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EFFECTIVENESS OF PLANT GROWTH-PROMOTING RHIZOBACTERIA (PGPR) ON THE GROWTH AND YIELD OF CHILI PEPPER *(Capsicum frutesscens* L.*)*

Herliya[1*], Nining Triani Thamrin[2], Muhanniah[2]
[1]Department of Agrotechnology, Fakulty of Science & Technology, Universitas Muhammadiyah Sidenreng Rappang.
*e-mail: herlialia86@gmail.com

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ABSTRACT

Chili pepper (Capsicum frutescens L.) is a horticultural crop belonging to the Solanaceae family with high economic value. It is widely used as a culinary spice and constitutes one of the primary vegetables consumed daily by the Indonesian population. This study aimed to evaluate the effectiveness of Plant Growth-Promoting Rhizobacteria (PGPR) on the growth and yield of chili pepper plants and to determine the optimal PGPR concentration for enhancing plant development and productivity. The research was conducted from May until completion in Lakessi Village, Maritenggae Subdistrict, Sidenreng Rappang Regency, South Sulawesi Province, Indonesia. The treatments applied were as follows: K0 (control), K1 (12 ml/L of water), K2 (12.5 ml/L of water), K3 (13 ml/L of water), K4 (13.5 ml/L of water), and K5 (14 ml/L of water). The results showed that PGPR application had a significant effect on plant height but no significant effect on the number of leaves. The PGPR concentration of K2 (12.5 ml/L of water) resulted in the highest average plant height (42.33 cm). Meanwhile, for the number of leaves, the K2 concentration also recorded the highest average (50.67 leaves), although the difference was not statistically significant.

Keywords: Chili pepper, PGPR, plant growth, yield.

INTRODUCTION

Chili pepper (Capsicum frutescens L.) is a highly valuable horticultural crop belonging to the Solanaceae family. It is commonly used as a culinary spice and is one of the main vegetable commodities consumed daily by the Indonesian population. In addition to its role as a flavoring agent, chili pepper contains colloids, capsaicin, flavonoids, essential oils, and essential nutrients such as vitamins B1, C, and A, as well as iron, calcium, phosphorus, fats, carbohydrates, and proteins [1]. According to data from the Central Bureau of Statistics of South Sulawesi Province, chili production reached 1,194 quintals in 2016, 4,359 quintals in 2017, 11,230 quintals in 2018, 9,656 quintals in 2019, and 16,994 quintals in 2020 [2]. A decrease in production was recorded in 2017. Overall, the data indicate fluctuating chili yields across the years. Low chili productivity has been attributed to the degradation of soil physical, chemical, and biological properties, mainly due to poor land management practices. Therefore, the use of microorganisms capable of improving soil fertility has become increasingly important. One such group of beneficial microbes is Plant Growth-Promoting Rhizobacteria (PGPR).

PGPR refers to a group of bacteria originating from the rhizosphere, which can be transferred to different habitats and remain functional, provided suitable growth conditions are maintained. These microbes positively impact plant health either directly or indirectly. PGPR directly supports plant development by facilitating the availability, mobilization, or absorption of soil nutrients. Additionally, PGPR modulates the concentration of phytohormones that promote plant growth

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and enhances plant resistance against pathogenic attacks. PGPR can inhibit pathogen activity by producing metabolites or substances similar to antibiotics, particularly targeting soil-borne pathogens [3].

Several bacterial genera have been identified as PGPR, predominantly Gram-negative strains from the genera Serratia and Pseudomonas. Other genera include Flavobacterium, Erwinia, Burkholderia, Enterobacter, Rhizobium, Acetobacter, Azospirillum, and Bacillus. Although Bacillus strains are Gram-positive, certain strains have been categorized as PGPR due to their ability to colonize plant roots [4].

The ability of PGPR to produce and regulate phytohormone concentrations makes them attractive candidates for protecting plants from diseases. Their use is particularly valuable in minimizing the reliance on synthetic chemical inputs, which are known to cause long-term toxicity and decrease agricultural product quality. This is especially important for edible horticultural crops consumed by communities in South Sulawesi. PGPR formulations can be sourced from the roots of bamboo, elephant grass, or mimosa plants. When applying PGPR, it is crucial to adhere to recommended dosage levels to maximize benefits and avoid excessive use. PGPR has been successfully applied to vegetable crops, rice, legumes, and various annual plants [3].

