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THE EFFECT OF PROVIDING TYPES OF BIOLOGICAL AND RHIZOBIUM FERTILIZERS ON SOYBEAN (Glycine max L) CROP PRODUCTION

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Abstract

This research aims to determine the effect of giving Biohayati fertilizer, giving Rhizobium bacteria and also the interaction of giving Biohayati fertilizer on soybean production. This research was carried out in Laut Tador Village, Batu Bara Regency, North Sumatra Province. At an altitude of ± 12 meters above sea level with flat topography. This research used a factorial RAK (randomized group design) with 2 treatment factors. The first factor is the provision of Bio-Biological Fertilizer, which consists of four levels, namely: B0 = No treatment, B1 = Bio-biotic solution with a dose of 18 ml/liter of water, B2 = Bio-biological solution with a dose of 20 ml/liter of water, B3 = Bio-biological solution with a dose of 22 ml/liter of water. The second factor is that the administration of Rhizobium bacteria is carried out at three levels, namely: R0 = no treatment, R1 = Rhizobium at a dose of 1.6 kg/plot (seeds mixed with Rhizobium solution), R2 = Rhizobium at a dose of 1.8 kg/plot (Rhizobium is watered in land). The results of the research show that the effect of providing Biohayati has a significant effect on soybean plant production, namely the number of pods and filled pods. The effect of giving Rhizobium bacteria has a significant effect on soybean plant production, namely the number of pods and filled pods. The interaction effect of giving Biohayati and Rhizobium bacteria on soybean production did not have a significant effect. Providing a biological solution at a dose of 22 ml/liter of water and Rhizobium at a dose of 1.6 kg/production plot to soybean plants is the best dose.

Keywords: ***Rhizobium fertilizer, Biohayati, Soybeans, Root nodules***

1. INTRODUCTION

Soybeans are widely used in food and industry, therefore the need for soybeans to meet market demand has increased. Soybeans can be processed into food and drinks. Apart from the seeds being used, the slightly dried leaves and stems can also be used as animal feed and green manure. Soybean productivity can be increased through cultivation techniques and fertilization. Soil as a medium for plant growth has a limited carrying capacity both as a source of nutrients and moisture. Soil management and fertilizer application must be carried out efficiently and effectively to obtain sustainable benefits without causing environmental damage. So far, fertilization programs have placed more emphasis on productivity aspects rather than total uptake by plants or economic aspects (Adisarwanto et al., 2016). Biofertilizer is an inoculum that contains live or latent cells from various types of efficient microbes that can live in symbiosis with plants or live freely, which have the ability to fix N2 from the air, or dissolve/mobilize phosphate nutrients from forms that cannot be utilized. plants into forms that can be utilized by plants, breaking down organic matter, the most famous example is rhizobia inoculum which is used to stimulate air N2 fixation in laguminosa plants. Various types of biological fertilizers can improve phosphate nutrition, such as phosphate solubilizing bacteria (Hanafiah, et al, 2009).

Rhizobium bacteria are bacteria that can form a symbiotic relationship with legume plants, form root nodules, and fix nitrogen from the air so that they can meet the plant's nitrogen needs by at least 75%. Bacteria that are able to bind free N2 are of the genus Rhizobium, but can only live if they are in symbiosis with plants from the Leguminoceae tribe (Purwaningsih, 2008). Rhizobium bacteria are soil microbes that are able to bind free nitrogen in the air to become ammonia (NH3) which will be converted into amino acids which then become nitrogen compounds that plants need to grow and develop. If sufficient N is available to plants, the chlorophyll content in the leaves will increase and the photosynthesis process will also increase so that more assimilate is produced, resulting in better plant growth (Purwantari, 2012).

2. IMPLEMENTATION METHOD

This research was conducted in Laut Tador Village, Batu Bara Regency, North Sumatra Province. At an altitude of ± 12 meters above sea level with flat topography. This research used a factorial RAK (randomized group design) with 2 treatment factors. The first factor is the provision of Biohazardous Fertilizer, which consists of four levels, namely: B0 = No treatment B1 = Biohazardous solution with a dose of 18 ml / liter of water B2 = Biological solution with a dose of 20ml / liter of water, B3 = Biohazardous solution with a dose of 22ml / liter of water . The second factor is that the administration of Rhizobium bacteria is carried out at three levels, namely: R0 = without treatment, R1 = Rhizobium at a dose of 1.6 kg/plot (seeds mixed with Rhizobium solution), R2 = Rhizobium at a dose of 1.8 kg/plot (Rhizobium is watered in land). The Biohayati organic fertilizer fertilization treatment was carried out 2 times. The dose is given according to the recommended dose one day after planting and given again 30 days after planting, while organic (bacterial) Rhizobium fertilization in the soil (plot) is given according to the existing treatment. Rhizobium is given in two stages, namely in the first application before the seeds are planted, the seeds are first sprinkled with rhizoka solution. The second treatment is given again according to the recommended dose two days after planting.

