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The Effect of Sugarcane Filter Cake and PGPR (Plant Growth Promoting Rhizobacteria) on the Growth of Oil Palm (*Elaeis guineensis* Jacq.) Seedlings in the Pre-Nursery

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ABSTRACT

The objective of this study was to evaluate the growth response of oil palm seedlings to the application of Sugarcane Filter Cake (blotong) and PGPR at the pre-nursery stage. The research was conducted at the Research and Educational Garden (Experimental farm) in Maguwohardjo Village, Depok Sub-district, Sleman Regency, Special Region of Yogyakarta. This study took place from December 2024 to March 2025. The research method used was a factorial experiment arranged in a Completely Randomized Design (CRD) with two factors. The first factor was the dosage of Sugarcane Filter Cake, with four treatment levels: control (NPK 3 gram), 100 g, 150 g, and 200 g per seedling. The second factor was the application of PGPR, with four concentration levels: control (0 ml), 5 ml, 10 ml, and 15 ml per polybag. The data were analysed using Analysis of Variance (ANOVA), and the results were further tested using Duncan's Multiple Range Test (DMRT) at a 5% significance level. The observed parameters included plant height, number of leaves, stem diameter, shoot fresh weight, shoot dry weight, root fresh weight, root dry weight, root volume, and leaf area. The results showed no interaction between the Sugarcane Filter Cake dosage and PGPR concentration in influencing the growth of oil palm seedlings. The application of a 100 g dose of Sugarcane Filter Cake per seedling showed optimal growth for the parameters of plant height and number of leaves.The application of sugarcane filter cake can replace in the NPK fertilizer. The application of PGPR up to a concentration of 15 ml did not have a significant effect on any of the observed parameters for the oil palm seedlings in the pre-nursery.

KEYWORDS: Sugarcane filter cake, blotong, PGPR, oil palm, pre-nursery

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INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is a plant that produces vegetable oil and is currently considered the most efficient and profitable compared to other vegetable oils. According to data from the Central Statistics Agency (BPS), in 2023, large plantations in Indonesia will be predominantly dominated by oil palm. The planted area reached 9.14 million hectares (ha), an increase of 569.8 thousand ha compared to the previous year, which was recorded at 8.57 million ha (BPS, 2024). The Geospatial Information Agency (BIG) and the Indonesian Ministry of Agriculture are collaborating to update data on oil palm planted areas. A report from BIG indicates that the oil palm planted area has reached 17.3 million hectares (BIG, 2024).

Developing an oil palm plantation requires high-quality seedlings, as these directly impact the yield of the oil palm crop. A nursery is where plants are grown after germination to prepare them for field planting. The quality of the seedlings plays a crucial role in determining the success of oil palm cultivation. The health of the plants during the nursery stage significantly affects their future development and the abundance of harvests once planted in the field. Growing media is vital in the nursery process because it directly influences root growth. Therefore, to produce healthy and superior seedlings, good growing media, such as organic fertilizers, is essential. Excellent organic fertilizers can be derived from blotong and PGPR.

Blotong, or filter cake, is a waste product from the sugar industry, resulting from the filtration of sugarcane juice. (Asriana, 2018)

states that the use of blotong as organic fertilizer has been widely researched regarding its impact on soil characteristics and its effect on plant growth. Blotong fertilizer contains 26.51% Carbon I, 1.04% Nitrogen, a C/N ratio of 25.62, 6.142% Phosphate, 0.191% Potassium, and 0.115% Manganese (Supari *et al*., 2013). The application of blotong can increase soil nutrient content, especially Nitrogen, Phosphorus, and Calcium, along with other micronutrients. It can be concluded that blotong functions similarly to compost or other organic fertilizers in improving soil fertility.

PGPR (Plant Growth-Promoting Rhizobacteria) are a group of microorganisms that can colonize plant roots and play a role in influencing plant development through various direct and indirect methods. They improve plant growth and protect plants from diseases or damage caused by pests. Some types of bacteria categorized as PGPR include *Pseudomonas*, *Azotobacter*, *Azospirillum*, *Acetobacter*, *and Bacillus* (Candraningtyas & Indrawan, 2023).

