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# OIL PALM (*ELAEIS GUINEENSIS*) RESPONSE TO COMPOST MANURE AND NPK COMPOUND FERTILIZER IN GROWTH CHARACTERS

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## SUMMARY

Oil palm seedlings require both macro and micronutrients for their growth and development processes. The following study aimed to determine the effect of compost manure made of empty fruit bunches and NPK compound fertilizer (16:16:16) and their interaction on the growth characters of oil palm (*Elaeis guineensis* Jacq.) seedlings. The study proceeded in a complete randomized design (CRD) with a factorial arrangement. The first factor was the compost manure of empty fruit bunches (EFB) of oil palm with 100 g (EFB1), 150 g (EFB2), and 200 g (EFB3) per plant. The second factor was the NPK compound fertilizer (P) (16:16:16) with three levels at 40 g (P1), 60 g (P2), and 80 g (P3) per plant. The study results revealed the best EFB compost at a dose of 200 g per plant can increase the oil palm seedlings' growth in the parameters of stem base diameter, the number of leaves, leaf area, and dry weight of seedlings. The best provision of the NPK fertilizer was a dose of 60–80 g per plant, which can increase plant height, stem base diameter, the number of leaves, and dry weight of seedlings. The combination of 200 g EFB compost per plant and 60 g NPK fertilizer per plant can enhance the growth of oil palm seedlings in the main nursery.

**Keywords:** Oil palm (*E. guineensis*) seedlings, compost manure, NPK compound fertilizer, factors interaction, growth characters

**Key findings:** Results showed the EFB compost (200 g plant$^{-1}$) increased the growth of oil palm (*E. guineensis*) seedlings. The best provision of the NPK fertilizer with a dose of 60–80 g per plant enhanced the growth of oil palm (*E. guineensis*) seedlings. The combination of EFB compost (200 g plant$^{-1}$) and NPK fertilizer (60 g plant$^{-1}$) considerably improved the oil palm seedlings' growth.

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## INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is one of the main plantation commodities that produce vegetable oil, with a higher productivity than other vegetable oil-producing crop plants. Oil palm plantation has an essential role in the vegetable oil industry and a bright future in Indonesia. Riau province, Indonesia, is an area with a fairly large plantation because it gains support from the topography of the land, which tends to be flat and wet. However, for the past years, a decline occurred in oil palm production in Riau (Directorate General of Plantations, Ministry of Agriculture, Republic of Indonesia, 2021).

The oil palm plantation area has incurred an increase in the Riau Province and is inversely proportional to the decreased production. In 2020, the area of plantation in Riau Province was 2,853,800 hectares, and the production was 9,984,300 tons, with productivity of 3.499 kg $ha^{-1}$. In 2021, the area of oil palm plantations rose to 2,860,000 hectares, but the total production was only 8,629,100 tons, with a productivity of 3.017 kg $ha^{-1}$. The decline in oil palm production happened due to old-aged trees. The economic life of oil palm plants is between 25–30 years. Afterward, oil palm plants require rejuvenation (replanting) to maintain optimal crop production (BPS-Statistics Indonesia, 2023 and Anggreany *et al.*, 2016).

Replanting is one of the activity to maintain crop production, which also requires quality seedlings. The provision of quality seedlings needs conditions to support their growth. One of the organic materials supporting seedlings' growth is compost empty fruit bunches of oil palm or EFB (Fauzi *et al.,* 2002). The nutrient content in the EFB compost is in the form of essential macronutrients: N, P, K, Ca, and Mg, and micronutrients: Fe, Zn, Mn, Ni, Cu, and B. The high nutritional content is N, P, and K at 2.21%, 3.65%, and 0.49%, respectively (Wahi and Yusup, 2016). In Riau Province, EFB raw materials are abundant waste requiring management. This waste control can succeed by changing EFB into something useful, such as organic fertilizer, to fertilize the soil. According to Paramananthan (2013), organic fertilizers can improve the soil's physical, chemical, and biological properties and help release nutrients from soil colloidal bonds.