3. RESULTS AND DISCUSSION

Number of Pods

The results of variance analysis showed that the application of biochemicals had a significant effect on the number of pods, while the application of Rhizobium bacteria had a significant effect on the number of pods. The interaction between providing bio-organisms and Rhizobium bacteria had no significant effect on the number of pods. The results of the test of the average difference between the provision of bio-organisms and Rhizobium bacteria on the number of pods are seen in Table 1.

Table 1. Application Mean Difference Test for Providing Biologicals and Rhizobium Bacteria Against the Number of Pods

Treatment	R0	R1	R2	Average
B0	25.38	29.52	28.48	27.79 d
B1	24.33	42.33	25.90	30.86 c
B2	28.62	28.00	37.14	31.25 b
B3	38.14	33.19	39.24	36.86 a
Average	29.12 c	33.26 a	32.69 b	

Note : Numbers followed by letters that are not the same in the same treatment group are significantly different at the 5% level based on the DMRT test and those without notations indicate that they are not significantly different.

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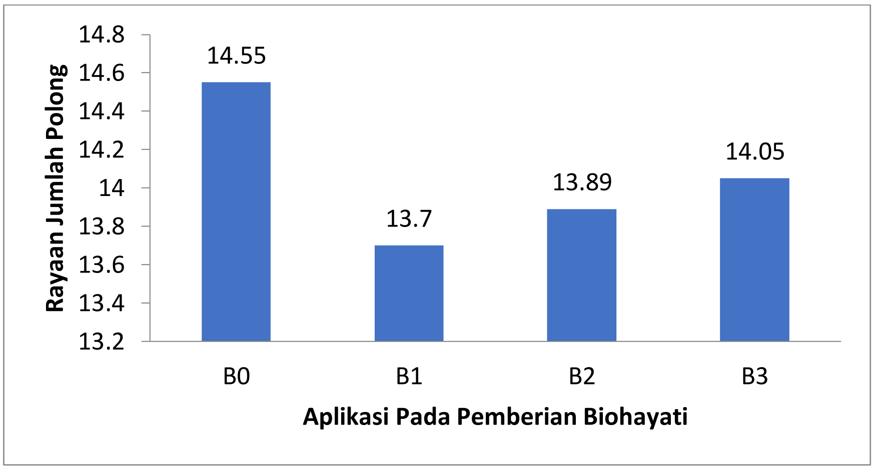

Figure 1. Average Application of Biobiological Applications to the Number of Pods

