International Journal of Educational Research Excellence (IJERE)
https://ejournal.ipinternasional.com/index.php/ijere
Volume 01, Number 02, December 2022
e-ISSN: 2830-7933
Doi: https://doi.org/10.55299/ijere.v1i2.647

EFFICIENCY OF NPK FERTILIZATION AND ADDITION OF BIODIVE FERTILIZERS ON THA PRODUCTION OF SOYBEAN (*Glycine max* (L) Merill)

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Article history: received 04 November 2022; revised November 16, 2022; accepted November 29, 2022

Abstract. This research was carried out at the Experimental Garden of the Faculty of Agriculture, Islamic University of North Sumatra, Jln. Eka Warni, Medan Johor District, Medan Municipality with a height of ± 25 meters above sea level with flat topography. The aim of the research was to determine the effect of providing biological fertilizer by reducing the dose of NPK fertilizer on soybean crop production. This research used the Factorial Randomized Block Design (RBD) method with two factors studied, namely: The first factor is bio quality (H) biological fertilizer which consists of 2 treatment levels, namely H_0 (Control), H_1 (10 cc/l water); The second factor is NPK fertilizer with 4 treatment levels, namely N_0 (Control), N_1 (20 g/plot), N_2 (40 g/plot) and N_3 (60 g/plot). The parameters observed were the number of pods per plant, seed weight per plant, production per plot and weight of 100 seeds. The results of the research showed that the application of bio quality biological fertilizer had a significant effect on production per plot and the number of pods per plant, but had no significant effect on the weight of seeds per plant and the weight of 100 seeds. Providing NPK fertilizer had a significant effect on the number of pods per plant and seed weight per plant , but had no significant effect on production per plot and the weight of 100 seeds. Meanwhile, the interaction between biological fertilizer and NPK fertilizer had a significant effect on production per plot and seed weight per plant, but had no significant effect on the number of pods per plant and the weight of 100 seeds.

Keywords: Soybeans, NPK fertilizer, bio quality biological fertilizer

INTRODUCTION

Soybean is a commodity that has commercial value and good prospects for development because it is really needed by the Indonesian population as a source of vegetable protein. The protein standard required by the Indonesian population per day is 46 g of protein per person and can only be met at around 37-39 g. The protein content of soybeans can range from 50%, carbohydrates 15-25% and new cultivars contain up to 25% oil (Arsyad, 2001).

Based on BPS data (2013), soybean production in 2013 was 807,568 tons of dry beans and this production amount decreased compared to production in 2012, namely 843,153 tons. Meanwhile, in North Sumatra itself, soybean production decreased from 5419 tonnes (2012) to 3163 tonnes (2013). This decrease was caused by a decrease in harvested area, which in 2012 was 5475 Ha to 3080 Ha in 2013

Soybean productivity can be increased, including by improving cultivation techniques through fertilization systems and the use of superior varieties. Soybean plants have many varieties, each variety will provide different growth responses and production levels. Each variety has different genetic characteristics , this can be seen from the appearance and character of each variety. Thus it can be stated that soybean growth and production will be influenced by varieties, soil and plant management, as well as other environmental conditions (Hindersah, 2004).

The current condition of agricultural land is quite worrying, where quite a lot of agricultural land has been damaged due to the continuous use of land and chemical fertilizers which has caused

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soybean productivity to decline. The provision of chemical fertilizers must be balanced with the provision of organic fertilizers. Chemical fertilizers play a role in providing large amounts of nutrients for plants, while organic materials tend to play a role in maintaining soil function so that the nutrients in the soil are easily utilized by plants to absorb the nutrients provided by chemical fertilizers (Pratama, 2011) .

