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Research Article

Morphophysiological and production responses of peanut (*Arachis hypogaea* L.) 'Takar 2' to organic, biological, and NPK fertilizers

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ABSTRACT

Peanuts (Arachis hypogaea L.) is the second most important type of legume after soybeans in Indonesia. Fertilizers were given in either organic or inorganic forms. However, the continuous use of chemical fertilizers was found to have negative impacts on the environment and the microorganisms in the soil. Therefore, organic and biological fertilizers were recommended because they had positive effects on both the environment and the soil's microorganisms. Some of the bacteria that were beneficial for plant growth were Pseudomonas sp. and Azotobacter sp. This study aimed to analyze the use of organic fertilizers, biological fertilizers, and NPK combinations on the growth and yield of peanut plants of the Takar 2 variety. The study was conducted from March to June 2024, located at the Leuwikopo Experimental Station of IPB, Bogor, Indonesia. The experiment used a randomized complete block design (RCBD) with two factors and three replications. The factors are NPK fertilizer doses (100% and 50% recommended dose) and types of organic + biological fertilizer (control, Azotobacter sp., Pseudomonas sp., humate, and a combination of humate and biological fertilizer). Observations were made on 5 sample plants per treatment. The characteristics observed were plant morphology, physiological characteristics, and plant production. The results of the study showed that the application of 100% NPK fertilizer at the recommended dose, in combination with Pseudomonas sp., Azotobacter sp., and humate, had a significant effect on various morphological, physiological, and production-related plant variables. This study shows the potential for a combination of NPK and organic biological fertilizers to increase the growth and production of peanuts.

Keywords: *Azotobacter* sp; humate; morphology; physiology; *Pseudomonas* sp

INTRODUCTION

Peanuts (*Arachis hypogaea* L.) are one of the second most important legumes after soybeans in Indonesia. Behind its high economic value, this plant has many contents that are beneficial to human health, such as carbohydrates and proteins. Peanuts in every 100 g contain 29% calories, 46% protein, 165% fat, 12% carbohydrates, 22% fiber, 44% vitamin E, 1.5% vitamin K, 52% vitamin B1, 25% vitamin B2, 86% vitamin B3, 23% vitamin B6, 62% vitamin B9, 6% calcium, 15% iron, 35% zinc, 52% magnesium and 48% phosphorus (Dickson, 2023).

Over time, as the population continues to grow, along with increasing nutritional needs, food diversification, and the expanding industrial demand for both food and animal feed, the demand for peanuts in Indonesia has also risen. According to the Directorate General of Food Crops, BSIP (2023), the country's annual peanut demand averages 626,532 tons. This figure is considered quite high, as domestic production remains insufficient to meet national needs. Peanut production in Indonesia has been declining over the past three years. In 2020, production reached 418,414 tons, decreasing to 390,465 tons in 2021, and further dropping to 379,928 tons in 2022 (BSIP, 2023).

The continuous use of chemical fertilizers has detrimental effects on soil fertility. These negative impacts include nutrient imbalances, increased soil compaction, and a decline in soil microorganisms. As a result, land productivity and crop quality decrease over time. Recognizing the harmful effects of inorganic fertilizers, it is essential to adopt more environmentally friendly alternatives, such as organic and biofertilizers. (Murnita & Taher, 2021).

The application of organic and biofertilizers has a positive impact on both the environment and soil microorganisms. Among the beneficial bacteria for plant growth are *Pseudomonas* sp. and *Azotobacter* sp. These bacteria can help dissolve phosphorus (P) that is bound to other compounds, making it more available for plant uptake. Additionally, phosphate-solubilizing bacteria play a crucial role in photosynthesis, root development, and essential metabolic and respiratory processes in plants (Sitanggang et al., 2017). Phosphorus is a vital nutrient for plants, playing a key role in the formation of macromolecules such as proteins and other essential secondary compounds. It is crucial for plant metabolism, supporting healthy growth, and maximizing yield potential. (Satyaprakash et al., 2017). Although phosphorus is important for plant growth and metabolism, and its availability is abundant in the soil, especially the topsoil, only a small portion can be utilized by plants (Zhu et al., 2018).

