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The Effect of Phosphoric Fertilizer and Types of Organic Fertilizer on Soybean Production (Glycine max. L) in Ultisol Soils

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Abstract

Glycine max L., or soybean meal, is a highly suited crop for Indonesian farming. Soybean growth can be aided by the right fertilizer and Indonesia's tropical environment. The study aims to determine how soybean (Glicine max. L) yield is affected by the use of phosphorus fertilizer. The relationship between Ultisol soil and the types of organic and phosphorus fertilizers. This study was carried out at an elevation of ± 25 meters above sea level at the Tador Sea, a causeway in northern Sumatra with flat terrain. This study examined two components using a randomized block design (RAK). The three parameters for applying inorganic phosphorus fertilizer are P1 = 40 g/plot, P2 = 60 g/plot, and P3 = 80 g/plot. O0= no treatment, O1= TKKS fertilizer = 16 kg/plot, O2= MAS fertilizer = 3 kg/plot, and O3= Biohayati fertilizer = 12 ml/liter of water/plot are the four degrees of organic fertilizer application parameters. The number of pods or sample plants, number of filled pods or sample plants, number of empty pods or sample plants, weight of the pods or sample plants, weight of seeds or plots, and pest and disease inventory were among the observed parameters.

Key words: Phosphorus Fertilizer, Organic Fertilizer, Soybean Plants, Ultisol Soil.

Introduction

Glycine max L., or soybeans, have long been grown in Indonesia. This is because soybeans, which require heated enough air, grow well in Indonesia's tropical environment. Alluvial soil types such as regosol, grumusol, latosol, and andosol that have high drainage and aeration are conducive to the growth of soybeans (Sugeng, 2001 in Sumiyanah and Sungkawa, 2018; Yahya et al., 2022). Soybeans are the main food item for the majority of Indonesians. With a less than 2.2 million tons capacity, Indonesia can produce more soybeans than is needed. Dega 1 is the result of crossing the Malabar and Grobogan types. Artificial crossing was carried out in 2009, and cultivation was carried out from 2010 to 2012 until the lines were obtained (Novita, 2016).

Diversification, rehabilitation, intensification, and extensification are the main strategies for boosting soybean production (Department of Agriculture, 2003; Sumiyanah & Sungkawa, 2018). Intensification efforts are achieved through better farming techniques, such as using superior seeds, ideal plant spacing, sufficient fertilization, planting and applying legumes to marginal land, controlling plant pest organisms, and better irrigation.

Ultisol soil is a soil order characterized by an argillic or kandic horizon and a base saturation of less than 35%. Many are found in areas with high rainfall and intense weathering, so the bottom layer experiences clay illuviation. Ultisols are often found in areas of Indonesia with old rock parent material and wavy to hilly topography. It is acidic and constitutes dry, primarily land not used for agriculture (Hardjowigeno, 1993). Mechanical soil processing is complex due to the wavy and hilly topography. Due to limited infrastructure provision, agricultural activities on Ultisol land are difficult and expensive. High input makes it difficult to maintain soil fertility, which causes much degradation in Ultisol.

Chemical fertilizers must be balanced with organic fertilizers. The balanced use of organic materials and chemical fertilizers will increase soil productivity, encouraging the growth of soybean plants. On the other hand, chemical fertilizers maintain soil function so that plants can easily absorb the nutrients provided by chemical fertilizers (Subakti et al., 2022; Aziz et al., 2022).

Better cultivation techniques like organic fertilizer can increase soybean production (Fang et al., 2021). Organic fertilizer is made after organic material is decomposed by microbes, which can provide the nutrients needed by plants (Wang et al., 2018; Joshi et al., 2015; Weithmann et al., 2018). Plants will grow well and be fertile if sufficient and balanced nutrients are available. If nutrients are available to plants, the formation of new shoots or leaves will be better (Dewi, 2016; Zahrotun et al., 2019). For plant growth and development, plants need the nutrient element phosphorus. Phosphorus helps in cell division, albumin formation, flower, fruit, and seed formation, as well as strengthening stems, accelerating fruit ripening, root development, carbohydrate metabolism, and improving plant quality. Phosphorus also helps plants resist disease (Ritbang, 2019).

