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# N, P AND K NUTRITION UPTAKE AND GROWTH OF SOYBEAN (Glycine max) PLANTS ON INORGANIC FERTILIZER TREATMENT AND TYPES OF MANURE

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**Abstract**

This research was carried out in Laut Tador Village, Sei Suka District, Batu Bara Regency, North Sumatra Province. This place is at an altitude of ±25 meters above sea level (masl), with flat topography. This research was carried out from November 2021 to February 2022. This research aims to determine the dose of inorganic fertilizer and types of manure on N, P and K nutrient uptake and on the growth of soybean plants (Glycine max). This research began in October 2021 to February 2022. Factorial pattern research with a factorial Randomized Block Design/RAK. Treatment factors use various types of manure (O) as the first factor and the second factor is the application of inorganic fertilizer (A). The results of soil analysis on the experimental land are generally low, indicated by the organic matter content at the location, namely 0.25%, not reaching 3% according to ideal soil conditions. . Research Results: The type of manure treatment had a significant effect on the number of primary branches, plant height, stem diameter, crown dry weight, number of root nodules, root nodule weight, while the interaction of organic and anoragnic fertilizers had no significant effect on the number of primary branches, plant height and nutrient uptake. . Providing chicken manure at a dose of 15 tons ha produced the highest number of primary branches, plant height, stem diameter, crown dry weight, number of root nodules, and root nodule weight.

Keywords**: *N, P, K nutrition uptake, growth of soybean***

## 1. INTRODUCTION

Soybean plants (Glycine max) are a type of plant that contains quite high levels of protein and vegetable oil, respectively 38% and 18%, which is now being promoted in Indonesia. So far, soybean cultivation has not been able to meet the increasing needs of the population (Sirenden, Anwar and Damanik. 2016). Currently, soybean commodities are not only positioned as food ingredients and industrial raw materials, but are also positioned as healthy food ingredients and non-food industrial raw materials (Hanum, 2013). Efforts to increase productivity can be made by improving land conditions with amelioration, balanced and integrated fertilization, using superior varieties and improving water management. Alternative amelioration and fertilization technologies are available but need to be adapted to local land conditions considering the potential variations in land suitability. Soil has an important role in plant growth and crop production. In cultivating food crops, soil has a function as a provider of nutrients and water. The nutrients and water in the soil can decrease, and can even disappear. This loss of function causes soil productivity to be less than optimal for plant growth needs and it becomes marginal land. If this land is cultivated for crop cultivation, it will require appropriate technology, thereby increasing costs for farming. Apart from that, this land also does not have a good ecological function for the environment (Sari et al., 2020)

Marginal or "suboptimal" land is land that has potential for agriculture, both for food crops, plantation crops and forest crops. Naturally, the fertility of marginal land is low. This is indicated by an acidic soil reaction, low nutrient reserves, exchangeable bases and low base saturation, while

aluminum saturation is high to very high. However, assessing the productivity of land is not only based on natural fertility, but also the response of soil and plants to the application of land management technology. Through improvements in land management technology, the productivity of land can be increased significantly compared to conditions where soil fertility is naturally low (Hakim et al. 1986). Organic fertilizer is defined as fertilizer that is partly or wholly derived from plants and/or animals that have gone through an engineering process, can be in solid or liquid form which is used to supply organic material to improve the physical, chemical and biological properties of soil (Kurnia, 2014). One type of plant fertilizer that is widely used is fertilizer made from livestock or manure. And like most fertilizers, this plant fertilizer functions to meet nutrient needs and helps in the plant growth process. This fertilizer also stimulates cell enlargement and increases cell volume in plants.

Manure is fertilizer that comes from animal waste such as poultry, cows, buffalo and goats. In general, manure is differentiated based on animal feces that excrete urine and those that do not. Examples of animals that do not urinate are cows, goats and buffalo. Animals that do not excrete urine are mostly poultry such as chickens, ducks and ducks (Kurnia, 2014). Improving soil fertility is the main key in increasing the productivity of dry acid land, including through fertilization and/or the application of organic matter. The use of organic fertilizer on acidic dry land is not only intended to improve soil fertility but also reduces the use of inorganic fertilizer. Manure is a source of organic fertilizer that is relatively widely used by farmers. The technical problem with the use of organic fertilizer at the farmer level is that the nutrient levels in manure, especially N, P and K, are generally low, so they must be provided and transported to the land in quite large quantities if they are to completely or mostly replace inorganic fertilizer. Procuring and transporting organic fertilizer in large quantities will face problems in acid dry land areas which are generally found outside Java due to the relative shortage of labor. Therefore, the use of organic fertilizer which contains more nutrients or is rich in nutrients is expected to be more effective and relatively cheap in terms of price and application.

The type of soil in Batu Bara Regency is dominated by the inceptisol order, namely a type of mineral soil that has shown the initial signs of mature soil (semi-ripe soil) and is characterized by a profile with layers in the form of A, B (Bw), and C horizons. B is formed at the initial level and is called the Kambic horizon (Bw), which is a horizon whose only color and structure is different from the A horizon. This soil is more developed than the soil of the entisol order. Inceptisol soils in Batu Bara Regency with the great groups dystropepts and tropaquepts are soils developed from parent materials that are very resistant to climatic destruction, generally located on alluvial plains, while the great groups dystrandepts and eutrandepts are soils in a rather steep landscape position ( wavy) which is generally located in the western area bordering Simalungun Regency. Apart from the inceptisol order, the soil that also dominates the Batu Bara Regency area is the entisol order. Entisols are a group of young (undeveloped) and generally shallow soils, characterized by a profile with layers (horizons) A and C or A and R only. Based on the description stated above, it is necessary to carry out research to determine "NPK nutrient uptake and soybean plant growth (glycine max) when administering doses of inorganic fertilizer and types of manure".

## 2. MATERIALS AND METHODS

### 2.1 Place and time of research

This research was carried out on the Tador Sea land, North Sumatra Highway, Tador Sea District, Batu Bara Regency, altitude ± 25 m above sea level, with flat topography with soil type of the inceptisol order. This research began in October 2021 to February 2022.

