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Influence of Organic Fertilizer Application on Durian (*Durio zibethinus* L.) Seedling Growth and Soil Nutrient Dynamics in Sumbawa Regency

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Abstract

Durian is an economically important tropical fruit in Southeast Asia; however, its productivity remains low in dryland areas such as Sumbawa Regency due to poor soil fertility and suboptimal cultivation practices. This study aimed to evaluate the effect of organic fertilizer application on the growth performance of durian seedlings and soil nutrient status. The experiment was arranged in a Randomized Complete Block Design (RCBD) with eight replications and eight treatments, consisting of organic fertilizer doses ranging from 0 to 100 g.plant^{-1}. Growth variables were observed at early (12 days after planting, DAP) and vegetative stages (30–90 DAP), including hypocotyl and epicotyl characteristics, root development, plant height, number of leaves, and stem diameter. Soil chemical properties (pH, N, P, K, Ca, and Mg) were analyzed before planting and after harvest. The results showed that organic fertilizer significantly improved seedling growth and soil nutrient status. At 12 DAP, moderate fertilizer application (40 g.plant^{-1}) produced optimal hypocotyl and epicotyl development, while the highest dose (100 g.plant^{-1}) enhanced root biomass and total plant weight. During the vegetative stage, 100 g.plant^{-1} consistently resulted in the highest plant height, number of leaves, and stem diameter. Soil analysis indicated that organic fertilizer significantly increased the availability of essential nutrients (N, P, K, Ca, and Mg), although soil pH remained stable across treatments. Correlation analysis revealed strong positive relationships between plant growth variables and nutrient availability, particularly nitrogen and phosphorus. In conclusion, the application of organic fertilizer, especially at 100 g.plant^{-1}, effectively improves durian seedling growth and soil fertility. This approach represents a sustainable strategy for enhancing durian cultivation in dryland environments such as Sumbawa Regency.

INTRODUCTION

Durian (*Durio zibethinus* L.), widely known as the 'king of fruits', is a tropical commodity with high economic value in Indonesia (Handayani et al., 2016). It is believed to have originated from Borneo Island, which harbors the greatest diversity of durian species, and remains an iconic and seasonal fruit across Southeast Asia, particularly in Indonesia, Malaysia, Thailand, and the Philippines (Husin et al., 2018; Aziz & Jalil, 2019). The fruit is characterized by a complex aroma profile composed of numerous volatile compounds, including esters, sulphur-containing compounds, thioacetals, thioesters, thiolanes, and alcohols, which contribute to its distinctive sensory properties (Belgis et al., 2016). Despite its economic importance, durian cultivation is often carried out in forest-based or semi-managed systems with minimal

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agronomic inputs. Many existing trees are inherited from previous generations and have been cultivated for decades or even centuries, resulting in relatively low productivity (Hamid et al., 2018). In addition, durian in Indonesia is predominantly propagated generatively through seeds, leading to high genetic variability, inconsistent fruit quality, and a prolonged juvenile phase, with trees typically bearing fruit only after 6–8 years or more (Febjislami et al., 2020).

In recent years, the application of organic fertilizers has gained increasing attention as a sustainable approach to improving plant growth and soil quality while reducing reliance on inorganic inputs (Zheng et al., 2020; Saputra et al., 2024). Organic fertilizers are environmentally friendly and contribute to the enhancement of soil physical, chemical, and biological properties. They supply essential macro- and micro-nutrients, as well as bioactive compounds such as gibberellic acid (GA), indole-3-acetic acid (IAA), and vitamins, which support plant growth and development (Islam et al., 2017). Furthermore, organic amendments have been reported to increase soil nutrient availability, particularly nitrogen, and improve overall soil fertility (Asharī et al., 2019). The use of locally available organic inputs, such as farmyard manure, compost, vermicompost, and biochar-based materials, also promotes sustainable agricultural practices through waste recycling and resource efficiency (Han et al., 2016; Keni et al., 2022; Huang et al., 2023; Zykov et al., 2024; Rotowa et al., 2025). Previous studies have demonstrated that bio-organic fertilizers, including vermicompost, significantly enhance seedling growth variables, such as height, stem diameter, and leaf nutrient content (Huang et al., 2023). However, fertilization practices must be carefully managed according to plant requirements to minimize nutrient losses and maximize efficiency (Mpanga et al., 2018).

