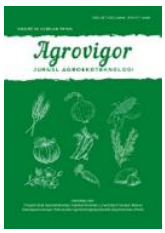
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Article

Vegetative Growth and Leaf Greenness of Oil Palm Seedlings as Affected by Chicken Manure and Compost in Ultisol Subsoil Media

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ABSTRACT

Oil palm seedling growth is highly affected by the planting media. The planting media commonly used in oil palm nurseries are derived from subsoil, which has low fertility levels and therefore requires improvement through the addition of organic fertilizers. The application of compost and chicken manure has been shown to enhance the growth of oil palm plants by increasing macro and micronutrient availability, improving organic matter content, enhancing soil structure, and supporting microbial activity. This study aimed to determine the optimal planting medium combination for the growth of oil palm seedlings during the main nursery stage. The experiment was arranged in a Randomized Complete Block Design (RCBD) with five treatments, namely: P0 = control (subsoil), P1 = 2:1 (subsoil + compost), P2 = 1:1 (subsoil + compost), P3 = 2:1 (subsoil + chicken manure), and P4 = 1:1 (subsoil + chicken manure). Each treatment was replicated four times, and the observed parameters included plant height, number of leaves, stem diameter, leaf greenness, and c-organic. The observed data were analyzed using an F-test, followed by a Least Significant Difference (LSD) test at the 5% significance level. The results showed that the addition of compost or chicken manure to the subsoil planting medium improved the growth of oil palm seedlings at the main nursery stage. The P4 treatment (subsoil + chicken manure at a 1:1 ratio) significantly improved plant height, number of leaves, stem diameter, and leaf greenness of oil palm seedlings, and produced the highest organic carbon content among treatments.

INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is one of Indonesia's most strategic plantation commodities and plays a vital role in supporting the national economy. This crop produces vegetable oil that is widely utilized as a raw material for cooking oil, industrial oil, cosmetics, and biofuel (biodiesel) (Ariyanti et al., 2018). Beyond its contribution to agricultural output, the oil palm sector also generates substantial employment opportunities, increases farmer income, and contributes significantly to national foreign exchange earnings. According to data from Statistics Indonesia, national oil palm production reached 47.474 million tons in 2024 (Badan Pusat Statistik, 2025). This achievement firmly positions Indonesia as the world's largest palm oil producer and provides significant opportunities for palm oil marketing in both domestic and international markets.

As the world's leading palm oil producer, Indonesia faces the challenge of maintaining and enhancing oil palm productivity in a sustainable manner. Efforts to increase oil palm productivity are not solely determined by environmental conditions and plantation management practices, but are also strongly influenced by the quality of planting materials used. High quality seedlings with vigorous early growth play a decisive role in determining plant performance during the mature production phase.

The nursery stage is a critical phase in the oil palm cultivation cycle, as it strongly determines plant growth and development during subsequent field stages. Healthy and vigorous seedlings with well developed root systems positively affect the plant's ability to absorb water and nutrients, and enhance tolerance to environmental stresses such as drought and disease incidence (Lukman & Kusrianty, 2021). Seedlings that do not grow optimally during the nursery stage tend to exhibit slower growth after field planting and may potentially reduce crop productivity during the production phase.

One of the important factors in oil palm nurseries is the growing medium. Ariyanti et al. (2018) reported that different planting media compositions result in significant variations in seedling height, leaf number, and biomass accumulation during the nursery stage. An ideal growing medium should be able to supply sufficient nutrients, possess a loose soil structure, provide good aeration and drainage, and have adequate water holding capacity to support root and canopy development. Previous studies have also demonstrated that nursery management practices and growing environment conditions strongly influence oil palm seedling performance.