In soybean plants, the application of biological fertilizer can reduce the need for nitrogen fertilizer by 100%, phosphorus 25-50% and potassium 50% of the recommended amount, while in peanut plants, the application of biological fertilizer can reduce the need for NPK fertilizer by 25-50% and increase yields. The results of research by Cahyadi (2011) showed that the application of biological fertilizer to caisin plants combined with 0.5 to 1 dose of NPK was able to produce a wet weight of canopy per plant that was no different from treatment with 1 dose of NPK alone. Thus, the use of biological fertilizer can reduce the use of inorganic fertilizer by up to 50%. Based on this, it is hoped that the use of chemical fertilizers can be reduced in relation to the damage to agricultural land due to the negative effects of the use of chemical fertilizers (Arsyad, 2001).

RESEARCH METHODS

This research was carried out at the Experimental Garden of the Faculty of Agriculture, Islamic University of North Sumatra, Jln. Eka Warni, Medan Johor District, Medan Municipality. Height ± 25 meters above sea level with flat topography. This research was carried out from April to July 2018.

Research uses a factorial Randomized Block Design (RBD) which consists of 2 factors, namely: The first factor is Biological Fertilizer (H) which consists of 2 levels, namely: H 0 = Control, H 1 = Biological Fertilizer (10 cc/l water) .The second factor is the dose of NPK fertilizer (N) which consists of 4 levels, namely: N_0 = Control, N_1 = 50 kg/ha (20 g/plot), N_2 = 100 kg/ha (40 g/plot), N_3 = 150 kg/ha (60 g/plot). So that a total of 8 treatments were obtained with 3 repetitions, so 24 treatments were obtained. The parameters observed were soybean plant production, namely number of pods per plant (pods) , seed weight per planting (g), production per plot (kg), weight of 100 seeds (g).

RESEARCH RESULTS

Number of Pods per Plant (Pods)

The results of the analysis of variance showed that biological fertilizer treatment on the growth response and production of soybeans had a significant effect on the parameters of the number of pods per plant. The results of the analysis of variance showed that NPK fertilizer treatment on the response to growth and production of soybeans had a significant effect on the parameter number of pods per plant, but the interaction had no significant effect on the parameter number of pods per plant. Below is presented parameter data for the number of pods per plant.

Table 1. Average Number of Pods per Soybean Plant with Bio Quality Biofertilizer and NPK Fertilizer Treatment

Organic fertiliser	NPK Fertilizer				Average
	N_0	N_1	N_2	N_3	
H_0	27.67	27.67	28.07	29.13	28.14a
H_1	28.13	28.33	29.80	30.33	29.15b
Average	27.90a	28.00a	28.94b	29.73ab	

Note: Numbers followed by letters that are not the same in the same treatment group are significantly different based on the Duncan test at the 5% level.

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From Table 1 it can be seen that the treatment of providing biological fertilizer had a significant effect on the number of pods per plant, where the highest number of pods was obtained in H_1 (10 cc/l water), namely 29.15 which was significantly different from H_1 (10 cc/l water) which is 29.15. NPK fertilizer treatment had a significant effect on the number of pods per plant. The highest number of pods was obtained in N_3 (60 g/plot), namely 29.73, which was significantly different from N_1 (20 g NPK fertilizer/plot), namely 28.00 and N_0 (Control), namely 27.90, but not significantly different from the N_2 (40 g/plot), namely 28.94.

The relationship between the application of biological fertilizer and the number of pods per plant is linear with the equation $\hat{Y} = 0.101x + 28.14$ where the correlation is r = 0.99. This can be seen in Figure 1.