Pseudomonas sp. is a type of phosphate-solubilizing bacteria capable of converting unavailable phosphate compounds into forms that plants can readily absorb. This process occurs as the bacteria break down complex phosphate compounds into simpler, more accessible forms. Phosphate-solubilizing bacteria are beneficial because they produce organic acids such as formic acid, acetic acid, propionic acid, lactic acid, glycolic acid, glyoxylic acid, fumaric acid, tartaric acid, α-ketobutyric acid, succinic acid, and citric acid, which help release phosphorus into the soil for plant uptake (Venkateswarlu & Rao, 1983). *Pseudomonas* sp. bacteria in addition to dissolving phosphate elements, these bacteria are also able to fission nitrogen N in the atmosphere (Jumadi et al., 2015). *Pseudomonas* sp. bacteria that live in the root area act as phosphate-solvent microorganisms, bind nitrogen, and produce plant growth regulators (Muthiah et al., 2023). The application of *Pseudomonas fluorescens* and Rhizobium bacteria had a significant impact on soybean growth in saline soil. This was evident from the observation of key growth parameters, including the number of leaves, plant height, and fresh weight, particularly at a concentration of 15 kg ha^{-1} (Zulaikah & Yuliani, 2018).

Azotobacter sp. is a beneficial bacterium that supports plant growth and yield by producing antibiotic compounds, synthesizing vitamins, and solubilizing phosphate compounds (Jiménez et al., 2011). Additionally, these bacteria enhance the availability of essential macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), making them more accessible for plant uptake (Toago et al., 2017). The application of Azotobacter sp. has been shown to significantly improve the growth of long bean plants when administered at a concentration of 10 mL L^{-1} of water (Surbakti, 2023).

Humate is an organic fertilizer that contains compounds capable of improving soil structure, thereby enhancing plant growth and productivity. It plays a crucial role in increasing soil cation exchange capacity (CEC), regulating pH levels, improving soil structure, and serving as a complementary fertilizer additive. Additionally, humic acid supplies essential micronutrients, making it an effective organic fertilizer for plant growth (Canellas et al., 2015). Research has shown that humic acid application positively influences soil microorganisms, creating favorable soil conditions and providing essential nutrients such as nitrogen (N) and phosphorus (P) for plant development (Santi, 2016). Furthermore, humic acid contributes to soil structure improvement and enhances nutrient retention, thereby reducing nutrient leaching (Sari & Karnilawati, 2020). The purpose of this study was to analyze the use of organic fertilizers, biological fertilizers, and the combination of NPK on the growth and yield of peanuts of the Takar 2 variety.

MATERIALS AND METHODS

The research was conducted from March to June 2024 at the Leuwikopo Experimental Station of IPB, located in the Dramaga District, Bogor Regency, West Java, at an altitude of 240 m asl. The plant nutrients were analyzed in the laboratory of the Department of Agronomy and Horticulture, Faculty of Agriculture, IPB University.

This study used an experimental design with two factors and three replications. The first factor was NPK fertilizer, which consisted of two levels: 100% and 50% of the recommended dose. The second factor was organic and biological fertilizer, consisting of five treatments: control, *Azotobacter* sp., *Pseudomonas* sp., humic acid, and a combination of *Azotobacter* sp., *Pseudomonas* sp., and humate. These factors resulted in 10 treatment combinations, each repeated three times, generating a total of 30 experimental units.

The soil samples before the experiment began were analyzed and conducted at the Testing Laboratory of the Department of Soil Science and Land Resources, Faculty of Agriculture, IPB University. Soil samples were collected using a composite sampling method with simple random sampling at five different points. After land preparation, a total of 30 experimental plots were established, each measuring 3.75 m × 3 m, with a 50 cm spacing between plots. Before planting, according to the treatment, the seeds were soaked in a solution of bacteria (*Pseudomonas* sp. and *Azotobacter* sp.), 10 ml L^{-1} of water for 10 minutes. A planting hole is made with a depth of 2-3 cm by digging and a planting distance of 40 cm x 20 cm. One seed of peanut was planted in each planting hole.

The application of biological fertilizers, namely *Pseudomonas* sp. and *Azotobacter* sp. was done three times. Firstly, it was carried out during soaking the seed, secondly when the plants were 2 weeks after planting WAP and the last it was at 4 WAP old. Before fertilization, bacteria were multiplied in the plant molecular biology laboratory 1 by growing them on nutrient agar (NA) media for 24-48 hours. One streak of bacteria was put into 100 mL of distilled water and 1 mL of nutrient broth (NB) and shaken using a shaker. The suspension formed had a bacterial count of 10^8-10^{10} cfu mL^{-1}. Bacteria application was carried out by spraying the bacterial suspension at the base of the plant. The volume of bacteria sprayed at the time of each application was 10 ml of bacteria with a population of ± 10^7 cfu mL^{-1}.

