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Application of Plant Growth Promoting Rhizobacteria (PGPR) Dosage on Growth and Production of Lettuce (*Lactuca sativa* L.)

Yoga Wahyudi Putra*, Fedri Ibnusina, Alfikri
Agribusiness Management Study Program, Food Growing Program, Politeknik Pertanian Negeri Payakumbuh, Lima Puluh Kota, West Sumatera, Indonesia.

*Corresponding author: yoga.28wahyudiputra@gmail.com

ABSTRACT

Lettuce plants belong to short-lived vegetable crops. Lettuce has different sizes of shapes and color of leaves according to the variety. The purpose of this study was to identify the dose of PGPR administration to the growth and production of lettuce plants, analyze the appropriate dose of PGPR application for lettuce plant growth and production and analyze the results of lettuce plant business analysis with PGPR doses. This research was carried out during the months of March to May 2022. The implementation of this research activity was carried out at the Payakumbuh State Agricultural Polytechnic. This study used an experimental method with Completely Randomized Design (CRD). The treatment used is such as inorganic fertilizer, PGPR by 300 and 350 ml. There were 504 populations, 3 treatments with 6 tests, 18 beds and 90 plant samples, data analyzed using analysis of variance with a further test of Duncan's Multiple Range Test 5%. Business analysis is measured by calculating total costs, revenues, R/C ratio, BEP price, BEP production, profit and profitability. The results showed that with inorganic fertilizer treatment, PGPR by 300 and 350 ml differed markedly from leaf width, root length and fresh weight of plants and did not differ markedly from plant height and number of leaves. The treatment with the highest average value was found in the use of PGPR 350 ml with an average yield on plant height parameters with a value of 20.95 cm, leaf width of 13.13 cm, number of leaves 16.4 strands, root length of 12.41 cm and fresh weight of plants 102.9 g at plant age of 5 week after application. This research found that the application of PGPR by 300 and 350 ml were not significantly different in the observed variables of plant height and number of leaves, but they were significantly different in the observed variables of leaf width, root length and weight fresh plants.

Keywords: business analysis; growth stimulant; horticulture plant; R/C ratio.

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INTRODUCTION

Lettuce plants are short-lived vegetable plants. Lettuce plants are able to adapt to lowland and highland areas (Sunarjono, 2014). Lettuce has different leaf shapes and colors according to the variety. Lettuce has a plant length of between 30-40 cm, while the height of the crop lettuce plant is between 20-30 cm with a taproot and fibrous root system. Fibrous roots grow on the stem and spread in all directions by 20-50 cm or even deeper into the soil (Novriani, 2014). Lettuce is a plant that contains minerals, vitamin A, vitamin C, and fiber. Lettuce can be consumed raw or made into salads and can be used as a complementary vegetable in various types of dishes (Nazaruddin, 2003). Lettuce has benefits for preventing premature aging, maintaining weight, helping constipation sufferers, preventing cancer, relieving headaches and treating insomnia. The content of lettuce is 1.2 g protein, 0.2 fat, 2.9 g carbohydrates, 22 mg Ca, 25 mg P, 0.5 mg Fe. 162 mg vitamin A, 0.04 mg vitamin B1 and 8 mg vitamin C (Yelianti, 2011).

The problem that arises in lettuce cultivation is the use of organosol soil, where the soil has high acidity, and is generally less fertile. Organosol soil is characterized by a blackish soil color and a soft soil texture. These conditions are appropriate in the field where the land is organosol soil. According to Jumaidi et al. (2010), organosol soil has a high level of acidity, low base saturation, low levels of N, P, and K and the available organic material has not been properly decomposed. There are many ways to increase the productivity of organosol soil, one of which is by administering PGPR (Plant Growth Promoting Rhizobacteria). PGPR includes components that can increase lettuce production. PGPR belongs to a group of beneficial bacteria that actively colonize the rhizosphere. PGPR plays an important role in increasing plant growth, crop yields and soil fertility (Aryantha et al., 2004), PGPR can influence plants directly and indirectly. PGPR can directly stimulate plant growth by producing growth hormones, vitamins and various organic acids and increasing nutritional intake for plants. Improved plant growth indirectly plays a role in improving growth conditions through its ability to produce antimicrobial pathogens which can suppress the growth of fungi that cause growth diseases (phytopathogenic) (Zainudin et al., 2014). Based on the problems that arise in lettuce cultivation, it lies in the use of organosol soil,

