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Growth and Yield Response of Pagoda Mustard Seedlings (*Brassica Narinosa* L.) Accident to the Application of Some Concentration of Psb (*Photosyntetic Bacteria*) Payments

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A B S T R A C T

Research on "Growth Response and Yield of Pagoda Mustard Plants (Brassica narinosa L.) Due to the Application of Several Concentrations of Biofertilizer PSB (Photosynthetic Bacteria)" is being conducted as a field demonstration. was conducted in Muhammadiyah University's Faculty of Agriculture's experimental field in Tanjung Gadang Village, Koto Nan Ampek, West Sumatra. West Payakumbuh District, Payakumbuh City, is +/- 514 meters above sea level and features Inceptisol soil. Each plot had 16 plants, three of which were randomly selected sample plants at random. In order to treat photosynthetic bacteria, different dosages of biofertilizer were administered: 0 ml/liter, 10 ml/liter, 20 ml/liter, 30 ml/liter, and 40 ml/liter. The F test was used to statistically assess the observation data at a significance level of 5% after it was averaged. At a significance level of 5%, the DNMRT test was conducted if F count was greater than F table. The research findings showed that pagoda mustard greens can grow and produce more when given photosynthetic bacterial biofertilizer at a dose of 40 ml/L.

INTRODUCTION

Another name for pagoda mustard (Brassica narinosa) is Tatsoi which is another name for Ta Ke Chai. The distinctive shape and color of pagoda mustard is reminiscent of a blossoming flower, with oblong leaves that are a beautiful shade of dark green. One bibt can weigh up to 200 grams. Pagoda mustard has several benefits, including its crunchy texture, delicious taste, and beautiful appearance (Ansyahri, 2021).

According to (Kementerian Pertanian, 2024) explained that the production of mustard seeds in 2020 was around 33,929 tons, then in 2021 around 35,283 tons while the production of mustard bibt in 2022 amounted to 47.363 tons, this is an increase in the production of mustard seedlings in West Sumatra from 2020 to 2022, although mustard production has increased, bibt mustard pagoda has not been widely recognized by farmers for cultivation and although some Indonesian farmers have started planting it, this mustard variety is still rarely on the market and is less frequently produced and distributed than other varieties, even though pagoda mustard has the ability to grow. Given that the land and environment in Indonesia are favorable for the growth of this bibt, the production of pagoda mustard needs to be expanded there.

The successful cultivation of pagoda mustard seedlings can be supported by fertilization efforts. Fertilization, which is still considered a major contributor to agricultural productivity, is an important effort to increase crop yields. Generallyfarmers use inorganic fertilizers because they are easy to obtain and practical to use. According to (Dan & Cabai, 2024), the regular use of inorganic fertilizers can cause soil organic matter levels to decrease, soil structure is damaged, and environmental pollution. One fertilizer that contains microorganisms and is friendly to the environment is biological fertilizer.

LITERATURE REVIEW

Used to improve the quality and quantity of crop yields, biofertilizers are substances made from living things, especially microbes. Especially in the vegetative phase, seedlings need nutrients to function metabolism. With the help of these absorbed components, the photosynthesis process is expected to be enhanced by encouraging cell division and the formation of new cells to build better bibt parts such as leaves, stems, and roots. The microorganisms used are generally capable of symbiosis with their host bibt (Rahayu Relawati et al., 2019).

Autotrophic bacteria capable of photosynthetic activity are called photosynthetic bacteria (PSB). Bacteriophylls a and b, the pigments found in PSB, produce red, green, and purple pigments to absorb solar energy and use it as fuel for photosynthesis. Nitrogen (N) addition, improved flavor, enhanced root growth, and increased resistance to pests and diseases are some of the advantages of PSB for plants. PSB will improve fertilizer quality and bibt production when mixed with ecoenzyme fermented fertilizers (Mandataris et al., 2024).

