Jurnal Pertanian Terapan of JURNAL ROCE (AGROSCIENCE)
https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 2, Thn. 2026
https://doi.org/10.71275/roce.v3i2.185

THE EFFECTIVENESS OF NATURAL PLANT GROWTH REGULATORS (PGRS) FROM BEAN SPROUTS EXTRACT AND NPK 15-15-6-4 ON THE GROWTH OF OIL PALM SEEDLINGS (*Elaeis guineensis* Jacq.)

EFEKTIVITAS ZPT ALAMI EKSTRAK TOGE DAN NPK 15-15-6-4 TERHADAP PERTUMBUHAN BIBIT KELAPA SAWIT (*Elaeis guineensis* Jacq.)

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Abstract

Nursery management is a process of growing and developing seeds into seedlings ready for planting. This study aimed to determine the effectiveness of a natural plant growth regulator (bean sprout extract) and NPK 15-15-6-4 fertilizer on the growth of oil palm (*Elaeis guineensis* Jacq.) seedlings and to provide a recommended dosage for pre-nursery oil palm seedling growth. This study employed a non-factorial Randomized Complete Block Design (RCBD) with five treatments and five replications, resulting in 25 experimental units. The treatments were arranged as follows: K0 = Without bean sprout extract and NPK 15-15-6-4 (control); K1 = 10 ml bean sprout extract per seedling + 30 g NPK 15-15-6-4; K2 = 20 ml bean sprout extract per seedling + 30 g NPK 15-15-6-4; K3 = 30 ml bean sprout extract per seedling + 30 g NPK 15-15-6-4; K4 = 40 ml bean sprout extract per seedling + 30 g NPK 15-15-6-4. The observed parameters were plant height, leaf number, and stem diameter. The results showed that the application of bean sprout extract as a plant growth regulator and NPK 15-15-6-4 fertilizer did not significantly affect plant height, leaf number, or stem diameter of oil palm seedlings at 40–60 days after planting. The best treatment was K4 (40 ml of bean sprout extract and 30 g of NPK 15-15-6-4), which improved oil palm seedling growth.

***Keywords*:** Oil Palm Seedlings, Effectiveness, NPK Fertilizer, Bean Sprout Extract Plant Growth Regulator.

Abstrak

Pembibitan adalah proses menumbuhkan dan mengembangkan benih menjadi bibit yang siap ditanam. Penelitian ini bertujuan untuk mengetahui efektivitas ZPT alami ekstrak toge dan NPK 15-15-6-4 terhadap pertumbuhan bibit kelapa sawit (*Elaeis guineensis* Jacq.) serta memperoleh rekomendasi dosis terbaik untuk pertumbuhan bibit kelapa sawit pada pre-nursery. Penelitian ini menggunakan Rancangan Acak Kelompok (RAK) non faktorial dengan 5 perlakuan dan 5 ulangan sehingga diperoleh 25 satuan percobaan, dengan urutan perlakuan yaitu K0 = Tanpa Ekstrak Toge dan NPK 15-15-6-4 (kontrol), K1 = Pemberian Ekstrak Toge 10 ml/ bibit + 30 g NPK 15-15-6-4, K2 = Pemberian Ekstrak Toge 20 ml/ bibit + 30 g NPK 15-15-6-4, K3 = Pemberian Ekstrak Toge 30 ml/ bibit + 30 g NPK 15-15-6-4, dan K4 = Pemberian Ekstrak Toge 40 ml/ bibit + 30 g NPK 15-15-6-4. Parameter yang diamati adalah tinggi tanaman, jumlah daun dan diameter batang. Hasil penelitian menunjukkan bahwa perlakuan ZPT ekstrak toge dan NPK 15-15-6-4 tidak memberikan pengaruh nyata terhadap tinggi tanaman, jumlah daun, dan diameter batang bibit kelapa sawit pada umur 40-60 HST. Perlakuan terbaik diperoleh pada perlakuan

K4 (40 ml ekstrak ZPT toge dan 30 gram NPK 15-15-6-4) yang dapat meningkatkan pertumbuhan bibit kelapa sawit.

Kata Kunci: Bibit Kelapa Sawit, Efektivitas, Pupuk NPK, ZPT Ekstrak Toge.

INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is one of Indonesia's major plantation crops and a primary source of vegetable oil, contributing significantly to national export earnings (Harahap *et al*., 2025). Proper nursery practices and nutrition management have been shown to strongly influence the quality and growth of oil palm seedlings, which are critical for sustainable production (Pratiwi *et al*., 2026; Gusmawartati *et al*., 2025). High-quality seedlings, with optimal fertilization and media composition, enhance early growth performance during the nursery stage.

Oil palm nursery is the critical first step in producing high-quality seedlings for field planting, and nursery practices substantially affect the growth performance and quality of young plants (Oktafianti *et al*., 2025; Hardiyanti *et al*., 2023; Setyawati dan Witjaksono, 2021). Recent studies indicate that appropriate nutrient management and organic amendments can significantly enhance seedling height, stem diameter, and leaf development in oil palm nurseries (Oktafianti *et al*., 2025; Journal of Tropical Crop Science, 2025). Additionally, the use of plant growth regulators and bioherbicides as supportive treatments at early stages can further improve uniformity and nursery success (Prabowo *et al*., 2022; Sari *et al*., 2024).

Modern agricultural systems often rely on synthetic fertilizers, pesticides, and synthetic plant growth regulators to improve crop yields. However, their overuse has been linked to environmental degradation and adverse ecological effects (Emeka *et al*., 2023; Rauf *et al*., 2024). In response, recent research has focused on developing natural plant growth regulators from local organic sources to regulate plant growth while reducing environmental risks (Mozumder & Hossain, 2025; Arowosegbe *et al*., 2022).

Bean sprouts contain multiple plant growth regulators that can be quantitatively analyzed using advanced LC-MS/MS techniques (Cai *et al*., 2023). The effects of plant growth regulators on morphological and reproductive traits have been documented in several crops, including onion and aloe vera (Fadlillah *et al*., 2022; Romandianty dan Anggarani, 2023). Comparative application of gibberellin and cytokinin demonstrates significant impacts on yield and plant development (Nursandi *et al.,* 2024). Biotic sources and microbial modulation of phytohormones are emerging as important research areas for enhancing plant growth (Orozco-Mosqueda *et al*., 2023).

RESEARCH METHODS

Place and Time of Research

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 2, Thn. 2026
https://doi.org/10.71275/roce.v3i2.185

This research was conducted at the Plantation Management's experimental garden. Study Program at the Politeknik Indonesia Venezuela. The research was conducted over 3 months, from January to March 2025.

Tools and materials

The tools and materials used in the research are hoes, machetes, scissors, scales, containers with lids, polybags, bean sprout extract, husks, soil, water, pens, books, rulers, calipers, NPK 15-15-6-4 fertilizer, and oil palm seedlings.

Research Plan

This study used a Non-Factorial Randomized Block Design (RBD) with 5 treatments and 5 replicates, resulting in 25 experimental units, with the following treatment sequence:
K0 = Without Sprout Extract and NPK 15-15-6-4 (control)
K1 = Application of 10 ml Sprout Extract/seedling + 30 g NPK 15-15-6-4
K2 = Application of 20 ml Sprout Extract/seedling + 30 g NPK 15-15-6-4
K3 = Application of 30 ml Sprout Extract/seedling + 30 g NPK 15-15-6-4
K4 = Application of 40 ml Sprout Extract/seedling + 30 g NPK 15-15-6-4

Research Implementation

Site preparation began with thoroughly cleaning the research area, followed by placing the oil palm seedlings in polybags in the shade. The three-month-old Sriwijaya 1 variety oil palm seedlings were obtained from a community-owned oil palm plantation in Panton Reu Subdistrict, West Aceh Regency. The seedlings were planted in polybags filled with soil, with each seedling placed in the middle of the bag at a depth of 7 cm. They were then arranged and placed under shade. A total of 25 seedlings were used. Mung bean sprout extract was prepared by mixing 1,000 g of sprouts with 1,000 ml of water, then coarsely blending the mixture. This mung bean sprout extract was applied three times: first after transplanting into polybags, second at 11 days post-transplanting, and third at 21 days post-transplanting. It was applied by pouring it in a circular motion around the polybag. The dosage of mung bean sprout extract was determined for each treatment. NPK 15-15-6-4 fertilizer was obtained from the agricultural supply store in Kecamatan Ingin Jaya, Aceh Besar. This fertilizer was applied once, specifically after planting in polybags and after applying mung bean sprout extract. It was applied by spreading it in a circular pattern according to the specified dosage.

