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Article

Growth Performance of Elephant Grass (Pennisetum purpureum) Treated with Liquid Organic Fertilizer from Cattle Urine and Fruit Waste

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A B S T R A C T

This study aimed to evaluate the effect of liquid organic fertilizer (LOF) derived from a fermented mixture of cattle urine and fruit waste on the growth performance of elephant grass (Pennisetum purpureum). The research employed a Completely Randomized Design (CRD) with 4 treatment levels and 5 replications: P0 (control), P1 (50 ml LOF/liter of water), P2 (100 ml LOF/liter of water), and P3 (150 ml LOF/liter of water). The parameters assessed included plant height, leaf length, and fresh weight of the elephant grass. The statistical analysis showed that the application of LOF had a significant effect on all growth parameters. The concentration of 150 ml LOF/liter of water (P3) yielded the best results for plant height (140.60 cm), leaf length (130.20 cm), and fresh weight (3,637.00 grams). The application of LOF significantly improved the productivity of elephant grass compared to no fertilization.

1. Introduction

The continuous availability of high-quality forage is one of the key factors in supporting the success of ruminant farming enterprises, such as cattle, goats, and sheep (Novita et al., 2023). Elephant grass (Pennisetum purpureum) is recognized as one of the superior tropical forage grasses highly popular among farmers due to its high biomass productivity, wide adaptability, and good nutritional content. To optimize vegetative growth and increase biomass production, fertilization plays a crucial role in providing essential macro and micro-nutrients (Badat et al., 2021).

Amidst the high prices of synthetic inorganic fertilizers and the demand for environmentally friendly sustainable agriculture practices, the utilization of organic waste serves as a highly strategic alternative solution. Livestock waste in the form of cattle urine and domestic/market waste in the form of residual fruits have the potential to be processed into Liquid Organic Fertilizer (LOF). Cattle urine contains relatively high levels of nitrogen and potassium, while fruit waste fermentation contributes macro-nutrients and organic acids that can improve soil biological and chemical properties while accelerating nutrient uptake by plant tissues (Sukendah et al., 2023; Suryadi et al., 2025).

Although the use of liquid organic fertilizers from livestock urine or fruit waste separately has been widely explored in various agronomic studies (Badat et al., 2021; Suryadi et al., 2025), research specifically formulating a combination of Cattle Urine and Fruit Waste-based Liquid Organic Fertilizer for application in elephant grass (Pennisetum purpureum) cultivation remains very limited.

Based on this background, this study aims to evaluate the effect of applying liquid organic fertilizer derived from a combination of cattle urine and fruit waste on the growth performance of elephant grass (Pennisetum purpureum), with testing parameters including plant height, leaf length, and fresh weight of the grass.

2. Literature Review

2.1 Characteristics and Growth of Elephant Grass (*Pennisetum purpureum*)

Elephant grass (*Pennisetum purpureum* Schumach.) is a perennial tropical grass species from the Poaceae family that holds high potential as a quality forage source for ruminant livestock (Johannes et al., 2024). This plant originates from Africa and is known for its wide adaptability to various environmental conditions, drought tolerance, and exceptionally rapid growth rate (Johannes et al., 2024). Morphologically, elephant grass grows erect, forming dense clumps with a deep root system, and can reach heights between 2 to 6 meters depending on soil fertility conditions and management practices (Mukhtar et al., 2022).

The growth characteristics of elephant grass are highly responsive to the availability of both macro and micronutrients. The primary parameters used to measure the growth performance of elephant grass include plant height, number of tillers, stem diameter, leaf length and width, and fresh as well as dry biomass weight production (Kalebbi et al., 2024; Bahri et al., 2022). In forage cultivation systems, fertilization plays a crucial role in optimizing vegetative growth. The use of liquid organic fertilizer (LOF), including those sourced from livestock waste such as animal urine, as well as household or fruit organic waste, has been proven to improve the physical, chemical, and biological properties of the soil, thereby optimizing the uptake of essential nutrients such as Nitrogen (N), Phosphorus (P), and Potassium (K) (Bahri et al., 2022). The Nitrogen content in liquid organic fertilizer plays a vital role in stimulating the formation of plant vegetative organs such as shoots, stems, and leaves, which will ultimately increase the photosynthetic rate and total biomass growth of elephant grass (Mukhtar et al., 2022).