Sumbawa Regency, located on Sumbawa Island, is characterized by rich biodiversity but relatively low durian productivity, with a production level of only 32.49 ton. This is considerably lower than that of East Lombok Regency, which produces 977.99 ton, making it the leading durian-producing area in West Nusa Tenggara Province. At the national level, Indonesia's durian production reached 1,696,936.77 ton in 2025 (Badan Pusat Statistik, 2026). The low productivity in Sumbawa is likely associated with the genetic limitations of local durian varieties, suboptimal cultivation practices, and environmental constraints, including dryland conditions, low rainfall, and poor soil fertility. To address this limitation, durian seeds sourced from Klaten Regency, an area with relatively high production (23,412.10 ton in 2025), were utilized in this study as a potential strategy to improve seedling performance. Therefore, this study aimed to evaluate the effect of organic fertilizer application on the growth performance of durian seedlings and soil nutrient status, in order to identify appropriate fertilization strategies for enhancing durian productivity under dryland conditions in Sumbawa Regency.

MATERIALS AND METHODS

Materials and Location

The materials used in this study included locally cloned durian seeds obtained from Klaten Regency, Central Java, Indonesia (Figure 1), and cow manure compost as the organic fertilizer. The growing media solely consisted of field soil and organic fertilizer. The experiment was conducted in Pernek Sub-District, Moyo Hulu District, Sumbawa Regency, West Nusa Tenggara Province, Indonesia, at an altitude of 40 m above sea level (8°34'19" S; 117°26'39" E) from February to July 2023. The environmental conditions at the study site were characterized by an average temperature of 31.02 ± 0.15°C, relative humidity of 75.80 ± 0.20%, light intensity of 44,582.13 ± 12.16 lx, and wind speed of 3.60 ± 0.05 m/s.

Experimental Design

The treatments comprised the applications of organic fertilizer at doses of 5, 10, 20, 30, 40, 50, and 100 g per plant, along with a control treatment. The experiment was arranged in a Randomized Complete Block Design (RCBD) with eight replications. Organic matter was incorporated into the soil to a depth of 10 cm. Irrigation was applied every two days, adjusted according to rainfall conditions. Plants were spaced at 50 × 50 cm. Prior to transplantation into polybags



Figure 1. Durian seeds were germinated using moist tissue paper under dark conditions for 14 days

(40 × 40 cm), durian seeds were germinated under shaded conditions for 14 days. The average seed weight was 86.85 ± 1.18 g. Each polybag was filled with 8 kg of field soil, which served as the sole growing medium. The soil was free from weeds as well as organic and inorganic debris, and was sieved through a 1 cm mesh to remove coarser particles and other impurities. Harvesting was conducted one month after transplanting. The nursery phase lasted 30 days, followed by a cultivation period of 30 days.

Soil Analysis

Soil samples were collected prior to planting and at 95 days after planting (DAP), with a total of three samples obtained. The soil at the experimental site was classified as Entisol. Samples with particle sizes ranging from 0.05 to <2 mm were used for the analysis of various soil parameters. Total nitrogen (N) was determined using the Kjeldahl method, while total phosphorus (P) and potassium (K) were analyzed following the Morgan–Wolf method. Soil pH was measured using a pH meter (Digital Soil Analyzer Tester).

Growth Variables

Early seedling growth was assessed at 12 DAP by measuring hypocotyl fresh weight (g), hypocotyl diameter (cm), epicotyl weight (g), and epicotyl length (cm). Root characteristics, including root fresh weight (g) and root length (cm), were also evaluated, along with total fresh weight (g) and total dry weight (g) of the seedlings. Subsequently, vegetative growth was monitored from 30 to 90 DAP through periodic measurements of plant height, number of leaves, and stem diameter to comprehensively evaluate plant growth dynamics over time.

Data Analysis

The observed data were analyzed under the assumptions of normal distribution and homogeneity of variance. Accordingly, statistical analysis was performed using Analysis of Variance (ANOVA). When significant differences were detected, post hoc comparisons were conducted using Tukey's Honestly Significant Difference (HSD) test at significance levels of $\alpha = 0.05$, 0.01, and 0.001. Pearson correlation, Principal Component Analysis (PCA) biplots and overall data analyses were performed using JMP version 16 and SAS® OnDemand for Academics, accessed via a web browser (https://welcome.oda.sas.com/).