PGPR (Plant Growth-Promoting Rhizobacteria) play a crucial role in supporting plant growth, increasing crop yields, and improving soil fertility. The presence of these microbes provides significant benefits to plants. These bacteria assist in the physiological processes and development of plants (Husnihuda *et al*., 2017)

MATERIALS AND METHODS

Place and Time of research

The study was conducted at the Education and Research Farm of Instiper, located in Maguwoharjo Village, Depok District, Sleman Regency, Special Region of Yogyakarta. The research activities were carried out from December 2024 to March 2025.

Tools and materials

The materials and tools used were a sieve, hoe, polybags, digital scale, calipers, ruler, stationery, blotong fertilizer, PGPR, and oil palm sprouts.

Research design

This study employed a factorial experimental method arranged in a Completely Randomized Design (CRD), consisting of two factors. The first factor was the dose of blotong fertilizer, comprising: B0 = no treatment (control NPK 3 gram); B1 = 100 grams; B2 = 150 grams; B3 = 200 grams. The second factor was PGPR, consisting of: P0 = 0 ml/l; P1 = 5 ml/l; P2 = 10 ml/l; P3 = 15 ml/l. This resulted in 16 treatment combinations, replicated 5 times, leading to a total of 80 experimental units.

RESULTS AND DISCUSSION

Observation results after being analyzed with Anova and Duncan Multiple Range Test (DMRT) at a test level of 0.5% can be seen as follows.

Table 1. The Effect of Blotong Fertilizer on Oil Palm Seedling Growth in the *Pre nursery* Stage.

	Sugarcane Filter Cake (g)/seedling			
Parameter	Control (NPK 3 g)	100/g	150/g	200/g
Plant Height (cm)	16.05b	18.25a	18.31a	18.77a
The Sum Of Leaves	2.40b	2.40b	2.65a	2.80a
Stem (cm)	4.26a	4.39a	4.60a	4.70a
Crown Fresh Weight (g)	1.42a	1.55a	1.70a	1.85a
Crown Day Weight (g)	0.38a	0.40a	0.46a	0.48a
Root Fresh Weight (g)	0.65a	0.69a	0.71a	0.82
Root Day Weight(g)	0.13a	0.14a	0.14a	0.17a
Root Volune (g)	0.69a	0.86a	0.94a	1.03a
Leaf Wide (cm2)	11.85a	12.30a	12.97a	14.52a

Note: Means followed by the same letter in the same column are not significantly different according to DMRT at the 5% significance level.

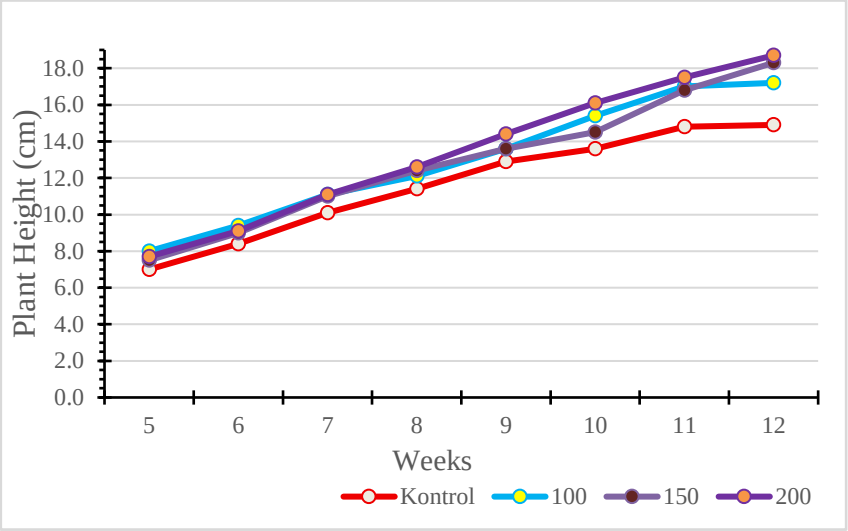

Figure 1. Graph of the Effect of Blotong Dose on Oil Palm Seedling Height.