Several studies have demonstrated that PGPR application can improve growth and yield in various crops. For example, a concentration of 200 ml/plant resulted in the highest mustard green biomass [5], while the best growth and yield of lettuce were achieved with two applications of 25 g of PGPR [6]. Similarly, a concentration of 20 ml/L of PGPR produced the highest fresh biomass of onion per clump compared to other treatments [7]. Based on these considerations, this study aims to evaluate the effectiveness of PGPR application on the growth and yield of chili pepper (Capsicum frutescens L.).

MATERIAL AND METHODS

Study Location and Period

This study was conducted from May onwards in Lakessi Village, Maritenggae Subdistrict, Sidenreng Rappang Regency, South Sulawesi Province, Indonesia.

Materials and Tools

The materials used in this study included chili seeds, bamboo roots, granulated sugar, fermented shrimp paste (terasi), finely ground bran, water, lime water, and compost fertilizer. The tools employed were buckets, machetes, a stove, cooking pots, jerry cans, measuring glasses, plastic sieves, rulers, labeling paper, sprayers, polybags, stationery, a camera, and other supporting equipment.

RESULT AND DISCUSSION

Plant Height (cm)

Based on the results of the analysis of variance, the effectiveness of *Plant Growth Promoting Rhizobacteria* (PGPR) on the growth and yield of chili plants did not significantly affect plant height (cm).

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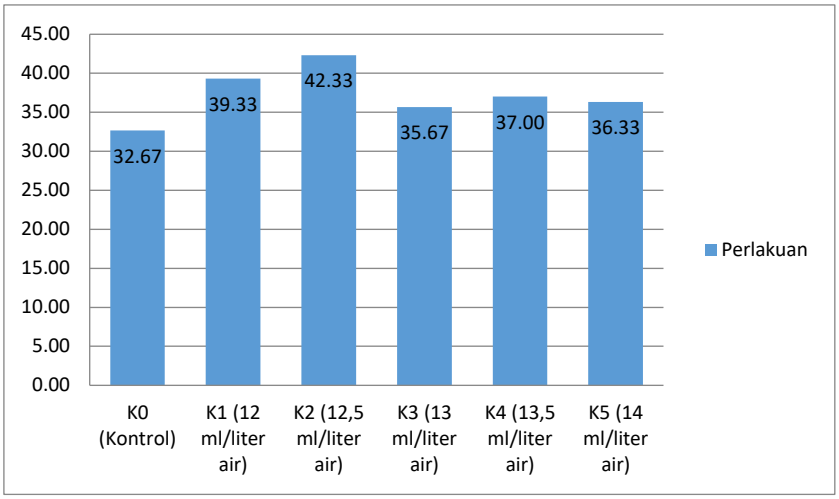

Figure 2. Diagram of the average plant height of chili with the application of *Plant Growth Promoting Rhizobacteria* (PGPR).

Based on Figure 2, it can be seen that the PGPR treatment with a dose of K2 (PGPR 12.5 ml/liter of water) resulted in the highest average plant height of 42.33 cm, followed by the K1 treatment (PGPR 12 ml/liter of water) with an average height of 39.33 cm. The next treatment, K4 (PGPR 13.5 ml/liter of water), resulted in an average height of 37.00 cm, K3 (PGPR 13 ml/liter of water) with an average height of 35.67 cm, K5 (PGPR 14 ml/liter of water) with an average height of 35.33 cm, and K0 (control) with an average height of 32.67 cm.

Number of Leaves (leaves)

Based on observations and the results of the analysis of variance, the effectiveness of PGPR on the growth and yield of chili plants had a highly significant effect on the number of leaves (leaves).

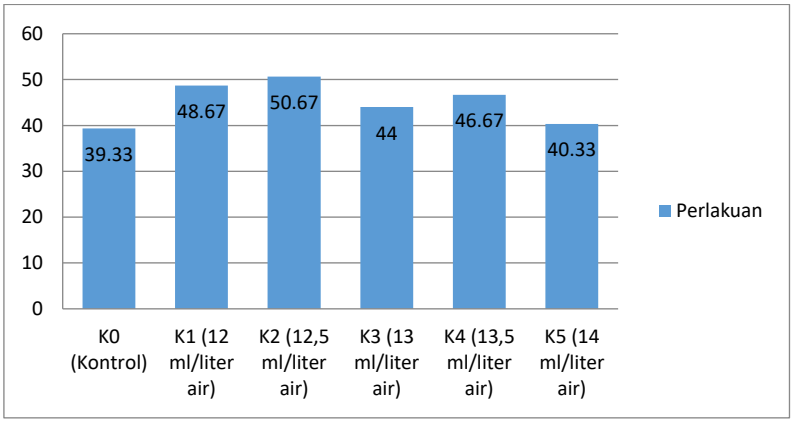

Figure 3. Diagram of the average number of leaves of chili plants with the effectiveness of *Plant Growth Promoting Rhizobacteria* (PGPR) on the growth and yield of chili plants.

