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Solanum Melongena L. Reaction to Combining Doses of PGPR *Imperata Cylindrica* and Cow Manure: Growth and Yield

Daniela Hapsari Nareswari[1*], Elisabeth Nanik Kristalisasi[2], Fani Ardiani[3*]
[1,2,3]*Faculty of Agriculture, Institut Pertanian Stiper, Yogyakarta, Indonesia*

Corresponding email: fani@instiperjogja.ac.id

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Abstract
This study aims to examine the interaction between PGPR roots of *Imperata cylindrica* and cow manure on the growth and yield of *Solanum melongena* L., and to determine the optimal dose of both treatments. The study used a factorial Completely Randomized Design (CRD) with two factors: the dose of PGPR roots of *Imperata cylindrica* (0, 10, 30, 50 ml) and cow manure (0, 1, 2 kg), with five replications, the data were analyzed by ANOVA at a 5% level and further tested with DMRT at a 5% level. The results showed a significant interaction between PGPR roots of *Imperata cylindrica* and cow manure on plant height and number of leaves, with the best results being PGPR 30 ml and cow manure 2 kg. The dose of PGPR *Imperata cylindrica* roots of 30 ml can increase plant height, number of leaves, fruit weight, fresh root weight, and root length. However, the dose of PGPR *Imperata cylindrica* roots of 50 ml can reduce the percentage of fruit wilting. The dose of 2 kg of cow manure can increase plant height, number of leaves, number of fruits, fruit weight, fresh root weight, dry root weight, and root length of plants. This study concluded that PGPR *Imperata cylindrica* roots and cow manure or their combination affect the growth and production of *Solanum melongena* L. plants.

Keywords— Cow Manure; Increased Production; Organic Matter; PGPR *Imperata Cylindrica*, *Solanum Melongena*

Introduction

Solanum melongena L. is an important Solanaceae plant consumed worldwide (Mandal et al., 2025). *Solanum melongena* L., commonly known as eggplant, is a low-calorie vegetable with high nutritional value because it is rich in fiber, vitamins, minerals, and bioactive compounds, especially polyphenols, which provide antioxidant properties (Kellab et al., 2025). In 2023, the total eggplant production in Indonesia reached 699,896 tons, and its productivity increased from the previous year, which was 691,738 tons (BPS, 2024). The market has the potential to be one of the places to market fruit and vegetables. One effort to increase crop production is by adding organic matter. Organic fertilizers can increase crop productivity by improving soil fertility and nutrient content (Goda et al., 2025).

PGPR (Plant Growth Promoting Rhizobacteria) is a group of beneficial bacteria that can be found in plant roots (one of which is in the roots of *Imperata cylindrica*) which acts as an organic fertilizer, growth stimulant, and biocontrol of pathogens in the soil that are harmful to plants (Paulus et al., 2023; Sopialena et al., 2023). The *Imperata cylindrica* rhizosphere has the potential to be an antagonistic agent against plant pathogen attacks; this is one of the advantages of *Imperata cylindrica* PGPR (Hapsari, 2017). Research by Dahlan et al. (2021) showed that applying *Imperata cylindrica* root PGPR to mustard greens can help more intensive height

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growth. Organic fertilizers can also be decomposed entirely, including cow manure, which has a complex nutrient content. The use of cow manure can also support the use of livestock waste (Hendri et al., 2015). Cow manure has nutrients, including organic carbon (C-Organic), nitrogen (N), phosphorus (P), and potassium (K). Combining rhizobacteria isolated from *Imperata cylindrica* roots and cow manure can help eggplant growth by providing nutrients and improving soil structure. Cow manure also provides nutrients to microorganisms such as PGPR, so PGPR activity encourages plant growth. Research by Saputri et al. (2021) shows a good interaction between cow manure and PGPR in increasing eggplant plant growth and yield. In addition, rhizosphere research is increasingly important in applying knowledge to improve productivity and sustainable agricultural practices (Mandal et al., 2025).

Literature Review

Solanum melongena L. is a short-lived crop cultivated mostly in warm-weather tropical and subtropical regions worldwide (Abrham & Shumbulo, 2024). For optimal growth, yield, and fruit quality, annual rainfall of 1000–1500 mm and an altitude of 0–1600 meters above sea level are required (Maurya et al., 2014). *Solanum melongena* L. prefers fertile, well-drained soil with a pH of 5.5–6.8 and a high organic content (Chen et al., 2002). Nutrient management is an important component that influences the production of vegetable crops, including *Solanum melongena* L. (Abrham & Shumbulo, 2024). It is very responsive to fertilizer, and its deficiency will inhibit growth, quality, and low yields (Okeowo & Sanni, 2016). Plant Growth Promoting Rhizobacteria (PGPR) are soil bacteria that inhabit the rhizosphere of plants and can stimulate plant growth directly or indirectly through soil nutrient cycling, plant growth regulation, and biological control (Zhang et al., 2024). Furthermore, some PGPR strains secrete plant hormones such as indole acetic acid (IAA) to stimulate plant growth (Feng et al., 2023; Fu et al., 2023; Liu et al., 2024). Furthermore, it has been reported that PGPR application to plants can increase yield and quality (Devi et al., 2023; Neshat et al., 2023).