Materials and Methods

The study was conducted in the Tador Sea area, which has flat terrain and an altitude of ± 25 meters above sea level, near North Sumatra Cross Road in the Tador Sea District of Batu Bara Regency. Tractors, hoes, hammers, measuring tapes, scales, and several auxiliary instruments were used in this study. The DEGA variety of soybean seeds, compost, bio-bio, MAS fertilizer, and phosphorus fertilizer were the ingredients employed in this study.

The research method used was a randomized block design (RAK) with two factors studied:

1. Factors for providing 3 levels of inorganic phosphorus fertilizer, namely:

P1 = 40 g /plot

P2 = 60 g /plot

P3 = 80 g /plot

2. Factors for providing 4 levels of organic fertilizer :

O0 = No treatment

O1 = TKKS fertilizer 16 kg/plot

O2 = MAS fertilizer 3 kg/plot

O3 = Biofertilizer 12 ml/liter of water/plot

The number of treatment combinations is 3×4 = 12 combinations, namely :

P_1O_0	P_2O_0	P_3O_0
P_1O_1	P_2O_1	P_3O_1
P_1O_2	P_2O_2	P_3O_2
P_1O_3	P_2O_3	P_3O_3

Based on the treatment combination, the number of replications can be determined as follows :

(t – 1) (n – 1) ≥ 15

(12 – 1) (n – 1) ≥ 15

12n –12 ≥ 15

12-n ≥ 15 + 12

n ≥ 27/12

n ≥ 2,5

n ≥ 3 repetitions

Number of repetitions : 3 repetitions

Number of experimental plots: 36 plots

Distance between plots : 50 cm

Distance between repetitions : 75 cm

Number of Plants/plot : 32

Planting Distance : 40 x 20

Plot size : 2 m x 2m

Research Data Analysis

According to Gomez and Gomez (1996), the linear model proposed for the Factorial Randomized Block Design (RAK) is:

Yijk = μ + βi + Tj + kk + (KT)jk + €ijk

Where:

Yijk = Observation Results of the P (phosphorus) factor at the jth level and the O (organic) factor at the kth level in the ith replication

μ = Effect of the mean value

βi = Effect of the block at level i

Tj = Effect of factor O (organic) at the jth level

Kk = Effect of factor P (phosphorus) at the kth level

(KT)jk = Combined Effect of factor P (phosphorus) at the jth level and factor O (organic) at the jth level

€ijk = Error Effect of factor P (phosphorus) at the jth level and factor O (organic) at the kth level in replication.

Research procedure

Perama analyzes soil samples to ascertain their condition and characteristics, including nutrients, contamination, composition, and acidity. Next, the land is opened by clearing the vegetation on the land you want to use. After that, the soil is loosened and covered to prevent flooding from hitting the plants. Making a plot begins with preparing materials and tools such as stakes, plastic rope, hammer, hoe, etc. Next, stick a loop stake in the corner of the land to be used as a plot. To make it square, measure two meters from one side and two meters from the other using a tape measure.

DEGA variety soybean seeds, which can be harvested at 69 to 73 days, are used. This variety is resistant to leaf rust disease and is suitable for agriculture. Each plot requires 1 kilogram or 3,600 seeds. Planting is done at a distance of 40 x 20 cm. Each hole is filled with two to three seeds and then covered lightly with soil. Planting is done when the soil is wet.

Plant Maintenance

If there is not enough water, soybean plants will die. After planting, the initial vegetative growth phase (15–21), flowering phase (25–35), and pod filling phase (55–70) need water. At this stage, soybean plants need water, and irrigation must be carried out if the rain does not fall. To prevent interference with soybean growth, weeds or wild grass growing around soybean plants are destroyed. This is done because it will cause competition for nutrition.

According to previous treatment, organic fertilizer is planted in the soil (plot). TKKS and MAS organic fertilizers are given two weeks before planting in the recommended dose, and Bio Hayati is given at the time of planting. This organic fertilizer is only given once. Next, the land (plot) is given phosphorus fertilizer according to the previous treatment. This is done one day before planting and is used only once. After that, the essential fertilizer, urea, is used for the first time and given half doses at 10 DAP.

Observed parameters:

Number of pods/sample plants

Counting the number of mature and immature pods that form on the sample plants yields the number of pods. Counting begins when the plant bears fruit until harvest.