In Indonesia, subsoil is commonly used as a growing medium because of its wide availability and lower cost compared with topsoil (Mulyani & Sarwani, 2017). However, subsoil typically exhibits low fertility, limited organic matter content, and relatively low microbial activity. These characteristics make subsoil less suitable for seedling growth when used without amendment. Rosniawaty et al. (2020) reported that subsoil used as nursery media requires improvement through the application of organic fertilizers to enhance nutrient availability, soil structure, and biological activity. The dense physical condition and low organic matter content of subsoil can restrict root penetration, reduce nutrient uptake efficiency, and ultimately limit seedling growth and development.

Organic fertilizers are widely recognized for their capacity to improve soil physical, chemical, and biological properties. Their application increases soil organic matter content, improves soil aggregation, enhances porosity, and stimulates microbial activity involved in nutrient mineralization (Febriani et al., 2021). Panjaitan et al. (2019) further reported that organic-based planting media significantly improved the early growth performance of oil palm seedlings in nursery conditions, emphasizing the importance of appropriate organic material composition in supporting seedling establishment.

Compost is a type of organic fertilizer produced through the decomposition of organic materials, such as plant residues and other organic wastes. Compost application contributes to improving soil fertility and humus content, while enhancing soil structure and water holding capacity. In addition, compost provides macro and micronutrients gradually in accordance with plant requirements (Lhaj et al., 2025). Ramadhan & Nasrul (2022) reported that the growth of oil palm seedlings increased following the application of compost at a rate of 250 g per plant. Improvements were observed in plant height, number of leaves, stem diameter, canopy and root volume, plant dry weight, and the shoot–root ratio of oil palm seedlings. These findings indicate that compost has considerable potential to support oil palm seedling growth during the nursery stage.

Chicken manure is a widely used organic fertilizer in plantation crop nurseries and is characterized by relatively high contents of nitrogen (N), phosphorus (P), and potassium (K) compared with other livestock manures (Safitri et al., 2022). These nutrients play a crucial role during the vegetative growth phase and have been reported to significantly enhance plant growth and yield (Warman et al., 2023).

In addition to supplying nutrients, chicken manure improves soil physical properties, increases cation exchange capacity, and stimulates soil microbial activity (Laili & Anggreni, 2023). Its application has been shown to increase the availability of nitrogen, phosphorus, and potassium in soil and promote overall plant growth, indicating its effectiveness in improving soil fertility and nutrient availability (Bhoki et al., 2021). Similar positive effects on plant growth and yield have also been reported when chicken manure is combined with compost (Putri et al., 2020).

Haslinda et al. (2024) reported that the application of chicken manure at a rate of 300 g per polybag significantly increased plant height, number of leaves, leaf area, and stem diameter of oil palm seedlings. The observed improvements in growth indicate that chicken manure has strong potential to enhance growing media conditions while simultaneously supplying essential nutrients required by plants during the nursery stage.

The addition of compost and chicken manure has the potential to exert synergistic effects in improving the quality of subsoil growing media. Both organic fertilizers are expected to increase soil organic matter content, improve soil structure, enhance nutrient availability, and create a more favorable root environment for the growth of oil palm seedlings at the main nursery stage.

This study aimed to determine the optimal growing media combination through the application of compost and chicken manure for enhancing the growth of oil palm seedlings at the main nursery stage.

MATERIALS AND METHODS

The study was conducted at the oil palm nursery field of the State Polytechnic of Lampung from June to September 2025. The materials used in this study included three month old oil palm seedlings of the Simalungun variety obtained from the pre nursery stage. The seedlings were carefully selected based on uniformity, healthy appearance, and the absence of visible pest and disease symptoms. The growing media consisted of Ultisol subsoil as the base material, combined with compost and chicken manure according to the respective treatments. Polybags measuring 35 × 40 cm were used as planting containers. In addition, NPK fertilizer (16–16–16) was applied as a maintenance fertilizer, and Decis 25 EC insecticide was used for pest control when necessary. The equipment used in this study included hoes, cutters, buckets, hand hoes, weighing scales, hand sprayers, measuring tapes, a SPAD meter, vernier calipers, a 1 L measuring cylinder, and a wheelbarrow.