where the organosol soil is less fertile and the organic material has not been properly decomposed. To increase productivity in organosol soil, it is necessary to provide PGPR. PGPR functions to increase plant growth and strengthen plant roots, so that providing PGPR is a solution in cultivation on organosol soil. The objective of this research was to identify the dose of PGPR on the growth and production of lettuce and analyze the appropriate dose of PGPR for the growth and production of lettuce.

MATERIAL AND METHODS

This research was carried out from March to May 2022. The research location was carried out at the Payakumbuh State Agricultural Polytechnic Land, The tools used in this research were a hoe, kored, gembor, medium-sized bucket, marker board, label paper, measuring cup, meter, analytical scales, writing tools and cell phone camera. The materials used in this research were lettuce seeds, organosol soil, manure, inorganic fertilizer, PGPR, and water.

The plant media used for lettuce plants is: planting media mixed with manure and organosol soil. The size of the bed made is 1.5 x 1.5 m with a planting distance of 25 x 25 cm. For every 1 replication there are 28 populations. Planting is carried out in the afternoon because the temperature is still relatively low so the plants are not stressed. Planting is done by making planting holes 2-3 cm deep, each bed contains 28 lettuce plants. Lettuce maintenance consists of watering, replanting, applying PGPR fertilizer and Pest and Disease Control. Watering is carried out once every day on a regular basis and is carried out in the morning and evening. Carry out replanting when the lettuce plants are 10 days after transplanting to replace dead lettuce plants.

PGPR was applied to the plants 3 times, namely: when the lettuce plants were 1, 2 , and 3 WAP according to the treatment dose, it was administered using a cast system per plant. Pest and disease control is done by weeding by pulling out weeds that grow around the lettuce plants. Harvesting is done when the lettuce plants reach the age of 5 WAP. Harvesting is done in the morning. Harvesting is done manually by removing lettuce plants from the beds.

Experimental Design The research method used a Completely Randomized Design (CRD) with 3 treatments, namely P1: 100% inorganic fertilizer, P2: PGPR 300 ml and P3: PGPR 350 ml. There were 6 replications in the three treatments so there were 18 beds, each bed contained 28 plants in 1 replication, resulting in 504 plants and a total of 90 samples. Data analysis used the ANOVA test followed by the 5% DMRT test.

RESULT AND DISCUSSION

Plant height growth parameters at the observation ages of 3, 4 and 5 WAP (Figure 1). The highest average plant height values were found in the 350 ml PGPR treatment with values of 12.04, 16.81 and 20.95 cm respectively. The results of the analysis of the various changes observed showed that the treatment with various doses of PGPR had no significant effect on lettuce plant height at 5 WAP. The results of the DMRT analysis show plant height parameters at the observation age of 5 WAP with PGPR dose treatment which can be seen in Table 1.

Plant height parameters showed results that were not significantly different for each treatment aged 5 WAP. Observation age 5 WAP The highest average plant height was found in the 350 ml PGPR treatment with a value of 20.95 cm, not significantly different from the inorganic fertilizer treatment with a value of 19.4 cm and not significantly different from the 300 ml PGPR treatment with a value of 18.03 cm. The lowest average plant height was found in the 300 ml PGPR treatment, not significantly different from the inorganic fertilizer treatment and not significantly different from the 350 ml PGPR treatment. Providing PGPR can add nutrients and increase the pH in organosol soil. By providing PGPR it can overcome the problem of organosol soil which is less fertile due to a lack of nutrients and acidic soil pH. The results of the research that was carried out showed that the highest plant height was found in the 350 ml PGPR treatment, amounting to 20.95 cm. The results of plant height research conducted by Wulandari at al, (2019), showed that the 200 ml PGPR treatment obtained the highest plant height results of 14.02 cm. This is in accordance with the quote from Masnilah et al. (2007). PGPR's ability to produce phytohormones allows plants to increase root surface area and increase the availability of nutrients in the soil.