Number of pods containing/sample plants

Counting the number of ripe and unripe pods on the sample plant yields the number of filled pods parameter. It begins when the plant bears fruit and continues until harvest.

Number of empty pods/sample plants

Counting the number of empty pods on both ripe and unripe sample plants will yield the parameter for the number of empty pods. Counting begins when the plant bears fruit until harvest.

Pod weight/sample plant

Counting the number of pods on the ripe and unripe sample plant yields the pod weight parameter. Counting begins when the plants are harvested.

Seed/plot weight

Calculating the weight of seeds harvested and cooked from plants is a way to calculate seed weight parameters. It begins when the plants are harvested and shelled.

Weight of 100 seeds

After sorting by total weight and treatment, one hundred seeds were chosen from the harvest and weighed using an analytical balance.

Results and Discussion

Number of Pods/ pods/ Sample Plants Age 12 WAP

Based on information about the typical quantity of pods displayed. The investigation results indicated that the phosphorus fertilizer application did not significantly affect the average number of pods. The average number of pods did not significantly change when applying organic fertilizer. The average number of pods was not significantly affected by applying organic fertilizer and treating with phosphorus fertilizer.

Table 1. Average Number of Pods/Pods at 12 WAP of Soybean Plants in the Treatment of Providing Phosphorus Fertilizer and Providing Types of Organic Fertilizer.

P treatment	O treatment				Average
	O_0	O_1	O_2	O_3	
P_1	14,00	12,05	20,76	16,86	15,92
P_2	12,71	17,86	19,62	12,05	15,56
P_3	13,48	14,57	18,19	21,76	17,00

Average	13,40	14,83	19,52	16,89	16,16

Table 1 demonstrates that the phosphorus fertilizer application did not significantly affect the average number of pods. Treatment P3 (80 g phosphorus fertilizer/plot) produced the most significant average number of pods (17.00 pods), while treatment P2 (60 g phosphorus fertilizer/plot) produced the lowest average number of pods (15.56 pods). Because the soil used in this study is categorized as ultisol soil, which is low in nutrients, the amount of phosphorus delivered is still insufficient, meaning that the number of pods is unaffected by the amount of phosphorus given. Thus, low P = 6.48 ppm is shown in the first soil analysis, and medium P = 17.8 ppm is shown in the last soil study.

There was no discernible impact on the average number of pods from examining the treatment of applying organic fertilizer. The O0 treatment (without organic fertilizer) produced the lowest average number of pods, 13.40 pods, while the O2 treatment (MAS organic fertilizer) produced the highest average number of pods, 19.52 pods. Providing organic fertilizer increases pod filling, and the amount of organic fertilizer given still needs to be increased. In this study, the number of pods was relatively small. This is by (Assefa & Tadesse, 2019 Hartatik et al., 2015), which states that organic fertilizer can increase soil and plant productivity.

The average number of pods was not significantly affected by the interaction between phosphorus fertilizer and organic fertilizer; it is likely that these two types of fertilizers were independent of one another or did not interact at all. The highest average number of pods was obtained in the P_3O_3 treatment (80 g phosphorus fertilizer/ plot and bio-biological organic fertilizer), namely 21.76 pods, and the lowest average number of pods was obtained in the P1O1 treatment (40 g phosphorus fertilizer/ plot and TKKS organic fertilizer) namely 12.05 pods. The treatment of phosphorus and bio-organic fertilizer can produce the highest pod weight because organic bio-fertilizer contains 6.35% protein, 1.55% fat, 3.09% fiber, 75.83% carbohydrates, and 342.67 Kcal/100g calories. Can be seen in the analysis results in the attachment.

Number of Empty Pods/Pods/Sample Plants Age 12 WAP

The average number of empty pods was used as a basis for the analysis, which revealed that neither the organic fertilizer treatment nor the phosphorus fertilizer treatment significantly impacted the average number of empty pods. Furthermore, the interaction between the organic fertilizer type and the phosphorus fertilizer treatment influenced the average number of empty pods.

Table 2. Average Number of Empty Pods/Pods Age 12 WAP of Soybean Plants in the Treatment of Providing Phosphorus Fertilizer and Providing Organic Fertilizer Types .

