IIAJ INTERNATIONAL INTEGRATED AGRICULTURAL JOURNAL
Volume 01 Number 02
November 2025
p-ISSN: 0000-0000
e-ISSN: 0000-0000

Response of growth and production of cowpea (*Vigna unguiculata* L.) to the application of several concentrations of bamboo root of *Plant Growth Promoting Rhizobacteria* (PGPR)

Nisa Wardatul Khusnah[1], Andarula Galushasti[1], Rr. Liliek Dwi Soelaksini[1], Jumiatun[1]

[1] *Food Crop Production Technology, Department of Agricultural Technology, State Polytechnic of Jember, Indonesia*

Correspondence should be addressed to:
Nisa Wardatul Khusnah
nisawardatul4@gmail.com

Abstract:
Cowpea is one of the food crops that has a fairly high protein content, but the production of cowpea is still relatively small. The cultivation technology applied is still not right, so that cowpea production does not increase. This study aims to determine the effect of applying several PGPR concentrations on the growth and production of cowpea. This study was conducted on the land of the Jember State Polytechnic from July 2024 to October 2024. This study used a Non-Factorial Randomized Block Design (RBD) with 6 treatments and 4 replications. Observation data was analysed statistically using Analysis of Variance (ANOVA). The treatments were PGPR concentrations of 0 ml/L, 18 ml/L, 29 ml/L, 40 ml/L, and 51 ml/L. The results showed that PGPR treatment with a concentration of 51 ml/L showed a difference in plant height, dry seed weight per plant, and 100 seed weight per plot. This is thought to be due to the role of PGPR as a biofertilizer and bio stimulant. Thus, PGPR can provide nutrition and produce growth hormone. This will have an impact on fulfilled the nutritional needs of cowpea, thus affecting the growth and production of cowpea.

Article info:
Submitted:
02-07-2025
Revised:
03-11-2025
Accepted:
06-11-2025

Keywords:
bamboo root PGPR, biofertilizer, bio stimulant, cowpea

INTRODUCTION

The demand for food in Indonesia is increasing, along with the growing awareness of the community regarding the nutritional value of food sourced from plant-based protein. Legumes serve as a rich source of protein, fat, and carbohydrates (Wulandari et al., 2020). Especially soybeans, which are used to produce one of the basic domestic necessities. However, soybeans are still not able to meet the food needs of the Indonesian people. Therefore, there is a need for efforts to optimize the potential of local legumes. Which has high productivity and nutritional value, similar to soybeans, is the cowpea. Cowpea is a local legume that is abundant and can be a source of protein. The protein content of winged beans is 22.90% (Ismayanti and Harijono, 2015).

However, the production of cowpea in Indonesia is still quite low due to the inappropriate cultivation technology, specifically inadequate fertilization. Plant Growth Promoting Rhizobacteria (PGPR) is a group of beneficial bacteria that offer several advantages, including providing essential nutrients, producing growth hormones, and enhancing soil fertility (Setyawan et al., 2022). Based on the description, PGPR can be a solution for cowpea cultivation technology.

Volume 01 Number 02
November 2025
p-ISSN: 0000-0000
e-ISSN: 0000-0000

METHOD

The study took place in Jember State Polytechnic, Sumbersari District, from July 2024 to October 2024. Jember Regency, East Java Province, at the coordinates 8°15'75.76" South latitude and 113°72'38.15" East longitude. With an elevation of 89 meters above sea level and a soil pH of 6.3. The humidity is around 58%, with an average annual rainfall of 206 mm, and the average temperature range is 23 °C to 33 °C.

The tools used in this research include scales, banners, a camera, a hoe, a sickle, a chisel, a dibble, a kenco, a bucket, a watering can, a treatment nameplate, a measuring cup, a tape measure, plastic, and stationery. The materials used in this study include cowpea seeds. Albina IPB variety, cow manure, PGPR from bamboo roots, urea fertilizer, SP-36 fertilizer, KCL fertilizer, and demolish insecticide with a concentration of 2 ml/L and Avidor with a dose of 1 gram/L.

The research design used is a Randomized Block Design. Using a 1-factor (non-factorial) design, the factor used is PGPR concentration with 6 treatment levels (Zamzami, 2023), as follows: 0 mL/L (control), 7 mL/L, 18 mL/L, 29 mL/L, 40 mL/L, and 51 mL/L. There are 6 treatment levels, and each is repeated 4 times, resulting in 24 research units.

The method of implementing this research involves the development of PGPR bacteria, land preparation, and planting, which is done by hoeing to a depth of 3 cm with a planting distance of 40 cm x 20 cm (Gustiani and Widaryanto, 2019). In each planting hole, put 2 seeds of the Albina IPB variety cowpea, and then apply carbofuran to protect the seeds from pests and diseases. The application of PGPR to plants is done at 14 HST, 28 HST, 42 HST, and 52 HST (Pramata, 2019).

