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THE EFFECT OF PGPR (PLANT GROWTH PROMOTING RHIZOBACTERIA) AND CHICKEN MANURE IN SUBSOIL ON THE GROWTH OF PALM OIL in MAIN NURSERY

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Abstract

The research was conducted at the Instiper Education and Research Farm (KP2) in Wedomartani Village, Sleman, Yogyakarta, from November 2024 to February 2025. A factorial experiment was applied using a Completely Randomized Design (CRD) with two factors. The first factor was chicken manure application on subsoil planting media, consisting of three levels (0, 100, and 150 g/polybag). The second factor was the PGPR alang-alang dose, consisting of four levels (0, 125, 150, and 175 ml/l). Data analysis was performed using ANOVA at a 5% significance level (α = 0.05), followed by a DMRT test if significant differences were observed. The findings indicated a significant interaction between PGPR 175 ml/l with 100 g of chicken manure and PGPR 150 ml/l with 150 g of chicken manure in increasing the number of leaves. The application of PGPR at 175 ml/l significantly enhanced stem diameter, crown fresh mass, root fresh mass, total plant fresh mass, crown dry mass, and total plant dry mass. Similarly, the application of 100 g of chicken manure significantly improved stem diameter, crown fresh mass, root fresh mass, total plant fresh mass, crown dry mass, and total plant dry mass.

Keywords: main nursery, PGPR, chicken manure, sub soil

INTISARI

Penelitian ini dilakukan di Kebun Pendidikan dan Penelitian (KP2) INSTIPER, yang terletak di Desa Wedomartani, Sleman, Yogyakarta, pada periode November 2024 hingga Februari 2025. Metode yang digunakan dalam penelitian ini adalah percobaan faktorial dengan Rancangan Acak Lengkap (RAL), terdiri dari dua faktor. Faktor pertama adalah penggunaan pupuk kotoran ayam pada media tanam subsoil dengan tiga variasi perlakuan (0, 100, dan 150 g/polybag). Faktor kedua adalah pemberian PGPR alang-alang dengan empat dosis berbeda (0, 125, 150, dan 175 ml/L). Data dianalisis dengan uji ANOVA pada tingkat signifikansi (α) 0,05. Jika ditemukan perbedaan yang signifikan, analisis dilanjutkan dengan uji DMRT pada taraf signifikansi yang sama. Hasil penelitian menunjukkan bahwa kombinasi PGPR 175 ml/L dengan pupuk kotoran ayam 100 g, serta PGPR 150 ml/L dengan pupuk kotoran ayam 150 g, memberikan dampak signifikan terhadap peningkatan jumlah daun. Selain itu, pemberian PGPR 175 ml/L secara nyata meningkatkan diameter batang, bobot segar tajuk, bobot segar akar, bobot segar tanaman, bobot kering tajuk, dan bobot kering tanaman. Sementara itu, penggunaan pupuk kotoran ayam 100 g terbukti berpengaruh signifikan terhadap peningkatan diameter batang, bobot segar tajuk, bobot segar akar, bobot segar tanaman, bobot kering tajuk, dan bobot kering tanaman.

Kata kunci : *main nursery*, PGPR, pupuk kotoran ayam, *sub soil*

Introduction

Indonesia has a plantation commodity with the ability to drive economic growth and provide considerable employment opportunities, namely the oil palm commodity. Increased expansion of oil palm cultivation requires the availability of high-quality seedlings that are adaptive to the environment and sustainable. The quantity of soil used for seedlings is also increasing and the soil that is widely used is topsoil because it contains organic matter. Therefore, the availability of topsoil for nurseries is decreasing and makes oil palm farmers or oil palm plantation companies look for other alternatives that can be used as a planting medium. Subsoil is not as fertile as topsoil, but subsoil can still be used as a growing medium by mixing additional organic matter so that it can be used as a growing medium (Rosniawaty et al., 2020).

Soil bacteria or so-called PGPR (Plant Growth Promoting Rhizobacteria) are around plant roots that can contribute directly or indirectly to plant growth and development (Jeyanthi & Kanimozhi, 2018) . Some soil bacteria contained in PGPR have the potential to increase plant yield and growth. Direct soil application of PGPR can increase atmospheric nitrogen fixation, phosphate solubility, and excretion of plant hormones such as indole acetic acid, gibberellins, cytokinins, and ethylene. This helps plants to adjust to stressful environmental conditions (Nugroho et al., 2022) . Sub-soil has a low level of fertility, so efforts are needed to increase fertility related to improving its physical, chemical, and biological properties, such as adding organic materials both solid and liquid (Rosniawaty et al., 2020). Solid organic materials that can be used as a mixture of media for planting, one example is chicken manure. According to (Laili & Anggreni, 2023) when compared to other poultry manure fertilizers, chicken compost has a higher nitrogen, phosphorus, and potassium content so that it can improve soil physical, chemical, and biological factors in plants. Subsoil has a low level of physical, chemical, and biological fertility compared to top soil so it is less suitable to be used

as a planting medium. The use of PGPR and chicken manure has the potential to improve the quality of subsoil by improving physical structure, increasing nutrient availability, and supporting the activity of soil microorganisms.