Chemical fertilizers urea, SP-36, and KCl were applied one week after planting (WAP). The recommended dose of 100% NPK, with a urea dose of 50 kg ha^{-1}, SP-36 100 kg ha^{-1}, and KCl 75 kg ha^{-1}. The application of 50% NPK recommended dose of urea doses 25 kg ha^{-1}, SP-36 50 kg ha^{-1}, KCl 37.5 kg ha^{-1}. Plant maintenance was carried out through weed removal, pest and disease control, and regular watering according to plant needs. Pest and disease control was managed by spraying thiamethoxam and chlorantraniliprole for insect pests and fungicides propineb for fungal infections.

Peanut variety Takar 2 is generally harvested at the age of 85-90 DAP (BSIP, 2023). Harvesting was done by uprooting the plants. The peanut plants were harvested when 75% of the leaves had turned yellow and fallen off, and 80% of the pods were old and large, the pod skin is hard and has a brownish color, the seed skin is thin and shiny, and the pod cavity looks full. Following the harvest criteria, the harvest varies for each treatment.

RESULTS AND DISCUSSION

Morphological characteristics

Based on the research findings, the highest values for the number of leaves, number of branches, and leaf area at 8 WAP were observed in the treatment with 100% optimum dose of NPK + combination of bacteria and humate, with respective values of 257.73, 7.3, and 28.47, compared to the treatment of 50% optimum dose + combination of bacteria and humate, with respective values of 240.14, 6.8, and 25.07, The differences in growth results can be attributed to the addition of growth-stimulating substances, such as *Pseudomonas* sp., *Azotobacter* sp., and humate, which enhance peanut plant development.

Table 1. Number of leaves, number of branches, and leaf area of 8 WAP peanut plants.

NPK	Organic and biological fertilizers	Leaf number	Branch number	Leaf area (cm^2)
100% recommended dose	Control	234.7e	6.0e	25.7d
	Azotobacter sp.	241.1bc	6.4c	26.6b
	Pseudomonas sp.	241.6b	6.4c	26.3b
	Humate	236.3d	6.0e	25.8d
	Organic and biological fertilizer	257.7a	7.3a	28.5a
50% recommended dose	Control	228.3g	6.0e	21.3g
	Azotobacter sp.	232.5f	6.2d	22.8f
	Pseudomonas sp.	234.7e	6.2d	22.7f
	Humate	229.3g	6.0e	21.3g
	Organic and biological fertilizer	240.1c	6.8b	25.1e
	CV (%)	0.33	1.43	0.73
	F-test	**	**	**

Note: Numbers followed by the same letter in the same column indicate non-significant differences based on the DMRT test α = 5%. ** = significant at 0.01 level.

The number of leaves, number of branches, and leaf area were significantly higher with a combination of 100% NPK recommended dose, bacteria, and humate compared to other treatments. Meanwhile, the treatment using the 50% NPK recommended dose combined with bacteria and humate showed better results than the control, as well as treatments with bacteria alone but not with humate alone (Table 1). These improved plant growth parameters can be attributed to the addition of growth-promoting substances, such as Pseudomonas sp., Azotobacter sp., and humate. The application of nitrogen-fixing bacteria like Azotobacter sp. enhances nitrogen availability in the soil and helps neutralize soil pH, creating a more favorable environment for bacterial activity and plant growth (Rohmah et al., 2016). Pseudomonas sp. bacteria have been shown to influence leaf development in corn plants (Rasya, 2019) and significantly affect the number of leaves in tomato plants (Sabrina et al., 2020). This is because Pseudomonas sp. acts as a phosphate-solubilizing bacterium, breaking down phosphate bound to other soil compounds, and making it more accessible for plant absorption. Furthermore, humate and NPK fertilizers have a significant impact on plant height, number of leaves, number of branches, and leaf area in peanut plants (Indra et al., 2019). Humate increases the uptake of nitrogen (N) and phosphorus (P), facilitating the expansion of leaf cells and ensuring stable cell division (Sitanggang et al., 2017). Providing humate can increase the absorption of nitrogen (N) and phosphorus (P) by plants so that plants can enlarge leaf cells and maintain stable cell division (Sembiring et al., 2015), Additionally, the use of organic materials such as humate enhances soil structure and nutrient availability, supporting optimal plant growth (Sugiarti et al., 2020).