2.2 Potential of Dairy Cattle Urine and Fruit Waste Liquid Organic Fertilizer

Liquid Organic Fertilizer (LOF) serves as an innovative alternative in agriculture and animal husbandry to enhance soil fertility while optimizing the growth of forage crops, particularly elephant grass (*Pennisetum purpureum*) (Kalebbi et al., 2024). The utilization of livestock and agricultural waste, such as dairy cattle urine and fruit waste, as raw materials for LOF is considered highly strategic because, aside from being environmentally friendly, these wastes are rich in macro and micronutrients essential for plants (Badat et al., 2021).

Dairy cattle urine contains major nutrients such as nitrogen (N), phosphorus (P), and potassium (K), as well as natural plant growth regulators like auxins, which are essential for stimulating plant cell division, elongation, and differentiation (Badat et al., 2021). Based on previous studies, the application of cattle urine-based LOF has been proven to significantly increase the productivity of elephant grass in terms of plant height, number of tillers,

fresh weight, and dry weight (Prayogo et al., 2019). Appropriate concentration levels and application frequency of cattle urine allow it to be optimally absorbed through leaf stomata or roots without damaging plant tissues (Badat et al., 2021).

On the other hand, the addition of fruit waste in LOF production acts as a source of carbohydrates and simple sugars, serving as nutrition for local microorganisms (LM) during the fermentation process. The combination of fruit waste and livestock urine produces a nutrient synergy that enriches the quality of LOF, thereby improving soil physical, chemical, and biological properties and optimally stimulating the vegetative growth of elephant grass (Kalebbi et al., 2024). The utilization of this integrated organic waste not only supports sustainable agricultural principles (zero waste) but also provides an efficient solution to reduce production costs for high-quality forage for ruminant livestock (Bahri et al., 2022).

2.3 Effect of Liquid Organic Fertilizer Application on Plant Growth

Liquid Organic Fertilizer (LOF) is a highly effective fertilization alternative for supplying nutrients to plants, including forage crops such as elephant grass (*Pennisetum purpureum*). Elephant grass is known as a plant with high productivity and responsiveness to nutrient application (Mihrani & Novanto, 2024). The use of LOF sourced from livestock waste, such as animal urine, or combined with horticultural organic waste (fruit waste), plays an essential role in improving soil physical, chemical, and biological properties, as well as providing macro and micronutrients that are readily absorbed by the plant root system.

Livestock urine (such as cattle or goat urine) contains primary macronutrients such as Nitrogen (N), Phosphorus (P), and Potassium (K), as well as natural growth regulators like auxins that support plant cell division, elongation, and differentiation processes (Mihrani & Novanto, 2024; Sastrawan et al., 2021). Meanwhile, the addition of fruit waste in the LOF fermentation process serves as an additional carbon source and enriches micro-nutrient contents that support soil microorganism activity in degrading organic matter.

Various studies over the past decade indicate that the application of urine- and organic waste-based LOF exerts a significant effect on the vegetative growth parameters of elephant grass. These parameters include increases in plant height, number of leaves, number of tillers, and the production of fresh and dry biomass weight (Mihrani & Novanto, 2024). Appropriate dosage and frequency of application have been reported to maximize nutrient absorption by leaf and root tissues, thereby optimizing the photosynthetic rate and allowing plant growth to reach its maximum potential (Sastrawan et al., 2021).

3. Research Methodology

This research was conducted at the Agrostology Laboratory, Universitas Pahlawan Tuanku Tambusai, from March to May 2025.

This study used a Completely Randomized Design (CRD) with 4 treatments and 5 replications. Each replication unit consisted of 3 plants grown separately in polybags, resulting in a total of 60 experimental units in this study. The treatments included:

P0 : Without the application of liquid organic fertilizer (LOF) from cow urine and fruit waste (LOF CUFW).
P1 : Application of LOF CUFW at a dose of 50 ml / 1 liter of water.
P2 : Application of LOF CUFW at a dose of 100 ml / 1 liter of water.
P3 : Application of LOF CUFW at a dose of 150 ml / 1 liter of water.

Plant maintenance was carried out to support optimal growth and reduce nutrient competition. Watering was done daily to maintain the moisture of the growing media in the polybags to meet the growth requirements of elephant grass. In addition, weed control was carried out daily (manual weeding) to ensure that all nutrients in the growing media were absorbed effectively by the main plant (*Pennisetum purpureum*).

3.1 Instruments and Materials

1. Elephant Grass Seeds: The elephant grass seeds used were stem cuttings obtained from the grass garden field of the Agrostology Laboratory, UP Farm.
2. Soil: The soil used was topsoil from the grass garden field of the Agrostology Laboratory, UP Farm.
3. Fertilizer: The fertilizer used was a mixture of liquid organic fertilizer made from cow urine obtained from UP Farm and fruit waste obtained from fruit juice stalls in Bangkinang and surrounding areas.