### 2.2 Materials and tools

1. Material

The materials used during this research were: Ring 1 soybean seeds, organic fertilizer and inorganic fertilizer

### 2.3 Research methods

This research used a Factorial Randomized Group Design (RAK) with two treatment factors, namely:

1. Using various types of manure (O) as the first factor consisting of:

O0 = No Treatment
O1 = Cow manure 15 tonnes/ha
O2 = Goat manure 15 tonnes/ha
O3 = Chicken manure 15 tonnes/ha

2. Using inorganic fertilizer (A) as a factor consisting of:

A0 =No treatment
A1 = 100 kg Urea, 75 kg sp36 and 50 kg KCl/ha
A2 = 200 kg Urea, 150 kg SP 36 and 100 kg KCl/ha
A3 = 300 kg urea, 225 kg SP36 and 150 kg KCl/ha

Number of repetitions: 3 repetitions
Number of Experimental Plots: 48 plots
Planting Distance: 40 x 20 cm
Distance Between Repetitions: 100cm
Distance Between Plots: 50cm
Number of Plot Plants: 50 Plants
Sample Plants: 5 Plant Samples

Plot Size: 2 m x 2 m

### 2.4 Research Data Analysis

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

$$Yijk = \mu + \beta i + Tj + kk + (KT)jk + €ijk$$

Where:

Yijk= Observation Results of Organic factors at the jth level and Inorganic factors at the kth level in the ith replication

μ= The effect of the mean value
βi= The effect of the block on the ith level
Tj= Effect of Organic factors on the jth level

kk= the effect of inorganic factors at the kth level

(KT)jk= The combined effect of Inorganic factors at the kth level and Organic factors at the jth level

€ijk= Effect of error from Organic factors at the jth level and Inorganic factors at the kth level in replication.

## 2.5 Research Procedures

1. Soil Analysis

Carry out soil analysis of soil samples taken at the research location.To find out soil conditions and characteristics, such as N, P, K, contamination, composition, acidity

2. Land Clearing

The land is cleared by clearing the vegetation on the land you want to use, then loosening the soil.

3. Plotting

Plot creation aims to ensure that the plants being cultivated are not easily affected by flooding and other things that can disrupt plant growth and production.

4. Fertilizing Organic Fertilizer

Fertilizing organic fertilizer on the soil (plot) is given according to the existing treatment. Organic fertilizer treatment is given 2 weeks before planting and 2 weeks after planting.

5. Seed Preparation

In order to get maximum results, it is best to use certified superior seeds. If you want to make your own seeds, choose seeds from plants that are healthy and have high productivity. Good soybean seeds are seeds obtained from plants that are quite old and healthy. Seed requirements range from 40 – 50 kg/hectare.

6. Planting

Planting is done by ditugal method, with a spacing of 40 x 20 cm or adjusted to the level of soil fertility. Each hole is filled with 2-3 seeds and then covered lightly with soil.

7. Inorganic Fertilization

Inorganic fertilizer will be dosed according to the existing treatment, where each plot is given the plot area formula: the number of doses per hectare then multiplied by the area of 1 hectare, and for the application of inorganic fertilizer it is carried out at planting time.

## 2.6 Plant Maintenance

1. Watering

Soybean plants are watered in the morning and evening, in the morning at 07.00 WIT - 09.00 WIT and in the afternoon at 16.00-17.30 WIT, using a sprinkler or hose. If it rains enough, this is not done.

2. Weeding

Weeds or wild grass that grow around soybean plants need to be weeded. If not, the growth of soybean plants will be disrupted due to competition for nutrients, and weeding is done by removing weeds that grow in the soybean plot.

3. Pest and Disease Control

Control can be carried out by sanitizing the land and spraying Decis 50 EC insecticide 1-2 ml / liter of water. Control can be done by spraying with the fungicide Dithane M-45 at a concentration of 1-2 g / liter of water. Spraying fungicide according to field conditions.

4. Harvest

The soybeans used are the ring 1 variety, the maturity date is 75 days after planting. The characteristics of soybeans that are ready to harvest are that the leaves turn yellow and fall off easily, the seed pods dry out and are brownish in color. Harvesting is done by cutting the stems / scything with a sickle.

### 2.7 Observation Variables

The parameters that will be carried out in this research are as follows:

1. Number of Plant Branches

   Count the number of branches on the main stem of the sample plant.

2. Plant height

   Plant height (cm) was measured at the end of the vegetative period.

3. Bar Diameter

   Stem diameter (mm) was measured at the end of the vegetative period.

4. Plant Dry Weight

   Dry weight tanaman (g) was weighed after being oven-baked for ± 48 hours at a temperature of 70º C.

5. N, P and K uptake

   Plant N uptake (mg/plant) by multiplying plant N content by shoot dry weight, plant P uptake (mg/plant) by multiplying plant P content by shoot dry weight. Plant K uptake (mg/plant) by multiplying the plant K content by shoot dry weight. Uptake = nutrient content (%) x dry weight (g). For example, lowland rice has a K content in straw of 1% of the weight. Dry harvest is: 2 tons/ha, then the amount of K transport in straw = 0.01 x 2,000 kg/ha = 20 kg K/ha. Fertilization efficiency is the ratio between the nutrients that can be absorbed by plants and the nutrients provided.

6. Number of Root Nodules

   It is calculated when the flowering/vegetative period ends by removing one of the sample plants, and after that the roots are washed so that the attached root nodules are visible.

7. Root Nodule Weight

   It is calculated when the flowering/vegetative period ends by removing the sample plants and then drying them for 48 hours after which they are weighed.

## 3. RESULTS AND DISCUSSION

### 3.1 Results of Soil Analysis and General Conditions of the Experimental Land

The results of soil analysis and general conditions of the Tador Sea experimental land, North Sumatra Cross Road, Tador Sea District, Batu Bara Regency, are in (Appendix 17), Based on the results of analysis at the BPTP North Sumatra laboratory, it shows moderate pH (H2O) values, C content The organic content is very low, the total N content is low and the total C/N and P ratio is moderate while the soil texture is sandy clay where the sand fraction is classified as 56.98% while for dust it is 6.45% and clay is 36.57%, (Table 1).

**Table 1.** Analysis of Experimental Soil Fertility Before Giving Doses of Inorganic Fertilizer and Types of Manure to Soybean Plants

| No | Parameter | Mark | Unit | Criteria |
|---|---|---|---|---|
| **1** | Sand Fraction | **56.98** | **%** | |
| **2** | Dust Fraction | **6.45** | **%** | Sandy Clay |
| **3** | Clay Fraction | **36.57** | **%** | |
| **4** | pH (H2O) | **5.93** | **-** | A bit sour |
| **5** | C-organic | **0.25** | **%** | Very low |
| **6** | N-total | **0.04** | **%** | Low |
| **7** | C/N | **14.32** | **-** | Currently |
| **8** | P. Total | **7.44** | **me/100g** | Currently |

If we look at the results of the analysis of the soil fertility level in this location, it is classified as infertile, which is in line with the soil pH value which is classified as slightly acidic (5.935) and the very low C-organic content (0.25%) (Table 1) indicating that this soil requires additional organic matter through fertilizerorganic so that it can support the growth and development of plants that live on it.