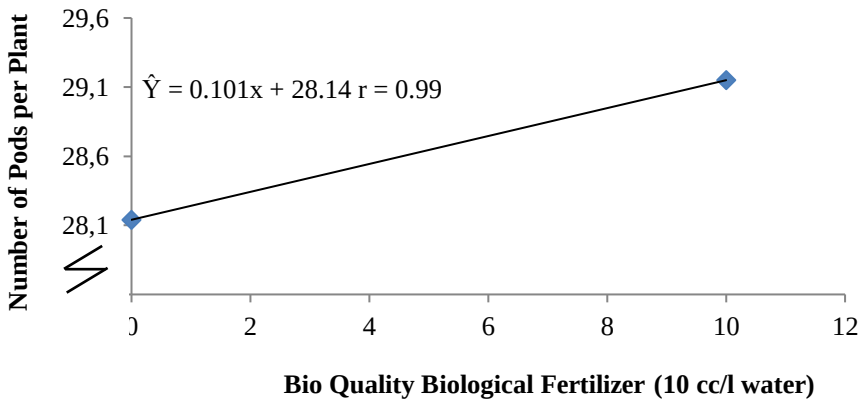

Figure 1. Relationship between the number of pods per soybean plant and the provision of bio-quality biological fertilizer (cc/l a ir).

The relationship between NPK fertilizer application and the number of pods per plant is linear with the equation $\hat{Y} = 0.0321x + 27.678$ where the correlation r = 0.9248 . This can be seen in Figure 2.

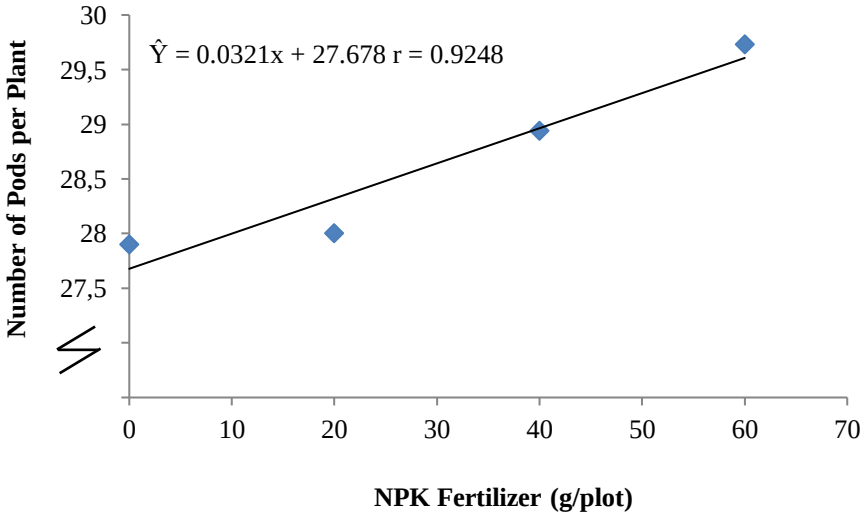

Figure 2. Relationship between the number of pods per soybean plant and the application of NPK fertilizer (g/plot).

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e-ISSN: 2830-7933
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However, the interaction between the two treatments had no significant effect on the number of pods per plant. The highest number of pods was found in the combination of $H_1 N_3$ treatment (Biological Fertilizer 10 cc/l water and NPK Fertilizer 60 g/plot) namely 30.33 and the lowest average number of pods per plant was found in the $H_0 N_0$ (Control) treatment, namely 27 .67.

Seed Weight per Plant (g)

The results of the analysis of variance showed that the biological fertilizer treatment had no significant effect on the seed weight parameters per plant, however the NPK fertilizer treatment and the interaction of the two treatments had a very significant effect. Below is presented data on seed weight parameters per soybean plant.

Table 2. Average Seed Weight per Plant With Bio Quality Biofertilizer and NPK Fertilizer Treatment.

Organic fertiliser	NPK Fertilizer				Average
	N_0	N_1	N_2	N_3	
H_0	6.32c	5.79b	6.41c	5.96bc	6.12
H_1	5.27a	6.44cd	6.52d	6.67d	6.23
Average	5.80a	6,12ab	6.47b	6.32b	

Note: Numbers followed by letters that are not the same in the same treatment group are significantly different based on the Duncan test at the 5% level.