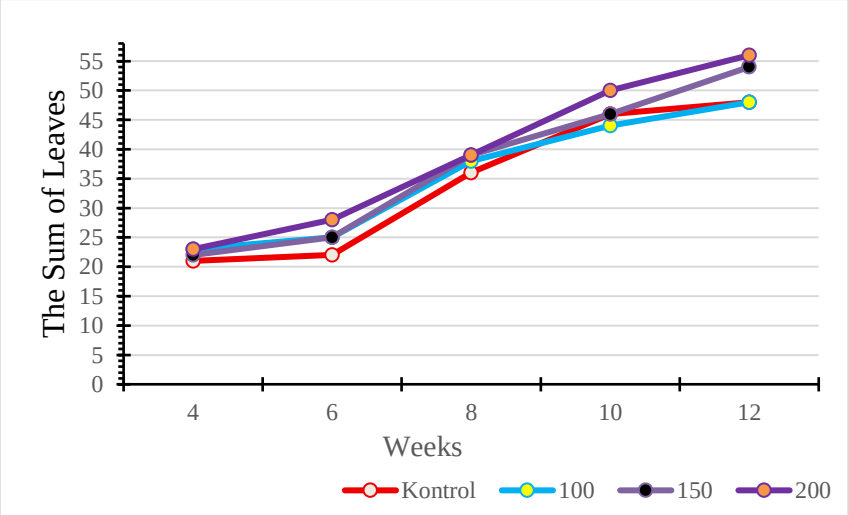

Figure 2. Graph of the Effect of Blotong Dose on the Number of Oil Palm Seedling Leaves.

Table 2. The Effect of PGPR on Oil Palm Seedling Growth in the Pre-nursery Stage.

	PGPR (ml/l)			
Parameter	0 ml/l	5 ml/l	10 ml/l	15 ml/l
Plant Height (cm)	17.35p	18.38p	17.68p	17.97p
The Sum Of Leaves	2.50p	2.70p	2.45p	2.60p
Stem (cm)	4.42p	4.79p	4.34p	4.41p
Crown Fresh Weight (g)	1.59p	1.74p	1.65p	1.53p
Crown Day Weight (g)	0.41p	0.45p	0.46p	0.40p
Root Fresh Weight (g)	0.66p	0.76p	0.78p	0.68p
Root Day Weight(g)	0.14p	0.16p	0.15p	0.14p
Root Volune (g)	0.76p	1.13p	0.84p	0.79p
Leaf Wide (cm2)	12.49p	12.82p	13.71p	12.62p

Note: Means followed by the same letter in the same column are not significantly different according to DMRT at the 5% significance level.

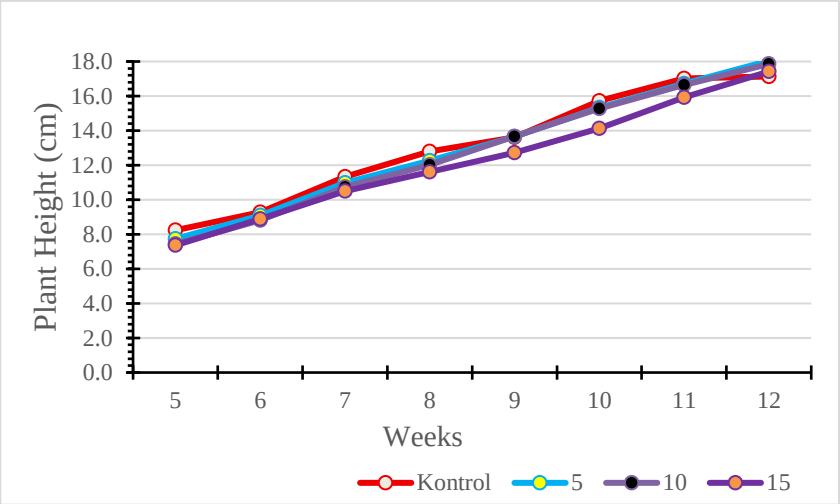

Figure 1. Graph of the Effect of PGPR on Oil Palm Plant Height.