The three treatments used during this research experienced an increase each time they were observed at the ages of 3, 4 and 5 WAP. The widest average value of leaf width was found in the 350 ml PGPR treatment with values respectively 9.86, 11.35 and 13.13 cm. The results of the analysis of the various changes observed showed that treatment with various doses of PGPR had a significant effect on lettuce leaf width at 5 WAP. The results of the DMRT analysis show leaf width parameters at the observation age of 5 WAP with PGPR dose treatment which can be seen in Table 1.

Leaf width parameters showed significantly different results for each treatment aged 5 WAP. The observation age was 5 WAP, the highest average plant height was in the 350 ml PGPR treatment with a value of 13.13 cm, significantly different from the inorganic fertilizer treatment with a value of 11.85 cm and significantly different from the 300 ml PGPR treatment with a value of 10.7 cm. The lowest average plant height was found in the 300 ml PGPR treatment, not significantly different from the inorganic fertilizer treatment and significantly

Table 1. Lettuce growth and yield with PGPR dose treatment at 5 WAP age observations.

Treatment	Plant height	Leaf width	Number of leaves	Root length	Fresh weight of plants
Anorganic fertilizer	19,4a	11,85ab	14,5a	11,18ab	73,6a
PGPR 300 ML	18,03a	10,7a	14,76a	10,46a	66,6a
PGPR 350 ML	20,95a	13,13b	16,4a	12,41b	102,9b

Note: Numbers accompanied by the same letters indicate that they are not significantly different based on the 5% DMRT

different from the 350 ml PGPR treatment. Adding nutrients and increasing the pH of organosol soil by administering PGPR. One effort to overcome the organosol soil problem. The results obtained were that a PGPR dose of 350 ml produced the widest leaves of 13.13 cm. These results are in accordance with research by Tabijri, Sholilah and Meidiantie (2016), which shows that the use of PGPR concentration has a very significant effect on the leaf width of lettuce plants. A PGPR concentration of 100 g/l produced the largest leaf width, at all ages observed at 12.75 cm. According to Widawati, Suliasih and Saefudin (2015), the application of a biological fertilizer formula derived from PGPR bacteria is able to increase the soil pH from slightly acidic (5.8) to neutral (7.12). According to Timmusk & Wagner (2004), the increase in plant growth is caused by its ability to produce auxin and cytokinin. Apart from that, it can also fix nitrogen and dissolve phosphate and the role of roots is the main plant organ which supplies water, minerals and important substances for plant growth and development.

Average development of the number of leaves at the observation age of 3, 4 and 5 WAP. The highest average number of leaves was found in the 350 ml PGPR treatment with values of 7.23, 10.26 and 16.4 respectively. The results of the analysis of variance of the observed changes showed that the treatment with various doses of PGPR did not significantly differ in the number of lettuce leaves at 5 WAP. The results of the DMRT analysis show parameters for the number of leaves at the observation age of 5 WAP with PGPR dose treatment which can be seen in Table 1.

The leaf number parameter showed that the results were not significantly different for each treatment aged 5 WAP. At the observation age of 5 WAP, the highest average number of leaves was found in the 350 ml PGPR treatment with a value of 16.4, not significantly different from the inorganic fertilizer treatment with a value of 14.5 and not significantly different from the 300 ml PGPR treatment with a value of 14.76. The lowest average number of leaves was found in the 300 ml PGPR treatment, not significantly different from the inorganic fertilizer treatment and not significantly different from the 350 ml PGPR treatment. There are many ways to increase the productivity of organosol soil, one of which is by administering PGPR. PGPR can add nutrients and increase the pH in organosol soil, overcoming the problem of organosol soil which is less fertile due to a lack of nutrients and acidic soil pH. The results of the research that was carried out showed that the highest number of leaves was found in the 350 ml PGPR treatment, amounting to 16.4 pieces. Research conducted by Wulandari at all (2019), stated that the highest number of leaves was found in the 300 ml treatment, amounting to 14.28 pieces. According to Iswati (2012), PGPR bacteria can provide benefits in plant physiological processes and growth, such as producing and changing the concentration of phytohormones that encourage plant growth, increasing nutrient availability for plants by providing and mobilizing the uptake of various nutrients in the soil and suppressing the development of pests or diseases. .

