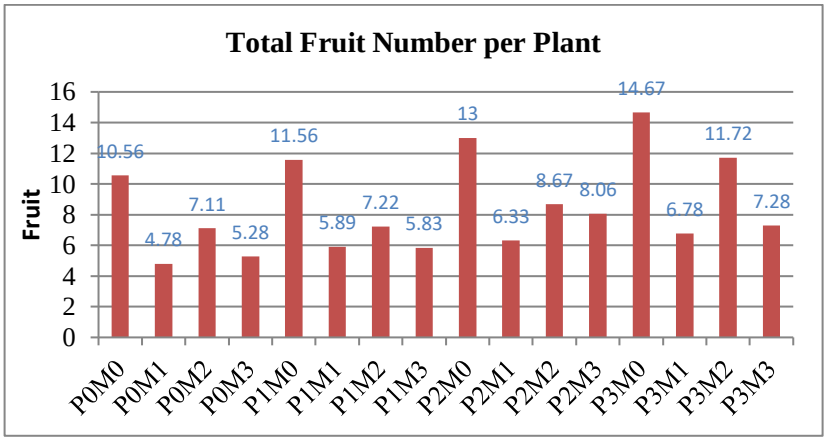

Figure 3. Chart of Total Fruit Number per Plant Purple Eggplant

Based on Figure 3, an interaction was observed between the organic fertilizer combinations and the total number of fruits harvested over the five-week period. At the end of the harvest, the combination of 1,000 g/plant goat manure and banana peel liquid organic fertilizer (P3M2) yielded the highest organic-based result with 11.72 fruits. This was significantly different from the 1,000 g/plant goat manure combinations using *eco-enzyme* (P3M1) at 6.78 fruits and cabbage waste (P3M3) at 7.28 fruits. However, the combination of 1,000 g/plant goat manure and the NPK 16:16:16 control (P3M0) produced the overall maximum yield of 14.67 fruits per plant.

Tabel 3. Average Total Fruit Number per Purple Eggplant Plant in Combination Treatment of Doses of Goat Manure and Varieties LOF

Dose of Fertilizer Goat Manure Dosage (g/plant)	**Total Fruit Number per Purple Eggplant Plant**			
	Type of Liquid Organic Fertilizer			
	Control (NPK)	***Eco-enzyme* LOF**	**Banana Peel LOF**	**Cabbage Waste LOF**
Soil (Control)	10.56 ± 0.48 bc	4.78 ± 0.48 a	7.11 ± 0.48 ab	5.28 ± 0.48 a
500 g/plant	11.56 ± 0.48 c	5.89 ± 0.48 ab	7.22 ± 0.48 ab	5.83 ± 0.48 ab
750 g/plant	13.00 ± 0.48 cd	6.33 ± 0.48 ab	8.67 ± 0.48 b	8.06 ± 0.48 b
1,000 g/plant	14.67 ± 0.48 d	6.78 ± 0.48 ab	11.72 ± 0.48 c	7.28 ± 0.48 ab
HSD 5%	2.54			

Notes: The numbers followed by the same letter indicate no significant difference in the 5% HSD test.

Table 3 indicates that the combination of 1,000 g/plant goat manure and banana peel liquid organic fertilizer (LOF) resulted in the highest total fruit count per plant. This outcome is attributed to the presence of essential nutrients in both organic fertilizers, particularly phosphor (P) and potassium (K). Phosphor plays a vital role in fruit formation; sufficient availability of this element accelerates optimal fruit development. Conversely, a phosphor deficiency can lead to malformed fruit with a yellowish-purple discoloration (Triadiawarman et al., 2022). Furthermore, potassium is essential for protein and carbohydrate synthesis, which enhances disease resistance and ensures maximum fruit quality (Kadafi et al., 2023; Kholifah et al., 2025).

The application of goat manure provides a balanced supply of nutrients that directly correlates with the total number of fruits per plant. Increasing the dosage of goat manure enhances the nutrient availability required for fruit formation, thereby significantly boosting the overall productivity of purple eggplant (Pata'dungan, 2020).

Total Fruit Weight per Plant

The total fruit weight per plant was determined by accumulating the weights from all harvests between the first and fifth weeks. Figure 4 illustrates the trends in total harvest weight for the purple eggplant. According to Figure 4, an interaction was observed between the organic fertilizer combinations and the cumulative fruit weight over the five-week harvesting period. The combination of 1,000 g/plant goat manure and banana peel liquid organic fertilizer (P3M2) achieved the highest organic-based yield at 1,635.94 grams. This result was significantly different from the 1,000 g/plant goat manure treatments using *eco-enzyme* (P3M1) at 843.30 grams and cabbage waste (P3M3) at 958.59 grams. However, the combination of 1,000 g/plant goat manure and the NPK 16:16:16 control (P3M0) produced the overall maximum fruit weight of 2,088.30 grams per plant.