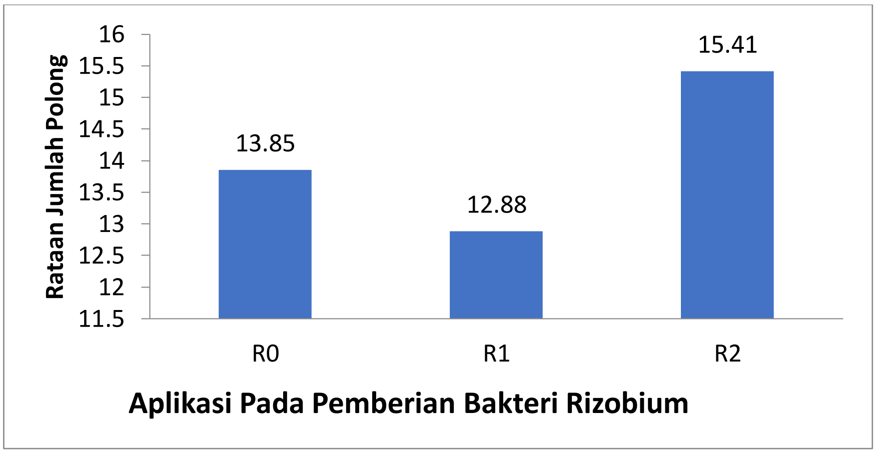

Figure 2. Average Application of Giving Rhizobium Bacteria to the Number of Pods

According to Padjar (2012), the first soybean pods are formed around 7 - 10 days after the appearance of the first flowers or after 28 - 35 HST so this causes the flowering period to be delayed and the flowering of edamame is not uniform, as a result the pods formed are few compared to the number of pods planted. soybeans that grow in an environment that supports the flowering period, the difference in the number of pods in soybean yield is due to differences in the rate of photosynthesis during the reproductive phase, which is less than optimal. Good upper growth will support the photosynthesis process during the seed filling period, which is around 35 HST during the flowering period and pod formation is also influenced by temperature and humidity and the average temperature during the flowering period or at 28 - 35 HST is 28.25º C, while The optimal temperature for flowering is 24º C – 25º C (Hidayat, 2016).

Number of Pods Contained/plant (pods)/sample

The results of variance analysis showed that the application of biochemicals had a significant effect on the number of filled pods, while the application of Rhizobium bacteria had a significant effect on the number of filled pods. The interaction between providing bio-organisms and Rhizobium bacteria had no significant effect on the number of filled pods. The test results of the average difference between the provision of bio-organisms and Rhizobium bacteria on the number of filled pods are seen in Table 2.

Table 2. Application Mean Difference Test for Providing Biologicals and Rhizobium Bacteria Against the Number of Pods Contained

Treatment	R0	R1	R2	Average
B0	24.43	30.19	33.24	29.29 d
B1	28.00	37.05	30.90	31.98 b
B2	32.86	27.29	31.86	30.67 c
B3	28.95	27.52	42.00	32.83 a
Average	28.56 c	30.51 b	34.50 a	

Note : Numbers followed by letters that are not the same in the same treatment group are significantly different at the 5% level based on the DMRT test and those without notations indicate that they are not significantly different.

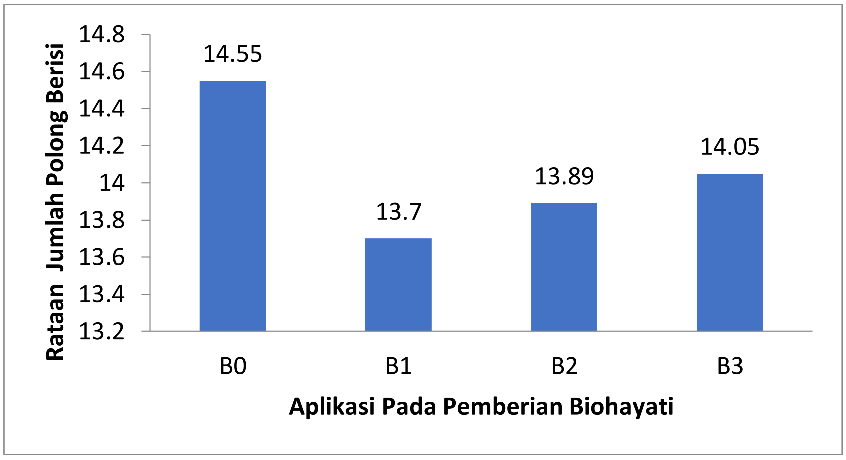

Figure 3. Application to the Provision of Biobiology on the Number of Pods Contained

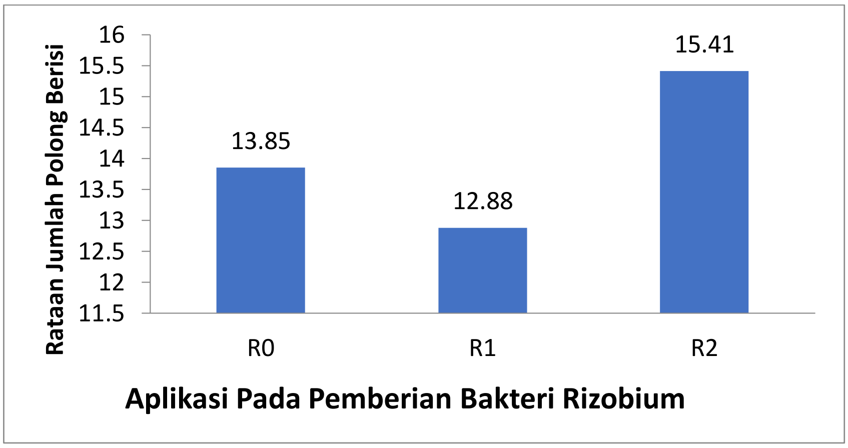

Figure 4. Application to Providing Rhizobium Bacteria on the Number of Pods Contained