The experiment was arranged in a Randomized Complete Block Design (RCBD) with a single factor, namely the growing media combination. Five treatment levels were evaluated: P0 as the control (subsoil without organic fertilizer addition), P1 with a 2:1 ratio of subsoil to compost, P2 with a 1:1 ratio of subsoil to compost, P3 with a 2:1 ratio of subsoil to chicken manure, and P4 with a 1:1 ratio of subsoil to chicken manure. Each treatment was replicated four times.

The initial stage of the experiment involved the preparation of the nursery area, including weed removal and leveling of the soil surface. The growing media were prepared by mixing subsoil with compost or chicken manure according to the designated treatments. The materials were thoroughly mixed until a homogeneous medium was obtained. The prepared media were then filled into polybags measuring 35 × 40 cm with an approximate volume of 38.5 L, labeled according to treatment, and arranged neatly in the nursery area with a spacing of 70 × 70 cm between polybags.

The oil palm seedlings were then transplanted into the polybags in an upright position. The growing medium surrounding the root system was gently compacted to ensure seedling stability and proper placement of the root collar. After transplanting, the seedlings were immediately watered to maintain medium moisture and facilitate plant adaptation to the new environment.

Seedling maintenance included watering twice daily, in the morning and afternoon, with adjustments based on weather conditions. Weed control was performed manually once a week to reduce competition for nutrient uptake. Fertilization was carried out using NPK fertilizer (16–16–16) at a rate of 5 g per plant per month and was applied uniformly across all treatments.

Pest and disease management was conducted using both preventive and curative measures when symptoms of infestation or infection that could potentially interfere with seedling growth were observed.

The observed parameters in this study included plant height, number of leaves, stem diameter, leaf greenness, and soil organic carbon content. Seedling growth observations were conducted periodically throughout the experimental period. Leaf greenness was measured using a SPAD meter, while soil organic carbon analysis was performed at the end of the experiment. The collected data were analyzed using analysis of variance (F test) at the 5% significance level. When significant differences were detected, the analysis was followed by the Least Significant Difference (LSD) test at the 5% level to determine differences among treatments.

RESULTS AND DISCUSSION

The results of the study demonstrated that the addition of organic fertilizers, namely compost and chicken manure, to subsoil media had a significant effect on the growth of oil palm seedlings at the main nursery stage. All observed growth variables, including plant height, number of leaves, stem diameter, leaf greenness, and soil organic carbon content, generally showed better responses in treatments supplemented with organic fertilizers compared with the control treatment consisting of subsoil without organic amendments. These findings indicate that the presence of organic matter in the growing media plays an important role in supporting the vegetative growth of oil palm seedlings.

The subsoil medium used as the control treatment in this study exhibited relatively low fertility, particularly in terms of organic matter content and macronutrient availability. This condition was reflected in the slower growth of seedlings in the control treatment compared with those receiving organic fertilizer amendments. Rosniawaty et al. (2020) reported that subsoil generally has low organic matter content, a less friable soil structure, and limited capacity to retain water and nutrients. Consequently, subsoil is less optimal when used directly as a nursery growing medium without appropriate improvement measures.

The addition of organic fertilizers to subsoil media represents an effective strategy to improve the physical, chemical, and biological quality of the growing medium. Organic materials derived from compost and chicken manure contribute to improving soil structure, increasing porosity and water holding capacity, and providing energy sources for soil microorganisms. The application of organic fertilizers has been reported to increase soil organic matter content, enhance soil aggregation, improve porosity, and stimulate microbial activity involved in nutrient mineralization (Febriani et al., 2021).

Compost and chicken manure differ in their characteristics with respect to nutrient release into the soil. Chicken manure generally contains higher nitrogen levels and provides nutrients more rapidly available to plants, thereby promoting faster vegetative growth responses. In contrast, compost tends to release nutrients gradually, contributing to sustained nutrient availability over a longer period (Lukman & Kusrianty, 2021). These differences in nutrient release characteristics were reflected in the variation in growth responses of oil palm seedlings among the treatments..