P treatment	O treatment				Average
	O_0	O_1	O_2	O_3	
P_1	1,62	1,33	1,38	1,57	1,48
P_2	1,76	1,86	2,43	1,19	1,81
P_3	1,38	2,52	1,43	1,33	1,67
Average	1,59	1,90	1,75	1,37	1,65

Table 2 indicates that the phosphorus fertilizer application did not significantly affect the average number of empty pods. Treatment P2 (60 g phosphorus fertilizer/plot) produced the most significant average number of empty pods, 1.81 pods, while treatment P_1 (40 g phosphorus fertilizer/plot) produced the lowest average number of empty pods, 1.48 pods. Providing phosphorus fertilizer does not affect the number of empty pods because the amount of phosphorus still needs to be increased. After all, the soil in this study is classified as nutrient-poor. So, in the soil analysis, the first one showed a low P of 6.48 ppm, and the last soil analysis showed P medium = 17.8 ppm.

The analysis's findings indicate that the organic fertilizer treatment did not significantly impact the average number of empty pods. With 1.90 empty pods on average from the O1 treatment (EFB fertilizer), the highest average number was obtained; with 1.37 empty pods from the O3 treatment (biohayati organic fertilizer), the lowest average number was obtained. Adding organic fertilizer does not reduce the quantity of empty pods because it increases pod filling. The quantity of empty pods in this investigation was relatively low. According to this (Hartatik et al., 2015), adding organic fertilizer can boost plant and soil output.

The interaction between giving phosphorus fertilizer and giving organic fertilizer has no significant effect on the average number of empty fruit; for example, phosphorus fertilizer and organic fertilizer stand alone, or there is no interaction. The highest average number of empty pods was obtained in the P_3O_1 treatment (80 g phosphorus fertilizer/plot and 3 kg MAS organic fertilizer/plot), namely 2.52 pods, and the lowest average number of empty pods was obtained in the P_2O_3 treatment (60 g phosphorus fertilizer/plot and fertilizer organic bio-biological) namely 1.19 pods. MAS organic and phosphorus fertilizer treatment can produce the highest pod weight because MAS fertilizer has 24.37% organic C, 1.34% N(nitrogen), 1.40% P (phosphorus), and 3.65% K (potassium). On the test results in the attachment.

Number of Contained Pods/Pods/Sample Plants Age 12 WAP

According to the data analysis results, the average number of filled pods was shown to be non-significantly affected by the application of phosphorus fertilizer. On the other hand, the average number of whole pods was considerably impacted by applying organic fertilizer. Other than that, the average number of complete pods between the type of organic fertilizer and the phosphorus fertilizer treatment remained the same.

Table 3. Average Number of Pods Contained/Pods Age 12 WAP of Soybean Plants When Treated with Phosphorus Fertilizer and Organic Fertilizer Types.

P treatment	O treatment				Average
	O_0	O_1	O_2	O_3	
P_1	12,38	10,76	19,38	15,29	14,45
P_2	10,86	16,00	17,10	10,86	13,70
P_3	12,10	18,38	16,86	13,90	15,31
Average	11,78c	15,05b	17,78 a	13,35 b	14,49

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.

Table 3 demonstrates that the phosphorus fertilizer application did not significantly affect the average number of complete pods. Treatment P3 (80 g phosphorus fertilizer/plot) produced the most significant average number of filled pods, 15.31 pods, while treatment P2 (60 g phosphorus fertilizer/plot) produced the lowest average number of filled pods, 13.70 pods. Because the soil utilized in this study is categorized as ultisol soil, which is low in nutrients, the phosphorus content does not affect pod filling because the amount of phosphorus is still insufficient. As a result, the initial soil study revealed a low P of 6.48 ppm, and the last one revealed a medium P of 17.8 ppm.

According to the data, the organic fertilizer application significantly impacted the average number of filled pods. The O0 treatment (without organic fertilizer) produced the lowest average number of filled pods, 11.78, while the O2 treatment (3 kg MAS organic fertilizer/plot) produced the highest average number of filled pods, 17.78. Because there was still very little organic fertilizer applied, the quantity of complete pods was unaffected by adding organic fertilizer. In this study, the soil used included soil that was poor in the nutrient elements C organic 0.83%, N-total 0.02%, P 6.48 ppm, and K 1.04 (me/100g). This is by Hartatik et al. 2015 which states that providing organic fertilizer can increase soil and plant productivity.