The PGPR roots of Imperata cylindrica, Bacilliaceae, Azotobacter, and Pseudomonas sp. bacteria were found to stimulate plant growth (Sopialena et al., 2023). Knežević et al.'s (2025) research highlights the potential of *Bacillus* as an effective solution for integrated pest management in cereal crops, such as its antifungal effect on *Fusarium poae* and its insecticidal effect on wireworms (*Agriotes lineatus* larvae) in barley. Ali et al. (2023) stated that *Azotobacter* can stimulate plant growth, increase nutrient mobilization in soil reconditioning, and improve nutrient accessibility. Furthermore, Silletti et al. (2021) also reported that *Azotobacter* can potentially promote plant growth in dry and N-deficient environments. Some *Pseudomonas* help in nutrient solubilization by fixing atmospheric nitrogen (Sanow et al., 2023; Wu et al., 2023), converting insoluble phosphate into soluble forms (Bakki et al., 2024; Dasila et al., 2023), increasing plant resistance to various pathogens (Dehbi et al., 2023; N. R. Wang et al., 2022), and producing hormones (indole-3-acetic acid (IAA) and cytokinin (CK)) (Orozco-Mosqueda et al., 2023). Organic fertilizers, both manure and compost, have many benefits, such as reducing the risk of groundwater pollution and environmental damage, improving soil quality, and increasing crop yields (Moghaddam et al., 2021; Shaji et al., 2021). Several studies have shown several benefits of using organic manure, such as increasing plant biomass in plants such as Japanese mint (*Mentha arvensis* L.) (Bajeli et al., 2016), dragonhead (*Dracocephalum moldavica*) (Fallah et al., 2018), and dill (*Anethum graveolens*) (Rostaei et al., 2018).

Research Method

This research was conducted at the Research and Education Estate of the Institut Pertanian Stiper, located in Depok District, Sleman Regency, 118 meters above sea level. The research was conducted from November 2024 to February 2025. The materials in this study were Yuvita F1

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eggplant seeds, planting media, PGPR *Imperata cylindrica* roots, cow manure, and 35 x 35 cm polybags. The tools used were digital scales, pH meters, and thermometers. The research design used a factorial design arranged in a Completely Randomized Design (CRD) consisting of 2 factors. The first factor is the dose of PGPR with four levels, namely 0, 10, 30, and 50 ml/plant for each application, which is given starting from when the plants are 7 days after planting (dap) until the plants are 84 days old, with a frequency of once every 7 days. The second factor is the dose of cow manure with three levels, namely 0, 1, and 2 kg/plant, which is mixed into the planting medium. From the two treatments above, 12 treatment combinations were obtained with five replications for 60 experimental units.

The research observation parameters were plant height, number of leaves, number of fruits per plant, fruit length, total fruit weight per plant, fresh root weight, dry root weight, root length, and fruit wilting level. Data were analyzed using analysis of variance (ANOVA) at a significance level of 5%; if there was a significant difference, a further Duncan Multiple Range Test (DMRT) was carried out with a significance level of 5%.

Results and Discussion

Based on the results of the analysis, there was a significant interaction between the administration of PGPR of *Imperata cylindrica* roots and cow manure on the height and number of plant leaves. However, both applications separately had a significant effect on plant growth and production. Various doses of PGPR significantly affected root length, fresh root weight, total fruit weight per plant, and eggplant fruit wilting. Meanwhile, various doses of manure significantly affected the parameters of the number of fruits per plant, fruit weight, fresh root weight, dry root weight, and root length. The results of the analysis are presented in Tables 1-3.