The equipment used for elephant grass production included polybags, hoes, machetes, knives, measuring tapes, buckets, ropes, and scales.

3.2 Data Collection and Analysis

The generated research data were statistically processed using Analysis of Variance (ANOVA) according to a Completely Randomized Design. The differences between treatments were further tested using Duncan's Multiple Range Test (DMRT).

4. Results and Discussion

This research was conducted to observe the growth of elephant grass, covering plant height, leaf length, and fresh weight. The results of the study are presented in Table 1.

Table 1. Effect of Treatments on the Growth and Production of Elephant Grass (*Pennisetum purpureum*)

Treatment	Mean Growth and Production		
	Plant Height (cm)	Leaf Length (cm)	Fresh Weight Production (gram)
P0	96,60[d]	86,60[d]	2802,00[b]
P1	109,20[c]	99,00[c]	3518,40[a]
P2	126,60[b]	116,40[b]	3527,00[a]
P3	140,60[a]	130,20[a]	3637,00[a]

4.1 Effect of Liquid Organic Fertilizer (LOF) Made from a Mixture of Cattle Urine and Fruit Waste on Plant Height

Based on the data in the table, the application of the LOF mixture of cattle urine and fruit waste had a significant effect on the plant height of elephant grass (*Pennisetum purpureum*), where treatment P3 (140.60 cm) showed the highest result and was significantly different from the other treatments, including the control (P0: 96.60 cm). This increase in plant height is in line with the availability of macro (N, P, K) and micro-nutrients contained in cattle urine and fruit waste. According to Badat et al. (2021), the N content in cattle urine functions to stimulate vegetative growth such as stems and leaves, while P and K elements assist in the division of meristematic tissues. The natural auxins contained in cattle urine also play an important role in the cell elongation process, which directly contributes to plant height growth.

4.2 Effect of Liquid Organic Fertilizer (LOF) Made from a Mixture of Cattle Urine and Fruit Waste on the Leaf Length of Elephant Grass

The results showed that an increase in the LOF dose was consistently followed by an increase in leaf length. Treatment P3 produced the best leaf length (130.20 cm) compared to the control P0 (86.60 cm). The more optimal leaf length in treatments with LOF application can be attributed to the improvement of plant metabolism. Nutrients easily absorbed from the LOF support a more efficient photosynthesis process, resulting in higher photosynthate production which is then allocated for the expansion of vegetative organs such as leaves. This is supported by the research of Firlyadi (2019), which stated that the application of cattle urine-based LOF has a very significant effect on increasing the leaf length and leaf width of elephant grass. According to Novita et al. (2023), providing proper nutrition through media or fertilizers can significantly increase plant vegetative productivity. The applied LOF functions as a nutrient source that is easily absorbed by plants, thereby accelerating the rate of photosynthesis and producing maximum leaf elongation along with the optimization of the given dose.

4.3 Effect of Liquid Organic Fertilizer (LOF) Made from a Mixture of Cattle Urine and Fruit Waste on the Fresh Weight of Elephant Grass

The fresh weight production of elephant grass increased significantly with the application of LOF, where treatments P1, P2, and P3 were not significantly different from one another, but all three were significantly different from the control (P0). The higher fresh weight in the treatment groups (reaching 3,637.00 grams in P3) reflects an increase in plant biomass due to adequate nutrient availability. Plants with good vegetative growth (height and leaf length) generally have higher water content and tissue biomass. Consistent with the research of Novita et al. (2023), the application of organic fertilizers has been proven to significantly increase plant productivity. Increasing the LOF dose to the optimal level in this study proved capable of triggering greater growth, which ultimately directly contributed to the increase in the fresh weight of elephant grass. According to the research of Mihrani and Novanto (2024), liquid organic fertilizer from cattle urine helps improve the physical and chemical properties of the soil, facilitating more optimal nutrient absorption to support biomass accumulation. This increase in fresh weight is in line with the increase in plant height and leaf length, which cumulatively increases the total fresh forage production of elephant grass.

5. Conclusion

Based on the results of statistical analysis (Table 2), the application of liquid organic fertilizer (LOF) made from a mixture of cattle urine and fruit waste has a significant effect on all growth parameters of elephant grass. Generally, a concentration of 150 ml/liter (P3) is the most optimal dose for enhancing the vegetative growth and biomass production of elephant grass.

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