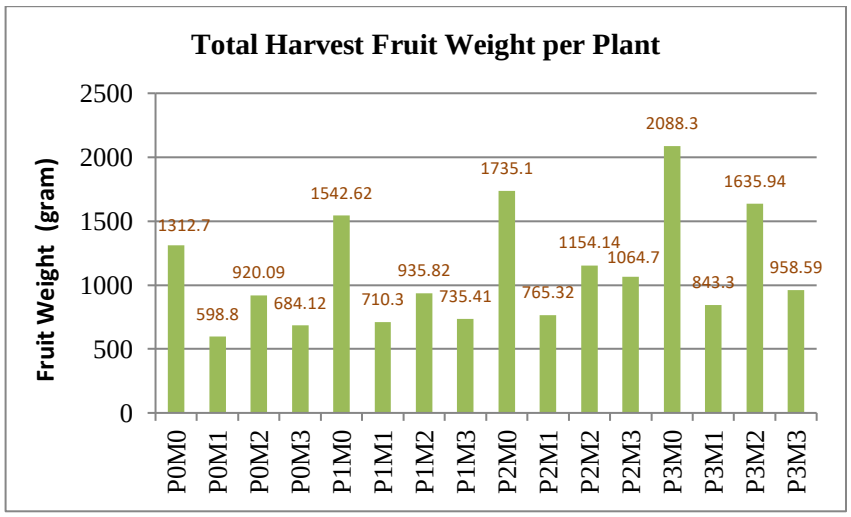

Figure 4. Chart of the Total Harvest Fruit Weight per Plant Purple Eggplant

Table 4 indicates that the combination of 1,000 g/plant goat manure and banana peel liquid organic fertilizer (LOF) produced the highest total fruit weight per plant. This outcome is likely due to the varying concentrations of essential nutrient and the specific dosages applied in each treatment, which resulted in differing levels of effectiveness regarding crop yield. This is supported by Jariyah et al., (2022) and Buana et al., (2025), who state that the type and dosage of both solid and liquid organic fertilizers significantly influence the quality and quantity of purple eggplant yields. Consequently, the absorption of macro and micronutrients varies across treatments, directly impacting parameters such as the total harvested fruit weight per plant.

Table 4. Average Weight of Total Harvested Fruit per Purple Eggplant Plant in Combination treatment of Doses of Goat Manure and Varieties LOF

Dose of Fertilizer Goat Manure Dosage (g/plant)	Weight of Total Harvested Fruit per Plant Purple Eggplant			
	Type of Liquid Organic Fertilizer			
	Control (NPK)	*Eco-enzyme* LOF	Banana Peel LOF	Cabbage Waste LOF
Soil (Control)	1312.70 ± 66.87 c	598.80 ± 66.87 a	920.09 ± 66.87 ab	684.12 ± 66.9 ab
500 g/plant	1542.62 ± 66.87 cd	710.30 ± 66.87 ab	935.82 ± 66.87 ab	735.41 ± 66.9 ab
750 g/plant	1735.10 ± 66.87 d	765.32 ± 66.87 ab	1154.14 ± 66.87 bc	1064.70 ± 66.9 bc
1,000 g/plant	2088.30 ± 66.87 e	843.30 ± 66.87 ab	1635.94 ± 66.87 cd	958.59 ± 66.9 b
HSD 5%	352.39			

Notes: The numbers followed by the same letter indicate not significantly different at 5% HSD test.

The application of goat manure demonstrated a positive dose-response effect, with higher dosages significantly increasing the total fruit weight per plant. This align with the findings of Barasa et al., (2024), which indicate that goat manure substantially enhances total harvest weight. The essential nutrients provided-specifically nitrogen, phosphor, and potassium-promote photosynthesis and stimulate generative growth, including fruit formation. Furthermore, goat manure improves soil structure, nutrient availability, and microbial activity, all of which directly enhance the overall productivity of the purple eggplant.

CONCLUSION

The results demonstrate that the combination of 1,000 g/plant goat manure and banana peel liquid organic fertilizer (LOF) significantly enhanced all growth and yield parameters, including plant height (46.67 cm), leaf count (16.33 leaves), total fruit count (11.72 fruits), and harvest weight (1,635.94 grams). Individually, the 1,000 g/plant goat manure treatment and the banana peel LOF treatment both outperformed other organic alternatives, yielding superior results across all measured variables. Physiologically, these outcomes are driven by a synergy between phosphor, which expands root reach, and the high potassium and cytokinin levels in banana peels that accelerate photosynthesis and nutrient translocation. Consequently, this combined treatment produced vegetatively robust plants and superior generative performance, characterized by intense anthocyanin fruit coloration and maximum harvest weight compared to either single or alternative organic fertilizer combinations. This research provides a strategic contribution to sustainable agriculture as an effective substitute for inorganic fertilizers. The integration of slow-release nutrients from goat manure and immediate-release nutrients from liquid organic fertilizer (LOF) fulfills comprehensive crop requirements. Implementing this

organic waste-based fertilization model effectively maintains high productivity while enhancing the physical and biological structure of the polybag growing media. Consequently, utilizing organic waste offers a viable solution to minimize chemical dependency, reduce production costs, and ensure healthy, environmentally friendly yields. Future research should explore increased dosages of all three LOF types: *eco-enzyme*, banana peel, and cabbage waste.

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