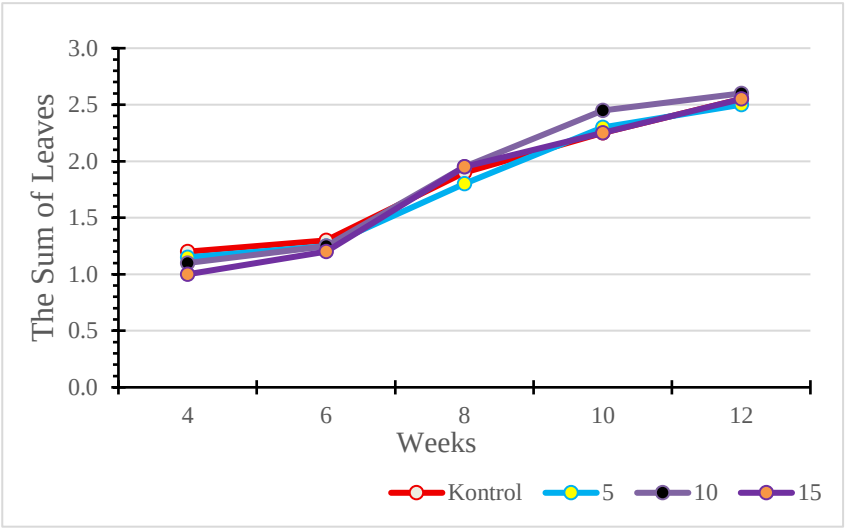

Figure 2. Graph of the Effect of PGPR on the Number of Oil Palm Seedling Leaves.

The ANOVA results showed no interaction between the various blotong fertilizer and PGPR treatments on all observed clove seedling growth parameters. This means that each treatment did not work synergistically.

Based on the analysis of variance, the treatments with doses of blotong fertilizer and concentrations of Plant Growth Promoting Rhizobacteria (PGPR) up to 15 ml per seedling did not show a significant interaction on the pre-nursery seedlings across all observed parameters. This indicates that each treatment independently affected the plant growth.

The analysis of variance indicate that the application of blotong fertilizer significantly influences the height and number of leaves of oil palm seedlings. At a dosage of 100 grams of blotong, the seedlings exhibited a height growth of 18.77 cm² (Table 1). According to (Ogi *et al.*, 2023), the ideal growth for three-month-old oil palm seedlings is 20 cm. This suggests that incorporating blotong into the growing medium up to 100 grams can positively impact seedling height. The application of blotong also significantly affects the number of leaves in oil palm seedlings in the pre-nursery stage. Applying 150 and 200 grams of blotong resulted in better outcomes compared to the control and 100-gram treatments (Table 1). This indicates that adding blotong up to 150 grams is sufficient to increase the number of leaves. According to (Astuti, 2022), soil water availability can be enhanced through the addition of organic materials, which improve soil structure and increase its water retention capacity. Blotong also enriches soil nutrients. Nutrients play a role in promoting growth and cell division in the leaf meristem, supporting the expansion and division of cells at the leaf meristem tip, thereby facilitating the development of new leaves. Nitrogen contributes to protein formation in plants, chlorophyll synthesis, and metabolic processes. This element also forms essential organic compounds such as amino acids, proteins, and nucleic acids (Pardede & Fathurrahman , 2024). The application of organic fertilizers like blotong can enhance and improve soil properties. According to (Pohan, 2021), blotong contains Nitrogen (0.2-0.7%), Phosphorus (0.4-1.8%), Potassium (0.02%), and Calcium (0.8-1.1%). The effect of blotong dosage application to the plant height and number of leaves every weeks shows on Figure 1 and 2.

The application of blotong (sugarcane filter cake) did not significantly affect stem diameter, fresh and dry weight of the canopy, fresh and dry weight of the roots, root volume, or leaf area. This indicates that the control treatment (NPK 3 g per seedling) was comparable to the use of blotong. Consequently, blotong can serve as an organic medium to replace inorganic fertilizers like NPK. Incorporating blotong into the soil provides nutrients and elements equivalent to NPK 3 g per seedling. Additionally, blotong is beneficial for improving soil physical characteristics, thereby enhancing its water retention capacity. The organic matter content in blotong not only benefits plant growth but also contributes to ameliorating compacted soil, positively influencing seedling height growth (Sinnipar, 2019).