RESULTS AND DISCUSSION

Effects of Organic Fertilizer on Early Seedling Growth

Durian is one of the most economically important tropical fruit crops in Southeast Asia, with more than 200 cultivars identified (Teh et al., 2017). In this study, organic fertilizer application significantly affected early seedling growth. Visual observations (Figure 2) showed that seedlings treated with the highest dose (100 g.plant^{-1}) exhibited more vigorous growth compared to the control, indicating the positive role of organic inputs in early development. At 12 DAP, organic fertilizer significantly influenced

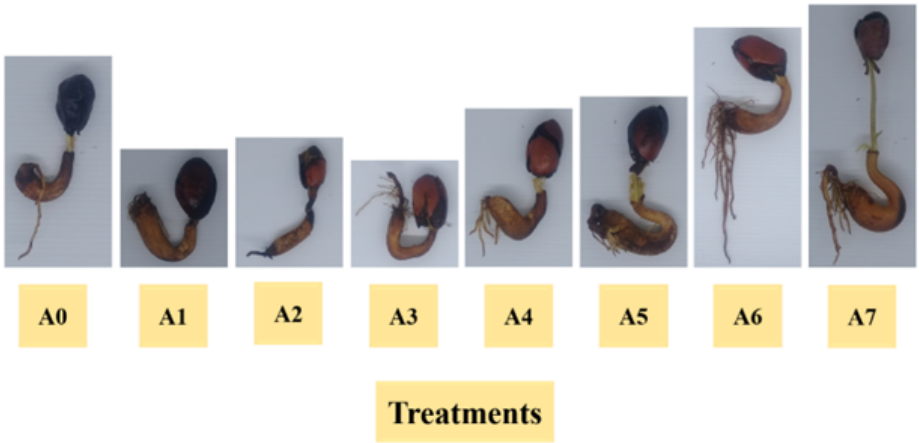


Figure 2. Effect of different organic fertilizer application rates on seedling growth at 12 days after planting

Note: T0 = 0 g.plant^{-1}; T1 = 5 g.plant^{-1}; T2 = 10 g.plant^{-1}; T3 = 20 g.plant^{-1}; T4 = 30 g.plant^{-1}; T5 = 40 g g.plant^{-1}; T6 = 50 g.plant^{-1}; T7 = 100 g.plant^{-1}

Table 1. Effects of organic fertilizer application rates on hypocotyl and epicotyl characteristics at 12 days after planting

Treatments	Fresh Weight of Hypocotyl (g)***	Hypocotyl Diameter (cm)***	Epicotyl Weight (g)***	Epicotyl Length (cm)***
0 g.plant^{-1}	2.64 ± 0.29 e	0.98 ± 0.003 f	0.33 ± 0.41 abc	1.58 ± 0.04 e
5 g.plant^{-1}	7.16 ± 0.08 c	1.56 ± 0.002 b	0.16 ± 0.03 bc	1.07 ± 0.06 f
10 g.plant^{-1}	7.23 ± 0.07 c	1.52 ± 0.003 c	0.70 ± 0.04 abc	3.04 ± 0.05 c
20 g.plant^{-1}	6.03 ± 0.12 d	1.25 ± 0.005 e	0.27 ± 0.04 abc	1.57 ± 0.06 e
30 g.plant^{-1}	9.48 ± 0.09 b	1.68 ± 0.014 a	0.25 ± 0.04 abc	2.12 ± 0.04 d
40 g.plant^{-1}	12.2 ± 0.04 a	1.65 ± 0.003 a	0.84 ± 0.01 a	4.06 ± 0.01 b
50 g.plant^{-1}	6.19 ± 0.03 d	1.43 ± 0.010 d	0.13 ± 0.03 c	2.04 ± 0.04 d
100 g.plant^{-1}	9.29 ± 0.07 b	1.44 ± 0.005 d	0.79 ± 0.03 ab	8.09 ± 0.01 a

Note: the number followed by the same letter in the same column has not significant difference based on Tukey's HSD test (* = α 0.05; ** = α 0.01; *** = α 0.001); mean ± standard deviation (n = 8)

hypocotyl and epicotyl (Table 1). The application of 40 g.plant^{-1} (T4) resulted in the highest values for most variables, indicating optimal early shoot development at moderate fertilizer levels, while epicotyl length reached its maximum value (8.09 cm) under the highest dose (100 g.plant^{-1}). Similarly, root growth and total biomass were significantly affected by organic fertilizer application (Table 2). The highest dose (100 g.plant^{-1}; T7) produced the greatest values for most variables, particularly total fresh weight and total dry weight, demonstrating enhanced biomass accumulation. However, root length was highest at 50 g.plant^{-1} (10.55 cm), suggesting that moderate fertilizer levels may be more favorable for root elongation, while higher doses promote root mass and overall biomass. These results indicate that organic fertilizer improves early seedling establishment by enhancing nutrient availability, which supports both shoot and root development. The variation in response among variables suggests that different growth components may have different optimal nutrient requirements, with moderate doses favoring elongation processes and higher doses enhancing biomass accumulation.