Leaf dry weight and stem dry weight

The dry weight of leaves and stems had the highest increase with the treatment combining a 100% recommended dose of NPK with bacteria and humate, compared to the control (Table 2). This effect can be attributed to the larger leaf area observed in this treatment. A larger leaf area enhances the photosynthesis process, leading to higher photosynthate production, which in turn supports the development of vegetative organs and contributes to the increased dry weight of leaves and stems. Azotobacter sp. bacteria promote plant growth by fixing atmospheric nitrogen and producing phytohormones that benefit plant development (Hindersah et al., 2017). Similarly, Pseudomonas sp. enhances plant growth by producing phytohormones, fixing nitrogen, and solubilizing phosphate, making these nutrients more accessible for plant uptake (Gupta & Shailendra, 2015)

Furthermore, the combined application of humate and NPK has been found to significantly influence plant height, number of leaves, leaf area, and total dry weight in peanut plants (Indra et al., 2019). The use of NPK fertilizer at a rate of 300 kg ha^{-1} along with Azotobacter sp. bacteria has been shown to increase root and shoot dry weight in peanut plants (Ikhsani et al., 2018). Additionally, humic acid plays a crucial role in improving soil properties, such as pH balance and organic carbon content, which enhances nutrient absorption, particularly nitrogen (N) (Nuraini et al., 2020)

Table 2. Dry weight of leaves and dry weight of stems of peanut plants.

NPK	Organic and biological fertilizers	Dry weight of leaves (g)	Dry weight of stems (g)
100% recommended dose	Control	12.50e	22.76e
	Azotobacter sp.	13.10c	24.56b
	Pseudomonas sp.	13.06c	23.83c
	Humate	12.17d	23.50d
	Organic and biological fertilizer	14.73a	26.33a
50% recommended dose	Control	11.56g	21.50g
	Azotobacter sp.	12.20f	22.63e
	Pseudomonas sp.	12.16f	22.30f
	Humate	12.03f	22.23f
	Organic and biological fertilizer	13.43b	24.76b
	CV (%)	1.98	0.65
	F-test	*	*

Note: Numbers followed by the same letter in the same column indicate non-significant differences based on the DMRT test α = 5%. * = significant at 0.05 level.

Leaf color

Leaf color index was significantly highest with the treatment combining a 100% recommended dose of NPK with bacteria and humic acid compared to other treatments Meanwhile, the treatment using 50% of the recommended NPK dose combined with bacteria and humate showed better results than the control, as well as treatments with bacteria alone or humate alone (Table 3). The addition of bacteria and humate had a notable impact on leaf coloration, as these components effectively enhance nutrient availability for plant growth and development, particularly leaf formation. The presence of sufficient nutrients promotes chlorophyll production, which is essential for photosynthesis, thereby improving overall plant health and productivity. The application of biofertilizers increases leaf area, thereby enhancing nitrogen absorption and optimizing the photosynthesis process (Efendi et al., 2017). Improved availability of essential nutrients, such as nitrogen, phosphorus, and potassium, supports leaf development by promoting cell expansion and division, leading to healthier and more vibrant leaves. Moreover, *Azotobacter* sp. and *Pseudomonas* sp. influence leaf color in peanut plants through various mechanisms, including nitrogen fixation, phytohormone production, and enhanced nutrient uptake (Suryatmana et al., 2022). These bacteria contribute to soil fertility by breaking down organic matter and converting nutrients into more accessible forms, ultimately improving leaf pigmentation and overall plant vigor. Furthermore, humate plays a crucial role in improving soil structure, increasing water retention capacity, and promoting root development, all of which indirectly enhance leaf health and color. By facilitating the absorption of macro- and micronutrients, humate ensures a balanced supply of essential elements required for chlorophyll synthesis and metabolic activities. The synergistic effect of NPK, beneficial bacteria, and humate creates optimal growing conditions for peanut plants, resulting in greener, healthier leaves that maximize photosynthetic efficiency and ultimately improve crop yield.

Table 3. Peanut plant leaf color under different dosages and types of fertilizers.

NPK	Organic and biological fertilizers	Leaf color
100% recommended dose	Control	39.50e
	Azotobacter sp.	42.10b
	Pseudomonas sp.	41.56bc
	Humate	40.60de
	Organic and biological fertilizer	43.13a
50% recommended dose	Control	37.76f
	Azotobacter sp.	41.40c
	Pseudomonas sp.	41.26c
	Humate	40.20de
	Organic and biological fertilizer	42.06b
CV (%)		1.59
F-test		**

Note: Numbers followed by the same letter in the same column indicate non-significant differences based on the DMRT test α = 5%. ** = significant at 0.01 level.

Leaf NPK nutrient

The leaf N, P, and K contents showed higher values (not statistically analyzed) in the treatment with 100% of the recommended NPK dose combined with bacteria and humic acid, compared to other treatments. (Table 4). At 8 MST, the leaf N, P, and K levels were higher due to the increased nutrient absorption facilitated by *Pseudomonas* sp. and *Azotobacter* sp. bacteria, which form a beneficial symbiotic relationship with peanut plants. This symbiosis enhances the plant's ability to utilize soil nutrients more effectively, leading to improved growth and development. The application of biofertilizers containing *Azotobacter* sp. positively influences nutrient availability in the soil and plays a crucial role in stabilizing soil pH, creating an optimal environment for peanut plant growth (Rohmah et al., 2016). Additionally, *Pseudomonas* sp. bacteria contribute to nutrient absorption by producing indole acetic acid (IAA), an organic compound that accelerates plant growth, promotes root system development, and increases root hair density. These effects ultimately enhance the plant's ability to absorb essential nutrients from the soil, leading to better overall health and productivity (Venkateswarlu & Rao, 1983).