Table 1. Effect of PGPR and cow manure doses on plant height (cm) and number of leaves (strands)

Treatment	Plant height	Number of leaves
0 ml PGPR + 0 kg cow manure	17.60 g	5.60 g
0 ml PGPR + 1 kg cow manure	48.60 e	18.40 f
0 ml PGPR + 2 kg cow manure	65.80 b	22.20 cd
10 ml PGPR + 0 kg cow manure	22.30 f	7.00 g
10 ml PGPR + 1 kg cow manure	59.60 c	19.40 ef
10 ml PGPR + 2 kg cow manure	67.40 ab	24.00 bc
30 ml PGPR + 0 kg cow manure	22.60 f	5.80 g
30 ml PGPR + 1 kg cow manure	68.60 ab	24.80 ab
30 ml PGPR + 2 kg cow manure	70.20 a	26.20 a
50 ml PGPR + 0 kg cow manure	19.30 g	5.60 g
50 ml PGPR + 1 kg cow manure	55.40 d	19.60 ef
50 ml PGPR + 2 kg cow manure	66.40 b	20.60 de

Information: The average number followed by the same letter in the same column shows a significant difference based on the DMRT test at a significance level of 5%.

Table 1 shows that the combination of a PGPR dose of 30 ml with 2 kg of cow manure has the highest impact on plant height and number of leaves. This result is significantly different from other combinations. In this dose combination, the availability of N and P elements shows the highest figures compared to other combinations, namely N 25 mg/kg and P 105 mg/kg (Table 4). Research by Jannah et al. (2022) shows that PGPR can support plant growth through its mechanism of N (nitrogen) fixation. Azotobacter sp is one of the microbes that live in the PGPR of cogongrass roots (Sopialena et al., 2023). Azotobacter sp that lives in the PGPR of cogongrass helps plants in N fixation, an important element in plant vegetative growth (Marfuah & Majid,

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2017).

Purple eggplant plants require P for several purposes, including increasing leaf count (Adawiyah et al., 2024). Cow manure can provide P availability, and its bound P content can be efficiently improved by administering PGPR from *Imperata cylindrica* roots (K. W. Sari & Attahira, 2022). Hapsari's (2017) research found several microbial isolates in *Imperata cylindrica* roots that act as P solvents, including *Bacillus* sp., *Pseudomonas* sp., and Azotobacter sp. Utilization of PGPR is an alternative technology that can increase agricultural production and is safer because the bacteria that live in the plant's root area can stimulate plant growth and reduce the intensity of Phytophthora fungal attacks (Roeswitawati et al., 2024; Utami & Ambarwati, 2017). *Bacillus* and *Pseudomonas* also facilitate the absorption of essential nutrients such as nitrogen (N) and phosphorus (P), which support plant growth (Y. Wang et al., 2024).

Separately, the administration of various doses of PGPR had a significant effect on several observation parameters. The results of the analysis are presented in Table 2.

Table 2. Plant response to various doses of PGPR *Imperata cylindrica*

Parameter	doses of PGPR (ml)			
	0	10	30	50
Root length (cm)	35.56 qr	37.29 pq	41.84 p	32.11 r
Root fresh weight (g)	24.51 q	23.95 q	30.62 p	27.22 pq
Fruit weight (g)	371.00 q	404.00 pq	436.90 p	364.40 q
Fruit wilting rate (%)	16.70 q	15.70 pq	16.70 q	13.60 p

Information: The average number followed by the same letter in the same line shows a significant difference based on the DMRT test at a significance level of 5%.

Table 2 shows that applying PGPR from *Imperata cylindrica* roots significantly affected root length, root fresh weight, total fruit weight per plant, and fruit wilting. A dose of 30 ml of PGPR from *Imperata cylindrica* roots produced the best results for root length, root fresh weight, and fruit weight. However, administering PGPR *Imperata cylindrica* roots at a dose of 50 ml resulted in the lowest percentage of fruit wilting. This is in line with the research of Wilujeng et al. (2022), which showed a significant effect of PGPR administration on the increase in root length of eucalyptus seedlings. The fresh weight of the roots increased significantly with the administration of PGPR from *Imperata cylindrica* roots. This indicates that PGPR increases root growth. Research by Wardana et al. (2024) concluded that the administration of PGPR significantly affected the growth of bangle roots compared to no treatment. Larger and healthier roots reflect better absorption of water and nutrients, which ultimately supports overall plant growth. This is related to higher fruit weight, indicating that the plant can absorb nutrients optimally. Research by Fiqa et al. (2021) also showed a significant effect of 30 ml of PGPR on tomato fruit weight.

However, 50 ml of *Imperata cylindrica* root PGPR resulted in the lowest percentage of fruit wilting. The lower the percentage of wilting, the better the storage life of eggplant, thus extending its shelf life (Paath et al., 2017). Higher doses of *Imperata cylindrica* root PGPR, such as 50 ml/L, can increase plant resistance to pathogens. Azotobacter sp bacteria exist in *Imperata cylindrica* root PGPR (Hindersah et al., 2018). Azotobacter sp bacteria can produce secondary metabolites and antimicrobials that fight phytopathogenic bacteria and fungi that cause disease in plants by increasing the activity of defense enzymes (Kaya et al., 2020).