Effects of Organic Fertilizer on Vegetative Growth

Organic fertilizer application significantly influenced vegetative growth, including plant height, number of leaves, and stem diameter (Figures 3–5). The highest dose (100 g.plant^{-1}) consistently produced the best results at all observation times (30–90 DAP). Plant height increased progressively with increasing fertilizer dosage, with the highest values observed in T7. Similarly, the number of leaves and stem diameter were significantly higher under the highest fertilizer treatment. These results indicate that organic fertilizer enhances vegetative growth by improving nutrient availability, particularly nitrogen, phosphorus, and

Table 2. Effects of organic fertilizer application rates on root characteristics and total biomass at 12 days after planting

Treatments	Fresh Weight of Root (g)***	Root Length (cm)***	Total Fresh Weight (g)***	Total Dry Weight (g)***
0 g.plant^{-1}	0.10 ± 0.02 e	5.45 ± 0.12 bc	67.09 ± 0.67 c	43.95 ± 0.51 e
5 g.plant^{-1}	0.28 ± 0.03 d	3.72 ± 0.03 d	77.38 ± 1.00 ab	47.24 ± 0.52 d
10 g.plant^{-1}	0.14 ± 0.02 e	2.61 ± 0.04 e	76.57 ± 0.18 b	46.96 ± 0.52 d
20 g.plant^{-1}	0.54 ± 0.02 c	4.54 ± 0.11 cd	78.10 ± 0.80 ab	51.12 ± 0.34 c
30 g.plant^{-1}	0.53 ± 0.02 c	3.62 ± 0.36 d	78.90 ± 0.15 ab	54.09 ± 1.26 b
40 g.plant^{-1}	0.93 ± 0.02 b	4.12 ± 0.06 d	78.95 ± 0.15 ab	58.13 ± 0.04 a
50 g.plant^{-1}	0.87 ± 0.03 b	10.55 ± 0.52 a	76.97 ± 0.40 b	58.52 ± 0.42 a
100 g.plant^{-1}	1.07 ± 0.03 a	5.91 ± 0.29 b	79.80 ± 0.44 a	60.73 ± 0.33 a

Note: the number followed by the same letter in the same column has not significant difference based on Tukey's HSD test (* = α 0.05; ** = α 0.01; *** = α 0.001); mean ± standard deviation (n = 8)

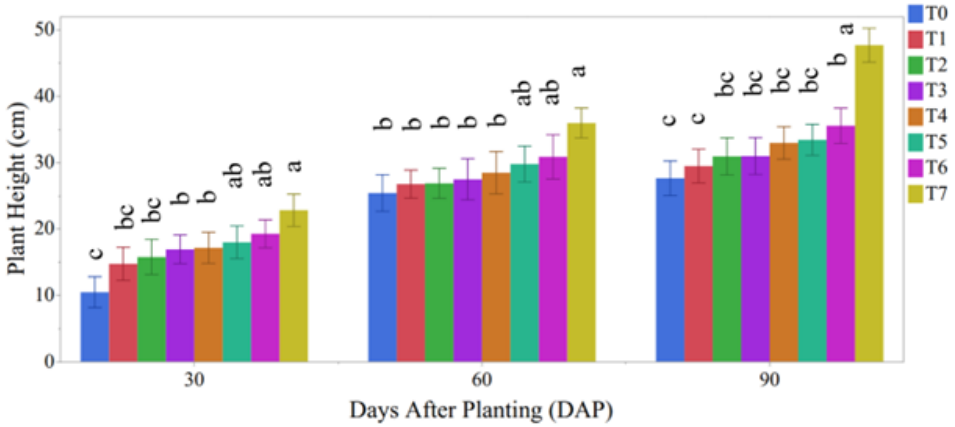


Figure 3. Plant height as affected by organic fertilizer application from 30 to 90 days after planting