The stages of maintenance for cowpea are replanting, thinning, irrigation, fertilization, staking, weeding, hilling, and pest and disease control. Harvesting is done when the cowpeas are 58-69 days after planting. Characteristics of the cowpea that indicate it is ready for harvest are when 85-90% of the pods are dry or have started to turn dark brown.

Observation variables are plant height, stem diameter, dry pod weight per sample, dry seed weight per plant, and weight of 100 seeds per plot. This research uses a Randomized Block Design (RBD) for the data results. Observations are statistically analyzed using the Analysis of Variance (ANOVA) method. In this study, the Least Significant Difference (LSD) test was used. If the treatment shows a significant difference, then a test will be conducted. Continue with the 5% LSD test, and if there are treatments showing differences that are very significant, then an LSD test will be conducted at the 1% level.

RESULT

Based on the results of the research that has been conducted, plant height at 20 HST, stem diameter, dry pod weight per sample, dry seed weight per plant, and the weight of 100 seeds per plot. Then, the observation data were obtained and analyzed using Analysis of Variance (ANOVA). Here are the results of the variance analysis recap in Table 1 below.

Volume 01 Number 02
November 2025
p-ISSN: 0000-0000
e-ISSN: 0000-0000

Table 1. Recapitulation of Variance Parameters Observations

No.	Parameters observations	Notation
		Concentration (P)
1	Plant Height	*
2	Stem Diameter	ns
3	Dry Pod Weight Per Sample	ns
4	Dry seed weight per Plant	*
5	Weight of 100 Seeds Per Plot	**

Notes: ns = is not significantly different
* = significantly different
** = is significantly different

Based on the results of the variance recapitulation of the observation parameters presented in Table 1, it was found that the observation variables of stem diameter and dry pod weight per sample showed no significant difference (p> 0.05).

Plant Height

Observation of plant height was conducted when the plants were 20 HST by measuring the height of the plants in the entire sample. The observation data results obtained are then tested using Analysis of Variance (ANOVA). The results of the Analysis of Variance (ANOVA) conducted show significantly different results. real. Therefore, the LSD further test was conducted at a 5% level as follows:

Table 2. Plant Height 20 HST in the Treatment of PGPR Concentration of Bamboo Root

PGPR Concentration		Mean (cm)	LSD value
(P0)	0 ml/L	12.57 a	1.98
(P1)	7 ml/L	12.49 a	
(P2)	18 ml/L	10.70 a	
(P3)	29 ml/L	11.41 a	
(P4)	40 ml/L	12.54 a	
(P5)	51 ml/L	14.13 b	

Notes: Numbers followed by different letters indicate results that significantly different in the 5% LSD test.

Based on the results of the analysis of variance presented in Table 2, the application of PGPR bamboo roots is significantly different (*) against the height of cowpea plants at 20 HST. Therefore, conducted further LSD (Least Significant Difference) tests at a 5% significance level. Statistically, the treatments P0 (0 ml/L), P1 (7 ml/L), P2 (18 mL/L), P3 (29 mL/L), and P4 (40 mL/L) show no significant difference. Meanwhile, treatment P5 (51 ml/L) shows a significantly different effect compared to other treatments.

Stem Diameter

Based on the data analyzed using ANOVA, the concentration of PGPR showed no significant difference (ns) in stem diameter. Therefore, no further LSD test was conducted.

Volume 01 Number 02
November 2025
p-ISSN: 0000-0000
e-ISSN: 0000-0000

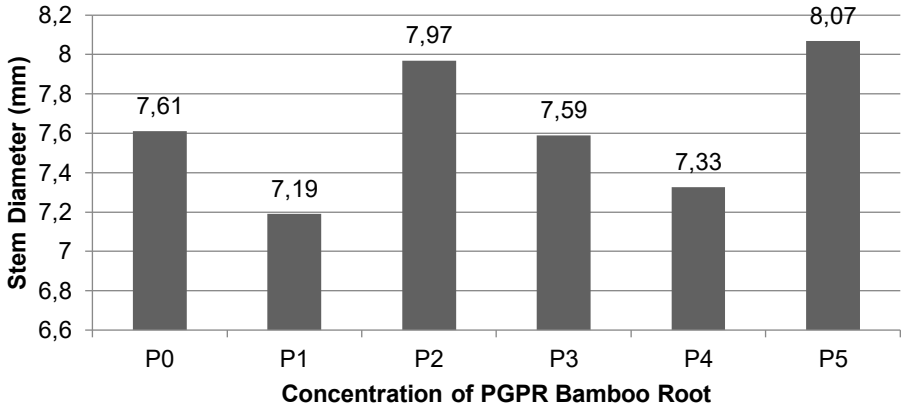

Figure 1. Stem Diameter of Cowpea

Based on Figure 1, the stem diameter of the cowpea that showed the highest results was P5 (51 ml/l) with an average of 8.07 mm, while the lowest result was P1 (7 ml/l) with an average of 7.19 mm.