Table 2 shows that the biological fertilizer treatment had no significant effect on the seed weight parameters per soybean plant. The highest number of seed weights was obtained in H_1 (10 cc/l water), namely 6.23. NPK fertilizer treatment had a very significant effect on the seed weight parameters per soybean plant. The highest number of seed weights was obtained in N_2 (60 g/plot), namely 6.47, which was significantly different from N_1 (20 g/plot), namely 6.12 and the N_0 (Control) treatment, namely 5.80 but not different. real with N_3 (60 g/plot) treatment, namely 6.32.

The relationship between NPK fertilizer application and the number of pods per soybean plant is linear with the equation $\hat{Y} = 0.0096x + 5.891$ where the correlation is $r = 0.7248$. This can be seen in Figure 3.

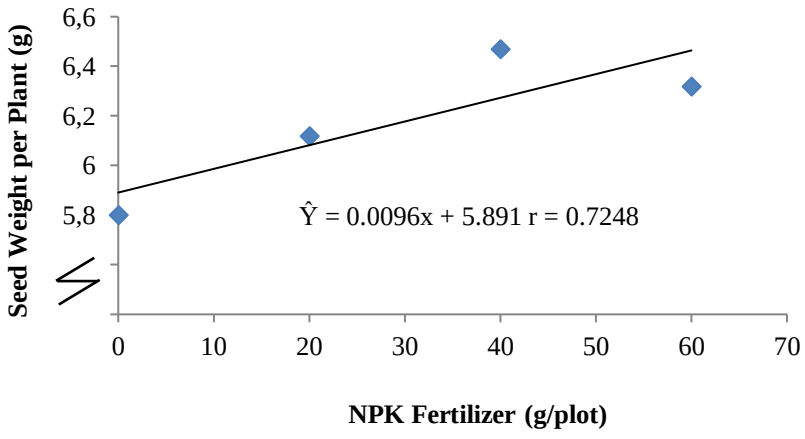

Figure 3. Relationship between seed weight per soybean plant and NPK fertilizer (g/ p lot).

The interaction of the two biological fertilizer treatments with NPK fertilizer had a very significant effect on seed weight per soybean plant. The highest seed weight was obtained in the combination of $H_1 N_3$ treatment (10 cc/l biological fertilizer and 60 g NPK fertilizer/plot) namely 6.67 and the lowest average seed weight was obtained in the treatment combination H_1N_0 (10 cc/lot biological fertilizer). l water and control) namely 5.27.

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The relationship between the interaction of giving biological fertilizer and NPK fertilizer on seed weight per soybean plant can be seen in the picture below.

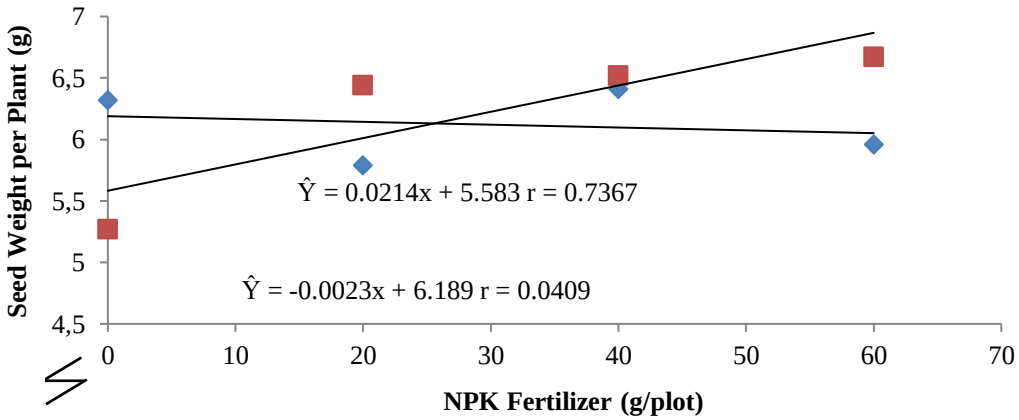

Figure 4. The Relationship Between Providing Biological Fertilizer and NPK Fertilizer on Seed Weight per Plant.