### 3.2 Number of Plant Branches (branches)

Based on observation data and analysis of variance in the number of plant branches, it shows that the typeManure (O) has a significant effect on the number of plant branches and inorganic fertilizer (A) has a significant effect on the number of plant branches. The interaction between providing various types of manure and inorganic fertilizer did not have a significant effect on the number of plant branches. The results of the mean difference test on the effect of the type of manure and inorganic fertilizer on the number of plant branches are seen in Table 2.

**Table 2.** Mean Difference Test of Application of Types of Manure and Inorganic Fertilizer on the Number of Plant Branches

| Types of Manure (O) | Inorganic Fertilizer (A) | | | | Average |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| | Number of branchesplant (branch) | | | | |
| O0 (no treatment) | 7.97 | 8.01 | 8.73 | 9.23 | 8.48 d |
| O1 (chicken manure) | 7.97 | 8.23 | 8.82 | 9.47 | 8.62 b |
| O2 (goat manure) | 7.44 | 8.38 | 8.79 | 9.59 | 8.55 c |
| O3 (cow manure) | 8.20 | 8.44 | 9.08 | 10.33 | 9.01 a |
| Average | 7.89 d | 8.26 c | 8.85 b | 9.66 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

Table 2 shows that the type of administrationmanurehas the effect of increasing jnumber of branchesplantin treatment O3 with a number of branches of 9.01 cm, it was significantly different from treatment O2, namely 8.55 cm, and significantly different from treatment O1, namely 8.62 cm, all treatments were significantly different from O0 (control), namely 8.48 cm. Meanwhile, the provision of grade A inorganic fertilizer0(without treatment) is significantly different from all treatment levels (A1A2fund3). The results of the study showed that giving chicken manure15 tons/ha produces the highest and lowest number of branches without treatment hThis shows that the number of soybean plant branches can increase due to the addition of organic material. Organic material in this soil can improve soil conditions and increase soil biological life, which results in

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optimizing the availability and balance of nutrient cycles. This is in accordance with the opinion of Amir and Astuti (2020), giving a dose of 15 tons/ha of organic chicken manure fertilizer gives the best results. branches on soybean plants (Glycine max (L), compared with applying goat and chicken manure, because chicken manure can stimulate soil biological activity, increase water holding capacity and improve soil physical properties (soil structure).

Type of organic fertilizer that causes the number of branchesplantThe highest is chicken manure organic fertilizer, this is because chicken manure is mixed with chicken food scraps and husks which can help provide additional nutrients to the plants. This chicken manure always provides the best plant response in the first season, this is because chicken manure decomposes relatively quickly and has sufficient nutrient levels compared to goat and cow manure, besides that the benefits of chicken manure are that it is easily penetrated by the roots and contains a number of microbes that are useful for the decomposition of organic materials. It can be seen that the quality of chicken manure is the best followed by cow manure and goat manure in increasing the number of branchesplantnamely in the chicken manure treatment of 15 tons/ha.

The dose of inorganic fertilizer given had a positive liner regression. The dose of inorganic fertilizer causes the number of branchesplantThe highest is treatment A3, it can be seen that the quality of inorganic fertilizer is the best followed by treatment A2and treatment A1,The number of branches of soybean plants can increase due to soil conditions and supply nitrogen elements which are really needed by plants, which results in optimizing the availability and balance of nutrient cycles so that this situation is thought to mean that inorganic fertilizers have a better balance of nutrients in the soil than organic fertilizers. The existence of a balance of nutrients in the soil is very important in influencing the solubility of one or more elements. So the soil is said to be fertile if there is a balance of nutrients, not because there is more of one element than another. According to Pincus et al. (2016, . A harmonious balance of nutrients in the soil greatly influences good absorption, so it is hoped that it can increase plant growth and production.

### 3.3 Plant Height (cm)

Based on observation data and analysis of plant height variance, it shows that the type of manure(O) has a significant effect on plant height and inorganic fertilizer (A) has a significant effect on plant height.The interaction between giving organic fertilizer and inorganic fertilizer did not have a significant effect on plant height. Results of the mean difference test on the influence of the type of manureAndinorganic fertilizer on plant height can be seen in Table 3

**Table 3.** Mean Difference Test of Application of Manure Type and Inorganic Fertilizer on Ta Heightname

| Types of Manure (O) | Inorganic Fertilizer (A) | | | | Average |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| | Plant height(cm) | | | | |
| O0 (no treatment) | 13.05 | 14.36 | 28.60 | 30.64 | 21.66 d |
| O1 (chicken coop) | 19.85 | 21.83 | 29.47 | 32.17 | 25.83 a |
| O2 (goat pen) | 13.25 | 21.93 | 30.11 | 33.40 | 24.67 b |
| O3(cowshed) | 6.62 | 22.09 | 30.47 | 33.90 | 23.27 c |
| Average | 13.19 d | 20.05 c | 29.66 b | 32.53 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

Table 3 shows that the type of administrationManureincreasing effectplant height compared to control treatment (O0) namely 21.66 cm, pO3 treatment with a plant height of 23.27 cm producedplant heightsignificantly different from the O2 treatment, namely 24.67 cm, the O1

treatment, namely 25.83 cm. And providing grade A inorganic fertilizer0(without treatment) is significantly different from all treatment levels (A1A2fund3). The results showed that the application of cow manure resulted in the highest plant height. This happens because cow manure has a higher water content than goat and chicken manure. So, the humidity level is also higher. Even though the humidity level is high, cow dung has a dense texture with high fiber content, such as cellulose. Sufficient fertilization of cow manure can improve the growth of plant organs and increase the photosynthate formed, which ultimately supports plant yields (Kresnatita et al, 2013). Cow manure is made from a mixture of cow dung, urine and feed remains. deposited in one place for some time. This organic fertilizer can improve soil structure and provide soil nutrients.

Graph between treatment of giving types of manure andinorganic fertilizers are presented in Figures 3 and 4.