Research (Payumi et al., 2022) found that the wet weight of kailan bibt roots, as well as the parameters of leaf number and leaf area, changed significantly when given photosynthetic bacteria at the rate of 20 ml/L. When applied to the

vegetative growth of purple eggplant (Solanum melongena L.) F1 hybrids, photosynthetic bacteria fertilizer (PSB) had a significant effect on plant height, number of leaves, chlorophyll content, number of flowers, and relative growth rate, according to research findings (Hal et al., 2024). P2 fertilizer with photosynthetic bacteria (PSB) at a concentration of 10 ml/L was most effective in increasing plant height, number of leaves, leaf area index, number of flowers, and relative growth rate.

METHODOLOGY

The field study, which used Inceptisol soil type and was conducted at an altitude of ± 514 meters above sea level, was conducted at the experimental land of the Faculty of Agriculture, Muhammadiyah University of West Sumatra, Tanjung Gadang Koto Nan Ampek Village, West Payakumbuh District, Payakumbuh City. The trial will take place between July and September 2024.

Eggs, pagoda mustard seeds, MSG, water, urea, SP36, KCl, and natural insecticides were the components used in this experiment. The equipment used included scales, buckets, hoes, sickles, scissors, tags, stakes, brand boards, ropes, paddles, calculators, scissors, and stationery.

Using a Randomized Block Design (RCD) with five treatments and four groups, this study resulted in 20 experimental plots each measuring one by one meter. Each plot contained sixteen plants, three of which were randomly selected sample bibs. At the 5% actual level, the F test was used to statistically assess and average the observed data. A second DNMRT test at the 5% actual level will be conducted if the calculated F is higher than the F table. The treatments include the application of PSB biofertilizer at the following concentrations: Provide a range of PSB biofertilizer concentrations as follows: 0 ml/liter of water, 10 ml/liter, 20 ml/liter, 30 ml/liter, and 40 ml/liter of water as the first five choices.

The seeds used were the Takecai variety, pagoda mustard seeds purchased at a kiosk where agricultural materials and tools and have passed the BPSB (Seed Certification Testing Center) test. Before the seeds are planted in the seedbed, they are first put into a nursery box where the planting medium is a mixture of soil and manure in a ratio of 1:1. 10-14 HST is when the seeds are in the nursery. Created photosynthetic bacteria with a solution of water, MSG and eggs. For two weeks, the component mixture is fermented until photosynthetic bacteria develop. Store outdoors or expose to the sun. Depending on the water used, the color may turn reddish orange, yellow, or dark brown (appendix 4). This indicates that the fermentation process is successful (Seminar and *Proceding* PAGI ., 2019)

Tillage is the process of removing weeds and other unwanted plants from the field, then hoeing and chopping the soil and letting it sit for a week. A week later, experimental plots measuring 1 m × 1 m were made, with a distance between plots of 50 cm, a distance between plots of 30 cm, distance between plots and field boundaries of 30 cm, and a plot perimeter of 1 m high. Previously, ten

tons of chicken manure per hectare, or one kilogram per plot, was applied to each plot.

The second tillage was followed by planting for a week, planting seedlings that were 2 weeks old by planting 1 seedling per planting hole with a depth of 3-5 cm, planting distance of 25 cm x 25 cm. The planting hole is watered so that the soil in the planting hole becomes moist. Planting is done in the afternoon. Stakes were placed 5 cm from the back of the plants, and treatment-specific labels were placed on each experimental plot. A marker was set five centimeters above the soil surface on each sample bibt stake. This was to prevent any changes in measurements.

The application of photosynthetic bacteria began at the age of 2 weeks, 3 weeks and week 4. The application of bacteria is done by spraying into the bibt which has been dissolved in water according to the treatment. The treatments are A: 0 ml/liter of water B: 10 ml/liter of water C: 20 ml/liter of water D: 30 ml/liter of water and E: 40 ml/liter of water. To get PSB with a concentration of 10 ml/liter of water is done by taking 10 ml of PSB and adding 990 ml of water. In the treatment of PSB with a concentration of 20 ml/liter of water is done by taking 20 ml of PSB and 980 ml of water. In the treatment of PSB with a concentration of 30 ml / liter of water is done by adding 30 ml of bacteria and adding 970 ml of water and in the provision of PSB treatment with a concentration of 40 ml / liter of water is done by adding 40 ml of PSB and adding 960 ml of water. Each experimental plot was given 1 liter of PSB solution which was sprayed evenly on all plants.