Production per Plot (g)

The results of the analysis of variance showed that the biological fertilizer treatment had a significant effect on production per plot, but the NPK fertilizer treatment had no significant effect. The results of the variance analysis also showed that the interaction of the two biological fertilizer treatments with NPK fertilizer had a significant effect on production per plot. Below is presented data on production parameters per plot of soybean plants.

Table 3. Average Production per Plot With Bio Quality Biofertilizer and NPK Fertilizer Treatment.

Organic fertiliser	NPK Fertilizer				Average
	N_0	N_1	N_2	N_3	
H_0	418.77a	488.48b	357.32a	417.99a	420.64a
H_1	436.18a	456.33ab	533.99b	466.00b	473.12b
Average	427.48	472.40	445.65	441.99	

Note: Numbers followed by letters that are not the same in the same treatment group are significantly different based on the Duncan test at the 5% level.

Table 3 shows that biological fertilizer treatment has a significant effect on production per plot of soybean plants. The highest production amount was obtained in the H_1 (10 cc/l water), namely 473.12, which was significantly different from the H_0 (Control), namely 420.64. NPK fertilizer treatment had no significant effect on production per plot of soybean plants. The highest production amount was obtained in the N_1 (20 g/plot), namely 472.40 .

The relationship between biological fertilizer application and production per plant plot is linear with the equation $\hat{Y} = 5.2488x + 420.64$ where correlation = 0.945. This can be seen in Figure 5.

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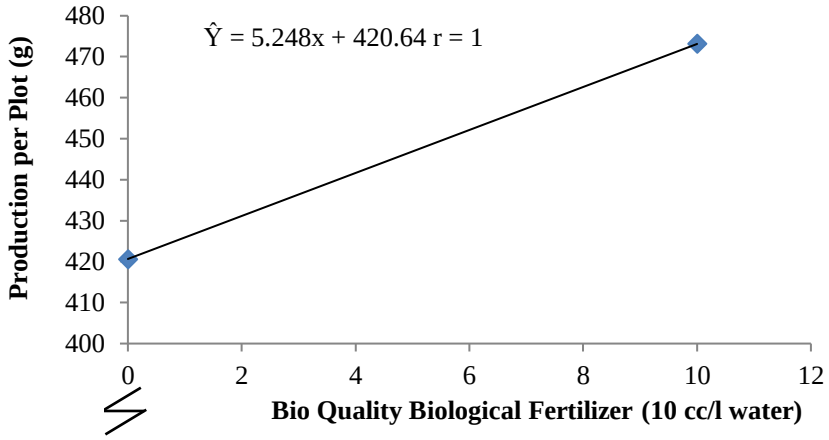

Figure 5. Relationship between production per plot of soybean plants with the provision of bio-quality biological fertilizer (cc/l water).

The interaction of the two treatments had a significant effect on production per plot of soybean plants. The highest production was obtained in the combination treatment of H_1N_2 (Bio quality biological fertilizer 10 cc/l water and NPK fertilizer 40 g/plot) namely 533.99 while the lowest production was found in the combination treatment of H_0N_2 (Control and 40 g NPK fertilizer/plot) namely 357.32.

The relationship between the interaction of giving biological fertilizer and NPK fertilizer on the production per plot of soybean plants can be seen in the figure below.