Previous research showed composting with empty fruit bunches (EFB) of oil palm at the rate of 150 g per plant can provide the best results in increasing the growth of oil palm seedlings (Hidayat and Astarina, 2016). However, providing EFB compost also needs support from inorganic materials rich in nutrients. Inorganic material (NPK compound fertilizer 16:16:16) can aid the growth of oil palm seedlings, recognized as an excellent fertilizer for the growth and development of plant seedlings (Agung *et al*., 2019).

Based on previous research results, it is a fact that the use of NPK compound fertilizer level of 60 g per plant provide the best results in increasing oil palm seedlings' growth (Aminullah *et al*., 2017). Combining the use of organic and inorganic fertilizers with the right dosage can deliver optimal growth in oil palm seedlings. This study aimed to determine the effect of the combination of empty fruit bunches (EFB) compost with NPK compound fertilizer and formulate the right level of combination in improving the oil palm seedlings' development (Leonardo *et al*., 2016). The benefits of this research are controlling the abundant EFB waste and improving soil health, namely, improving the soil's physical, chemical, and biological properties, and reducing the use of inorganic fertilizers.

## MATERIALS AND METHODS

The research on oil palm (*E. guineensis* Jacq.) ran from February to May 2023 at the Experimental Garden of the Faculty of Agriculture, University of Riau, Pekanbaru, Indonesia. The microclimate at the research location had temperatures 22 °C–27 °C and humidity of 76%–96% at night, while during the day, the temperature ranged at 29 °C–32 °C and humidity of 56%–75%. The composting process the following steps: chopping the EFB to a size of 2–4 cm, weighing the EFB with a 50-kg weighing scale, stacking the EFB with

dimensions of 120 cm (l) × 80 cm (w) × 100 cm (h), and making the pile of composting materials by adding 3000 ml of EM4.

Research materials (seedlings) maintenance included watering the seedlings, weeding, and controlling pests and diseases on seedlings. Watering of oil palm seedlings transpired in the afternoon using a sprinkling can. No watering happens if it rains and the planting medium is moist, as irrigation maintains the availability of water for plant growth. Land clearing of all vegetation that interferes with seedling growth took place. The purpose of weeding is to prevent competition for nutrients between seedlings and weeds. Weeding continued manually by pulling out weeds growing around the planting area, once every two weeks until the end of the study. Pest control ensued by spraying Carbaryl pesticide at a concentration of 2 g $l^{-1}$ water using a hand sprayer onto the plants. Disease control proceeded using Mancozeb 80% at a concentration of 2 g $l^{-1}$ water. Pest and disease control had intervals of once every 10 days and if symptoms of attack appeared.

The study employed a complete randomized design (CRD) with a factorial arrangement with three replicates. The main nursery comprised planting seedlings in large polybags. The first factor was the compost manure of empty fruit bunches (EFB) of oil palm with 100 g (EFB 1), 150 g (EFB 2), and 200 g (EFB 3) per plant. The second factor was the NPK compound fertilizer (P) (16:16:16) with three levels, i.e., 40 g (P1), 60 g (P2), and 80 g (P3) per plant, applied every two weeks for four months, from three to seven months of seedling age. The analysis of the experimental soil also occurred (Table 1).

**Data recorded and analysis**

The parameters observed were the plant height, diameter of the trunk circumference, the number of leaves, and root volume in oil palm seedlings. The obtained data on all the parameters underwent the analysis of variance (ANOVA) using SAS application. The means' further comparison and separation used the HSD Test at a 5% level of probability.

## RESULTS AND DISCUSSION

**Seedling height**

Results revealed the combined application of the oil palm's empty fruit bunches (EFB) compost (200 g $plant^{-1}$) and NPK compound fertilizer (80 g $plant^{-1}$) provided the tallest plant height (12.23 cm) in oil palm seedlings (Table 2). Individual application of EFB compost (200 g $plant^{-1}$) showed influential results in increasing the seedling height (10.49 cm). The NPK compound fertilizer individual application (80 g $plant^{-1}$) also influenced raising the seedlings' height (10.32 cm). The interaction between EFB compost and NPK showed significantly different results on the said trait. This could be due to the nutrients contained in both types of fertilizers complementing each other. In addition to the EFB compost, NPK fertilizer affected plant