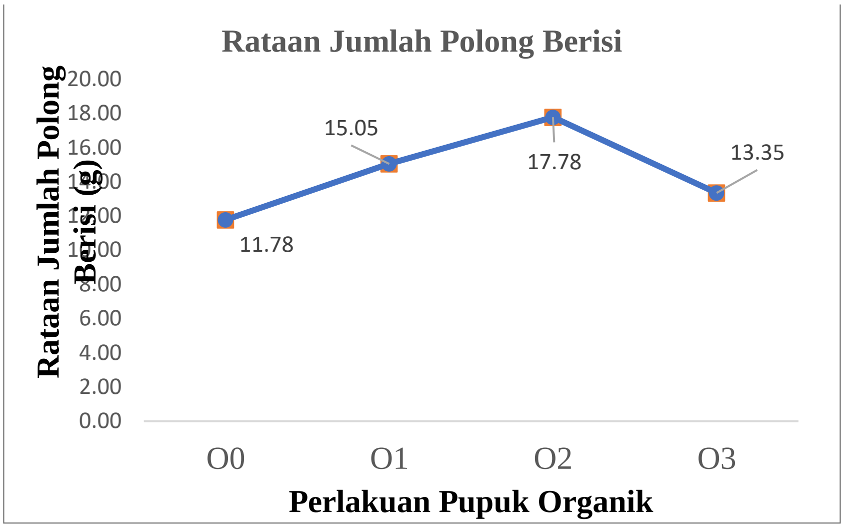

Figure 1. Treatment curve for giving organic fertilizer to the average number of filled pods.

The average number of complete pods was not significantly affected by the interaction between phosphorus fertilizer and organic fertilizer; instead, it is thought that the two nutrients were either independent or did not interact at all. P_1O_2 treatment (40 g phosphorus fertilizer/plot and MAS organic fertilizer) produced the highest average number of filled pods (19.38). The P1O1 treatment (40 g phosphorus fertilizer/plot and TKKS organic fertilizer) produced the lowest average number of filled pods (10.76). MAS organic and phosphorus fertilizer treatment can produce the highest pod weight because MAS fertilizer has 24.37% organic C, 1.34% N(nitrogen), 1.40% P (phosphorus), and 3.65% K (potassium). On the test results in the attachment.

Pod Weight/ g/ Sample Plant Age 12 WAP

Based on average pod weight data, the research revealed that neither the organic fertilizer treatment nor the phosphorus fertilizer treatment had a statistically significant impact on average pod weight. Aside from that, there was no discernible difference in the average pod weight between the phosphorus and organic fertilizer combination treatment.

Table 4. Average Pod Weight/g Age 12 WAP of Soybean Plants When Treated with Phosphorus Fertilizer and Organic Fertilizer Types.

P treatment	O treatment				Average
	O_0	O_1	O_2	O_3	
P_1	14,67	12,76	20,81	19,29	16,88
P_2	12,57	17,57	17,71	11,86	14,93
P_3	14,00	20,86	19,67	16,00	17,63
Average	13,75	17,06	19,40	15,71	16,48

Table 4 shows that the phosphorus fertilizer application did not significantly affect the average pod weight. The P3 treatment (80 g of phosphorus fertilizer/plot) yielded the highest average pod weight of 17.63 g. In contrast, the P2 treatment (60 g of phosphorus fertilizer/plot) produced the lowest average pod weight of 14.93 g. Because phosphorus affects seed production, providing phosphorus can result in a rise in pod weight. However, the phosphorus given in this study was small, or the amount of phosphorus given still needed to be increased because the soil used in this study was nutrient-poor. It was proven from the soil analysis that the first one showed a low P of 6.48 ppm, and the last soil analysis showed a medium P = 17.8 ppm.