Research by Wang et al. (2024) *Bacillus* sp and *Pseudomonas* sp bacteria in PGPR play an important role in increasing plant resistance through the production of lipopeptides and phenazines, which can trigger the induction of systemic resistance (ISR) in plants, increasing resistance to abiotic stresses such as drought or salinity, which ultimately contributes to the quality

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and quantity of fruit yields. Conversely, lower doses, such as 30 ml/L, may support vegetative growth and root development more effectively. PGPR also contributes to phytoremediation, namely the restoration of soil contaminated by heavy metals or other hazardous chemicals (Igiehon et al., 2024). Fruit that lasts longer after harvest indicates better quality and less decay, thereby increasing the economic value of the harvest.

Table 3. The effect of cow manure application on the growth of eggplant plants

Parameter	doses of cow manure (kg)		
	0	10	30
Number of Fruits (fruit)	-	3,10 b	3,35 a
Fruit Weight (g)	-	375,55 b	412,60 a
Root Fresh Weight (g)	3,58 c	30,61 b	45,53 a
Root Dry Weight (g)	1,08 c	8,03 b	10,73 a
Root Length (g)	20,00 b	43,21 a	46,83 a

Information: The average number followed by the same letter in the same line shows a significant difference based on the DMRT test at a significance level of 5%.

Table 3 shows that the application of cow manure significantly affected the number of fruits, total fruit weight per plant, fresh root weight, dry root weight, and root length. A 2 kg/plant fertilizer dose produced the best results for these parameters. The N and P content of the soil at a dose of 2 kg of cow manure had the highest figures, namely 44 mg/kg and 149 mg/kg (Table 4). Environmental factors and nutrient availability can also contribute to fruit development, especially the number and weight of fruit (Fiqa et al., 2021).

Research by D. E. Sari & Sudiarso (2022) showed that manure can potentially increase the weight of fruit plants produced. The application of 2 kg of cow manure also significantly affected the fresh weight of plant roots (Mukti et al., 2024) and the dry weight of purple eggplant plants (Seftianingsih et al., 2023). Plant roots with a high dry weight indicate good water absorption; plants with a higher root dry weight indicate plants that are resistant to drought (Torey et al., 2015).

Table 4. N and P content before and after treatment with PGPR

Treatment PGPR + cow manure (kg)	Test value (mg/kg)			
	Before		After	
	N	P	N	P
1 : 0	0	0	0	0
1 : 1	36	130	0	44
1 : 2	44	149	2	52
2 : 0	0	0	0	0
2 : 1	36	130	22	97
2 : 2	44	149	25	105
3 : 0	0	0	0	0
3 : 1	36	130	0	44
3 : 2	44	149	18	88

Table 4 shows the N and P content before and after the study. Before the study, N and P measurements were performed on three treatment samples: without PGPR and cow manure, without PGPR + 1 kg of cow manure, and PGPR + 2 kg of cow manure. The results showed that the 2 kg dose had the highest soil N and P content, at 44 mg/kg N and 149 mg/kg P. The results showed that the synergy between PGPR and cow manure can increase the availability and efficiency of plants' nutrient uptake. *Bacillus* and *Pseudomonas* also facilitate the absorption of essential nutrients such as nitrogen (N) and phosphorus (P), which support plant growth (Wang

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et al., 2024). Overall, the combination of 30 ml of PGPR from *Imperata cylindrica* roots and 2 kg of cow manure produced good results for the growth and yield of purple eggplant plants. PGPR is a solution for environmental improvement through the potential use of bacteria as biofertilizers for sustainable agriculture (Gogoi et al., 2025).

Conclusion

This study concluded that there was a significant interaction between PGPR of *Imperata cylindrica* roots and cow manure on plant height and number of leaves of purple eggplant plants, with the best combination being 30 ml ml and 2 kg of cow manure. A dose of PGPR of *Imperata cylindrica* roots of 30 ml can increase plant height, number of leaves, fruit weight, fresh weight of roots, root length, while PGPR of *Imperata cylindrica* roots of 50 ml can reduce the percentage of wilting of purple eggplant fruit. In addition, 2 kg of cow manure can increase plant height, number of leaves, number of fruits, fruit weight, fresh weight of roots, dry weight of roots, and root length of purple eggplant plants. The use of PGPR *Imperata cylindrica* root and cow manure in *Solanum melongena* L. cultivation is one of the efforts to increase production and support sustainable agriculture.