The maximum results obtained in the B3 treatment are thought to be caused by the large amount of N contained in the bio-organisms, so that the N needs of soybean plants are met. This is confirmed by the opinion of Ratmawati (2017), in her research explaining that the greater the number of filled pods, the greater the number of seeds produced.

Number of Empty Pods

The results of variance analysis showed that the application of biobiologicals had no significant effect on the number of empty pods, while the application of Rhizobium bacteria had no significant effect on the number of empty pods. The interaction between providing bio-organisms and Rhizobium bacteria had no significant effect on the number of empty pods. The test results of the average difference between the provision of bio-organisms and Rhizobium bacteria on the number of empty pods are seen in Table 3.

Table 3. Application Mean Difference Test for Providing Biologicals and Rhizobium Bacteria Against the Number of Empty Pods

Treatment	R0	R1	R2	Average
B0	3.24	2.38	2.29	2.63
B1	3.81	2.48	2.67	2.98
B2	2.24	3.24	2.29	2.59
B3	2.90	2.67	3.57	3.05
Average	3.05	2.69	2.70	

Note : Numbers followed by letters that are not the same in the same treatment group are significantly different at the 5% level based on the DMRT test and those without notations indicate that they are not significantly different.

The results of Table 3 show that the highest application of biofertilizer was found in the number of empty pods in the treatment (B3) of 3.05 and the lowest in the treatment (B2) 2.59, while the application of rhizobium bacteria was highest in the treatment (R0) 3.05 and the lowest was in the treatment (R1) 2.69. Rhizobium is a group of bacteria that has a symbiotic relationship with leguminous plants which is able to fix abundant N2 in the air, the results of which can be used for plant growth. In line with research that has been carried out, the results of research by Permanasari et al (2014) state that giving Rhizobium increases the number of pods by 13.22% compared to without giving Rhizobium. This means that the bacteria that work together with the root nodules affect the plants in the form of pods so that plants given Rhizobium have a greater number of pods compared to plants that are not given Rhizobium. On the problem of empty pods, the role of Biobiology is very clear that it cannot have an influence because this problem arises during the seed development and pod growth phase which causes the pods and seeds to become deflated and then the pods become dry and empty. This is thought to be because when providing Biohayati the nutrients needed by plants are not available in a balanced state and cannot trigger good growth (Syamsafitri, et al., 2023).

Number of Root Nodules

The results of variance showed that the application of biobiologicals had no significant effect on the number of root nodules, nor did the application of Rhizobium bacteria have a significant effect on the number of root nodules. The interaction of bioavailables and Rhizobium bacteria also had no significant effect on the number of root nodules.

Table 4. Application Mean Difference Test for Providing Biologicals and Rhizobium Bacteria On the Number of Root Nodules

Treatment	R0	R1	R2	Average
B0	8.33	10.29	13.95	10.86
B1	14.05	10.81	8.95	11.27
B2	15.00	16.00	13.62	14.87
B3	18.43	14.38	16.90	16.57
Average	13.95	12.87	13.36	

Note: Numbers followed by letters that are not the same in the same treatment group are significantly different at the 5% level based on the DMRT test and those without notations indicate that they are not significantly different.

The results of Table 4 show that the highest application of biofertilizer was found in the number of root nodules in the treatment (B3) of 16.57 and the lowest in the application treatment (B0) 10.86, while the highest application of rhizobium bacteria was in the treatment (R2) 13.36 and the lowest was in the treatment (R0) 13.95. Rhizobium is the most important bacteria in nitrogen fixation (Wirmas, et al., 2006). Rhizobia cause the formation of root nodules on the roots of legume plants. Without rhizobia, legume plants cannot fix nitrogen, whereas without rhizobia, legume plants cannot fix nitrogen. The success of an inoculation depends on the effectiveness and efficiency of the bacteria involved, and their compatibility with the host plant (Sumarno and Harnoto, 1983). Freire (1977) added that the technique and time of inoculation also greatly influence growth. so they have different abilities in adapting and the ability to compete with indigenous microbes. This indicates that the inoculated Rhizobium bacteria have a positive response to the growth of soybean plants. As stated by Bertham et al., 2009, the number of root nodules is an indicator of the success of Rhizobium inoculation which is often used to assess its effect on the growth and yield of soybean plants.