The analysis results on the treatment of giving organic fertilizer also had no significant effect on the average pod weight. The highest average pod weight was obtained in the O_2 treatment (MAS organic fertilizer). Namely, 19.40 g and the lowest average pod weight was obtained in the O_0 treatment (without organic fertilizer), 13.75 g. Providing organic fertilizer does not affect the weight of the pods because the organic fertilizer given is still tiny, or the amount given still needs to be increased. In this study, the soil used was poor in the nutrient elements C organic 0.83%, N-total 0.02%, P 6.48 ppm, and K 1.04 (me/100g), as seen in the soil test results in the attachment

The interaction between treatments of phosphorus fertilizer and organic fertilizer had no significant effect on the average pod weight. The highest average pod weight was obtained in the P_3O_1 treatment (80 g phosphorus fertilizer/ plot and TKKS organic fertilizer), namely 20.86 g, and the lowest average pod weight was obtained in the P_2O_3 treatment (60 g phosphorus fertilizer/ plot and bio-biological organic fertilizer) namely 11.86 g. Treatment of phosphorus and organic TKKS fertilizer can produce the highest pod weight because TKKS fertilizer has organic C 44.67%, N(nitrogen) 1.04%, P (phosphorus) 0.42% and K (potassium) 2.21%. The results of the laboratory analysis are in the attachment. So that it can provide organic material and support the availability of phosphorus for plants. This is by Zahrotun et al. (2019), who state that providing organic fertilizer can increase soybean production.

Seed Weight / g/ Per Plot Age 12 WAP

According to the data analysis results, the average seed weight per plot was shown to be unaffected significantly by the phosphorus fertilizer application. On the other hand, the average seed weight per plot was considerably affected by the organic fertilizer treatment. Aside from that, the average seed weight per plot was not significantly affected by the combination of phosphorus fertilizer and organic fertilizer treatments.

Table 5. Average Seed Weight/g/ Plot age 12 WAP of Soybean Plants in the Treatment of Providing Phosphorus Fertilizer and Providing Organic Fertilizer Types.

P treatment	O treatment				Average
	O_0	O_1	O_2	O_3	
P_1	129,67	168,33	221,00	259,33	194,58
P_2	154,00	194,33	207,33	197,33	188,25
P_3	135,00	261,33	283,00	272,67	238,00
Average	139,56 c	208,00 b	237,11 a	243,11 a	206,94

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.

Table 5 demonstrates that the application of phosphorus fertilizer did not significantly affect the average seed weight per plot. Treatment P_3 (80 g phosphorus fertilizer/plot) yielded the highest average seed weight of 238.00 g, while treatment P_2 (60 g phosphorus fertilizer/plot) produced the lowest average seed weight of 188.25 g. Because phosphorus fertilizer affects seed production, providing it can increase seed weight. This is by (2006), which states that giving NPK phonska, which contains phosphorus, can increase soybean yields.

The results of the analysis on the treatment of organic fertilizer had a significant effect on the average seed weight per plot. The highest average seed weight per plot was obtained in the O_3 treatment (12 ml bio-organic fertilizer/liter of water). 243.11 g, and the lowest average seed weight per plot was obtained in the O_0 treatment (without organic fertilizer), 139.56 g. Providing organic fertilizer can increase production because organic bio-fertilizer contains 6.35% protein, 1.55% fat, 3.09% fiber, 75.83% carbohydrates, and 342.67 Kcal/100g calories, as seen in the analysis results in the attachment.

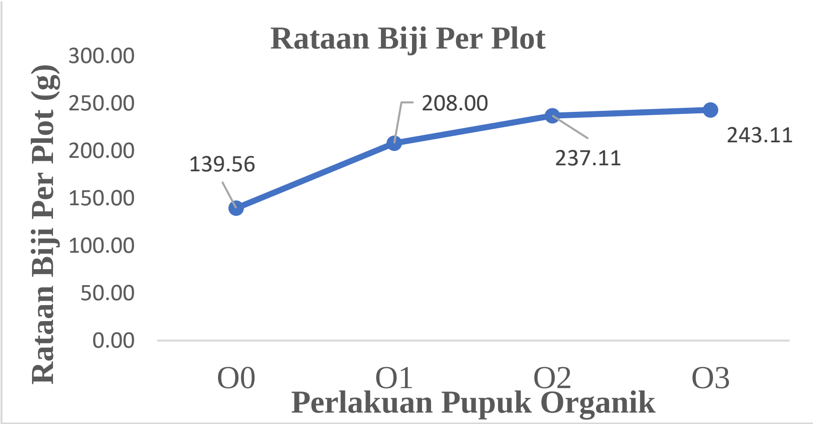

Figure 2. Curve of giving organic fertilizer to the average seed weight per plot.