**Table 1.** Analysis of the experimental soil.

| Sample | pH ($H_2O$) | pH (KCL) | N-total | P-total (mg 100 $g^{-1}$) | K-total (mg 100 $g^{-1}$) |
|---|---|---|---|---|---|
| initial soil | 6,00 $^{sa}$ | 5,80$^{sa}$ | 0,18 $^{l}$ | 22,43 $^{c}$ | 12,43 $^{l}$ |
| K1P1 | 4,95 $^{a}$ | 4,73 $^{a}$ | 0,18 $^{l}$ | 292,43$^{vh}$ | 79,14$^{vh}$ |
| K1P2 | 4,64 $^{a}$ | 4,47 $^{a}$ | 0,25 $^{c}$ | 304,57$^{vh}$ | 135,38$^{vh}$ |
| K1P3 | 4,87 $^{a}$ | 4,22 $^{a}$ | 0,32 $^{c}$ | 357,71$^{vh}$ | 142,09$^{vh}$ |
| K2P1 | 4,87 $^{a}$ | 4,30 $^{a}$ | 0,18 $^{l}$ | 309,87$^{vh}$ | 118,77$^{vh}$ |
| K2P2 | 4,65 $^{a}$ | 4,21 $^{a}$ | 0,25 $^{c}$ | 293,35$^{vh}$ | 157,93$^{vh}$ |
| K2P3 | 4,77 $^{a}$ | 4,32 $^{a}$ | 0,18 $^{l}$ | 515,05$^{vh}$ | 154,14$^{vh}$ |
| K3P1 | 4,85 $^{a}$ | 4,28 $^{a}$ | 0,18 $^{l}$ | 403,59$^{vh}$ | 122,63$^{vh}$ |
| K3P2 | 4,99 $^{a}$ | 4,37 $^{a}$ | 0,25 $^{c}$ | 351,43$^{vh}$ | 131,83$^{vh}$ |
| K3P3 | 4,94 $^{a}$ | 4,39 $^{a}$ | 0,18 $^{l}$ | 400,45$^{vh}$ | 134,97$^{vh}$ |

Description: $^{a}$ = acid, $^{sa}$ = slightly acid, $^{n}$ = neutral, $^{l}$ = low, $^{c}$ = currently, $^{h}$ = high, $^{vh}$ = very high.

**Table 2.** Effect of EFB compost and NPK compound fertilizer on the plant height in oil palm seedlings.

| NPK fertilizer dosage (g) | EFB dosage (g) | | | Means (cm) |
|---|---|---|---|---|
| | 100 | 150 | 200 | |
| 40 | 7.49 c | 8.62 c | 8.04 c | 8.05 b |
| 60 | 7.88 c | 10.68 ab | 11.19 ab | 9.95 a |
| 80 | 9.23 bc | 10.78 ab | 12.23 a | 10.32 a |
| Means (cm) | 8.20 b | 10.03 a | 10.49 a | |

Numbers in the same row and column followed by the same lowercase letters are not real according to the HSD Test at a 5% level.

height because it is available for direct use of the plants. Likewise, the EFB compost improved the soil's physical, chemical, and biological properties. Physical improvement of soil appeared by the soil becoming crumbly. Enriching chemical properties of soil is evident by an increase in soil fertility, such as the addition of macro and micronutrients. Herawati *et al*. (2023) stated the EFB compost can improve soil's physical, biological, and chemical properties and has a high potassium content.

The soil initial analysis showed the N-total was 0.18% in the soil, having classified as a low category, while the final analysis revealed an increase in the content of N-total to 0.25% and 0.32% in the soil (Table 1). The rise in the plant height of seedlings may also be because of an increased uptake of nutrients by oil palm seedlings. The NPK fertilizer with N content can stimulate the growth, especially in stems and leaves. Nitrogen is a constituent of chlorophyll, proteins, fats, coenzymes, and nucleic acids. The increase of nitrogen nutrients in the growing media will spur the growth of oil palm seedlings. According to Sari *et al.* (2015), the EFB compost and NPK compound fertilizer can enhance seedlings' height, the number of palm fronds, and diameter of the trunk circumference. Combining organic and inorganic fertilizers generally increase the production because organic matter can improve soil conditions and make nutrients more available to plants (Quansah, 2010).