Plant Height

The observation results indicated that the application of chicken manure to subsoil media resulted in significantly greater oil palm seedling height compared with the control treatment (only subsoil). However, seedling height under the chicken manure treatments did not differ significantly from that observed under compost application, as presented in Table 1. The P4 treatment (subsoil + chicken manure at a 1:1 ratio) produced the tallest seedlings, with an average height of 58.00 cm, whereas the P0 treatment (control/subsoil only) reached only 50.75 cm.

The increase in plant height observed under the chicken manure treatments was closely associated with the relatively higher macronutrient content, particularly nitrogen (N), phosphorus (P), and potassium (K), compared with other organic fertilizers. Nitrogen plays a crucial role in the formation of vegetative tissues, including stem elongation and leaf development. Laili & Anggreni (2023) reported that nitrogen is a primary component of chlorophyll and amino acids, both of which are essential during the vegetative growth phase. Phosphorus is involved in cell division and root system development, while potassium functions in water balance regulation and enzyme activation. The combined effects of these three nutrients support optimal oil palm seedling growth,

especially at the main nursery stage, which is characterized by intensive vegetative development (Fauzi et al., 2018).

The results of this study are consistent with the findings of Haslinda et al. (2024), who reported that the application of chicken manure to oil palm nursery media significantly increased plant height compared with media without organic amendments. In addition, the increase in organic matter content improved the structure of subsoil media, thereby allowing better root development and supporting canopy growth.

Compost application was also able to increase plant height, indicating its capacity to supply nutrients and improve soil structure, thereby supporting plant growth. Ramadhan & Nasrul (2022) reported that compost application in oil palm nurseries enhanced plant height by improving the soil's capacity to retain water and nutrients.

Table 1. Height of oil palm seedlings with the application of compost and chicken manure at 6 months old.

No	Treatment	Plant Height (cm)
1	P0	50,75 a
2	P1	55,50 ab
3	P2	55,25 ab
4	P3	57,75 b
5	P4	58,00 b
	LSD 5%	**5,24**

Description: P0 = Control (subsoil), P1 = Subsoil + Compost (2:1), P2 = Subsoil + Compost (1:1), P3 = Subsoil + chicken manure (2:1), P4 = Subsoil + chicken manure (1:1).

Number of Leaves

The application of compost and chicken manure to subsoil media resulted in a significantly higher number of leaves compared with the control treatment (subsoil alone), as shown in Table 2. This finding indicates that the addition of organic matter to subsoil media improved nutrient availability and the growing environment of oil palm seedlings, thereby supporting the formation of vegetative organs, particularly leaf leaves.

The increase in the number of leaves was closely associated with adequate nitrogen availability in the growing medium. Nitrogen plays a crucial role in leaf tissue formation, protein synthesis, and cell division and elongation, thereby accelerating the development of new leaves. According to Lukman & Kusrianty (2021), increases in leaf number in plantation crops are strongly influenced by nitrogen availability in the growing medium, particularly during the nursery stage when vegetative growth occurs intensively.

Chicken manure is known to contain relatively higher nitrogen levels and to release nutrients more rapidly than manure derived from other livestock sources. Thamrin & Hama (2022) reported that chicken manure can significantly enhance vegetative plant growth because its nitrogen content is easily decomposed and readily absorbed by plants. In addition, chicken manure also contains phosphorus and potassium, which support leaf tissue development and strengthen the root system, thereby improving nutrient uptake efficiency (Safitri et al., 2022). These conditions explain why the chicken manure treatment exhibited a better response in increasing the number of leaves compared with the control treatment.

Compost application also exerted a positive effect on the number of leaves. The organic matter content of compost plays an important role in improving soil physical properties, increasing water holding capacity, and stimulating soil microbial activity. Soil microorganisms are involved in the decomposition and mineralization of organic materials, resulting in the gradual release of nutrients that can be utilized by plants over a longer period. According to Febriani et al. (2021), compost application enhances sustained nutrient availability, which positively affects vegetative plant growth, including leaf and leaves formation.