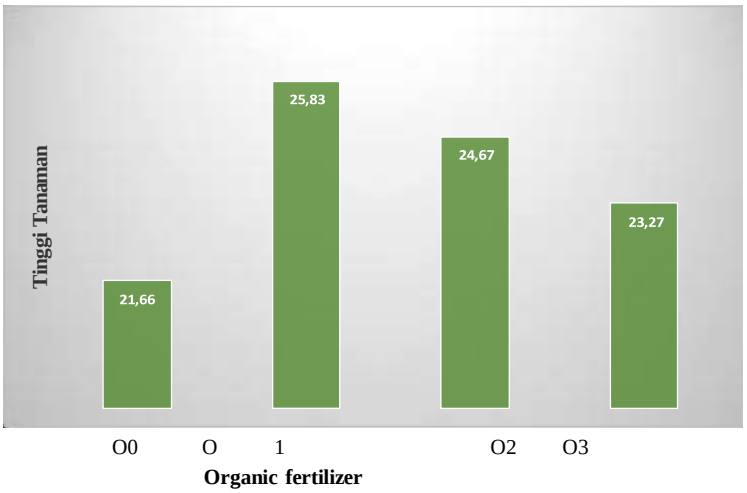


**Figure 3.** Histogram of the effect of manure applicationto the amount plant height

Figure 3 shows that the type of manure that causes the highest plant height is organic cow manure. It can be seen that the quality of cow manure is the best for increasing the height of soybean plants, followed by goat manure and chicken manure to increase plant height, namely in the cow manure treatment of 15 tons/ha,This shows that the increase in plant height is influenced by 15 tons/ha of cow manure. Parman (2007), states that the nitrogen content in cow manure plays a role in forming proteins which function for plant metabolism which in turn will stimulate cell division and elongation. cows on soybean plants can increase the effectiveness of Rhizobium inoculation, because organic materials can improve the physical properties of the soil, increase soil aeration so that the oxygen supply for plant roots becomes better as a result Rhizobium can also develop well, the higher the nitrogen content in the main ingredient for making fertilizerThe better the cage the material is.

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**Figure 4.** Graph of the effect of inorganic fertilizer applicationto the number of plant heights

Figure 4 shows that the type of inorganic fertilizer given has a positive liner regression. The type of inorganic fertilizer that caused the highest plant height was treatment A3, followed by treatment A2and treatment A1,soybean plant heightDjufryet al (2012), Plant height can also be influenced by variety, planting distance and fertilizer application. The height of soybean plants can grow tall because the spacing is spaced, resulting in etiolation of the plants because it can affect the reception of direct sunlight to the soybean plants (Rasyid, 2013). This is also supported by Gunawan and Kartini (2012), explaining that the higher the dose of nitrogen fertilizer, the higher the dose of nitrogen fertilizer. given, the plant height increases.

### 3.4. Bar Diameter (mm)

Based on observation data and analysis of variations in stem diameter, it shows that the typeManure (O) has a significant effect on stem diameter and inorganic fertilizer (A) has a significant effect on stem diameter.The interaction between the types of manure and inorganic fertilizer did not have a significant effect on stem diameter. Results of the mean difference test for the effect of typemanure andinorganic fertilizer on stem diameter can be seen in Table 4.

**Table 4.** Mean Difference Test Application of Manure and Inorganic Fertilizeragainst the Bar Diameter

| Types of Organic Fertilizer (O) | Inorganic Fertilizer (A) | | | | Average |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| | Bar Diameter(mm) | | | | |
| O0 (no treatment) | 3.41 | 3.79 | 4.37 | 4.65 | 4.06 c |
| O1 (chicken coop) | 3.44 | 3.84 | 4.41 | 4.57 | 4.07 c |
| O2 (goat pen) | 3.55 | 4.17 | 4.48 | 5.03 | 4.31 b |
| O3 (cow pen) | 3.92 | 4.20 | 4.93 | 5.39 | 4.61 a |
| Average | 3.58 c | 4.00 b | 4.55 a | 4.91 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

Table 4 shows that the type of administrationmanureincreasing effectstem diameterin the O3 treatment with a plant height of 4.61 cm producedstem diametersignificantly different from the O2 treatment which was 4.31 cm, the O1 treatment which was 4.07 cm and the O0 treatment (control) which was 4.06 cm. And for grade A inorganic fertilizer0(without treatment) is significantly different from all treatment levels (A1A2fund3). The results of the study showed that applying 15 tonnes/ha of chicken manure resulted in the highest stem diameter due to this situationinfluenced by the nutrient N contained in chicken manure. This is supported by Damanik et al. (2011) which

states that the N element in plants is very important for the formation of protein, leaves and various other organic compounds, nitrogen is the nutrient that plants need most and has a very important role for plant growth and fertilizer from chicken manure has The reaction is faster than fertilizer from broom and goat manure, so it is suitable for marginal soil characteristics. Chicken manure also contains relatively high levels of N nutrients compared to other organic fertilizers.

Graph between treatment of giving types of manure andInorganic fertilizers are presented in Figure 5

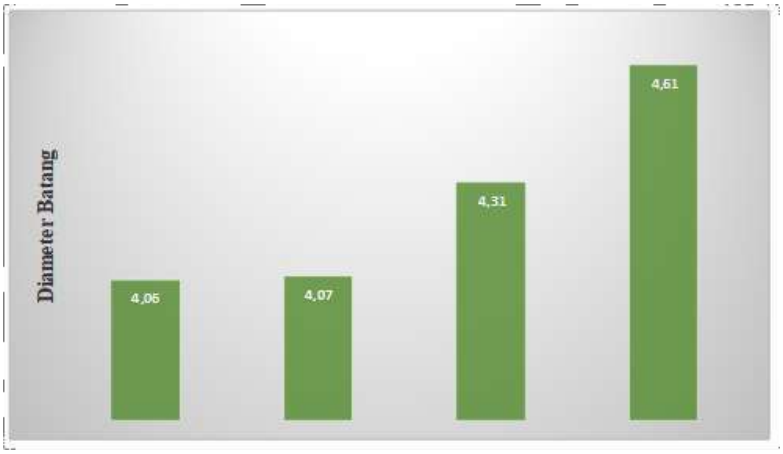


**Figure 5.** Histogram of the effect of manure applicationto the diameter of the rod

Figure 5 shows the type of manure that causes thisstem diameterThe highest is chicken coop organic fertilizer. It can be seen that the quality of chicken manure fertilizer is the best, followed by goat manure and cow manure, because according to Tohari, in the 2009 book Organic Chicken Manure Fertilizer, the nutrient content of chicken manure is Nitrogen (N) 1%, Phosphorus (P) 0.8% and Potassium (K) 0.4%. From this content, we can see that this fertilizer contains quite a lot of N, even more than cows and goats, which states that chicken manure has quite a high nitrogen content. And the application of chicken manure can cause the cells at the tip of the stem to be pushed or stimulated to immediately divide and enlarge.