This research aims to evaluate the interaction between different doses of PGPR and chicken manure on the growth of oil palm seedlings in the main nursery using subsoil as the planting medium.

Materials and metodhs

This research was conducted at the Instiper Education and Research Farm (KP2) located in Wedomartani Village, Sleman, Yogyakarta. The research was conducted in November 2024 - February 2025. In this study using tools, namely polybags measuring 35x40 cm, hoes, sieves, pH meters, stationery, meters, labels, vectors, scales and paddles. For materials using oil palm seedlings of PPKS varieties aged 3 months, PGPR from reed grass, sub soil, chicken manure and water.

A 2-factor completely randomized design was the experimental method used in this study. Chicken manure on sub soil planting media as the first factor consisted of 3 levels (0, 100 and 150 g/polybag). The PGPR Alang-alang dose as the second factor consisted of 4 levels (0, 125, 150 and 175 ml/l). There were 12 treatment combinations produced with these factors, with 4 replicates for each treatment, so the total number of seedlings needed was 48 seedlings. The calculation of the results used ANOVA Statistical Analysis with a significant level (α) 0.05, where there was further testing with the DMRT test at a significant level (α) 0.05 if the ANOVA test results obtained significant differences.

Results and discussion

The variance analysis results revealed a significant interaction between the doses of PGPR and chicken manure on subsoil planting media, influencing the growth of oil palm seedlings in the main nursery, particularly in terms of leaf number. This finding suggests that both factors work synergistically to positively impact the increase in the number of leaves in oil palm seedlings within the main nursery.

Table 1. The effect of PGPR doses and chicken manure on the number of leaves of oil palm seedlings

PGPR (ml)	Chicken manure (g)			
	0	100	150	
0	7.50 cde	8.75 ab	8.25 bcd	
125	6.75 e	8.00 bcd	8.25 bcd	
150	7.25 de	8.00 bcd	9.50 a	
175	8.50 abc	9.50 a	8.50 abc	(+)

Description : Mean values followed by different letters in the columns and the same row indicate a significant difference based on the DMRT test at a 5% significance level.
(+) : There is a real interaction

Table 1 shows that there are two treatment combinations that are able to provide the best effect related to the growth of the number of leaves of oil palm seedlings, namely 100 g chicken manure with 175 ml PGPR and 150 g chicken manure with 150 ml PGPR. Meanwhile, the lowest effect was shown by the treatment combination of 0 g chicken manure with 125 ml PGPR. This is thought to be because the nutrients contained in PGPR and chicken manure are more focused on increasing the number of leaves than plant height and stem diameter. According to (Novian, 2023) chicken manure has a higher content of macro and micro nutrients than other types of organic fertilizers. Based on research (Tufaila et al., 2014) the nutrient content in chicken manure includes nitrogen (N) of 1.72%, phosphorus (P_2O_5) of 1.82%, potassium (K_2O) of 2.18%,. The use of this fertilizer can enhance the soil's physical characteristics, such as increasing the looseness of the soil structure and improving its drainage. Biologically, the amount of organic matter can rise the number of microorganisms in the soil, because organic matter in chicken manure compost serves as a source of nutrients for soil microorganisms, including some of which play a role in binding nitrogen (Budianto et al., 2015) , while chemically, this material helps the absorption of nutrients from chemical fertilizers, increases soil porosity, and increases soil water availability. In addition, organic materials are safe to use in large quantities because they do not pollute the environment. The effectiveness of using organic fertilizers can increase if the absorption process is supported by PGPR. Research (Cristin Lidia Tampinongkol, Zetly Tamod, 2021) shows that the number of leaves produced by plants is strongly influenced by the availability of nitrogen (N) nutrients in the soil. *Rhizobium*, *Azotobacter*, and *Azospirillum* are bacteria that are able to fix free nitrogen from the air, thus providing nitrogen for plants. In addition, the presence of these bacteria also contributes to improving the aggregate structure of the soil, which has an impact on increasing plant growth (Roni et al., 2025) .

The variance analysis results indicated that the application of chicken manure on subsoil planting media effectively promoted the growth of oil palm seedlings in the main nursery, particularly in terms of the number of leaves. The detailed analysis results are presented in Table 2.