Parameters observed

Observations made on these oil palm seedlings included: number of fronds, plant height, and stem diameter.

Data Analysis

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Vol. 3, No. 2, Thn. 2026
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ANOVA analysis was conducted on observational data from variable growth, with a significance level of 95%. If there was a difference between treatments, different tests were conducted, and the smallest difference (BNT) was used (Sari *et al*., 2019).

RESULTS AND DISCUSSION

Plant Height

The results of the variance analysis indicate that the treatment of sprout extract PGR and NPK 15-15-6-4 did not have a significant effect on the height of oil palm seedlings at 40 DAP, 50 DAP, and 60 DAP. The average height of oil palm seedlings is shown in Table 1.

Table 1. Average Height Values of Oil Palm Seedlings at 40 DAP, 50 DAP, and 60 DAP.

Treatment	Plant Height (cm)		
	40 DAP	**50 DAP**	**60 DAP**
K0	15,70	15,88	15,92
K1	15,04	16,38	16,58
K2	16,00	16,08	16,65
K3	15,96	15,96	16,46
K4	15,90	16,34	17,10

Source: Processed data, 2025.

Based on Table 1, the treatment of sprout extract PGR and NPK 15-15-6-4 fertilizer on the height of oil palm plants at 40 DAP, 50 DAP, and 60 DAP did not have a significant effect. The highest average value of oil palm seedlings was found in treatment K4 (Application of 40 ml sprout extract/seedling + 30 g NPK 15-15-6-4), which was 17.10 cm, and the lowest average value of oil palm seedlings was found in treatment K0 (Without Sprout Extract and NPK 15-15-6-4 (control)), which was 15.92 cm. It is suspected that the PGR sprout extract and NPK 15-15-6-4 fertilizer provided were not sufficient for the growth in height of the oil palm seedlings.

According to Wartono *et al*. (2022), the absence of a significant effect on oil palm seedling growth is also influenced by soil with a somewhat compact structure, which slows the decomposition of NPK fertilizer. As a result, nutrient absorption by the roots is hindered, leading to nutrient deficiencies and uneven growth of oil palm seedlings. In line with the opinion of Dendi *et al*. (2019), proper fertilization should take into account the soil condition to support plant growth.

The use of mung bean sprout extract, although not statistically significant, increases the height of oil palm seedlings at 40 DAP, 50 DAP, and 60 DAP. Administering 40 ml of sprout extract can increase oil palm seedling height, whereas doses below 40 ml decrease it. This indicates that oil palm seedlings respond to the application of sprout extract, and it is suspected that doses exceeding 40 ml inhibit seedling growth. This aligns with the opinion of Munar et al.

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
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(2011), who stated that plant growth substances play a role in development by influencing cell division, cell enlargement, and cell differentiation. Therefore, using too low a dose does not affect growth, whereas excessive amounts can hinder plant growth.

Number of Leaf Sheaths

The results of the variance analysis showed that the treatment of sprout extract PGR and NPK 15-15-6-4 did not have a significant effect on the number of leaves of oil palm seedlings at 40 DAP, 50 DAP, and 60 DAS. The average number of leaves of oil palm seedlings can be seen in Table 2.

Table 2. Average Number of Leaves of Oil Palm Seedlings at 40, 50, and 60 Days After Planting.

Treatment	Leaf Sheaths (Quantity)		
	40 DAP	50 DAP	60 DAP
K0	0,32	0,34	0,34
K1	0,22	0,24	0,27
K2	0,30	0,36	0,39
K3	0,27	0,34	0,37
K4	0,26	0,33	0,41

Source: Processed data, 2025.