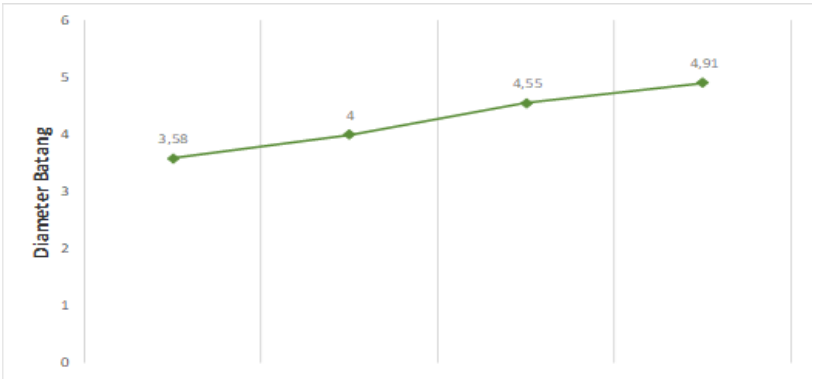


Figure 6. Graph of the effect of application of various types of inorganic fertilizerto the diameter of the rod

Figure 6 shows that the type of inorganic fertilizer given has a positive liner regression. The type of inorganic fertilizer that caused the highest stem diameter was treatment A3and then followed by treatment A2and treatment A1.This shows that inorganic fertilizers are better able to

improve soil fertility both physically and chemicallyinfluences the supply of soil nutrients by helping the decomposition of organic matter into ionic forms that are available for plant roots to be absorbed so that they can influence stem growth in the opinion of Tautges et al. (2016), this situation is thought to be influenced by the nutrient balance that occurs in the soil. A good balance of nutrients in the soil can influence the growth and production of a plant and inorganic fertilizers are easily decomposed and can be directly absorbed by plants, so that growth becomes more fertile.

### 3.5 Plant Dry Weight (grams)

Based on observation data and analysis of plant dry weight variance, it shows thattypes of organic fertilizer (O) have a significant effect on dry weightplantand inorganic fertilizer (A) also have a significant effectplant dry weightbecause inorganic fertilizers are easily decomposed and can be directly absorbed by plants, so growth becomes more fertile. The interaction between providing types of manure and inorganic fertilizer has no significant effect onplant dry weight. Results of the mean difference test for the effect of typemanure andinorganic fertilizer againstplant dry weightseen in Table 5.

**Table 5.** Mean Difference Test of Application of Types of Manure and Inorganic Fertilizer on Dry Weight of Tajnaman

| Types of Manure (O) | Inorganic Fertilizer (A) | | | | Average |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| | Plant dry weight (grams) | | | | |
| O0 (no treatment) | 13.05 | 14.36 | 28.60 | 30.64 | 21.66 d |
| O1 (chicken coop) | 19.85 | 21.83 | 29.47 | 32.17 | 25.83 a |
| O2 (goat pen) | 13.25 | 21.93 | 30.11 | 33.40 | 24.67 b |
| O3 (cow pen) | 6.62 | 22.09 | 30.47 | 33.90 | 23.27 c |
| Average | 13.19 d | 20.05 c | 29.66 b | 32.53 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

Table 5 shows that the type of administrationmanurehad an effect on increasing the dry weight of the plant, namely in the O1 treatment it was 25.38 g, the O3 treatment with a plant dry weight of 23.27 g produceddry weightplant dry weightsignificantly different from treatment O2namely 24.67 g, and O0 treatment (control) namely 21.66 g. And the provision of grade A inorganic fertilizer0(without treatment) is significantly different from all treatment levels (A1A2fund3). IThis is becauseplant dry weightis largely determined by root activity in transporting water and nutrients which are passed into the plant, and cow manure on the dry weight of soybean plants can increase the effectiveness of Rhizobium inoculation, because organic materials can improve the physical properties of the soil, increase soil aeration so that the supply of oxygen to plant roots becomes better as a result Rhizobium can also develop well. Plants will use a certain amount of water and organic material in metabolic processes. Plant dry weight is a measure of the biomass formed during growth which is an indicator of actual growth.

Graph between treatment of giving types of manure andinorganic fertilizers are presented in Figures 7 and 8.