Watering is done from planting to harvesting. Every day the soil is watered until moist in the morning and evening. On rainy days, watering is not done. Replacing seedlings that die or do not grow is a way of replanting. Replanting is done in the afternoon and at 7 to 10 HST.

After the bibt had grown to 14 HST, fertilizers were applied as recommended, namely urea 50 kg/ha (5 g/acre), SP36 50 kg/ha (5 g/acre), and KCl 50 kg/ha (5 g/acre). Between each plant, a row of fertilizer was applied.

Hilling is done at the same time as weeding to strengthen the stem posture and prevent the bibt from falling over and cover the roots that protrude above the soil surface. 2 WAP is used for beginners. The hilling process includes hilling the soil on the right and left sides of the plant rows. At 1 MST, temporary weeding is carried out. Weeding can be done with a hoe or by pulling weeds that grow around the bibt by hand.

Outdoors, caterpillars are pests that target pagoda mustard bibt. Control is carried out using chemical and mechanical methods. Removal of pests from the bibt environment is done mechanically. Natural insecticides prepared from a mixture of soursop, papaya, onion and sunshine leaves were sprayed to achieve chemical control. Application of natural insecticides during the day is done every other day.

The pagoda mustard bibt at the age of 41 HST was harvested. The leaves must be fresh and healthy, the base of the leaves must be healthy, and the bibt

height must be consistent and even for pagoda mustard to be harvested. Bibt in the allotment is pulled out by hand at the time of harvest.

The weight of each bibt (g), weight of each plot (kg), number of leaves per bibt (pieces), length of the longest leaf (cm), width of the widest leaf (cm), root length (cm), and weight per hectare (tons) were all recorded.

RESEARCH RESULT

a. Plant Height (cm)

Based on statistical analysis using the F test at the 5% level and then the DNMRT test at the 5% level, Table 1 displays the measurement findings of pagoda mustard height with the application of varying amounts of PSB biofertilizer.

Table 1. Height of Pagoda mustard seedlings at several concentrations of PSB biofertilizer at the age of 41 HST.

PSB Biofertilizer Concentration	Bibit height (cm)
40 ml/liter of water	15,92 a
30 ml/liter of water	15,09 b
20 ml/liter of water	14,50 b
10 ml/liter of water	14,25 b
0 ml/liter of water	13,42 c
KK	**6,08 %**

The numbers in the column above followed by the same lowercase letter are significantly different according to the DNMRT test at the 5% level

The high level of pagoda mustard seedlings on the application of 40 ml/L PSB biofertilizer concentration is due to the concentration of 40 ml/L is the optimal concentration for photosynthetic bacteria to work effectively so as to provide maximum benefits for the growth of pagoda mustard seedlings. In line with the opinion of (Pereira, Ribeiro, and Sousa, 2021) which states that photosynthetic bacteria (PSB) have the ability to fix nitrogen using sunlight energy so as to increase the high growth of pagoda mustard seedlings. Photosynthetic bacteria have a nitrogenase enzyme that can catalyze the nitrogen fixation reaction. Nitrogen fixation reaction is a complex reaction and requires a large amount of energy. Photosynthetic bacteria can fix nitrogen in the form of ammonia (NH3). Ammonia is a compound that is easily absorbed by plants. Bibt can use ammonia to form proteins, amino acids, and other nitrogen compounds needed for growth. Photosynthetic bacteria can fix nitrogen in various environmental conditions, including soil conditions that are poor in nitrogen nutrients.

b. Number of Leaves (cm)

Based on statistical analysis using the F test at the 5% level and the DNMRT test at the 5% level, Table 2 displays the findings of the pagoda mustard leaf count when PSB biofertilizer is applied in varying amounts.Table 2. Number of Pagoda Mustard Leaves at several concentrations of PSB biofertilizer at 41 HST.