Applying the EFB compost (200 g plant$^{-1}$) resulted in taller oil palm seedlings (10.49 cm) and were significantly different from other EFB compost doses (150 and 100 g plant$^{-1}$), which showed lower values for the said trait. The EFB compost can improve soil's physical, biological, and biochemical properties and nutrient contents in planting media. According to Eugene *et al.* (2010), organic matter plays a vital role in improving the physical, biochemical, and biological properties of soils, boosting crop productivity. Additionally, the EFB compost can elevate the absorption of soil binding power to water and improve the soil structure. In loose soil structures, roots can develop vertically and horizontally, thus, the surface area of the roots with the soil becomes high, allowing roots to absorb more nutrients.

Compost also contributes to soil fertility by releasing essential nutrients, both macro and micro-elements and augmenting the number of microorganisms in the soil (Teshome *et al*., 2014). Good soil fertility will encourage root development, expanding the range of roots in water absorption and nutrients, ensuring plant metabolism will run well. The EFB compost has an N value of 2.45%, which increases N absorption by plants in the form of nitrate and ammonium. Asra *et al.* (2015) mentioned the N element accelerates chlorophyll formation, beneficial to spur the vegetative growth, such as, plant height, number of leaves, leaf area, and diameter of the trunk circumference.

Study findings further revealed the NPK compound fertilizer (80 g plant$^{-1}$) produced higher oil palm seedlings and were at par in plant height with the seedling obtained from NPK at 60 g plant$^{-1}$. However, they appeared significantly different from the treatment of NPK at 40 g plant$^{-1}$. Adding NPK fertilizer can increase the nutrient content in the soil, thus providing optimal growth in oil palm seedlings. The administration of NPK fertilizer (60 g plant$^{-1}$) showed heightened seedling growth. This is because the nutrient

content in NPK were more available to the plants, causing optimal growth of oil palm seedlings. The initial soil analysis showed the N-total content in the soil was 0.18%, having classified as a low category. In contrast, the final analysis disclosed an elevated N-total content in the soil (Table 1).

In crop plants, the primary role of N elements is to stimulate plant growth, especially stems and leaves. Nitrogen is a constituent of chlorophyll, proteins, fats, coenzymes, and nucleic acids. The increase of nitrogen nutrients in the growing medium will enhance the growth of oil palm seedlings. However, if the plants lack nitrogen, the tissue will dry up and could die. Major nutrients N, P, and K are imperative in photosynthesis as a constituent of plant compounds that form the plant organs. The availability of nitrogen for plants can boost the amount of chlorophyll, thus supporting photosynthetic activities, causing more seedling growth. Phosphorus nutrients play a major role in photosynthesis and respiration, thereby improving the root system of crop plants. Potassium nutrient performs a remarkable role in enzyme activity, protein formation, and carbohydrates and enhancing plants' resistance to diseases. According to Hartika (2021), in crop plants, the growth increase has a close association with macronutrients, such as, nitrogen, phosphorus, and potassium.

**Trunk circumference**

The results revealed the EFB compost in interaction with NPK compound fertilizer showed no effect on the trunk circumference in oil palm seedlings. However, EFB compost (200 g plant$^{-1}$) produced the largest base stem diameter (2.03 cm), with a significant difference from other treatments of the same category (Table 3). Individual use of NPK fertilizer (80 g plant$^{-1}$) also gave a positive effect on increasing the diameter of the trunk circumference to an initial 2.00 cm. The NPK compound fertilizer has met the nutrients needed by the plants in raising the trunk circumference diameter, and the EFB compost can improve the soil's physical, chemical, and biological properties. The constant and excessive use of inorganic fertilizers causes the soil to harden, decreasing its productivity. In line with the opinion of Kalasari *et al.* (2020), the administration of inorganic fertilizers in excessive doses can negatively affect the microbial environment, especially in areas near fertilizer particles. This can intensify salt concentration in the soil solution, causing nutrient imbalance.