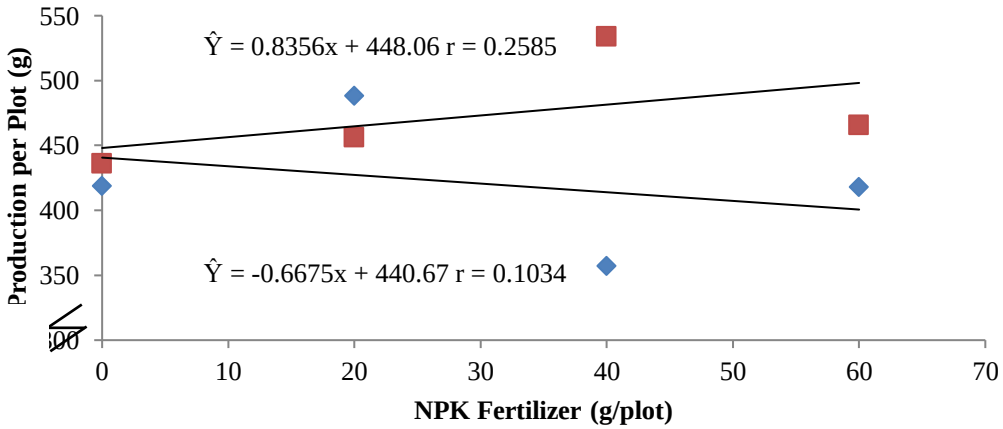

Figure 6. Graph of Interaction of Providing Biological Fertilizer with NPK Fertilizer on Production per Plot.

Weight of 100 Seeds (g)

The results of the analysis of variance showed that the biological fertilizer treatment had no significant effect on the total weight of 100 soybean seeds. The results of the analysis also showed that the NPK fertilizer treatment and the interaction of the two treatments had no significant effect on the total weight of 100 seeds. Below is presented data on the weight parameters of 100 soybean seeds.

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Table 4. Average weight of 100 seeds treated with Bio Quality Biological Fertilizer and NPK Fertilizer.

Organic fertiliser	NPK Fertilizer				Average
	N_0	N_1	N_2	N_3	
H_0	13.78	13.45	13.36	13.61	13.55
H_1	13.87	13.61	13.73	13.90	13.78
Average	13.82	13.53	13.61	13.70	

Note: Numbers followed by letters that are not the same in the same treatment group are significantly different based on the Duncan test at the 5% level.

From Table 4 it can be seen that the biological fertilizer treatment had no significant effect on the weight of 100 soybean seeds. The highest weight of 100 seeds was obtained in the H_1 (10 cc/l water), namely 13.78 . NPK fertilizer treatment had no significant effect on the weight of 100 soybean seeds. The highest weight of 100 seeds was obtained in N_0 (Control) namely 13.82. Treatment H_1N_3 (10 cc/l water bio-quality fertilizer and 60 g NPK fertilizer/plot) namely 13.90, while the weight was 100 The lowest seeds were found in the combination treatment of H_0N_2 (Control and 40 g NPK fertilizer/plot), namely 13.36.

DISCUSSION

1. Soybean Plant Production Response to the Application of Bio Quality Biological Fertilizer

In the treatment of bio quality biological fertilizer, it had a significant effect on production per plot and number of pods per plant, but had no significant effect on the weight of seeds per plant and the weight of 100 seeds.

In the parameter of the number of pods per plant, the application of bio quality biofertilizer has a significant effect on the number of pods per plant, apart from the complex nutrient composition, the combination of the application of biofertilizer with NPK fertilizer where the organic material also plays a role as a source of food and energy for the microbes in providing plant nutrients. . So the addition of organic material is not only a source of nutrients for plants, but also a source of energy and nutrients for microbes (Karamoy, 2009). A prominent use today is the use of microbes to increase the availability of P in the soil which functions in the development of plant generative processes.

In the parameter of the number of pods per plant, the provision of bio quality biological fertilizer has a significant effect on production per plot. This is because the provision of bio quality biological fertilizer has been able to meet the needs of the plants, so that the nutrients from the bio quality fertilizer provided are absorbed by the plant roots. In accordance with the opinion of Foth (1995), the role of organic matter can improve the physical properties of the soil. Good nutrient absorption will have an impact on the generative growth of plants in accordance with the opinion of Gardner *et al* (1991) that fertilization is an important event in plant production which is controlled by environmental and internal factors.