The interaction between giving phosphorus fertilizer and giving organic fertilizer has no significant effect on the average seed weight per plot; it is suspected that phosphorus fertilizer and organic fertilizer are independent or have no interaction. The highest average seed weight per plot was obtained in the P_3O_2 treatment (80 g phosphorus fertilizer/plot) and (3 kg MAS organic fertilizer/plot), namely 283.00 g, and the lowest average seed weight per plot was obtained in the P_1O_0 treatment (40 g phosphorus fertilizer/plot and without organic fertilizer) namely 129.67 g. Treatment of phosphorus fertilizer and MAS fertilizer can produce the highest production because MAS fertilizer has organic C 24.37%, N(nitrogen) 1.34%, P (phosphorus) 1.40%, and K (potassium) 3.65% as seen in the results test on the attachment.

Weight of 100 Seeds/ g/ Plot Age 12 WAP

The analysis results based on data on 100 average seeds showed that the treatment of giving phosphorus fertilizer significantly impacted the average weight of 100 seeds. In comparison, the treatment of giving organic fertilizer had no significant impact on the average weight of 100 seeds and the interaction between the treatments. Phosphorus fertilizer and organic fertilizer had no significant impact on the average weight of 100 seeds.

Table 6. The average weight of 100 seeds/g at 12 WAP of soybean plants treated with phosphorus and organic fertilizer

Perlakuan P	O Treatment				Averange
	O_0	O_1	O_2	O_3	
P_1	21,67	21,67	22,67	23,00	22,25 a
P_2	18,33	19,67	21,67	19,67	19,83 b
P_3	23,00	23,33	24,67	24,33	23,83 a
Averange	21,00	21,56	23,00	22,33	21,97

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.

Table 6 demonstrates that applying phosphorus fertilizer significantly impacted the average weight of 100 seeds. Treatment P_3 (80 g phosphorus fertilizer/plot) produced the highest average weight of 100 seeds, 23.83 g, while treatment P_2 (60 g phosphorus fertilizer/plot) produced the lowest average weight of 100 seeds, 19.83 g. Because phosphorus affects seed production, applying phosphorus fertilizer can make seeds heavier. This is by (2006), which states that giving NPK phonska, which contains phosphorus, can increase soybean yields.

Pay attention to the following image, which shows the relationship between the average weight of 100 seeds and the application of phosphorus fertilizer based on a linear equation: Y = 0.7927x +20,389 R2 = 0.154. This shows that the weight of 100 seeds is 15% influenced by phosphorus fertilizer treatment and 75% by other factors.

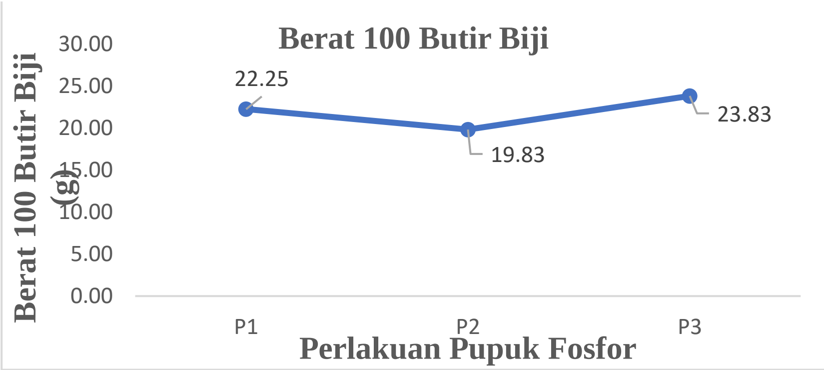

Figure 3. Curve of phosphorus fertilizer application on the average weight of 100 seeds.