Soils with an inappropriate high pH or low acidity cause inhibition of nutrient absorption by oil palm seedlings. The availability of potassium influences the enlargement of the trunk circumference. The lack of this element leads to limiting the enlargement of the trunk circumference. According to Firmansyah *et al.* (2017), plants need N and K nutrients more than other nutrients because nitrogen and potassium can help relatively quickly for vegetative growth. The availability of potassium causes the formation of carbohydrates to run well and the translocation of starch for forming a good base for stem. Ezz-El-Din *et al*. (2010) stated that potassium can synthesize carbohydrates and positively affect the plant water transport and cell elongation. The potassium strongly

**Table 3.** Effect of EFB compost and NPK compound fertilizer on the stem diameter in oil palm seedlings.

| NPK fertilizer dosage (g) | EFB dosage (g) | | | Means (cm) |
|---|---|---|---|---|
| | 100 | 150 | 200 | |
| 40 | 1.66 | 1.70 | 1.79 | 1.72 b |
| 60 | 1.81 | 2.01 | 2.11 | 1.98 a |
| 80 | 1.93 | 2.03 | 2.19 | 2.00 a |
| Means (cm) | 1.80 b | 1.91 b | 2.03 a | |

Numbers in the same row and column followed by the same lowercase letters are not real according to the HSD Test at a 5% level.

influences the increase in the plant stem diameter (Hapsoh *et al*., 2020). The EFB compost and NPK compound fertilizer contain macro- and micro-nutrients directly improving the physiology and metabolism and encouraging the formation of new cells to influence the development of plant tissues, namely, roots, stems, and leaves.

The application of compost EFB (200 g plant$^{-1}$) increased the stem diameter and significantly differed from two other doses (150 and 100 g plant$^{-1}$) in oil palm seedlings. This is because the EFB compost (200 g plant$^{-1}$) contributes more organic matter, improving soil fertility and physical properties. The EFB compost can also enrich soil fertility (chemistry) by contributing micro and macro-nutrients to the soil. In addition to enhancing the chemical properties of compost soil, the EFB can boost the physical properties of the soil, such as, increasing the soil's ability to absorb more water, amend soil aggregates, pores, and $O_2$ diffusion into the soil. Similarly, the compost EFB improves soil biology by increasing the activity of soil microorganisms as decomposers. The process of stem enlargement is inseparable from the role of nutrients and has interrelations with photosynthesis results. Leonardo *et al.* (2016) reported the EFB compost on inceptisol subsoil medium can improve the structure of clay soil to keep it looser, and the development of stem circumference is better. According to Bariyanto *et al.* (2015), the EFB compost contains macro- and micronutrients directly improving the physiology and metabolism of plants. This will encourage the formation of new cells, and it will influence the plant tissue, viz., roots, stems, and leaves, directly affecting the stem diameter in oil palm seedlings.

Applying the NPK fertilizer (80 g plant$^{-1}$) resulted in the trunk circumference diameter's greater increase. However, it was not significantly different from the NPK at 60 g plant$^{-1}$), but notably different from the NPK at 40 g plant$^{-1}$. One suspects that the nutrients contained in NPK fertilizer can accelerate the development of seedlings due to the accumulation of photosynthetic processes produced by plants relating to N, P, and K elements, through the provision of the NPK fertilizer. Sitorus *et al.* (2021) reported the administration of specific doses of nutrients has a good impact; however, the smaller dose will cause insufficient effect on crop plants, while excessive doses could cause poisoning.

Adding nitrogen nutrients can stimulate vegetative growth in the branches, stems, and leaves, which are constituent components of amino acids, proteins, and protoplasm-forming cells that can function to stimulate plant growth. Phosphorus is the main component of nucleic acids and vital in cell division at the growth point, also causing plant growth. Aside from nitrogen and phosphorus, potassium boosts plant growth by activating various enzymes. Asra *et al.* (2015) reported that the taller the oil palm seedling, the more leaves emerge, followed by an increasing diameter of the trunk circumference. The leaves and the trunk circumference were directly proportional to the increased number of leaves, and chlorophyll rises due to active photosynthesis, which can benefit seedling growth, such as the trunk circumference stem diameter.