Seed/plant weight

The results of variance analysis showed that the application of biobiologicals had no significant effect on seed/plant weight (g) while the application of Rhizobium bacteria had no significant effect on seed/plant weight (g). The interaction of providing bio-organisms and Rhizobium bacteria had no significant effect on seed/plant weight.

Table 5. Application Mean Difference Test for Providing Biologicals and Rhizobium Bacteria Against Seed/plant Weight (g)

Treatment	R0	R1	R2	Average
B0	3.24	4.76	3.68	3.89
B1	3.24	5.22	4.03	4.16
B2	6.54	2.77	4.57	4.63
B3	5.61	3.84	6.86	5.44
Average	4.66	4.15	4.79	

Note: Numbers followed by letters that are not the same in the same treatment group are significantly different at the 5% level based on the DMRT test and those without notations indicate that they are not significantly different.

The results of Table 5 show that the highest application of biofertilizer was found in the seed/plant weight treatment (B3) of 5.44 g and the lowest was in the application treatment (B0) 3.89 g, while the highest application of rhizobium bacteria was in the treatment (R2) 4.79 g. and the lowest was in the treatment (R1) 4.15. This is thought to be because Biohayati fertilizer and Rhizobium bacteria is one of the fertilizers which has an important role in fixing phosphorus which has a growth function in producing seeds and accelerating the ripening of pods. This is in accordance with the statement in Cahyono (2014) which states that Biohayati fertilizer which contains a lot of P elements is very necessary for plant growth, especially early growth, increasing pod formation, and accelerating pod maturity.

Weight of 100 Seeds (g)

The results of variance analysis showed that the application of biobiologicals had no significant effect on the weight of 100 seeds (g) while the application of Rhizobium bacteria had no significant effect on the weight of 100 seeds (g). The interaction between providing bio-organisms and Rhizobium bacteria had no significant effect on the weight of 100 seeds. The results of the test for the average difference between the provision of bio-organisms and Rhizobium bacteria on the weight of 100 seeds (g) are seen in Table 6.

Table 6. Application Mean Difference Test for Providing Biologicals and Rhizobium Bacteria Against the Weight of 100 Seeds (g)

Treatment	R0	R1	R2	Average
B0	14.05	12.42	17,19	14.55
B1	14.20	15.20	11.69	13.70
B2	12.41	12.32	16.93	13.89
B3	14.75	11.57	15.84	14.05
Average	13.85	12.88	15.41	

Note: Numbers followed by letters that are not the same in the same treatment group are significantly different at the 5% level based on the DMRT test and those without notations indicate that they are not significantly different.

The results of Table 5 show that the highest application of biofertilizer was found in the number of root nodules in the treatment (B3) of 14.05g and the lowest was in the application treatment (B1) 13.70g. Meanwhile, the highest application of rhizobium bacteria was in treatment (R2) 15.41g and the lowest was in treatment (R1) 12.88g, weight of 100 seeds. This means that an increase in seed weight per plant is not always followed by a weight of 100 seeds. When related to the number of filled pods, varieties that have many filled pods will have small seed sizes, due to competition between seeds for photosynthate (Susanto and Adie, 2006). The optimal growth phase can increase optimal plant production results as well. This is in line with the opinion of Hamida and Nugraheni (2011) who explained that plant height and stem diameter can influence fiber production, this is because plant height is a reflection of the length of fiber that will be produced. This is also reinforced by the opinion of Hamida and Nugraheni (2011) explaining that a good vegetative phase is reflected by plant height and plant diameter which will result in high productivity.

4. CONCLUSION

1. Providing Biohayati has a significant effect on soybean plant production, namely the number of pods and the number of filled pods.
2. Providing Rhizobium bacteria has a significant effect on soybean plant production, namely the number of pods and the number of filled pods.
3. Interaction of providing Biohayati and Rhizobium bacteria on plant production
4. Providing a biological solution at a dose of 22 ml/liter of water containing Rhizobium at a dose of 1.6 kg/production plot to soybean plants is the best dose.

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