Table 4. Analysis of NPK nutrients in peanut plant leaves.

NPK	Organic and biological fertilizers	Leaf nutrient elements		
		N (%)	P (%)	K (%)
100% recommended dose	Control	3.82	0.24	1.42
	Azotobacter sp.	3.95	0.26	1.87
	Pseudomonas sp.	3.90	0.28	1.76
	Humate	3.83	0.24	1.55
	Organic and biological fertilizer	4.17	0.31	2.07
50% recommended dose	Control	3.72	0.20	1.21
	Azotobacter sp.	3.81	0.25	1.37
	Pseudomonas sp.	3.80	0.25	1.35
	Humate	3.71	0.22	1.31
	Organic and biological fertilizer	3.91	0.27	1.58

Note: Composite samples and data were not statistically analyzed.

Number of pods and seeds

The application of 100% NPK combined with bacteria and humate resulted in the highest total number of filled pods per plant, total seeds per plant, and full seeds per plant. Conversely, the number of damaged seeds per plant and empty pods per plant was higher in the control treatment (Table 5). This improvement can be attributed to the enhanced availability of essential nutrients in the soil, which supports the optimal growth and development of peanut plants. The combination of NPK fertilizer with beneficial bacteria and humate plays a crucial role in improving nutrient absorption, ultimately fulfilling the plants' nutritional requirements for proper growth and productivity. The application of NPK fertilizer contributes to a more efficient photosynthesis process, leading to improved pod development (Arista et al., 2015). Adequate nutrient supply is essential for plant growth, with phosphorus (P) playing a vital role in protein formation and the production of ATP and ADP, both of which are fundamental for metabolic processes (Erlambang et al., 2018). Meanwhile, nitrogen (N) is crucial for carbohydrate and sugar synthesis, which in turn stimulates flower and fruit formation, ensuring better crop yield (Kurniahu et al., 2018). The combination of NPK fertilizer, beneficial bacteria, and humate enhances pod formation, leading to an increased number of seeds per plant. The presence of humate significantly influences pod production in peanut plants by improving soil structure, increasing nutrient availability, and facilitating root development (Indra et al., 2019).

Table 5. Number of total filled pods per plant, number of empty pods, number of total seeds per plant, number of damaged seeds per plant, and number of full seeds per plant.

NPK	Organic and biological fertilizers	Number of total filled pods per plant	Number of empty pods per plant	Number of total seeds per plant	Number of damaged seeds per plant	Number of full seeds per plant
100% recommended dose	Control	31.1de	2.3b	41.7e	4.7bc	36.8dc
	*Azotobacte*r sp.	33.9c	1.3d	44.9c	3.2ef	41.7b
	Pseudomonas sp.	34.1bc	1.3d	45.1bc	2.8g	42.3b
	Humate	32.5d	1.9c	43.1d	4.4c	38.7c
	Organic and biological fertilizer	40.7a	1.1e	52.7a	2.7g	49.7a
50% recommended dose	Control	26.2f	3.8a	38.4g	5.6a	32.5f
	Azotobacter sp.	31.1de	1.6d	42.4de	4.0cd	38.5c
	Pseudomonas sp.	31.2de	1.3d	42.0de	3.6de	38.1c
	Humate	28.2e	2.3c	39.6fg	4.8b	34.8e
	Organic and biological fertilizer	34.4bc	1.3d	46.0b	2.8g	42.5b
	CV (%)	0.8	8.0	1.3	4.1	1.6
	F-test	**	**	**	*	*

Note: Numbers followed by the same letter in the same column indicate non-significant differences based on the DMRT test α = 5%. ** = significant at 0.01 level; * = significant at 0.05 level.