References

Abrham, Y., & Shumbulo, A. (2024). Growth, yield and quality response of Eggplant (Solanum melongena L.) to blended NPSB fertilizer rates and intra-row spacing in Boloso Bombe district, Wolaita zone, South Ethiopia. *Heliyon*, *10*(15), e35671. https://doi.org/10.1016/j.heliyon.2024.e35671

Adawiyah, R., Mamma, S., & Arma, J. (2024). Pertumbuhan Tanaman Terung Ungu (Solanum Melongena L .) Pada Berbagai Dosis Pupuk Organik Cair (Poc) Berbahan Dasar Air Cucian Beras. *JURNAL AGROTEKNOS*, *14*(2). https://doi.org/https://ojs.uho.ac.id/index.php/agroteknos

Ali, F., Siddiqui, Z. S., Ansari, H. H., Zafar, U., Wajid, D., Abbasi, M. W., & Rao, Y. (2023). Halophilic soil microbial strains improve the moisture stress tolerance in oilseed crop by sustaining Photosystem II functionality. *Plant Physiology and Biochemistry*, *196*, 10–22. https://doi.org/10.1016/J.PLAPHY.2023.01.036

Bajeli, J., Tripathi, S., Kumar, A., Tripathi, A., & Upadhyay, R. K. (2016). Organic manures a convincing source for quality production of Japanese mint (Mentha arvensis L.). *Industrial Crops and Products*, *83*, 603–606. https://doi.org/10.1016/J.INDCROP.2015.12.064

Bakki, M., Banane, B., Marhane, O., Esmaeel, Q., Hatimi, A., Barka, E. A., Azim, K., & Bouizgarne, B. (2024). Phosphate solubilizing Pseudomonas and Bacillus combined with rock phosphates promoting tomato growth and reducing bacterial canker disease. *Frontiers in Microbiology*, *15*(May). https://doi.org/10.3389/fmicb.2024.1289466

BPS. (2024). *Produksi Tanaman Terung Indonesia*.

Chen, N. C., Kalb, T., Talekar, N. S., Wang, J. F., & Ma, C. H. (2002). Suggested Cultural Practices Guide for Eggplant. In *Asian Vegetable Research and Development Center* (pp. 1–8). https://avrdc.org/wpfb-file/culti_practices-pdf-2/

Dahlan, Aimanah, U., & Lipebri. (2021). Respons Tanaman Sawi (Brassica Juncea L.) Terhadap Pemberian Plant Growth Promoting Rhizobacteria (Pgpr) Akar Alang-Alang. *Jurnal Agrisistem*, *17*(2), 87–89. https://doi.org/10.52625/j-agr.v17i2.207

Dasila, H., Sah, V. K., Jaggi, V., Kumar, A., Tewari, L., Taj, G., Chaturvedi, S., Perveen, K.,

Journal of Agriculture (JoA)
Volume: 4 | Number 02 | July 2025
E-ISSN: 2829-2421
https://doi.org/10.47709/joa.v4i02.6663

Bukhari, N. A., Siang, T. C., & Sahgal, M. (2023). Cold-tolerant phosphate-solubilizing Pseudomonas strains promote wheat growth and yield by improving soil phosphorous (P) nutrition status. *Frontiers in Microbiology*, *14*. https://doi.org/10.3389/fmicb.2023.1135693

Dehbi, I., Achemrk, O., Ezzouggari, R., El Jarroudi, M., Mokrini, F., Legrifi, I., Belabess, Z., Laasli, S. E., Mazouz, H., & Lahlali, R. (2023). Beneficial Microorganisms as Bioprotectants against Foliar Diseases of Cereals: A Review. *Plants*, *12*(24). https://doi.org/10.3390/plants12244162

Devi, B., Tiwari, M., Yadav, N., & Singh, P. (2023). Intergenerational immune priming: Harnessing plant growth promoting rhizobacteria (PGPR) for augmented wheat protection against spot blotch. *Physiological and Molecular Plant Pathology*, *128*, 102164. https://doi.org/10.1016/J.PMPP.2023.102164

Fallah, S., Rostaei, M., Lorigooini, Z., & Abbasi Surki, A. (2018). Chemical compositions of essential oil and antioxidant activity of dragonhead (Dracocephalum moldavica) in sole crop and dragonhead- soybean (Glycine max) intercropping system under organic manure and chemical fertilizers. *Industrial Crops and Products*, *115*, 158–165. https://doi.org/10.1016/J.INDCROP.2018.02.003

Feng, J., Chen, L., Xia, T., Ruan, Y., Sun, X., Wu, T., Zhong, Y., Shao, X., & Tang, Z. (2023). Microbial fertilizer regulates C:N:P stoichiometry and alleviates phosphorus limitation in flue-cured tobacco planting soil. *Scientific Reports*, *13*(1). https://doi.org/10.1038/S41598-023-37438-W

Fiqa, A. P., Nursafitri, T. H., Fuziah, & Masudah, S. (2021). Pengaruh Faktor Lingkungan Terhadap Pertumbuhan Beberapa Aksesi Dioscorea Alata L. Terpilih Koleksi Kebun Raya Purwodadi. *Agro*, *8*(1), 25–39.