Note: T0 = 0 g.plant^{-1}; T1 = 5 g.plant^{-1}; T2 = 10 g.plant^{-1}; T3 = 20 g.plant^{-1}; T4 = 30 g.plant^{-1}; T5 = 40 g g.plant^{-1}; T6 = 50 g.plant^{-1}; T7 = 100 g.plant^{-1}; the number followed by the same letter on the same days after planting has no significant difference based on Tukey's HSD test α 0.001; mean ± standard deviation (n = 8)

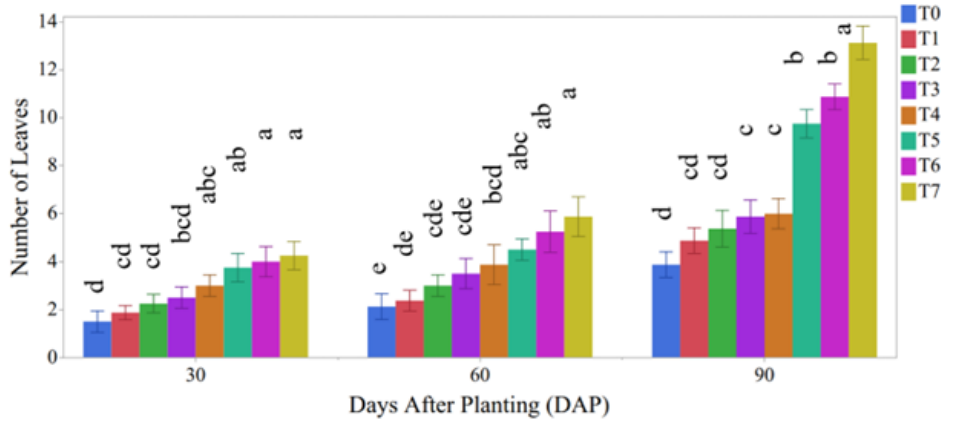


Figure 4. Number of leaves as affected by organic fertilizer application from 30 to 90 days after planting

Note: T0 = 0 g.plant^{-1}; T1 = 5 g.plant^{-1}; T2 = 10 g.plant^{-1}; T3 = 20 g.plant^{-1}; T4 = 30 g.plant^{-1}; T5 = 40 g g.plant^{-1}; T6 = 50 g.plant^{-1}; T7 = 100 g.plant^{-1}; the number followed by the same letter on the same days after planting has no significant difference based on Tukey's HSD test α 0.001; mean ± standard deviation (n = 8)

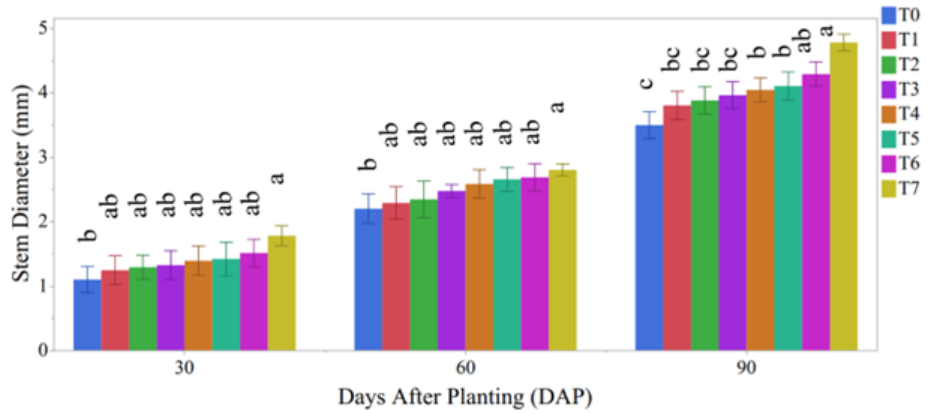


Figure 5. Stem diameter as affected by organic fertilizer application from 30 to 90 days after planting