PSB Biofertilizer Concentration	Number of Leaves
40 ml/liter of water	63,25 a
30 ml/liter of water	59.92 a b
20 ml/liter of water	57.34 a b
10 ml/liter of water	54,09 b
0 ml/liter of water	51,33 b
KK	**8,28%**

The numbers in the column above followed by the same lowercase letter are significantly different according to the DNMRT test at the 5% level

The higher number of leaves at the concentration of 40 ml/L PSB biofertilizer is because the concentration is the optimal concentration so that photosynthetic bacteria (PSB) can act as their function. Where photosynthetic bacteria (PSB) produce organic compounds, such as amino acids, vitamins, or growth hormones (such as auxins), which can stimulate plant photosynthetic activity. With more efficient photosynthesis, the bibit has more energy for vegetative growth, including leaf formation. Photosynthetic bacteria also produce growth hormones such as auxin and cytokinin. These hormones stimulate cell division and leaf bud development, thus increasing the number of leaves This is in line with the opinion of Soeparjono and Syamsunihar (2015) Photosynthetic bacteria produce organic matter through photosynthesis, which can be used by bibt as an additional source of carbon and energy that can increase soil productivity and support plant growth. The use of photosynthetic bacteria (PSB) can stimulate sucrose synthase activity in the vegetative phase, which has the potential to increase the efficiency of plant vegetative organs.

c. Widest Leaf Width (cm) and Longest Leaf Length (cm)

Based on statistical analysis using F test at 5% level and DNMRT test at 5% level, Table 3 shows the monitoring findings of the largest leaf width and the longest leaf length of pagoda mustard when applying varying amounts of PSB biofertilizer

Table 3. Widest Leaf Width (cm) and Leaf Length of Pagoda Mustard at several concentrations of PSB Biofertilizer at 41 HST.

"PSB Biofertilizer Concentration	Widest Leaf Width (cm)	Longest Leaf Length (cm)
40 ml/liter of water	7,17 a	13,25 a
30 ml/liter of water	6,59 b	12,75 b
20 ml/liter of water	6,50 b	12,33 b
10 ml/liter of water	6,25 b	11,85 c
0 ml/liter of water	6,0 c	11,58 c
KK:	**6,01%**	**4,86%"**

"The numbers in the column above followed by the same lowercase letter are significantly different according to the DNMRT test at the 5% level"

The longer and wider leaves of pagoda mustard greens by giving photosynthetic bacteria with a concentration of 40 ml / L is due to the concentration of 40 ml / L, which is the optimal concentration to increase bibt metabolism without causing negative effects, thus giving the best results on the growth of pagoda mustard greens leaves. Where photosynthetic bacteria can increase the rate of photosynthesis, tether the nitrogen element in the air and produce growth regulators such as auxins that stimulate division and elongation of plant cells. This has an impact on increasing the size of the leaves both in length and width. In line with Oktalia's opinion (2019) which states Table 3 shows the findings of statistical analysis using the F test at the 5% level and the DNMRT test at the 5% level to observe the widest leaf width and longest leaf length of pagoda mustard greens by applying varying amounts of PSB biofertilizer.

d. Root Length (cm)

Based on statistical analysis using F test at 5% level and DNMRT test at 5% level, Table 4 displays the findings of root length measurements of pagoda mustard with varying amounts of PSB biofertilizer.

"PSB Biofertilizer Concentration	Root Length
40 ml/liter of water	12,58 a
30 ml/liter of water	12,33 a
20 ml/liter of water	12,03 a
10 ml/liter of water	11,08 b
0 ml/liter of water	10,18 c

KK:	**8,95%"**

Table 4. Root Length of Pagoda Mustard at several concentrations of PSB Biofertilizer at the age of 41 HST.