The results of this study are in agreement with the findings of Suhadi et al. (2025), who reported that increases in leaf number of oil palm seedlings were positively correlated with improvements in growing media fertility resulting from organic matter addition. Therefore, the application of compost and chicken manure to subsoil media was proven to be effective in increasing the number of leaves of oil palm seedlings at

the main nursery stage, which may subsequently support better plant growth and performance under field conditions.

Stem Diameter

The results showed that the subsoil + chicken manure (1:1) treatment produced the largest stem diameter, reaching 32.23 mm, and was significantly different from the control treatment (28.13 mm). However, this treatment did not differ significantly from the subsoil + compost treatments or the subsoil + chicken manure (2:1) treatment, as presented in Table 3.

Yoedhistira & Darmawan (2022) reported that the application of chicken manure significantly improved vegetative growth, particularly stem development, due to increased nutrient availability and improved soil physical properties. The increase in stem diameter observed under the chicken manure treatment was presumably associated with enhanced nutrient availability and improved physical properties of the growing medium. Organic matter derived from chicken manure can improve soil aggregation, porosity, and water holding capacity, thereby supporting optimal stem tissue development.

Ganti et al. (2023) reported that the application of organic fertilizers to growing media increased plant stem diameter through improvements in soil physical and chemical properties. Similarly, Fatima et al. (2023) stated that chicken manure is effective in promoting vegetative plant growth due to its organic matter and nutrient contents, which improve growing media conditions, allowing better root development and supporting stem enlargement. Similar results were also reported by Rasyid et al. (2020), who found that increasing doses of chicken manure positively affected vegetative growth and yield.

Table 2. Number of leaves of oil palm seedlings with the application of compost and chicken manure at 6 months old.

No	Treatment	Number of Leaves
1	P0	8,75 a
2	P1	10,25 b
3	P2	10,50 b
4	P3	11,25 b
5	P4	11,25 b
	LSD 5%	**1,42**

Description: P0 = Control (subsoil), P1 = Subsoil + Compost (2:1), P2 = Subsoil + Compost (1:1), P3 = Subsoil + chicken manure (2:1), P4 = Subsoil + chicken manure (1:1).

The results of this study indicate that the combination of subsoil and chicken manure, particularly at a 1:1 ratio, provided more optimal growing media conditions for stem growth of oil palm seedlings. A larger stem diameter reflects better physiological conditions of the seedlings and indicates greater potential for producing more vigorous plants after field planting.

Table 3. Stem diameter of oil palm seedlings with the application of compost and chicken manure at 6 months old.

No	Treatment	Stem Diameter (mm)
1	P0	28,13 a
2	P1	31,25 ab
3	P2	31,13 ab
4	P3	31,45 ab
5	P4	32,23 b
	LSD 5%	**3,44**

Description: P0 = Control (subsoil), P1 = Subsoil + Compost (2:1), P2 = Subsoil + Compost (1:1), P3 = Subsoil + chicken manure (2:1), P4 = Subsoil + chicken manure (1:1).

Leaf Greenness

Leaf greenness measured using a SPAD meter reflects leaf chlorophyll content and indirectly indicates the nitrogen status of plants. Higher SPAD values indicate a greater ability of plants to absorb and utilize nitrogen efficiently for photosynthesis. The results showed that treatments of subsoil combined with chicken manure (2:1 and 1:1) as well as subsoil combined with compost (1:1) resulted in significantly higher leaf greenness levels compared to the control treatment (Table 4). This finding indicates that the addition of organic amendments improved nitrogen availability in subsoil media, which is naturally characterized by low nutrient content.