The results of the analysis of the various changes observed showed that the treatment with various doses of PGPR had significant differences in the root length of lettuce at 5 WAP. The results of the DMRT analysis show root length parameters at the observation age of 5 WAP with PGPR dose treatment which can be seen in Table 1.

Root length parameters showed significantly different results for each treatment aged 5 WAP. At 5 WAP the average longest root length was observed in the 350 ml PGPR treatment with a value of 12.41 cm, not significantly different from the inorganic fertilizer treatment with a value of 11.18 cm and significantly different from the 300 ml PGPR treatment with a value of 10.46 cm . The lowest average root length was found in the 300 ml PGPR treatment, not significantly different from the inorganic fertilizer treatment and significantly different from the 350 ml PGPR treatment. Research that has been conducted shows that the PGPR dose treatment has a significant effect on the root length of lettuce plants. This is due to the growth of vegetative organs and good photosynthesis processes because it is influenced by the width of lettuce leaves. There are many ways to increase the productivity of organosol soil, one of which is by providing PGPR. PGPR can add nutrients and increase the pH in organosol soil. Overcoming the problem of infertile organosol soil due to lack of nutrients and acidic soil pH. The highest root length results were found in the 350 ml PGPR treatment, amounting to 12.41 cm. These results are in accordance with research conducted by Wulandari et al (2019), research which used the Red Rapid variety and Lollo Rossa variety as well as PGPR doses at levels of 0, 100, 150, 200, 250 and 300 ml. The results showed that there was a real interaction between variety and PGPR dose on plant root length. The Red Rapid variety showed the highest yield compared to the Lollo Rossa variety and the PGPR dose of 300 ml showed the highest yield of all treatments with a PGPR dose of 9.79 cm. According to Dewi (2007), apart from the growth of root length and root circumference, it is greatly influenced by the environmental conditions of the surrounding soil, both directly and indirectly, including carbohydrate transport factors to the roots, rhizosphere factors such as humidity, temperature, nutrient content, toxic substances, aggregate strength and biological agents.

The results of the analysis of variance of the observed changes showed that the treatment with various PGPR doses had significant differences in the fresh weight of lettuce plants at 5 WAP. The results of the DMRT analysis show the fresh weight parameters of plants at the observation age of 5 WAP with PGPR dose treatment which can be seen in Table 1.

Plant fresh weight parameters showed significantly different results for each treatment aged 5 WAP. The observation age was 5 WAP. The average fresh weight of the heaviest plants was found in the 350 ml PGPR treatment with a value of 102.9 g, significantly different from the inorganic fertilizer treatment with a value of 73.6 gr and significantly different from the 300 ml PGPR treatment with a value of 66.6 g. The lowest average fresh plant weight was in the 300 ml PGPR treatment,

not significantly different from the inorganic fertilizer treatment and significantly different from the 350 ml

Wide leaves are good at absorbing photosynthesis which affects root length and good leaf thickness also affects the fresh weight of the plant. PGPR can add nutrients and increase the pH in organosol soil, one of the efforts to overcome the problem of organosol soil which is less fertile due to a lack of nutrients and acidic soil pH. The best fresh weight results for plants were found in the 350 ml PGPR treatment, amounting to 102.9 g. These results are in accordance with research by Wulandari at all (2019), stating that plant fresh weight is influenced by root length, number of leaves, and plant height. The best fresh weight results for plants were found in the 300 ml PGPR treatment, amounting to 95.59 g. These results were better than the 350 ml PGPR treatment amounting to 102.9 g.

Based on the research results of Husnihuda, Sawitri and Susilowati (2017), PGPR also functions as a biofertilizer which is useful for soil fertility because it can improve the physical, chemical and biological properties of the soil so that the nutrient and macro element content in the soil needed for plant growth can be optimally fulfilled and It can also stimulate plant growth through the process of photosynthesis.

CONCLUSION

This research found that the application of PGPR by 300 and 350 ml were not significantly different in the observed variables of plant height and number of leaves, but they were significantly different in the observed variables of leaf width, root length and weight fresh plants.

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