The numbers in the column above followed by the same lowercase letter are significantly different according to the DNMRT test at the 5% level

The longer root length of pagoda mustard bibt at PSB biofertilizer concentration of 20-40 ml/L is due to photosynthetic bacteria that can help increase the availability of nitrogen in the soil, which is an important element for root growth. With sufficient nitrogen, bibt can carry out photosynthesis more efficiently, producing the energy needed for root growth. This is in line with the opinion of Tambunan (2024) that the provision of PSB can help fix nitrogen, namely converting atmospheric N into a form that can be used by plants.

In addition, the provision of photosynthetic bacteria can produce phytohormones such as auxin (*indole-3-acetic acid/IAA*). The hormone auxin stimulates cell division and root elongation, resulting in longer and more branched roots. Auxin serves to stimulate the formation of new roots, mainly through a process known as root initiation. This hormone helps in accelerating cell division and cell differentiation in the root region, thereby increasing the number and length of roots formed. According to (Nofiyanti et al., 2021) explains about the hormone auxin as a whole plays a role in increasing rooting, inducing root initiation, improving root quality, and helping root uniformity (Nofiyanti et al., 2021) .

e. Wet Weight Per Seed (g), Wet Weight Per Plot (kg) and Wet Weight Per Hectare (tons)

The results of observations of plant wet weight, wet weight per plot and wet weight per hectare of pagoda mustard greens on the application of several concentrations of PSB biofertilizer after statistical analysis using the F test at the 5% level and followed by the DNMRT test at the 5% level can be seen in Table 5.

Table 5. Plant Wet Weight, Plot Wet Weight and Per Hectare Wet Weight of Pagoda Mustard at several concentrations of PSB Biofertilizer at the age of 41 HST.

PSB Biofertilizer Concentration	Wet Weight Per Seed (g)	Wet Weight Per Plot (kg)	Wet weight per hectare (tons)
40 ml/liter of water	191,75 a	1,64 a	16,38 a
30 ml/liter of water	183,50 a	1,54 b	15,38 b
20 ml/liter of water	158,75 b	1,44 c	14,38 c
10 ml/liter of water	155,33 b	1,41 c	14,13 c
0 ml/liter of water	143,17 c	1,40 c	14.00 c

KK:	**11,77%**	**5,29%**	**5,29%**

The numbers in the column above followed by the same lowercase letter are significantly different according to the DNMRT test at the 5% level

Ummah (2019) explained that when pagoda mustard seedlings received 40 ml/L photosynthetic bacteria biofertilizer, their high wet weight was directly correlated with previous vegetative growth, including height, number of leaves, longest leaf length, widest leaf width, and root length. These parameters are more effective when the concentration of photosynthetic bacteria is 40 ml/L, thus affecting the wet weight of pagoda mustard seedlings. Ummah (2019)explains that the increase in bibt weight will be followed by an increase in bibt height and number of leaves to increase plant biomass. According to (Asiva Noor Rachmayani, 2015) explains that the fresh weight of bibt reflects the composition of water and nutrients it absorbs. Water makes up about 70% of the weight of the plant.

In addition, a major factor in the vegetative growth of bibt is the process of photosynthesis. The photosynthesis process produces photosynthates necessary for the construction of plant organ systems and tissues. Water, CO2, nutrients, and sunlight all have an impact on the photosynthesis process. A favorable environment, sufficient nutrients, and water availability will increase the rate of photosynthesis in healthy vegetative growth.

CONCLUSION

From the experiments that have been carried out, it can be concluded that the application of photosynthetic bacterial biofertilizer concentration of 40 ml/L can increase the growth and yield of pagoda mustard**.** From the experiments that have been carried out can be suggested in the cultivation of pagoda mustard seeds can be given photosynthetic bacterial biofertilizer with a concentration of 40 ml / L.

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