The results of the analysis of the treatment of giving organic fertilizer had no significant effect on the average weight of 100 seeds. The highest average weight of 100 seeds was obtained in the O2 treatment (MAS organic fertilizer), namely 23.00 g, and the lowest average weight of 100 seeds was obtained in the O0 treatment (without organic fertilizer), namely 21.00 g. Providing organic fertilizer does not affect the weight of 100 seeds because the organic fertilizer given is still tiny. In this study, the soil used included soil that was poor in the nutrient elements C organic 0.83%, N-total 0.02%, P 6.48 ppm, and K 1.04 (me/100g). This is consistent with the fact that organic fertilizer increases soil and plant productivity (Hartatik et al., 2015).

The interaction between giving phosphorus fertilizer and giving organic fertilizer has no significant effect on the average weight of 100 seeds; it is suspected that phosphorus fertilizer and organic fertilizer are independent or have no interaction. The highest average weight of 100 seeds was obtained in the P_3O_2 treatment (80 g phosphorus fertilizer/ plot and 3 kg MAS organic fertilizer/ plot), namely 24.67 g, and the lowest average weight of 100 seeds was obtained in the P_2O_0 treatment (60 g phosphorus fertilizer/ plot and without organic fertilizer) namely 18.33 g. MAS organic and phosphorus fertilizer treatment can produce the highest pod weight because MAS fertilizer has 24.37% organic C, 1.34% N (nitrogen), 1.40% P (phosphorus), and 3.65% K (potassium). The analysis results in the attachment.

Pest and Disease Inventory

Table 7. Pest and Disease Inventory

No	Image of Pests and diseases	Symptoms of Pest and Disease Attacks	Plot
1.		Attacked by grasshopper nymphs, Valanga nigricornis, leaves have holes in the leaves.	Deuteronomy II P_2O_0 3 MST
2.		Attacked by Lamprosema larvae indicates curled leaves.	Deuteronomy I P_2O_0 3 MST

3.		Leaves attacked by the caterpillar Arctornis submarginata with symptoms of perforated leaves.	Deuteronomy II P_3O 8 MST
4.		Attacked by leaf rust disease caused by the fungus Phakopsora pachyrhizi with symptoms of spots and yellowing of the leaves.	Deuteronomy III P_3O_2 8 MST

Leaf rust disease (Herwansyah, 2019) in the Uredospore cycle only forms 9 days after infection, and formation can continue for up to 3 weeks, while uredium develops for up to 4 weeks. The second generation of uranium will grow at the edge of the first infection site, which can continue for up to 8 weeks. Uredospores develop very quickly and can be formed in huge numbers. In the inventory in this study, it was seen that in replication III, this disease attacked the age of 8 WAP. According to the description of the dega 1 variety, resistance to pests and diseases is somewhat resistant to leaf rust (Phakospora pachrirhyzi). Generally, pests (Lamprosema indicate), such as leafroller caterpillars, attack soybean plants 16 – 24 days after planting soybeans (Suanda et al., 2023). The attack is carried out by rolling the soybean plant leaves as a shelter for the caterpillars during the day (Feriadi, 2015). It can be seen in the research inventory that this leafroller caterpillar attacks at the age of 3 WAP.

The life cycle of caterpillars lasts 4-7 weeks, starting from eggs and then metamorphosing into caterpillars, pupae, and moths. The caterpillar stage becomes a pupa and lasts 9 days. However, due to extreme weather changes, especially during the transition to the rainy season, the life cycle of caterpillars can be accelerated to less than 4 weeks, and the caterpillar stage can be accelerated to less than 9 days (Arifin et al., 2011). In the research inventory, this caterpillar pest attacks soybean plants at the age of 8 WAP. The life cycle of grasshoppers will go through the stages Egg > Nymph > Imago (Adult). They do not go through the pupa or cocoon stage but immediately develop into nymphs or young insects that closely resemble their adult form and even eat the same type of food but are smaller and more fragile. It can be seen in the inventory that grasshopper nymphs attack soybean plants at 3 WAP.

Conclusion

This research has concluded three research findings, including :

1. The effect of using phosphorus fertilizer on soybean production (Glycine max. Seed.
2. The average number of empty pods, total number of pods, weight of 100 seeds, and pod weight are not significantly affected by applying different forms of organic fertilizer on soybean production (Glycine max) on ultisol soil. However, it has a significant impact on the quantity of pods and the average weight of seeds per plot.
3. There is no interaction between phosphorus fertilizer and several types of organic fertilizer on soybean production (Glycine max) in ultisol soil on all parameters.

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