**Number of leaves**

The results showed the individual application of the EFB compost treatments with the NPK compound fertilizer and the interaction of EFB compost (200 g plant$^{-1}$) and NPK compound fertilizer (80 g plant$^{-1}$), exhibited the most enhancement in the number of leaves in oil palm seedlings (Table 4). The EFB compost (200 g plant$^{-1}$) displayed a significant effect by increasing the number of leaves (8.63). The applied NPK fertilizer (80 g plant$^{-1}$) also demonstrated the considerable effect on the number of leaves, revealing the most number of leaves (8.52).

The combination of the EFB compost (200 g plant$^{-1}$) with the NPK fertilizer (80 g plant$^{-1}$) provided the most number of leaves. It seemed that the provision of NPK fertilizer has fulfilled the plant nutrients necessary to raise the number of leaves. However, the EFB compost may not work optimally in helping the nutrient absorption. This is due to the continuous and excessive application of inorganic fertilizers that can kill microorganisms in the soil. The EFB compost

**Table 4.** Effect of EFB compost and NPK compound fertilizer on the number of leaves in oil palm seedlings.

| NPK fertilizer dosage (g) | EFB dosage (g) | | | Means (#) |
|---|---|---|---|---|
| | 100 | 150 | 200 | |
| 40 | 7.33 | 7.44 | 7.89 | 7.56 b |
| 60 | 7.78 | 8.11 | 8.78 | 8.22 a |
| 80 | 8.00 | 8.33 | 9.22 | 8.52 a |
| Means (#) | 7.70 b | 7.96 b | 8.63 a | |

Numbers in the same row and column followed by the same lowercase letters are not real according to the HSD Test at a 5% level.

could enrich the soil's physical, chemical, and biological properties. The availability of nutrients N, P, and K plays a key role in cell division and helps in producing more leaves in oil palm seedlings. Leonardo *et al.* (2016) reported that N, P, and K elements available in planting media can help the cell division and enlargement, leading young leaves to reach the perfect shape faster.

Furthermore, the best combination of the EFB compost with the NPK fertilizer received support from the greener color of the oil palm seedling leaves. The greener the color of the oil palm seedling leaves, the higher the chlorophyll content. Optimum chlorophyll content will improve growth because chlorophyll is vital in the process of photosynthesis. This is the opinion of Fuady *et al.* (2019), where the optimal combination of organic and inorganic fertilizer treatments could enhance the greenness of leaves caused by a higher chlorophyll content, thus, enhancing the growth of oil palm seedlings.

The EFB compost (200 g plant$^{-1}$) produced the maximum number of leaves, which was significantly different from other treatments. The EFB compost can contribute more organic matter and enrich soil fertility. Agung *et al.* (2019) mentioned the good planting media could cause nutrient absorption by plants to be more effective, supporting plant growth, and increasing the number of leaves. The genetic nature of the crop plants influences the number of leaves in oil palm plants, however, when balanced with sufficient nutrients, it will help develop the leaf growth in oil palm seedlings. In forming leaves, the N element plays an essential role, since N is a constituent of chlorophyll. Yoseftabar (2013) stated the need for nitrogen is in relatively large quantities at growth stages, especially in the vegetative growth stage, to boost the number of leaves. Leghari *et al.* (2016) reported that nitrogen is crucial in various physiological processes, stimulating the growth of leaves, stems, and other vegetative parts.

The treatment of NPK fertilizer (80 g plant$^{-1}$) produces an ultimate number of leaves, and the said treatment was at par with NPK at 60 g plant$^{-1}$, but was remarkably distinct from NPK at 40 g plant$^{-1}$ in oil palm seedlings. Assumedly, the nutrients available in NPK (16:16:16) can provide nutrients needed by plants during vegetative growth, especially N and P elements. Aminullah *et al.* (2017) disclosed the N and P elements in the media can help the process of cell division and enlargement, which causes young leaves to reach a perfect shape. The greater number of leaves produce large photosynthetic results, which aid in plant growth and development. The availability of elements N and P will be able to alter the leaves in terms of shape and quantity.