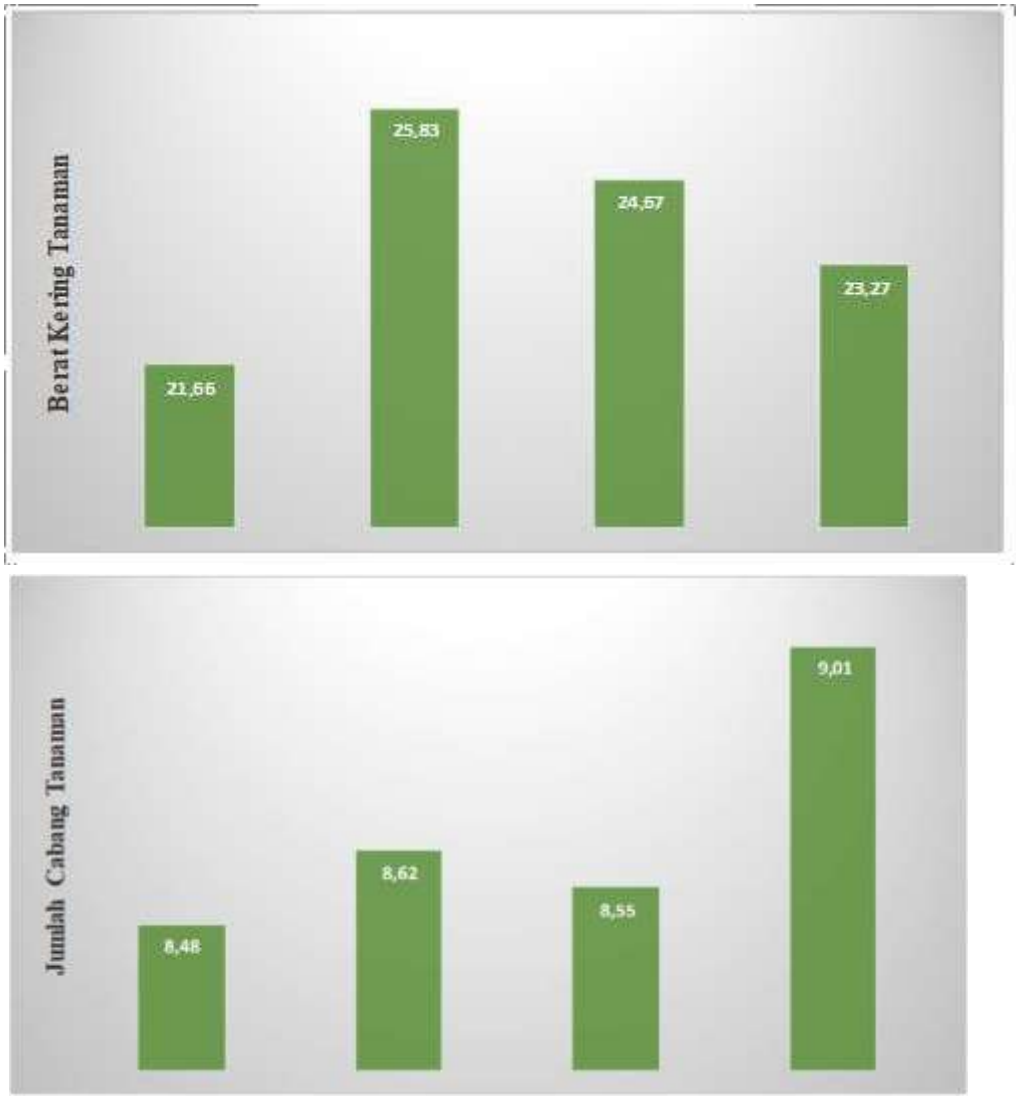


**Figure 7.** Histogram of the Effect of Application of Types of Manureto plant dry weight

Figure 7 shows the type of manure that causes thisplant dry weightThe highest is chicken coop organic fertilizer. It can be seen that the quality of chicken manure is the best because the macro nutrients N, P and K in chicken manure have a high content compared to manure originating from goat and cow manure, besides that chicken manure is a fertilizer that contains organic material, namely C/N is low, so the decomposition process of organic material is also completed quickly and the nutrients released are immediately available for plants. Therefore, the nutrient content of chicken manure can increase soil and plant fertility. Chicken organic fertilizer plays a role in improving the physical properties of soil, such as structure, consistency, porosity, water holding capacity, and maintaining soil resistance to erosion, and contains growth hormones from the auxin and gibberellin groups which are able to stimulate growth from sprout to fruit (Parmila et al ., 2019; Purba et al., 2019). Next is followed by goat dung and cow dung.

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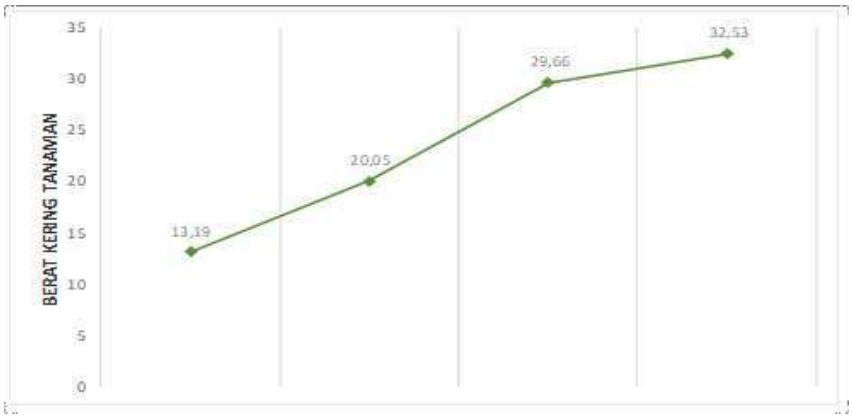


**Figure 8.** Influence Graphinorganic fertilizer on plant dry weight

Figure 8 shows that the type of inorganic fertilizer given has a positive liner regression. The type of inorganic fertilizer that caused the highest plant dry weight was treatment A3It can be seen that the quality of inorganic fertilizer is the best followed by treatment A2fund1.Based on research conducted by Mas'ud (2009), the high nitrogen (N) content in homemade nutrients stimulates an increase in the number of leaves and plant height compared to other artificial fertilizers, whileMaryani (2012) stated that plant dry weight is the result of the assimilation of photosynthesis which is translocated from the roots to all parts of the plant and the result of the increase in protoplasm due to the increase in size and number of cells.

### 3.6. Uptake of Nutrient Elements N, P and K from Leaves

1. Nutrients N Leaves

Based on observation data and analysis of variations in N nutrient uptake, it shows that the type of manure has no significant effect on N nutrient uptake and inorganic fertilizer (A) has no significant effect on N nutrient uptake. The interaction between giving organic fertilizers and inorganic fertilizers has no significant effect. on the uptake of the N nutrient. The results of the mean difference test of the effect of types of organic fertilizer and inorganic fertilizer on the uptake of the N nutrient are presented in Table 6.

**Table 6.** Mean Difference Test of Application of Manure and Inorganic Fertilizer Types on ND Nutrient Uptakeaun

| Types of Manure (O) | Inorganic Fertilizer (A) | | | | Average |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| | N Nutrient Uptake | | | | |
| O0 (no treatment) | 1.42 | 1.47 | 2.34 | 1.33 | 1.64 |
| O1 (chicken coop) | 1.55 | 1.51 | 1.51 | 2.16 | 1.68 |
| O2 (goat pen) | 1.63 | 2.13 | 1.25 | 2.05 | 1.77 |
| O3 (cow pen) | 2.20 | 2.02 | 1.83 | 1.54 | 1.90 |
| Average | 1.70 | 1.78 | 1.74 | 1.77 | |

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

From the results of the average difference test in Table 6, it shows that the type of manure on the N nutrient uptake was seen to be high in the treatmentO3 with a value of 1.90% and the lowest O0 (without treatment) with a value of 1.64%, and forinorganic fertilizerThe highest N

nutrient uptake in A3 treatment with a value of 1.77% and the lowest A0 (without treatment) with a value of 1.70%, this is due toThe growth of a plant is influenced by various factors, some of which come from within (factors of the plant itself), as well as other external factors, for example the soil in which the plant itself grows. Also by temperature, sunlight and rainfall. According to Buckman and Brady (1982), the adequacy and availability of nutrients for plants depends, among other things, on the type and amount of nutrients available in the soil, which is in balance according to plant growth. According to Hardjowigeno (1992), nitrogen in plants functions as a constituent of protoplasm, chlorophyll molecules, nucleic acids and amino acids which are constituents of protein, if nitrogen deficiency occurs it can cause disruption of vegetative growth. On the other hand, excess nitrogen in plants results in excessive vegetative growth, late flowering and low yield production

## 2. Leaf Nutrients P

Based on observation data and analysis of varianceuptake of the nutrient Pshows that typetypes of manure (O) have no significant effect onuptake of P nutrients andinorganic fertilizer (A) has no significant effect onuptake of the nutrient P.The interaction between providing types of manure and inorganic fertilizer has no significant effect onuptake of the nutrient P. Results of the mean difference test for the effect of typemanure andinorganic fertilizer againstuptake of the nutrient Pseen in Table 7.