Fu, C., Ma, W., Qiang, B., Jin, X., Zhang, Y., & Wang, M. (2023). Effect of Chemical Fertilizer with Compound Microbial Fertilizer on Soil Physical Properties and Soybean Yield. *Agronomy 2023, Vol. 13, Page 2488*, *13*(10), 2488. https://doi.org/10.3390/AGRONOMY13102488

Goda, D. A., El-Gamal, E. H., Rashad, M., & Abdel-Fattah, Y. R. (2025). The optimization of calcareous soil cation exchange capacity via the feather hydrolysate and N-P fertilizers integration. *Scientific Reports*, *15*(1), 1–13. https://doi.org/10.1038/s41598-025-86941-9

Gogoi, B., Islam, N. F., & Sarma, H. (2025). Biodegradation of nitro-PAHs by multi-trait PGPR strains isolated directly from rhizosphere soil. *The Microbe*, *6*(February), 100263. https://doi.org/10.1016/j.microb.2025.100263

Hapsari, F. (2017). *Eksplorasi PGPR Dari Rizosfer Alang-Alang Di Taman Nasional Bromo Tengger Semeru Serta Potensinya Sebagai Agens Antagonis Terhadap Xanthomonas oryzae pv. oryzae*.

Hendri, M., Napitupulu, M., & Sujalu, A. P. (2015). *Pengaruh Pupuk Kandang Sapi dan Pupuk NPK Mutiara Terhadap Pertumbuhan dan Hasil Tanaman Terung Ungu (Solanum melongena L.)*. *2*. https://doi.org/https://doi.org/10.31293/af.v14i2.1429

Jannah, M., Jannah, R., & Fahrunsyah. (2022). Kajian Literatur : Penggunaan Plant Growth Promoting Rhizobacteria (PGPR) untuk Meningkatkan Pertumbuhan dan Mengurangi Pemakaian Pupuk Anorganik pada Tanaman Pertanian. *Jurnal Agroekoteknologi Tropika Lembab*, *5*(1), 41–49. https://e-journals.unmul.ac.id/index.php/agro/article/view/7940

Kellab, R., Boulkenafet, F., Amokrane, S., Benmakhlouf, Z., Bensouici, C., Bounamous, A., Yahia, A., Lambiase, S., Al-Meklafi, F. A., & Wadaan, M. A. (2025). Chemical Profiling and in vitro Evaluation of the Antioxidant, Anti-inflammatory, and Anti-bacterial Effects of Algerian Solanum melongena L. *Indian Journal of Pharmaceutical Education and Research*, *59*(1), 338–350. https://doi.org/10.5530/ijper.20250132

Knežević, M., Dervišević, M., Jovković, M., Jevđenović, G., Maksimović, J., & Buntić, A. (2025). Versatile role of Bacillus velezensis: Biocontrol of Fusarium poae and wireworms and barley plant growth promotion. *Biological Control*, *206*, 105789. https://doi.org/10.1016/J.BIOCONTROL.2025.105789

Liu, J., Li, H., Yuan, Z., Feng, J., Chen, S., Sun, G., Wei, Z., & Hu, T. (2024). Effects of microbial fertilizer and irrigation amount on growth, physiology and water use efficiency of tomato in greenhouse. *Scientia Horticulturae*, *323*, 112553. https://doi.org/10.1016/J.SCIENTA.2023.112553

Mandal, M., Ghosh, B., & Mandal, S. (2025). Comparison of the rhizospheric soil bacteriomes of Oryza sativa and Solanum melongena crop cultivars reveals key genes and pathways involved in biosynthesis of ectoine, lysine, and catechol meta-cleavage. *Functional & Integrative Genomics*, *25*(20). https://doi.org/10.1007/s10142-025-01536-x

Marfuah, C., & Majid, F. A. (2017). Uji kemampuan beberapa jenis Natural Plant Growth Promoting Rhizobacteria (PGPR) terhadap pertumbuhan dan hasil tanaman kangkung di Kecamatan Wanasaba Kabupaten Lombok Timur. *Prosiding Seminar Nasional Dan Internasional*, *1*(1), 1–9.