Weight of seeds

The study showed that the weight of total seeds per plant and the weight measured using the crop cut method were significantly affected by the application of organic and biological fertilizers at different NPK levels. At the 100% recommended NPK dose, the combination of organic and biological fertilizers was the most effective treatment, as it resulted in the highest seed weight per plant (35.73 g) and the highest crop cut yield (357.26 g). Treatments with *Azotobacter* sp. and *Pseudomonas* sp. were also found to be significantly better than the control, as their seed weights and crop cut values were higher. The control treatment was the lowest in both parameters. Even at the 50% NPK dose, the combined use of organic and biological fertilizers was still effective, as the results were higher than those of other treatments at the same level. These findings indicated that organic and biological fertilizers were effective in increasing seed yield, even when the use of chemical fertilizers was reduced. (Suhartono et al., 2020). The integration of *Azotobacter* sp. with NPK fertilizer has been shown to increase plant dry weight, increase the number of pods, and improve pod dry weight in soybean plants (Purwaningsih et al., 2012). Furthermore, the combination of humic acid and NPK fertilizer has been proven to significantly influence seed weight in peanut plants (Indra et al., 2019). The application of humic acid can increase the efficiency of plants in absorbing nutrients (Lestari et al., 2021). In addition, humic acid also plays a role in increasing the metabolic process of plants, so that photosynthesis takes place more optimally (Lukmansyah et al., 2020).

Table 6. Weight of total seeds per plant and weight of crop cut method.

NPK	Organic and biological fertilizers	Weight of total seeds per plant (g)	Weight of crop cut method (g)
100% recommended dose	Control	28.68ef	287.20ef
	Azotobacter sp.	31.29bc	312.06ab
	Pseudomonas sp.	31.40b	314.11b
	Humat	29.74d	298.40d
	Organic and biological fertilizer	35.73a	357.26a
50% recommended dose	Control	26.18h	261.86h
	Azotobacter sp.	28.50f	285.06f
	Pseudomonas sp.	28.92e	289.26e
	Humat	26.57g	265.83g
	Organic and biological fertilizer	31.17c	301.03c
CV (%)		1.32	0.32
F-test		**	**

Note: Numbers followed by the same letter in the same column indicate non-significant differences based on the DMRT test α = 5%. ** = significant at 0.01 level.

CONCLUSIONS

The application of NPK fertilizer at the 100% recommended dose, in combination with *Azotobacter* sp., *Pseudomonas* sp., and humate, has a positive impact on morphological, physiological, and yield-related parameters. This treatment resulted in the most favorable effects on various growth indicators, including the number of leaves, number of branches, leaf area, leaf dry weight, stem dry weight, and leaf color, as well as the N, P, and K content at eight weeks after planting. However, the peanut production with the application of 50% NPK fertilizer combined with bacteria and humic acid was slightly lower than the 100% dose. Additionally, this combination significantly influences reproductive traits, such as the total number of pods per plant, the number of empty pods per plant, the total number of seeds per plant, the number of damaged seeds per plant, the number of fully developed seeds per plant, the total seed weight per plant, and the seed weight per seedling. These findings highlight the effectiveness of integrating beneficial bacteria and humic acid with NPK fertilizer to enhance overall plant growth, nutrient uptake, and yield potential.

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REFERENCES

Arista, D., SUryono, S., & Sudadi, S. (2015). Effect of N, P, and K fertilizer combinations to growth and yield of peanut on alfisol dry land. (In Indonesian.). *Agrosains: Jurnal Penelitian Agronomi*, *17*(2), 49-52. https://doi.org/10.20961/agsjpa.v17i2.18672

BSIP. (2023). *Main results of the activities of the instrument standard testing center for various legume plants*. Center for Standard testing of Various Legume Plant Instruments (BSIP Aneka Kacang). https://anekakacang.bsip.pertanian.go.id/

Canellas, L. P., Olivares, F. L., Aguiar, N. O., Jones, D. L., Nebbioso, A., Mazzei, P., & Piccolo, A. (2015). Humic and fulvic acids as biostimulants in horticulture. *Scientia Horticulturae*, *196*, 15–27. https://doi.org/10.1016/j.scienta.2015.09.013

Dickson, D. 2023. *Nutritional content of peanuts and health benefits of peanuts.* (In Indonesian.). Ilmu Pengetahuan Umum. https://ilmupengetahuanumum.com

Efendi, E., Purba, D. W., & Nasution, H. (2017). Response of giving NPK pearl fertilizer and rice straw bokashi on the growth and production of shallots (A*llium ascalonicu*m L). (In Indonesian.). *BERNAS*, *13*(3), 20–29.

Erlambang, R., Yamika, W. S. D., & Suryanto, A. (2018). The effectiveness testof biofertilizer on growth and productivity of eggplant (*Solanum melongena* L.). (In Indonesian.). *Jurnal Produksi Tanaman*, *6*(9), 2338–2345.

Gupta, G, Parihar, S. S., Ahiwar, N. K., Snehi, S. K., & Singh, V. (2015). Plant growth promoting rhizobacteria (PGPR): current and future prospects for development of sustainable agriculture. *Journal of Microbial & Biochemical Technology*, *7*(2), 96–102.