According to Kamil (1996), the availability of nutrients determines plant production, which is the result of three processes, namely the accumulation of assimilate through the photosynthesis process, the decrease in assimilate through the respiration process and the decrease in assimilate due to suspension and accumulation in storage. In accordance with the opinion of Harjadi (1991), if the plant gets enough nutrients, photosynthesis will proceed well, so that the accumulation of organic materials resulting from photosynthesis in the tissues, especially pods, will be greater and will have an impact on production.

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2. Soybean Plant Production Response to NPK Fertilizer Application

The application of NPK fertilizer had a significant effect on the number of pods per plant and seed weight per plant, but had no significant effect on production per plot and the weight of 100 seeds.

In this study, the treatment used for NPK fertilizer consisted of 4 levels, namely N_0 (Control), N_1 (20 g/plot), N_2 (40 g/plot) and N_3 (60 g/plot). From the NPK fertilizer treatment used, the N_3 (60 g/plot) treatment had a better effect compared to the N_0 (Control), N_1 (20 g/plot) and N_2 (40 g/plot) treatments. NPK fertilizer treatment had a significant effect in increasing soybean production.

Providing NPK fertilizer has a significant effect on the number of pods per plant. This is because the NPK fertilizer given can fulfill the nutrient requirements needed by the plants and also influence the development of the number of pods. According to Herawati (2009), the response to fertilizer given is determined by several factors, including the genetic nature of the plant, climate, soil, where these factors do not stand alone but rather one factor is related to other factors.

Providing NPK fertilizer also has a significant effect on seed weight per soybean plant. This is closely related to the availability of nutrients in the soil. The more nutrients we provide to the soil, the greater the opportunity for plants to absorb these nutrients. Nutrients are needed by plants for vegetative and generative growth. The element nitrogen (N) encourages the growth of organs related to photosynthesis, namely leaves. In plants , phosphorus (P) is an important element that makes up adenosine triphosphate (ATP) which directly plays a role in the processes and transfer of energy involved in plant metabolic processes and plays a role in increasing yield components . Potassium (K) acts as an activator of various enzymes that are essential in photosynthesis and respiration reactions as well as for enzymes involved in protein and starch synthesis (Ferdiansyah, 2012) .

3. The Effect of the Interaction of Biological Fertilizers and NPK Fertilizer on Soybean Crop Production

The results of the analysis show that the interaction between biological fertilizer and NPK fertilizer has a significant effect on production per plot and seed weight per plant. However, it had no real effect on the number of pods per plant and the weight of 100 seeds. The combination of the two treatments had no effect because the two factors covered each other in carrying out their activities. For production per plot and seed weight per plant which have a significant effect, this means that the two treatments support each other in fertilizing the soil. It can be seen an increase in plant growth with the combination of the two treatments when compared to without treatment. Intended to increase the number of microorganisms in the soil so that it can produce optimal plant growth.

This is also possible because one of the functions of bio quality biofertilizer is to help improve soil conditions both physically, chemically and biologically as a result of the activity of the microorganisms contained in the biofertilizer. Furthermore, when combined with NPK fertilizer it produces better value when compared to NPK fertilizer itself.

CONCLUSION

1. The treatment of bio quality biological fertilizer had a significant effect on production per plot and the number of pods per plant, but had no significant effect on the weight of seeds per plant and the weight of 100 seeds. Providing the best quality biofertilizer was obtained in the treatment H_1 (10 cc/l water).
2. The application of NPK fertilizer had a significant effect on the number of pods per plant and seed weight per plant , but had no significant effect on production per plot and the weight of 100 seeds. The best application of NPK fertilizer was obtained in the treatment N_3 (60 g/plot).
3. The interaction between biological fertilizer and NPK fertilizer has a significant effect on production per plot and seed weight per plant. However, it had no real effect on the number of

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pods per plant and the weight of 100 seeds. The best combination was obtained in the treatment H_1N_2 (Bio quality biological fertilizer 10 cc//l water.

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