The analysis of variance (ANOVA) revealed that the application of Plant Growth Promoting Rhizobacteria (PGPR) at concentrations of 0 ml/l (control), 5 ml/l, 10 ml/l, and 15 ml/l did not significantly affect any of the observed parameters, including seedling height, leaf number, root length, fresh root weight, dry root weight, and total dry weight (Table 2). This finding contrasts with the study by (Setyawati & Witjaksono, 2021), which reported that a PGPR concentration of 0 ml/l was the most efficient for oil palm seedling growth compared to 5 ml/l, 10 ml/l, and 15 ml/l. The discrepancy may be attributed to differences in experimental conditions, such as soil type and PGPR formulation. The soil used in this study was Regosol, a weakly developed mineral soil with low organic matter content. Regosols are often found in eroding lands and are characterized by minimal soil profile development due to young age and slow soil formation. This type of soil may not provide an optimal environment for the growth of PGPR microorganisms. Consequently, beneficial bacteria such as *Pseudomonas*, *Serratia*, *Acetobacter*, *Azospirillum*, and *Bacillus* may not thrive effectively, limiting their ability to perform functions like phosphorus and potassium solubilization and nitrogen fixation. Additionally, Regosol soils typically have low water retention capacity due to their high sand content, which can lead to unfavorable conditions for both plant roots and microbial activity. This may further explain the lack of significant effects observed from PGPR application in this study. In summary, while PGPR has shown positive effects in other studies, its efficacy in this research was limited by the unsuitable soil conditions of Regosol, which hindered the growth and activity of beneficial microorganisms. The effect of PGPR application on the plant height and number of leaves every week shows on Figure 3 and 4.

CONCLUSIONS

Based on the analysis and discussion, it can be concluded that: The application of 100 g of blotong per seedling optimally promotes seedling height and leaf number. Blotong can effectively replace 3 g of NPK fertilizer per seedling in the pre-nursery phase Various concentrations of PGPR did not significantly affect any growth parameters of oil palm seedlings during the pre-nursery stage.

Additionally, combinations of blotong and PGPR at different dosages and concentrations did not show significant interactions affecting the observed seedling parameters during the pre-nursery stage. These findings suggest that blotong is a viable organic alternative to synthetic fertilizers for oil palm seedlings in the pre-nursery stage, while PGPR application did not yield significant benefits under the conditions tested.

REFERENCES

1. Asriana, S. (2018). Environmental Management Accounting *(EMA)* as a Form of Eco-Efficiency Implementation to Improve the Economic Performance of Manufacturing Companies. Journal of Chemical Information and Modeling, 53(9), 1689–1699.
2. Astuti, S. K. (2022). The Effect of Pistia stratiotes Compost and Palm Oil Empty Fruit Bunch Ash on the Growth and Yield of Shallot *(Allium ascalonicum)* on Peat Media.
3. Candraningtyas, C. F., & Indrawan, M. (2023). *A*nalysis of the Effectiveness of *Plant Growth-Promoting Rhizobacteria (PGPR)* Use for Enhancing Sustainable Agriculture. Agricultural and Environmental Policy Brief, 10(2), 88–99. https://doi.org/10.29244/jkebijakan.v10i2.48342
4. Ikaf Husnihuda, M., Sarwitri, R., & Eko Susilowati, Y. (2017). Growth and Yield Response of Cauliflower *(Brassica oleracea var. botrytis L.)* to the Application of Bamboo Root PGPR and Growing Media Composition. (Vol. 2, Issue 1).
5. Ogi, B. D., Astuti, Y. T. M., & Yuniasih, B. (2023). Growth Response of Palm Oil Seedlings in Pre-Nursery to Vermicompost Application with Various Irrigation Volumes. Jurnal Agroforetech, 1(1), 67–71.
6. Pohan, A. L. (2021). Analysis of Moisture Content, pH, Ca, and Mg in Vermicompost Based on Dairy Cow Manure with the Addition of Filter Mud.
7. Roy Zansen Pardede & Fathurrahman F. (2024). Effect of Eco-Farming Fertilizer and NPK Mutiara on the Growth of Palm Oil Seedlings in the Main Nursery on Peat Media. Agricultural Dynamics, 40(1), 13–28. https://doi.org/10.25299/dp.2024.vol40(1).18864
8. Setyawati, E. R., & Witjaksono, G. (2021). Growth Response of Oil Palm *(Elaeis guineensis* Jacq.*)* Seedlings in Pre-Nursery to Organic Matter Composition and Concentration of *Plant Growth-Promoting Rhizobacteria.* Journal Agroista, 5(2).

9. Sinnipar, G. (2019). Growth and Yield Response of Peanut *(Arachis hypogaea L.)* to the Application of Corn Stalk Compost and 'Skipsi' Fertilizer. Organic Farming, 2(1), 9–15.
10. Supari, T., & Budi, G. (2013). Analysis of the Chemical Composition of Organic Fertilizer from Sugarcane Filter Mud Waste from Trangkil Sugar Factory. Proceedings of the 6th SNST, 2015, pp. 10–13.