Hindersah, R., Nurfitriana, N., & Fitriatin, B. N. (2017). *Azotobacter chroococcum* and soil amendments to reduce cadmium absorption by rice plants (*Oryza sativa* L.). (In Indonesian.). *Agrologia*, *6*(1), 19–25. https://doi.org/10.30598/a.v6i1.176

Ikhsani, D., Hindersah, R., & Herdiyantoro, D. (2018). Growth of peanut plants (*Arachis hypogea* L. Merril) after application of *Azotobacter chroococcum* and NPK fertilizer. (In Indonesian.). *Agrologia*, *7*(1), 1–8. https://doi.org/10.30598/a.v7i1.351

Indra, B. B., Purnamasari, R. T., & Pratiwi, S. H. (2019). The effect of humic acid doses on the growth and yield of peanut plants (*Arachis hypogea* L.). (In Indonesian.). *Agrosaintifika: Jurnal Ilmu-Ilmu Pertanian*, *2*(1), 98–102. https://doi.org/10.32764/agrosaintifika.v1i2.758

Jiménez, D. J., Montaña, J. S., & Martínez, M. M. (2011). Characterization of free nitrogen fixing bacteria of the genus *Azotobacter* in organic vegetable-grown Colombian soils. *Brazilian Journal of Microbiology*, *42*(3), 846–858. https://doi.org/10.1590/S1517-83822011000300003

Jumadi, O., Liawati, L., & Hartono, H. (2015). Growth promoting substance IAA (indole acetic acid) production and phospate solubilising caability of nitrogen-fixing bacteria isolated from Takalar Regency. (In Indonesian.). *Jurnal Bionature*, *16*(1), 43–48.

Kurniahu, H., Sriwulan, S., & Andriani, R. (2018). Indigenous PGPR application for (*Arachis hypogaea* L.) cv Tuban in former limestone mine. (In Indonesian.). *Agrovigor: Jurnal Agroekoteknologi*, *11*(1), 52–57. https://doi.org/10.21107/agrovigor.v11i1.4305

Lestari, S. A., Kulsum, U., & Ramdan, E. P. (2021). The efficacy of several biological agents againts in vitro growth suppression of *Pyricularia grisea*. (In Indonesian.). *Agrosains: Jurnal Penelitian Agronomi*, *23*(1), 31–36. https://doi.org/http://dx.doi.org/10.20961/agsjpa.v23i1.48174

Lukmansyah, A., Niswati, A., Buchari, H., & Salam, A. K. (2020). Effect of humic acid and Phospate fertilization on the soil respiration of corn plants on ultisols. (In Indonesian.). *Jurnal Agrotek Tropika*, *8*(3), 527-535. https://doi.org/10.23960/jat.v8i3.4529

Murnita, M., & Taher, Y. A. (2021). Effect of organic and inorganic fertilizers on soil chemical properties and rice plant production (*Oryza sativa* L.). (In Indonesian.). *Menara Ilmu*, *15*(2), 67–76.

Muthiah, A., Advinda, L., Anhar, A., Putri, I. L. E., & Farma, S. A. (2023). *Pseudomonas fluorescens* as plant growth promoting rhizobacteria (PGPR). (In Indonesian.). *Serambi Biologi*, *8*(1), 67–73.

Nuraini, C., Saida, S., Suryanti, S., & Nontji, M. (2020). Isolation and identification bacteria from corn rhizosfer on vegetative and generative phases. (In Indonesian.). *Jurnal AGrotekMAS, 1*(1), 24–30. https://doi.org/10.33096/agrotekmas.v1i1.103

Purwaningsih, H., Irawadi, T. T., Mas'ud, Z. A., & Fauzi, A. M. (2012). Engineering of rice straw biopolymers using grafting and cross-linking copolymerization techniques. (In Indonesian.). *Jurnal Kimia VALENSI*, *2*(4). https://doi.org/10.15408/jkv.v2i4.266

Rasya, N. A. B. (2019). Study of the use of *Pseudomonas* sp. and *Micrococcus* sp. bacteria on the growth and yield of corn plants in soil contaminated with chlorpyrifos pesticides [Bachelor's Thesis, Borneo University Trakan]. Borneo University Trakan Digital Repository. https://repository.ubt.ac.id/flipbook/baca.php?bacaID=11065

Rohmah, N., Muslihatin, W., & Nurhidayati, T. (2016). The effect of a combination of nitrogen-fixing bacterial bio-fertilizer carrier media on pH and nitrogen nutrients in the soil. (In Indonesian.). *Jurnal Sains dan Seni*, *4*(1), E44–E46.