Note: T0 = 0 g.plant^{-1}; T1 = 5 g.plant^{-1}; T2 = 10 g.plant^{-1}; T3 = 20 g.plant^{-1}; T4 = 30 g.plant^{-1}; T5 = 40 g g.plant^{-1}; T6 = 50 g.plant^{-1}; T7 = 100 g.plant^{-1}; the number followed by the same letter on the same days after planting has no significant difference based on Tukey's HSD test α 0.001; mean ± standard deviation (n = 8)

potassium, which are essential for cell division, elongation, and photosynthesis. The more pronounced effects observed at later growth stages (60–90 DAP) suggest that the gradual mineralization of organic matter provides a sustained nutrient supply, thereby supporting continuous plant growth and development. In addition, improved soil structure and increased microbial activity resulting from organic fertilizer application contribute to better root development and nutrient uptake efficiency. This condition ultimately enhances overall plant vigor and biomass accumulation. These findings are consistent with previous studies reporting that organic fertilizers significantly improve plant growth variables, such as plant height, leaf number, and biomass production (Ashari et al., 2019; Mustaffer & Jalani, 2025). Furthermore, the results align with reports that balanced nutrient inputs, including both macro- and secondary nutrients, are essential to optimize vegetative growth and ensure sustainable crop performance under nursery conditions.

Effects of Organic Fertilizer on Soil Chemical Properties

Soil chemical properties responded positively to organic fertilizer application. Soil pH (Table 3) did not show significant differences among treatments after harvest, indicating that organic fertilizer maintained stable soil conditions favorable for plant growth. In contrast, soil nutrient contents showed significant improvement with increasing fertilizer dosage. Treatment T7 resulted in the high est total nitrogen (N) and available phosphorus (P), although it had no significant effect on soil pH (Table 3). Similarly, exchangeable base cations, including potassium (K), calcium (Ca), and magnesium (Mg), were significantly higher under T7 compared to other treatments (Table 4). These results indicate that the highest dose of organic fertilizer effectively enhance soil nutrient status, particularly macronutrients and secondary nutrients essential for plant growth. The increase in soil nutrient content can be attributed to the addition of

Table 3. Soil pH, N, and P before planting and after harvest under different organic fertilizer application rates

Treatments	Soil pH		N Total (%)		P Availability (ppm)	
	Before Planting	95 DAP***	Before Planting	95 DAP***	Before Planting	95 DAP***
0 g.plant^{-1}	6.17 ± 0.29	6.00 ± 0.00 a	0.17 ± 0.02	0.13 ± 0.03 d	6.52 ± 0.03	6.33 ± 0.29 c
5 g.plant^{-1}		6.00 ± 0.00 a		0.13 ± 0.03 d		6.50 ± 0.00 c
10 g.plant^{-1}		6.00 ± 0.00 a		0.15 ± 0.00 cd		6.67 ± 0.29 c
20 g.plant^{-1}		6.00 ± 0.00 a		0.25 ± 0.00 bc		6.83 ± 0.29 c
30 g.plant^{-1}		6.00 ± 0.00 a		0.27 ± 0.03 b		7.17 ± 0.29 bc
40 g.plant^{-1}		6.00 ± 0.00 a		0.43 ± 0.03 a		8.33 ± 0.29 ab
50 g.plant^{-1}		6.00 ± 0.00 a		0.50 ± 0.00 a		8.33 ± 0.29 ab
100 g.plant^{-1}		6.00 ± 0.00 a		0.52 ± 0.03 a		8.50 ± 0.00 a

Note: DAP = days after planting; the number followed by the same letter in the same column has not significant difference based on Tukey's HSD test (* = α 0.05; ** = α 0.01; *** = α 0.001); mean ± standard deviation (n = 8)

Table 4. K, Ca, and Mg concentrations before planting and after harvest under different organic fertilizer application rates

Treatments	K Exchange (me%)		Ca Exchange (me%)		Mg Exchange (me%)	
	Before Planting	95 DAP***	Before Planting	95 DAP***	Before Planting	95 DAP***
0 g.plant^{-1}	0.43 ± 0.03	0.45 ± 0.00 b	6.50 ± 0.00	6.50 ± 0.00 b	0.53 ± 0.03	0.50 ± 0.00 b
5 g.plant^{-1}		0.47 ± 0.03 ab		6.50 ± 0.00 b		0.50 ± 0.00 b
10 g.plant^{-1}		0.48 ± 0.03 ab		6.50 ± 0.00 b		0.53 ± 0.03 b
20 g.plant^{-1}		0.48 ± 0.03 ab		6.50 ± 0.00 b		0.53 ± 0.03 b
30 g.plant^{-1}		0.48 ± 0.03 ab		6.50 ± 0.00 b		1.17 ± 0.29 ab
40 g.plant^{-1}		0.48 ± 0.03 ab		6.67 ± 0.29 ab		1.67 ± 0.29 a
50 g.plant^{-1}		0.50 ± 0.00 ab		7.00 ± 0.00 ab		1.83 ± 0.29 a
100 g.plant^{-1}		0.53 ± 0.03 a		7.17 ± 0.29 a		1.83 ± 0.29 a