Table 7. Mean Difference Test of Application of Manure and Inorganic Fertilizer on P Da Nutrient Uptakeun

| Types of Manure (O) | Inorganic Fertilizer (A) | | | | Average |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| | P Nutrient Uptake | | | | |
| O0 (no treatment) | 0.31 | 0.24 | 0.29 | 0.30 | 1.15 |
| O1 (chicken coop) | 0.23 | 0.30 | 1.13 | 1.13 | 2.79 |
| O2 (goat pen) | 0.23 | 1.10 | 0.28 | 0.30 | 1.90 |
| O3 (cow pen) | 0.24 | 0.28 | 0.27 | 0.33 | 1.12 |
| Average | 0.25 | 0.48 | 0.49 | 0.51 | |

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

From the results of the average difference test, Table 7 shows that the type of manure with high P nutrient uptake is seen in the O1 treatment.with a value of 2.79% and the lowest is O0 (without treatment) with a value of 1.15%, whereasinorganic fertilizerThe highest uptake of P nutrients was A3 treatment with a value of 0.51% and the lowest was A0 (without treatment) with a value of 0.25%This is because the uptake of P elements by plants is also influenced by the presence of N elements. Providing P elements combined with N has not been able to increase P uptake by plants. Soybean plants need P elements during each period of growth. Plants absorb more $H2PO4^{+}$ compared to $HPO4^{++}$and $PO4^{+\ +}$. Phosphate in the soil is easily available at a soil pH between 5.5 – 7.0. If the soil pH is above or below this range then P uptake by plants will decrease. According to Yusuf et al., (2017), phosphorus is a macro element that makes up the components of every living cell. Phosphorus in plants really helps the formation of proteins and minerals which are very important for plants, stimulates the formation of flowers, fruit and seeds, and can even speed up fruit ripening. and makes the seeds more weighty and circulates energy to all parts of the plant, stimulating root growth and development.

### 3. Leaf Nutrient K

Based on observation data and analysis of varianceK nutrient uptakeshows that typemanure (O) has no significant effect onuptake of K nutrients andinorganic fertilizer (A) has no significant effect onK nutrient uptake.The interaction between providing types of manure and inorganic fertilizer has no significant effect onK nutrient uptake. Results of the mean difference test on the influence of the type of manureAndinorganic fertilizersK nutrient uptakeseen in Table 8.

**Table 8.** Mean Difference Test of Application of Organic Manure and Inorganic Fertilizer on KD Nutrient Uptakeaun

| Types of Manure (O) | Inorganic Fertilizer (A) | | | | |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | Average |
| | Nutrient Uptake K | | | | |
| O0 (no treatment) | 2.33 | 2.44 | 2.43 | 2.49 | 2.42 |
| O1 (chicken coop) | 2.42 | 2.46 | 2.41 | 2.47 | 2.44 |
| O2 (goat pen) | 2.40 | 2.48 | 2.44 | 2.49 | 2.45 |
| O3 (cow pen) | 2.46 | 2.48 | 2.47 | 2.52 | 2.48 |
| Average | 2.40 | 2.47 | 2.44 | 2.49 | |

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

From the results of the average difference test, Table 8 shows that the type of manure has a high nutrient uptake in the O3 treatment.with a value of 2.48% and the lowest is O0 (without treatment) with a value of 2.42%, whereasinorganic fertilizerThe highest P nutrient uptake was treatment A3 with a value of 2.49% and the lowest was A0 (without treatment) with a value of 2.40%,This is because the effect of chicken manure can increase the availability of nutrients which can increase plant growth and production so thatpotassium is a macro element such as nitrogen and phosphorus, potassium plays an important role in photosynthesis, because it directly increases growth and leaf area Yusuf et al., (2017). Potassium can increase carbon dioxide uptake, transfer sugar to form starch and protein, help the process of opening and closing stomata, water storage capacity, expand root growth, increase plant resistance to pest and disease attacks, strengthen the plant body so that flower leaves and fruit do not fall off easily.. This is in accordance with the statement by Melati and Andriyani (2005) which states that among the types of manure, chicken manure has high levels of fiber such as cellulose. Chicken manure can provide several benefits, namely providing macro and micro nutrients for plants, loosening the soil, improving soil texture, increasing the porosity and composition of microorganisms in the soil, facilitating plant root growth.

### 3.7. Number of Root Nodules (items)

Based on observation data and analysis of variance, the number of root nodules shows that the typemanure (O) has a significant effect on the number of root nodules and inorganic fertilizer (A) also has a significant effect on the number of root nodules.The interaction between the types of manure and inorganic fertilizer did not have a significant effect on the number of root nodules. Results of the mean difference test on the influence of the type of manureAndinorganic fertilizer againstnumber of root nodulesseen in Table.

**Table 7.** Mean Difference Test Application of Manure and Inorganic Fertilizer on the Number of Root Nodules

| Types of Manure (O) | Inorganic Fertilizer (A) | | | | Average |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | |
| | Number of Root Nodules(item) | | | | |
| O0 (no treatment) | 9.67 | 10.00 | 9.00 | 8.67 | 9.33 c |
| O1 (chicken coop) | 8.00 | 9.33 | 10.00 | 10.00 | 9.33 c |
| O2 (goat pen) | 9.00 | 8.33 | 8.00 | 11.00 | 9.08 b |
| O3 (cow pen) | 9.33 | 8.00 | 8.33 | 12.67 | 9.58 a |
| Average | 9.00 b | 8.92 b | 8.83 c | 10.58 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

Table 7 shows that applying this type of manure has the effect of increasing the number of root nodules. Treatment O3with a plant height of 9.58, the number of root nodules was significantly different from the O treatment2namely 9.08, treatment O1namely 9.33 and treatment O0(control) namely 9.33 while inorganic fertilizer had the effect of increasing the number of root nodules. Treatment A3with the number of root nodules 10.58 which is significantly different from A0( without treatment) 9.00, treatment A1namely 8.92 and treatment A2namely 8.83, this is because the presence of bacteria in chicken manure and the dose of urea fertilizer is able to fix N2into the roots so that these bacteria enter into symbiosis and form root nodules, this is in accordance with the opinion of Adnyana (2012), Symbiosis between bacteria and their host plant is determined by the compatibility between each substrate produced and if there is a match, penetration occurs and the bacteria multiply in the root cells. thus forming root nodules.

Graph between treatment of giving types of manure andInorganic fertilizers are presented in Figures 10 and 11