Table 2. The effect of chicken manure dose on oil palm plant growth

Parameters	Chicken manure dosage		
	0 g	100 g	150 g
Number of Leaves (blade)	7.5	8.56	8.63
Stem Diameter Increase (cm)	1.55	1.77	1.68
Fresh Mass of Crown (g)	22.11	36.88	33.2
Root Fresh Mass (g)	14.73	18.65	15.72
Plant Fresh Mass (g)	36.84	55.54	48.92
Crown Dry Mass (g)	5.95	9.86	9.4
Root Dry Mass (g)	3.06	3.59	3.11
Plant Dry Mass (g)	9.01	13.45	12.52

Description : Means with different letters in the same row indicate a significant difference, as determined by the DMRT test at a 5% significance level.

Table 2 show that the treatment of chicken manure at a dose of 100 g showed the best results in all parameters, but not significantly different from the dose of 150 g on the parameter of stem diameter increase. The 150 g chicken manure also gave a good effect on the increase in the number of leaves, crown fresh mass, crown dry mass and plant dry mass. This is in line with the opinion of (Novian, 2023) which states that chicken manure has a higher content of macro and micro nutrients than other types of organic fertilizers. Based on research (Tufaila et al., 2014) the nutrient content in chicken manure includes nitrogen (N) of 1.72%, phosphorus (P_2O_5) of 1.82%, potassium (K_2O) of 2.18%. Using this fertilizer can enhance the soil's physical characteristics, such as increasing the looseness of the soil structure and improving its drainage. Chicken manure is able to supply macro and micro nutrients that can be directly absorbed by plants, this is thought to be because chicken manure contains N, P and K as well as micro elements to support plant growth even though it is mixed with subsoil. Chicken manure as an organic material has the ability to improve soil structure, thus supporting optimal growth (Wicaksono et al., 2016) .

The variance analysis results indicated that the application of PGPR fertilizer on subsoil planting media effectively enhanced the growth of oil palm seedlings in the main nursery, particularly in terms of leaf number. The detailed analysis results are presented in Table 3.

Table 3. The effect of PGPR dosage on oil palm plant growth

Parameters	Dose of reed PGPR			
	0 ml	125 ml	150 ml	175 ml
Number of Leaves (blade)	8.17	7.67	8.25	8.83
Stem Diameter (cm)	1.6	1.58	1.58	1.9
Fresh Mass of Crown (g)	30.35	26.36	26.67	39.54
Root Fresh Mass (g)	16.66	16.18	14.4	18.24
Plant Fresh Mass (g)	47	42.53	41.08	57.78
Crown Dry Mass (g)	8.61	7.43	6.94	10.64
Plant Dry Mass (g)	11.92	10.63	9.84	14.24

Description : Means with different letters in the same row indicate a significant difference, as determined by the DMRT test at a 5% significance level.

The results of the analysis in Table 3 show that PGPR treatment at a dose of 175 ml/l showed the best results in all parameters, but not significantly different from the doses of 0 ml/l and 125 ml/l in the parameter of root fresh mass, while at a dose of 150 ml/l gave low results on the growth of oil palm seedlings in the parameters of crown dry mass and plant dry mass. PGPR helps plant growth by helping bacteria colonizing the roots to produce growth hormones such as gibberellins, cytokinins, ethylene, and indole acetic acid (IAA). PGPR also increases nutrient availability by taking up nitrogen (N_2) from the air through symbiosis, dissolving phosphorus in the soil, and functioning as a biocontrol by producing metabolites that can deter soil pathogens (Sitawati et al., 2022) . PGPR can increase stem resistance by producing growth hormones such as gibberellins and cytokinins (Tan et al., 2015) . Cytokinin plays an important role in stimulating cell division, especially in meristematic tissues, which contributes to an increase in the number of cells in the plant, while gibberellin has the main function in accelerating cell elongation by increasing cell wall elasticity and supporting enzyme production for stem growth (Wicaksono et al., 2016) .

Conclusions

From the research findings and discussion above, the author can draw the following conclusions:

1. There is an interaction of PGPR and chicken manure on oil palm growth in the parameter of number of leaves.
2. Application of 175 ml/l PGPR can enhance the leaf count, stem diameter, as well as the fresh and dry mass of oil palm seedlings in the Main Nursery.
3. Application of 100 g of chicken manure significantly improved the leaf count, stem diameter, and both the fresh and dry mass of oil palm seedlings in the Main Nursery.

The results showed that not all plant growth parameters experienced a real interaction between PGPR and chicken manure. Therefore, the author suggests further research with more specific methods, such as variations in PGPR types, combinations with other organic fertilizers, or testing on different soil types.

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