Dry Pod Weight Per Plant

Based on the data analyzed using ANOVA, the concentration of PGPR showed no significant difference ($p < 0.05$) in dry pod weight per plant. Therefore, no further LSD test was conducted.

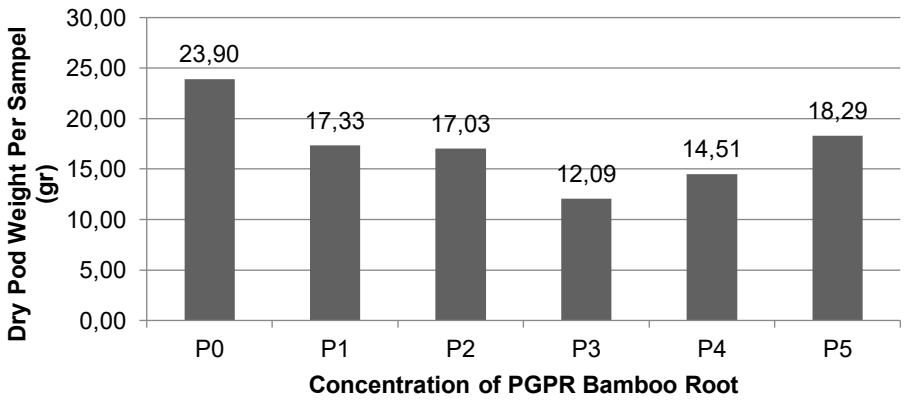

Figure 2. Dry Pot Weight Per Plant of Cowpea

Based on Figure 2, the dry pot weight per plant of the cowpea that showed the highest results was P0 (0 ml/l) with an average of 23.90 grams, while the lowest result was P3 (29 ml/l) with an average of 12.09 grams.

Dry Seed Weight Per Plant

Based on the data analyzed using ANOVA, it is evident that PGPR concentration has a significant effect on the seed weight variable of the dry sample. So, a further LSD test at the 5% level was conducted as follows:

Volume 01 Number 02
November 2025
p-ISSN: 0000-0000
e-ISSN: 0000-0000

Table 3. Dry Seed Weight Per Plant in the Treatment of PGPR Concentration of Bamboo Root

PGPR Concentration		Mean (gram)	LSD value
(P0)	0 ml/L	12,61 a	6.01
(P1)	7 ml/L	10,92 a	
(P2)	18 ml/L	9,79 a	
(P3)	29 ml/L	7,87 a	
(P4)	40 ml/L	9,93 a	
(P5)	51 ml/L	17,65 b	

Notes: Numbers followed by different letters indicate results that are significantly different in the 5% LSD test.

Based on the results of the analysis of variance presented in Table 3, the application of PGPR bamboo roots is significantly different (*) against the weight of dry seeds of the cowpea plant. Therefore, conducted further LSD (Least Significant Difference) tests at a 5% significance level. Statistically, the treatments P0 (0 mL/L), P1 (7 ml/L), P2 (18 mL/L), P3 (29 mL/L), and P4 (40 mL/L) show no significant difference. Meanwhile, treatment P5 (51 ml/L) shows a significantly different effect compared to other treatments.

Weight of 100 Seeds Per Plot

Based on the data analyzed using ANOVA, it is evident that PGPR concentration has a highly significant effect on the variable weight of 100 seeds per plot. So, a further LSD test at the 1% level was conducted as follows:

Table 4. Weight of 100 Seeds Per Plot in the Treatment of PGPR Concentration of Bamboo Root

PGPR Concentration		Mean (gram)	LSD value
(P0)	0 ml/L	13,68 a	3.43
(P1)	7 ml/L	14,10 a	
(P2)	18 ml/L	14,78 a	
(P3)	29 ml/L	13,98 a	
(P4)	40 ml/L	14,82 a	
(P5)	51 ml/L	19,63 b	

Notes: Numbers followed by different letters indicate results that are significantly different in the 1% LSD test.

Based on the results of the analysis of variance presented in Table 3, the application of PGPR bamboo roots is significantly different (*) against the weight of dry seeds of the cowpea plant. Therefore, conducted further LSD (Least Significant Difference) tests at a 5% significance level. Statistically, the treatments P0 (0 mL/L), P1 (7 mL/L), P2 (18 mL/L), P3 (29 mL/L), and P4 (40 mL/L) show no significant difference. Meanwhile, treatment P5 (51 ml/L) shows a significantly different effect compared to other treatments.