Note: DAP = days after planting; the number followed by the same letter in the same column has not significant difference based on Tukey's HSD test (* = α 0.05; ** = α 0.01; *** = α 0.001); mean ± standard deviation (n = 8)

organic matter, which improves nutrient availability, cation exchange capacity, and nutrient retention in the soil. This finding is consistent with previous studies reporting that organic amendments, such as compost and manure, significantly enhance soil fertility and nutrient uptake by plants (Zajícová & Chuman, 2019; Phanomsophon et al., 2024; Tang et al., 2024; Dang et al., 2025; Quyen et al., 2025). Therefore, the application of organic fertilizer, particularly at 100 g.plant^{-1}, plays a crucial role in improving soil chemical properties without adversely affecting soil pH.

Correlation Between Growth Variables and Soil Nutrients

The Pearson correlation analysis (Table 5) demonstrated strong relationships between plant growth variables and soil nutrient content. Root fresh weight exhibited very strong positive correlations with total dry weight, nitrogen, and phosphorus, highlighting the critical role of root development in nutrient uptake and biomass production. Similarly, total dry weight was strongly correlated with nitrogen, phosphorus, and magnesium, indicating that biomass accumulation is highly dependent on nutrient availability. Moreover, significant positive correlations among nutrients, particularly between nitrogen and phosphorus as well as nitrogen and magnesium, suggest synergistic interactions that enhance nutrient uptake and utilization efficiency. These interactions indicate that the availability of one nutrient may support or facilitate the absorption of others, thereby optimizing plant growth. The PCA biplot analysis (Figure 6) further supported these findings, showing that the highest organic fertilizer dose (100 g.plant^{-1}) was closely associated with root growth and key soil nutrients, including N, P, K, and Mg. This relationship confirms that organic fertilizer application not only promotes plant growth but also improves soil fertility simultaneously, creating a more favorable environment for sustained plant development.

Implications for Sustainable Durian Cultivation

The use of organic fertilizer in nursery management provides an effective approach to producing high-quality seedlings within a shorter period (Zhang et al., 2019). Organic fertilizers not only supply essential macro- and micronutrients but also improve soil physical, chemical, and biological properties, thereby enhancing overall soil fertility. In addition, their application reduces dependence on inorganic fertilizers, which are often associated with long-term environmental risks such as soil degradation, nutrient imbalance, and pollution (Christophe et al., 2019; Chatzistathis et al., 2021; Adip et al., 2022). This approach is particularly

Table 5. Pearson correlation coefficients among the measured variables

Variables	FWH	FWR	DH	RL	TFW	TDW	EL	EW	N	P	K	Ca
FWR	0.63											
DH	0.86**	0.36										
RL	-0.27	0.48	-0.26									
TFW	0.80*	0.64	0.80*	-0.09								
TDW	0.67	0.98***	0.46	0.47	0.69							
EL	0.51	0.66	0.20	0.05	0.41	0.65						
EW	0.57	0.34	0.24	-0.34	0.25	0.33	0.77*					
N	0.51	0.97***	0.28	0.63	0.52	0.97***	0.66	0.32				
P	0.62	0.96***	0.39	0.54	0.55	0.97***	0.68	0.42	0.98***			
K	0.46	0.80*	0.33	0.39	0.67	0.83*	0.80*	0.37	0.82*	0.79*		
Ca	0.24	0.81*	0.08	0.68	0.34	0.80*	0.74*	0.28	0.89**	0.85**	0.88**	
Mg	0.58	0.92**	0.39	0.58	0.48	0.95***	0.63	0.33	0.96***	0.98***	0.74*	0.84**

Note: FWH = fresh weight of hypocotyl; FWR = fresh weight of root; DH = diameter hypocotyl; RL = root length; TFW = total fresh weight; TDW = total dry weight; EL = epicotyl length; EW = epicotyl weight; N = N total; P = P availability; K = K exchange; Ca = Ca exchange; Mg = Mg exchange; (*) = significant α 0.05; (**) = significant α 0.01; (***) = significant α 0.001