The increase in leaf greenness is closely associated with the nitrogen content of organic fertilizers. Nitrogen is a key element in chlorophyll formation and plays a direct role in the photosynthetic process. Hou et al. (2020) reported that increased nitrogen supply in the growing medium enhances leaf chlorophyll content, expands effective leaf area, and increases the photosynthetic rate of plants. This condition is particularly important during the main nursery stage of oil palm, as optimal photosynthesis supports biomass accumulation and overall vegetative growth.

Chicken manure contains relatively higher nitrogen levels and is more readily decomposed than other organic fertilizers, allowing nitrogen to become available to plants more rapidly. According to Safitri et al. (2022), nitrogen derived from chicken manure undergoes faster mineralization, enabling direct uptake by plants for chlorophyll formation and vegetative tissue development. This explains why treatments involving chicken manure resulted in higher leaf greenness values compared to compost and control treatments.

In addition to its role in chlorophyll formation, nitrogen is also involved in the synthesis of amino acids and proteins, which serve as fundamental components for the production of plant growth hormones such as auxin, gibberellin, and cytokinin. Nurjanah et al. (2020) reported that gibberellins play a crucial role in enhancing plant metabolic activity, accelerating cell division and elongation, and supporting increased photosynthetic rates. Therefore, adequate nitrogen availability in the growing medium not only enhances leaf greenness but also supports overall vegetative growth of the plant.

The increase in leaf greenness values observed in the compost fertilizer treatments also indicates that organic matter is capable of improving the physical and biological properties of the soil, thereby supporting more efficient nutrient uptake. Febriani et al. (2021) stated that compost fertilizer plays an important role in enhancing soil microbial activity, which facilitates the gradual mineralization of nitrogen. Although its response is not as rapid as that of chicken manure, compost provides a more stable and sustained supply of nitrogen, thereby contributing to increased chlorophyll content in oil palm seedlings.

The increase in leaf greenness observed in the chicken manure and compost treatments indicates that the addition of organic fertilizers to subsoil media is effective in improving the nitrogen nutritional status of the plants. This condition strongly supports the growth of healthy and vigorous oil palm seedlings during the main nursery phase, which ultimately has a positive effect on the plants' adaptability and establishment when transplanted to the field.

C-Organic

Soil organic carbon content is an important indicator for assessing soil fertility. The results showed that the subsoil combined with chicken manure at a 1:1 ratio produced the highest soil organic carbon content, reaching 3.47%, which was above the overall treatment mean of 2.43% (Table 5). This finding indicates that chicken manure plays a significant role in increasing soil organic matter content.

Andini et al. (2025) stated that the addition of organic fertilizers can increase carbon accumulation in the soil, which plays a role in improving soil structure, enhancing cation exchange capacity, and supporting soil microbial activity. Sari & Yusmah (2023) reported that increased soil organic carbon content contributes to improved nutrient availability and greater efficiency of nutrient uptake by plants. The increase in soil organic carbon content in oil palm nursery media contributes to better seedling growth through improvements in the physical and biological properties of the soil. The chicken manure treatment indicated that organic matter derived from this fertilizer was more readily decomposed and accumulated in the soil compared to compost. This condition supports the fertility of subsoil planting media and contributes to the overall improvement of oil palm seedling growth.

Table 4. Leaf greenness of oil palm seedlings with the application of compost and chicken manure at 6 months old.

No	Treatment	Leaf Greenness (%)
1	P0	37,47 a
2	P1	41,57 ab
3	P2	43,29 b
4	P3	46,67 b
5	P4	46,32 b
	LSD 5%	**4,13**

Description: P0 = Control (subsoil), P1 = Subsoil + Compost (2:1), P2 = Subsoil + Compost (1:1), P3 = Subsoil + chicken manure (2:1), P4 = Subsoil + chicken manure (1:1).

Table 5. Soil organic carbon with the application of compost and chicken manure at 6 months old.