Sabrina, S. Q. A., Aisyah, A., & Huda, A. N. (2020). Role of organic materials and phosphate solubilizing bacteria to available phosphate in soil and growth of tomato plant (*Solanum lycopersicum*). (In Indonesian.). *Gontor AGROTECH Science Journal*, *6*(3), 199-232. https://doi.org/10.21111/agrotech.v6i3.4929

Santi, L. P. (2016). Effect of humic acid on the growth of cocoa (*Theobroma cacao*) seedlings and microbial population in the humic dystrudept. (In Indonesian.). *Jurnal Tanah dan Iklim, 40*(2), 87-94.

Sari, C. M., & Karnilawati, K. (2020). Test of the effectiveness of kirinyu fertilizer and humagold fertilizer concentration on the growth and yield of peanuts (*Arachis hypogaea* L.). (In Indonesian.). *Jurnal Unigha*, *2*(3), 71–80.

Satyaprakash, M., Nikita, T., Reddi, E. U. B., Sadhana, B., &Vani, S. S. (2017). Phosphorous and phosphate solubilising bacteria and their role in plant nutrition. *International Journal of Current Microbiology and Applied Sciences*, *6*(4), 2133–2144. https://doi.org/10.20546/ijcmas.2017.604.251

Sembiring, J. V., Nelvia, N., & Yulia, A. E. (2015). The growth of palm seedlings (*Elaeis guineesis* jacq.) at the experiment farm by using medium of subsoil ultisol that was treated with humic acid and fruitless palm bucnh compost. (In Indonesian.). *Jurnal Agroteknologi*, *6*(1), 25–32. http://dx.doi.org/10.24014/ja.v6i1.1373

Sitanggang, V., Sembiring, M., & Fauzi, F. (2017). Application of phosphate solubilizing microbes and sources of P fertilizer to increase P- uptake and corn growth in andisols erupted Sinabung Mountain. (In Indonesian.). *Jurnal Agroekoteknologi*, *5*(4), 768–773.

Sugiarti, L., Andriyani, D. M., Pratitis, M. P., & Setyani, R. (2020). Antibacterial activity of N-Hexane, ethyl acetate and water ethanol extract of parijoto leaves (*Medinilla Speciosa Blume*) against propionibacterium acnes and staphylococcus epidermidis. (In Indonesian.). *Cendekia Journal of Pharmacy*, *4*(2), 120–130. https://doi.org/10.31596/cjp.v4i2.105

Suhartono, S., Pawana, G., & Sulistri, S. (2020). Growth and production of mung beans (*Vigna radiata* L.) at various sorbitol concentrations drought stress intensities. (In Indonesian.). *Agrovigor: Jurnal Agroekoteknologi*, *13*(2), 124–135. https://doi.org/10.21107/agrovigor.v13i2.8414

Surbakti, R. G. (2023). Response of rice straw compost and Azotobacter sp. on the growth and production of long beans (*Vigna sinensis* L.) on ultisol soil [Bachelor's Thesis, Medan Area University]. Medan Area University Digital Repository. https://repositori.uma.ac.id/handle/123456789/19621

Suryatmana, P., Kamaluddin, N. N., & Setiawati, M. R. (2022). The effectiveness of *Azotobacter* sp. and *Pseudomonas* sp. as plant growth promoting rhizobacteria (PGPR) on Tomato plants (*Lycopersicum esculentum* Mill.) on Andisol-Lembang. (In Indonesian.). *Soilrens*, *20*(1), 51-60. https://doi.org/10.24198/soilrens.v20i1.41364

Toago, S. P., Lapanjang, I. M., & Barus, H. N. (2017). Application of compost and *Azotobacter* sp. on growth and production planting of chili (C*apsicum annuum* L.). (In Indonesian.). *E-J. Agrotekbis*, *5*(3), 291–299.

Venkateswarlu, B., & Rao, A. V. (1983). Response of pearlmillet to inoculation with different strains of *Azospirillum brasilense*. *Plant and Soil*, *74*, 379–386. https://doi.org/10.1007/BF02181355

Zhu, J., Li, M., & Whelan, M. (2018). Phosphorus activators contribute to legacy phosphorus availability in agricultural soils: a review. *Science of the Total Environment*, *612*, 522–537. https://doi.org/10.1016/j.scitotenv.2017.08.095

Zulaikah, D., & Yuliani, Y. (2018). Utilization biological agent *Rhizobium* sp. and *Pseudomonas fluorescens* on growth of soybean (*Glycine max*) in saline soil. *Lentera Bio*, *7*(3), 226–230.