Maurya, R. P., Skeete, L., & Chandler, J. S. A. (2014). Effect of Organic and Inorganic Fertilizers on Growth, Yield and Fruit Quality of Eggplant (Solanum melongena L.). *2014 ASHS Annual Conference*.

Moghaddam, H. K., Banihabib, M. E., Javadi, S., & Randhir, T. O. (2021). A framework for the assessment of qualitative and quantitative sustainable development of groundwater system. *Sustainable Development*, *29*(6), 1096–1110. https://doi.org/10.1002/SD.2205;REQUESTEDJOURNAL:JOURNAL:10991719;CTYPE:STRING:JOURNAL

Mukti, R. P., Setyawati, E. R., Nugraha, T., Santosa, B., Agroteknologi, P. S., Pertanian, F., & Yogyakarta, I. (2024). Pengaruh Dosis Pupuk Kandang Sapi dan Macam Pupuk P terhadap Pertumbuhan Bibit Kelapa Sawit (Elaeis guineensis Jacq .) di Main Nursery. *Agroforetech*, *2*(September), 1229–1234.

Neshat, M., Chavan, D. D., Shirmohammadi, E., Pourbabaee, A. A., Zamani, F., & Torkaman, Z. (2023). Canola inoculation with Pseudomonas baetica R27N3 under salt stress condition improved antioxidant defense and increased expression of salt resistance elements. *Industrial Crops and Products*, *206*, 117648. https://doi.org/10.1016/J.INDCROP.2023.117648

Okeowo, T., & Sanni, K. O. (2016). Growth, Yield Performance And Cost Benefit Of Eggplant (Solanum Melogena) Production Using Goat And Pig Manure In Ikorodu Lagos. *Internasional Journal of Scientific Research and Engineering Studies (IJSRES)*, *3*(4), 22–26. https://www.researchgate.net/publication/303848788

Orozco-Mosqueda, M. del C., Santoyo, G., & Glick, B. R. (2023). Recent Advances in the

Bacterial Phytohormone Modulation of Plant Growth. *Plants*, *12*(3). https://doi.org/10.3390/plants12030606

Paath, V. V., Wenur, F., & Longdong, I. (2017). Kajian Pengemasan Terhadap Mutu Terung ungu (Solanum melongena L) Selama Penyimpanan. *Thesis*, *1*, 1–8.

Paulus, J. M., Najoan, J., & Supit, P. C. H. (2023). Application of PGPR (plant growth promoting Rhizobacteria) to stimulate growth and improve productivity of rice on organic based. *The 2nd International Conference on Natural Sciences, Mathematics, Applications, Research, and Technology (ICON-SMART 2021): Materials Science and Bioinformatics for Medical, Food, and Marine Industries*, 2694 (050007). https://doi.org/10.1063/5.0137159

Roeswitawati, D., Sutarman, S., & Indratmi, D. (2024). Imperata cylindrica root as PGPR pressing the pathogen phytophthora infestant the cause of wilt disease in potato plant (Solanum tuberosum L.). *BIO Web of Conferences*, *143*. https://doi.org/10.1051/bioconf/202414301022

Rostaei, M., Fallah, S., Lorigooini, Z., & Abbasi Surki, A. (2018). The effect of organic manure and chemical fertilizer on essential oil, chemical compositions and antioxidant activity of dill (Anethum graveolens) in sole and intercropped with soybean (Glycine max). *Journal of Cleaner Production*, *199*, 18–26. https://doi.org/10.1016/J.JCLEPRO.2018.07.141

Sanow, S., Kuang, W., Schaaf, G., Huesgen, P., Schurr, U., Roessner, U., Watt, M., & Arsova, B. (2023). Molecular Mechanisms of Pseudomonas-Assisted Plant Nitrogen Uptake: Opportunities for Modern Agriculture. *Molecular Plant-Microbe Interactions*, *36*(9), 536–548. https://doi.org/10.1094/MPMI-10-22-0223-CR/ASSET/IMAGES/LARGE/MPMI-10-22-0223-CRT2-1697258862473.JPEG

Saputri, A. E., Djarwatiningsih, & Guniarti. (2021). Pengaruh Pemberian PGPR dan Pupuk Kandang Sapi Terhadap Pertumbuhan dan Hasil Tanaman Terong Ungu (Solanum melongena L.). *Seminar Nasional Agroteknologi FP-UPNVJT*, *2022*, 40–48. https://doi.org/http://dx.doi.org/10.11594/nstp.2022.2006

Sari, D. E., & Sudiarso. (2022). Pengaruh Aplikasi Pupuk Kandang Sapi dan PGPR (Plant Growth Promoting Rhizobacteria) pada Pertumbuhan dan Hasil Tanaman Tomat (Solanum lycopersicum L .) Effect of Cow Manure Application and PGPR (Plant Growth Promoting Rhizobacteria) on Growth and Yi. *Produksi Tanaman*, *10*(12), 709–716.