DISCUSSION

The increasing demand for food in Indonesia, which must be met, includes the need for soybeans, a necessity in the country. To replace the need for soybeans in Indonesia, one alternative is the consumption of cowpeas. Therefore, research on cowpea cultivation, specifically focusing on proper fertilization and the application of Plant Growth Promoting Rhizobacteria (PGPR), is ongoing. Based on the research data, the application of PGPR to cowpea plants has a significant effect on the variable plant height, as measured by 20 HST. This can occur because phytohormones, growth regulators derived from PGPR bacteria, work optimally in the vegetative phase of cowpea plants.

Volume 01 Number 02
November 2025
p-ISSN: 0000-0000
e-ISSN: 0000-0000

Especially the role of IAA hormones, which belong to the auxin hormone group, is notable. This hormone group has a function in controlling various important biological processes in plants, such as cell growth, tissue differentiation, and response to light (Setyawan et al., 2022).

The variable stem diameter of cowpea plants showed no significant difference; this was attributed to the fact that the time of PGPR application was not optimal, resulting in suboptimal PGPR performance on plant growth. In the variable dry seed weight per plant, this is assumed to occur because it is influenced by external factors, namely the planting distance that is too tight, causing the photosynthesis process in plants to become significantly different, and thus the photosynthesis process in plants becomes suboptimal. This is supported by Sakti and Sugito (2018), who stated that plant spacing can affect the intensity of sunlight, which plays a role in the photosynthesis process.

The variable weight of 100 seeds showed significantly different results. This is assumed to occur because bamboo root PGPR bacteria can work optimally. In bamboo root PGPR, there are phosphate-solubilizing bacteria, including the genera Bacillus, Pseudomonas, Arthrobacter, Bacterium, and Mycobacterium (Purwaningtyas and Nuraini, 2022). If the P nutrient element in plants is sufficient, it will affect the dry seed weight of cowpea, because the higher the availability of P nutrients, the better the energy transfer and plant metabolism, so that the dry seed weight of the plants produced is also higher (Lukman, 2021).

CONCLUSION

Based on the results of the research carried out, the following conclusions can be drawn. The treatment of bamboo root with PGPR application had a significantly different effect on plant height (20 HST, 14.13 cm) and a very significant effect on the weight of 100 seeds per plot (19.63 grams). While the variable stem diameter and dry pod weight per plant had different effects, they were not significant. The recommended concentration of PGPR bamboo root on the growth and production of cowpea is 51 ml/l.

REFERENCES

Gustiani, L. F., & Widaryanto, E. (2019). Effect of Herbicide Application and Planting Distance on Growth and Yield of Cowpea (Vigna Unguiculata L.). *Journal of Crop Production, 7*, 1006- 1015.

Ismayanti, M., & Harijono, H. (2015). Formulation of Mp Asi Based on Cowpea Sprouts Flour and Corn Flour with Linear Programming Method. *Journal of Food and Agroindustry, 3*, 996-1005.

Lukman, M. (2021). Synergy of Urea and Sp 36 Fertilizers on Cowpea (Vigna Unguiculata) Production. Thesis. Jember State Polytechnic.

Pratama, R. A. (2019). Application of Benzyl Amino Purine (BAP) and Plant Growth Promoting Rhizobacteria (PGPR) on Edamame (Glycine max (L.) Merrill) Production. *The Journal of Agrowiralodra, 2,* 23-28.

Purwaningtyas, D. M., & Nuraini, Y. (2022). Effect of Local Microorganisms Rebung and Plant Growth Promoting Rhizobacteria on Total Soil Nitrogen, Bacterial Population, and Peanut (Arachis Hypogaea L) Production. *Journal of Soil and Land Resources, 9*. 365- 373.

Sakti, I. T., & Sugito, Y. (2018). The Effect of Doses of Cow Manure and Planting Distance on the Growth and Yield of Red Onion Plants (Allium ascalonicum L.). *Journal of Agricultural Science, 3*, 110-117.

Volume 01 Number 02
November 2025
p-ISSN: 0000-0000
e-ISSN: 0000-0000

Setyawan, A., Jumadi, R., & Redjeki, E. S. (2022). Dose Differences of Plant Growth Promoting Rhizobacteria (PGPR) from Bamboo Roots on the Growth and Yield of Bambara Beans (Vigna Subterranea (L.) Verdcourt). *Journal of Tropicrops, 5*, 55-65.

Wulandari, E., Sari, H. R., Sukarminah, E., Kurniati, D., Lembong, E., & Filianty, F. (2020). Effect of Cowpea (Vigna Unguiculata) Addition on the Proximate Composition of Sorghum (Sorghum Bicolor (L) Moench) Sprouted Rice. *The Journal of Agritech, 40*. 169-174.

Zamzami, F. (2023). PGPR (Plant Growth Promoting Rhizobacteria) Application and Growth Response of Cowpea (Vigna Unguiculata). Thesis. Jember State Polytechnic.