Based on the table above, the treatments of the plant growth regulator (PGR) from sprout extract and the NPK 15-15-6-4 fertilizer did not have a significant effect on the number of oil palm leaves at 40 DAP, 50 DAP, and 60 DAP. The highest average leaf number for oil palm seedlings was observed in treatment K4 (Application of 40 ml sprout extract/seedling + 30 g NPK 15-15-6-4), with an average of 0.41 leaves. In comparison, the lowest average leaf number was observed in treatment K1 (Application of 10 ml sprout extract/seedling + 30 g NPK 15-15-6-4), with an average of 0.21 leaves. This is suspected to be due to the nitrogen in the growing medium not yet meeting the seedling's needs for increased leaf number.

According to Wijaya *et al*. (2015), the growth medium used contains a moderate level of nitrogen, so the addition of nitrogen nutrients from the NPK 15-15-6-4 fertilizer treatment did not contribute to the seedling height growth. However, when converted to tons per hectare, it remains insufficient for plant growth.

The use of bean sprout extract, although not statistically significant, increases the number of leaves in oil palm seedlings at 40, 50, and 60 days after planting. According to research by Efendi and Suwardi (2010), the leaf number index tends to increase quadratically with the addition of nitrogen fertilizer during the early seedling phase. In line with Jayanti *et al*. (2019), plant growth regulators absorbed by oil palm seedling roots can increase leaf number, albeit not significantly. This is suspected to be due to the auxin hormone content in bean sprouts, which promotes vertical cell elongation and increases the number of leaves.

Stem Diameter

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The analysis of variance results showed that the treatment of sprout extract PGR and NPK 15-15-6-4 did not have a significant effect on the stem diameter of oil palm seedlings at 40 DAP, 50 DAP, and 60 DAP. The average stem diameters of oil palm seedlings are shown in Table 3.

Table 3. Average Stem Diameter Values of Oil Palm Seedlings at 40 DAP, 50 DAP, and 60 DAP.

Treatment	Stem Diameter (Inches)		
	40 DAP	**50 DAP**	**60 DAP**
K0	0,32	0,34	0,34
K1	0,22	0,24	0,27
K2	0,30	0,36	0,39
K3	0,27	0,34	0,37
K4	0,26	0,33	0,41

Source: Processed data, 2025.

Based on Table 3, the treatment of sprout extract plant growth regulator (PGR) and NPK 15-15-6-4 fertilizer on the stem diameter of oil palm at 40 DAP, 50 DAP, and 60 DAP did not have a significant effect. The highest average height for oil palm seedlings was observed in treatment K3 (Application of 30 ml sprout extract/seedling + 30 g NPK 15-15-6-4), at 4.80 cm. In comparison, the lowest average oil palm seedling height was observed in treatment K1 (Application of 10 ml sprout extract/seedling + 30 g NPK 15-15-6-4), at 4.40 cm. This is suspected to be due to the low doses of macro- and micronutrients required by the plants, which may affect the increase in stem diameter. In line with Wartono *et al*. (2022), nutrient deficiencies in plants will have a detrimental effect on plant growth, including stem diameter. Nutrient availability plays an important role in plant growth.

According to Rokhim and Adelina (2021), bean sprout extract is an organic material that can be decomposed by soil microorganisms, allowing plants to utilize it as a nutrient. If nutrient elements are in excess, they cannot be used by plants and will be lost through leaching or evaporation. Additionally, nutrient elements, including macro- and micronutrients, affect seed quality and can improve seedling quality. The higher the seedling quality, the better the plant is for field planting, and the more ready the seedlings are to be planted.

Although the use of bean sprout extract was not statistically significant, it did increase stem diameter in oil palm seedlings at 40, 50, and 60 DAP. The availability of both elements plays an important role in cell division, thereby improving stem diameter growth in oil palm seedlings. This is consistent with the statement by Wijaya *et al*. (2015) that nitrogen enhances stem development both vertically and horizontally. The availability of phosphorus will strengthen the growth of the oil palm seedling stem, and a phosphorus deficiency can cause stunted seedlings, short fronds, and tapered stems.

CONCLUSION

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Based on the research results, it can be concluded that the treatments with sprout extract PGR and NPK 15-15-6-4 did not have a significant effect on plant height, leaf number, and stem diameter of oil palm seedlings at 40 DAP, 50 DAP, and 60 DAP. The best treatment was K4 (40 ml sprout extract PGR and 30 grams of NPK 15-15-6-4), which improved oil palm seedling growth.

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