No	Treatment	Soil Organic Carbon (%)
1	P0	1,82 %
2	P1	1,88 %
3	P2	2,06 %
4	P3	2,93 %
5	P4	3,47 %
	Rata-rata	**2,43 %**

Description: P0 = Control (subsoil), P1 = Subsoil + Compost (2:1), P2 = Subsoil + Compost (1:1), P3 = Subsoil + chicken manure (2:1), P4 = Subsoil + chicken manure (1:1).

Overall, the results of this study demonstrate that the application of compost and chicken manure is effective in improving the quality of subsoil media and enhancing the growth of oil palm seedlings at the main nursery stage. Subsoil media, which generally has low organic matter content and limited nutrient availability, can undergo improvements in its physical, chemical, and biological properties through the addition of organic amendments. These improvements were reflected in enhanced vegetative growth parameters of oil palm seedlings, including plant height, number of leaves, stem diameter, and leaf greenness.

Chicken manure in this study exhibited a relatively better growth response than compost, particularly in terms of plant height, stem diameter, leaf greenness, and soil organic carbon content. This response is presumably associated with its higher macronutrient content, especially nitrogen, phosphorus, and potassium, as well as the faster availability of these nutrients to plants. According to Laili & Anggreni (2023), chicken manure has a lower C/N ratio than compost, resulting in a faster decomposition process and more readily available nutrients for plant uptake. These conditions are highly favorable for oil palm seedlings, which require a substantial nutrient supply during the early vegetative growth stage.

In addition to enhancing nutrient availability, the application of organic fertilizers also contributes to increasing soil organic carbon content. Higher soil organic carbon plays an important role in improving soil structure, increasing cation exchange capacity, and supporting the activity of soil microorganisms involved in nutrient cycling. Andini et al. (2025) reported that increasing soil organic carbon through organic fertilizer application can create a more stable planting medium and promote optimal root development. This condition is particularly important in oil palm nurseries, as a well developed root system determines the plant's ability to absorb water and nutrients during subsequent growth stages in the field.

Organic fertilizers play a strategic role in supporting sustainable oil palm nursery systems, particularly when low fertility planting media such as subsoil are used. Suhadi et al. (2025) emphasized that the application of organic materials in oil palm nurseries not only enhances seedling growth but also improves the long term quality of the planting medium. Moreover, the use of organic fertilizers is considered more environmentally friendly and can reduce

dependence on inorganic fertilizers in nursery management systems.

Therefore, the use of compost and chicken manure can be recommended as an effective strategy to improve subsoil based planting media for enhancing oil palm seedling quality at the main nursery stage. Chicken manure, particularly at a 1:1 ratio with subsoil, showed greater potential in supporting optimal seedling growth. Nevertheless, compost remains an important source of organic matter that contributes to the gradual improvement of soil fertility. An appropriate combination of organic fertilizers is expected to enhance planting media quality and support the production of healthy, vigorous oil palm seedlings that are well prepared for field establishment.

CONCLUSION

The application of compost and chicken manure to subsoil was able to enhance the growth of oil palm seedlings during the main nursery stage. The treatment of subsoil combined with chicken manure at a 1:1 ratio significantly increased plant height, number of leaves, stem diameter, and leaf greenness of the seedlings, while also producing the highest average soil organic carbon content compared to the other treatments.

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AUTHORS CONTRIBUTIONS

DPW had the main responsibility for designing and coordinating the nursery experiment, supervising the implementation of oil palm seedling cultivation, and leading the overall research activities. BAP contributed to the research design, interpretation of results, manuscript preparation, the journal submission process, and manuscript revision based on reviewers' comments. TDC contributed to the measurement of growth parameters and data collection. H assisted in nursery management, sample preparation, and routine observations. AMHZ contributed to data collection, soil sampling, and laboratory analysis of soil organic carbon. AA contributed to statistical analysis and data tabulation. AF contributed to the coordination of research permits, equipment borrowing, and material procurement. LJAS assisted in field activities, including seedling watering, routine maintenance, and monitoring of nursery conditions. All authors reviewed, revised, and approved the final manuscript.

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