**Root volume**

The analysis revealed the provision of compost EFB with NPK fertilizer showed no effect on the root volume; however, the provision of compost EFB (200 g plant$^{-1}$) with NPK (80 g plant$^{-1}$) showed the largest root volume (40.00 ml) in oil palm seedlings (Table 5). Individual application of the compost EFB (200 g plant$^{-1}$) and NPK fertilizer (80 g plant$^{-1}$) displayed the greatest root volume of 38.56 ml and 35.89 ml, respectively. The provision of the NPK fertilizer has fulfilled the plants' nutrient needs

**Table 5.** Effect of EFB compost and NPK compound fertilizer on the root volume in oil palm seedlings.

| NPK fertilizer dosage (g) | EFB dosage (g) | | | Means (ml) |
|---|---|---|---|---|
| | 100 | 150 | 200 | |
| 40 | 31.67 | 32.00 | 36.67 | 33.44 |
| 60 | 31.67 | 32.67 | 39.00 | 34.44 |
| 80 | 31.67 | 36.00 | 40.00 | 35.89 |
| Means (ml) | 31.67 b | 33.56 b | 38.56 a | |

Numbers in the same row and column followed by the same lowercase letters are not real according to the HSD Test at a 5% level.

to increase the root volume of oil palm seedlings. Although, the EFB compost does not work optimally in helping nutrients absorption. This is because the continuous and excessive application of inorganic fertilizers can kill microorganisms in the soil. Plant roots have an influential role in absorbing the water and nutrients dissolved in the soil and transported to the shoots. The fulfillment of plants' nutrients largely determine the increase in root development. Sarief (2015) findings revealed the elements absorbed by plant roots play a remarkable role in supporting the plants' vegetative growth.

An individual application of the EFB compost (200 g plant$^{-1}$) produced the premier root volume, and the said treatment significantly differed from other EFB doses. The high doses of EFB compost can improve the soil structure, with the root growth also increasing. Moreover, the provision of EFB compost on the plant growing medium showed better results because it can increase the absorption and binding power of the soil to water and nutrients, which are vital inputs for root development. Leonardo (2016) reported the provision of EFB compost, in addition to improving physical properties, can enrich the biological planting medium, and the plant roots develop better. Hartika (2021) mentioned the organic fertilizers given through the soil can raise the activity of microorganisms in the soil, improve the soil structure, and add more nutrients to the soil. This, in turn, fulfill the needs of plants, leading to further increase the growth of oil palm seedlings.

Individually applying NPK fertilizer provided no effect on the root volume; however, the NPK (80 g plant$^{-1}$) produced the broadest root volume compared with other treatments. Assumingly, the nutrients contained in NPK were sufficient for the plants' need in increasing the root volume. Heightened root growth occurs through fertilizers containing potassium elements that can enhance root growth, and the absorption of nutrients becomes greater. The potassium element plays a key role in photosynthesis enzymes, carbohydrate translocation, and absorption of $CO_2$ in the leaf. Sarief (2015) reported the elements N, P, and K trigger the root elongation process. Plant roots have a critical role in absorbing water and nutrients dissolved in the soil, and then transporting to the shoots. Plants must have a root system to obtain nutrients and water following the plant's needs for the plants to grow well.

## CONCLUSIONS

The results enunciated the EFB compost (200 g plant$^{-1}$) enhanced the growth through stem diameter and the number of leaves in oil palm seedlings. Moreover, the NPK fertilizer (60 g plant$^{-1}$) boosted the plant height, the trunk circumference, and the number of leaves in oil palm seedlings. The interaction of the EFB compost (200 g plant$^{-1}$) and NPK fertilizer (60 g plant$^{-1}$) significantly increased growth through plant height parameters, the trunk circumference, the number of leaves, and root volume in oil palm seedlings. Furthermore, the application of EFB compost can reduce inorganic fertilizer by 25%, from 80 g to 60 g of inorganic fertilizers.

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