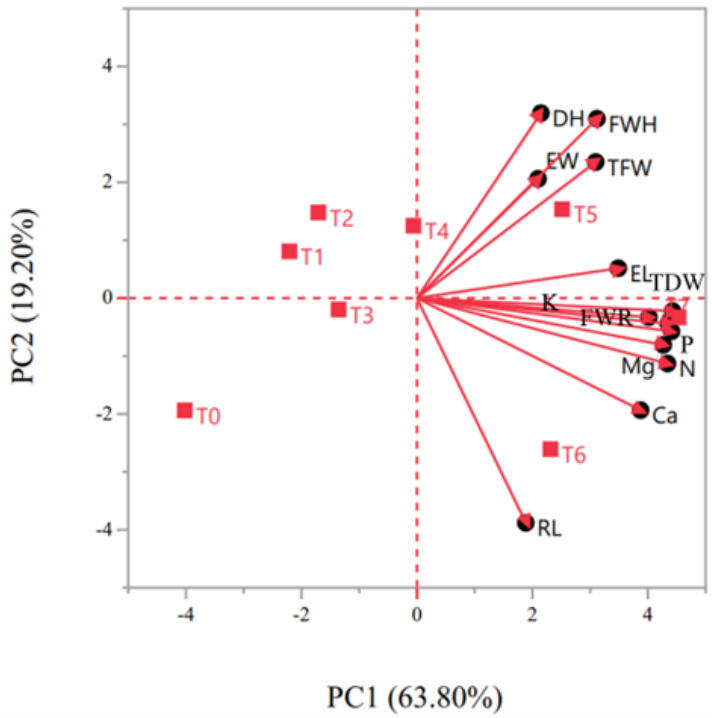


Figure 6. PCA biplot of the measured variables

Note: PC = principal component; black dot = observation variable; red square = treatments; FWH = fresh weight of hypocotyl; FWR = fresh weight of root; DH = diameter hypocotyl; RL = root length; TFW = total fresh weight; TDW = total dry weight; EL = epicotyl length; EW = epicotyl weight; N = N total; P = P availability; K = K exchange; Ca = Ca exchange; Mg = Mg exchange; T0 = 0 g.plant^{-1}; T1 = 5 g.plant^{-1}; T2 = 10 g.plant^{-1}; T3 = 20 g.plant^{-1}; T4 = 30 g.plant^{-1}; T5 = 40 g g.plant^{-1}; T6 = 50 g.plant^{-1}; T7 = 100 g.plant^{-1}

relevant for dryland areas such as Sumbawa, where low rainfall and poor soil fertility limit agricultural productivity. The improvement of soil nutrient status (N, P, K, Ca, and Mg) observed in this study indicates that organic fertilizer plays a crucial role in restoring soil fertility under such marginal conditions. Furthermore, organic amendments contribute to increasing soil organic carbon, improving cation exchange capacity, and enhancing soil buffering capacity, which are essential for sustainable crop production.

From a broader perspective, the use of organic fertilizers also supports circular agriculture systems by utilizing locally available organic waste materials such as manure and compost. This not only reduces production costs but also promotes environmentally friendly farming practices. Previous studies have shown that organic inputs, including manure and compost, can significantly improve plant growth and soil health, while maintaining long-term productivity. Therefore, the application of organic fertilizer, particularly at a dose of 100 g.plant^{-1}, can be recommended as an effective and sustainable strategy to enhance durian seedling growth, improve soil fertility, and support the development of sustainable durian cultivation systems in dryland environments, such as Sumbawa Regency.

CONCLUSIONS

The application of organic fertilizer significantly improved soil nutrient status and the growth performance of durian seedlings. The highest dose (100 g.plant^{-1}) consistently produced the best results in vegetative growth variables, including plant height, number of leaves, and stem diameter, as well as root development and total biomass. However, moderate doses (40–50 g.plant^{-1}) showed optimal responses in certain early growth parameters, such as hypocotyl development and root length, indicating that different growth stages may require different nutrient levels. Organic fertilizer application also enhanced soil chemical properties, particularly by increasing the availability of essential nutrients (N, P, K, Ca, and Mg), while maintaining stable soil pH conditions. The strong correlations between plant growth variables and soil nutrients further confirmed that improved nutrient availability plays

a key role in supporting seedling development. In conclusion, the use of organic fertilizer, especially at a dose of 100 g.plant^{-1}, can be recommended as an effective and sustainable strategy to improve durian seedlings growth and soil fertility, particularly under dryland conditions, such as those found in Sumbawa Regency.

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