Table 1. Analysis of variance for the average number of leaves of chili plants with the effectiveness of *Plant Growth Promoting Rhizobacteria* (PGPR) on the growth and yield of chili plants.

Treatment	Replicate			Average
	I	II	III	
K0	30	35	53	39.33[a]

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K1	56	55	35	48.67[a]
K2	45	52	55	50.67[a]
K3	50	42	40	44.00[a]
K4	45	60	35	46.67[a]
K5	35	60	26	40.33[a]
Averafe	44	51	41	45

Note: Numbers followed by the same letter in the column are not significantly different based on the 5% BNJ test

Based on the image above, the effectiveness of PGPR on the Growth and Yield of Chili Plants (Capsicum frutescens) shows that the treatment K2 (PGPR 12.5 ml/liter of water) resulted in the highest average number of leaves, which was 50.67, followed by K1 (PGPR 12 ml/liter of water) with an average of 48.67, K4 (PGPR 13.5 ml/liter of water) with an average of 46.67, K3 (13 ml/liter of water) with an average of 44.00, K5 (PGPR 14 ml/liter of water) with an average of 40.33, and K0 (Control) with the lowest average of 39.33.

Based on the analysis of variance, the effectiveness of PGPR (Plant Growth Promoting Rhizobacteria) on the growth and yield of chili plants showed a significant effect on plant height (cm). The plant height parameter with the highest average value was found in K2 (42.33 cm) with the application of PGPR 12.5 ml/liter of water, which was the highest compared to other treatments. This suggests that PGPR can optimize nutrient absorption for plant growth. This is in line with the statement by [3], which mentioned that various types of bacteria have been identified as providers or enhancers of nutrient absorption in the soil. Examples include Rhizobium, which supplies nitrogen to plants, phosphate-solubilizing bacteria, which help plants absorb phosphorus, and several other bacteria that supply macro and micronutrients to plants.

In addition to this capacity, PGPR's ability to supply and modify the concentration of growth hormones for plants may also be related to variations in the treatment results. Gibberellins, cytokinins, and IAA are some of the products produced by PGPR that can support plant growth and development. [8] states that PGPR contains gibberellins, cytokinins, ethylene, and IAA, which are active forms of auxin hormones commonly found in plants and contribute to the improvement of crop quality and yield. These hormones can encourage the growth of new roots, increase enzyme activity, and stimulate growth. According to [9], PGPR acts as a biocontrol agent for plants and accelerates plant growth as a rhizobacterium.

This result is consistent with [10], which found that applying PGPR at a concentration of 12.5 ml/liter of water can increase plant height because PGPR optimizes the absorption and utilization of nitrogen by plants. Based on the analysis of variance, the effectiveness of PGPR on the growth and yield of chili plants had no significant effect on the number of leaves (blades).

Chili plant growth in the number of leaves parameter showed the highest average value in K2, which was 50.67 leaves with the application of PGPR 12.5 ml/liter of water compared to other treatments. This suggests that PGPR application can improve the leaf growth phase, supported by sufficient nutrient availability, and speed up the photosynthesis process. [11] claims that the environment or the amount of available nutrients affects the number of leaves. An optimal environment will encourage plant development and result in more leaves. As the number of leaves increases, the plant will produce more

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carbohydrates during photosynthesis, accelerating its growth and development. [12] states that with the availability and ability of plants to absorb nutrients from PGPR quickly, nutrients become one of the important factors for plants, especially during the vegetative stage, as they are crucial for cell division and the formation of new cells, which are necessary for the development of stronger and better plant organs like leaves and stems, essential for effective photosynthesis.

CONCLUSION

The effectiveness of PGPR on chili plants had no significant effect on plant height, while PGPR had a significant effect on the number of leaves. The PGPR concentration treatment significantly affected plant height at concentration K2 (12.5 ml/liter), which resulted in a height of 42.33 cm, while the number of leaves did not show a significant effect at the same concentration, with a leaf count of 50.67 leaves.

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