Sari, K. W., & Attahira, S. S. (2022). Pengaruh Pemberian Plant Growth Promoting Rhizobacteria (Pgpr) Asal Akar Tanaman Bambu Terhadap Pertumbuhan Kecambah Padi. *Ecosolum*, *11*, 29–37. https://doi.org/10.20956/ecosolum.V11i1.21144

Seftianingsih, L., Suheri, H., & Nihla, F. (2023). *Pengaruh Sistem Bedengan dan Dosis Pupuk Kandang Sapi Terhadap Pertumbuhan dan Hasil Tanaman Terung Ungu Panjang (Solanum melongena L.)*.

Shaji, H., Chandran, V., & Mathew, L. (2021). Organic fertilizers as a route to controlled release of nutrients. *Controlled Release Fertilizers for Sustainable Agriculture*, 231–245. https://doi.org/10.1016/B978-0-12-819555-0.00013-3

Silletti, S., Di Stasio, E., van Oosten, M. J., Ventorino, V., Pepe, O., Napolitano, M., Marra, R., Woo, S. L., Cirillo, V., & Maggio, A. (2021). Biostimulant Activity of Azotobacter chroococcum and Trichoderma harzianum in Durum Wheat under Water and Nitrogen Deficiency. *Agronomy 2021, Vol. 11, Page 380*, *11*(2), 380.

https://doi.org/10.3390/AGRONOMY11020380

Sopialena, Sila, S., Sofian, & S, J. (2023). Mikrobia Pada Plant Growth Promoting Rhizobakteri Bambu, Alang-Alang dan Pisang. *Agrifor*, *22*(1), 55. https://doi.org/10.31293/agrifor.v22i1.6357

Utami, D. W., & Ambarwati, D. (2017). Genotype and Phenotype Characterization of Indonesian Phytophthora infestans Isolates Collected From Java and Outside Java Island. *HAYATI Journal of Biosciences*, *24*(4), 168–175. https://doi.org/10.1016/j.hjb.2017.10.002

Wang, N. R., Wiesmann, C. L., Melnyk, R. A., Hossain, S. S., Chi, M.-H., Martens, K., Craven, K., & Haney, C. H. (2022). Commensal Pseudomonas fl uorescens Strains Protect Arabidopsis from Closely Related Pseudomonas Pathogens in a. *MBio*, *13*(January), e02892-21. https://doi.org/10.1128/mbio.02892-21

Wang, Y., Pei, Y., Wang, X., Dai, X., & Zhu, M. (2024). Antimicrobial metabolites produced by the plant growth-promoting rhizobacteria (PGPR): Bacillus and Pseudomonas. *Advanced Agrochem*, *3*(3), 206–221. https://doi.org/10.1016/j.aac.2024.07.007

Wardana, S. T., Mangandi, W. F., & Setiawan, D. (2024). Respons Pertumbuhan Rimpang Bangle (Zingiber purpureum) Pada Perlakuan PGPR (Plant Growth Promoting Rhizobacteria). *Ilmiah Biologi*, *12*(2), 2449–2455.

Wilujeng, S., Wangi, M., Darlina, I., & Solihat, R. F. (2022). Efektifitas PGPR (Plant Growth Promoting Rhizobacteria) terhadap Pertumbuhan Anakan Kayu Putih (Malaleuca cajuputi Powell). *IEEJ Transactions on Power and Energy*, *142*(12), NL12_1-NL12_1. https://doi.org/10.1541/ieejpes.142.nl12_1

Wu, X., Wang, X., Meng, H., Zhang, J., Lead, J. R., & Hong, J. (2023). Pseudomonas fluorescens with Nitrogen-Fixing Function Facilitates Nitrogen Recovery in Reclaimed Coal Mining Soils. *Microorganisms 2024, Vol. 12, Page 9*, *12*(1), 9. https://doi.org/10.3390/MICROORGANISMS12010009

Zhang, T., Jian, Q., Yao, X., Guan, L., Li, L., Liu, F., Zhang, C., Li, D., Tang, H., & Lu, L. (2024). Plant growth-promoting rhizobacteria (PGPR) improve the growth and quality of several crops. *Heliyon*, *10*(10), e31553. https://doi.org/10.1016/J.HELIYON.2024.E31553