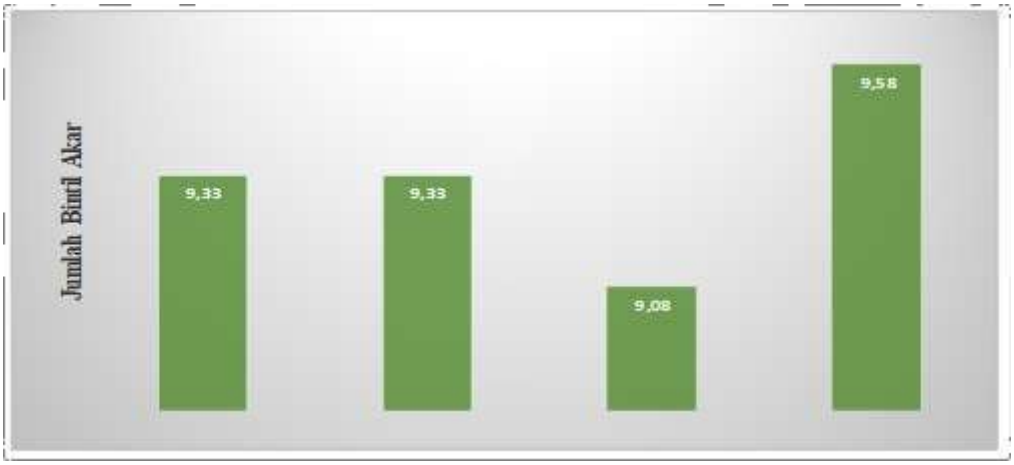


**Figure 10.** Histogram of the influence of manure typeon the number of root nodules

Figure 10 shows the type of manure that causes thisnumber of root nodulesThe highest is chicken coop organic fertilizer. It can be seen that the quality of chicken manure is the best, followed by goat manure and cow manure. To increase the number of root nodules, namely in the treatment of chicken manure, this is due to the benefits of Phosphorus (P), an energy source for plant assimilation and respiration, stimulating and accelerating plant root growth faster and better than goat and cow manure, and the presence of effective root nodules that can provides N nutrients to support plant growth. Where the rhizobium has started to infect the roots, since the roots are

formed, the root nodules that form can bind nitrogen from the air. The increase in the number of effective root nodules is due to the chicken's fertilizer which is able to create symbiosis with legume plants in accordance with the opinion of Saragih et al (2016). This bacteria will infect plant roots and form root nodules in them.

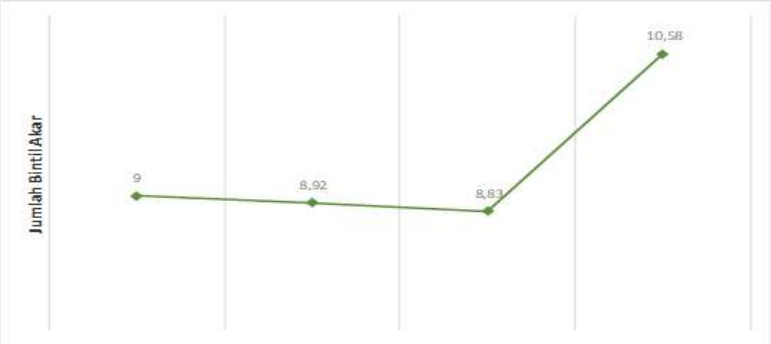


**Figure 11.** Influence Graphgiving fertilizer to the number of root nodules

Figure 11 shows that the type of inorganic fertilizer given has a positive liner regression. The type of inorganic fertilizer that caused the highest number of root nodules was treatment A3It can be seen that the quality of inorganic fertilizer is the best followed by treatment A2fund1 one example of a group of bacteria that has the ability to provide N nutrients plant. When in symbiosis with legume plants, this group of bacteria will infect the plant roots and form root nodules in them.This is in accordance with the statement of Saragih et al., (2016),The amount of nitrogen greatly influences whether or not the formation of root nodules will fail. legume plants will fail to form root nodules if the soil contains more than 100 kg N of nitrogen. Nitrogen deficiency in the host during the phase between infection and the start of N fixation2will interfere with the formation of leaf area that can provide sufficient photosynthate for nodule growth and activity.and according to Putra, AW (2021), the characteristics of effective root nodules are that they are large and rather long, pink in color, clustered near the main root and are able to bind as much free nitrogen as possible

### 3.8. Root Nodule Weight (grams)

Based on observation data and analysis of varianceroot nodule weightshows that typemanure (O) has a significant effect onroot nodule weightand inorganic fertilizer (A) have a significant effect onroot nodule weight.The interaction of providing types of manure and inorganic fertilizer has a significant effect onroot nodule weight. Results of the mean difference test for the effect of typemanure andinorganic fertilizer againstroot nodule weightseen in Table 9.

**Table 9.** Mean Difference Test of Application of Manure and Inorganic Fertilizer on Root Nodule Weight

| Types of Manure (O) | Fertilizer Application (A) | | | | |
|---|---|---|---|---|---|
| | A0 | A1 | A2 | A3 | Average |
| | Root Nodule Weight(grams) | | | | |
| O0 (no treatment) | 42.00 | 46.00 | 50.67 | 70.00 | 52.17 d |
| O1 (chicken coop) | 43.67 | 43.00 | 55.33 | 74.00 | 54.00 c |
| O2 (goat pen) | 45.00 | 46.00 | 61.33 | 74.00 | 56.58 b |
| O3 (cow pen) | 41.67 | 56.33 | 65.67 | 80.00 | 60.92 a |
| Average | 43.08 d | 47.83 c | 58.25 b | 74.50 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

Table 9 shows that the application of this type of manure had an effect on increasing the weight of root nodules in the O treatment3with a plant height of 60.92, the number of root nodules was significantly different from the O treatment2namely 56.58, treatment O1namely 54.00 and treatment O0(control) namely 52.17 , and inorganic fertilizer had the effect of increasing the weight of root nodules. Treatment A3with the number of root nodules 74.50 which is significantly different from A0( without treatment) 43.08, treatment A1and treatment A2..It can be seen that chicken manure is given the highest number of root nodules because according to Tohari (2009), the nutrient content of chicken manure is Nitrogen (N) 1%, Phosphorus (P) 0.8% and Potassium (K) 0.4%. From this content, we can see that this fertilizer contains quite a lot of N, even more than cow and goat manure.

Graph between treatment of giving types of manure andInorganic fertilizers are presented in Figures 12 and 13.

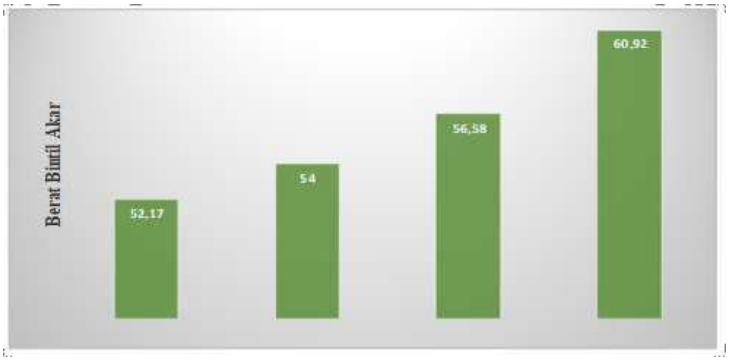


**Figure 12.** Histogram of the influence of manure typeon root nodule weight

Figure 12 shows the type of manure that causes thisroot nodule weightThe highest is chicken coop organic fertilizer. It can be seen that the quality of chicken manure is the best, followed by goat manure and cow manure to increase the number of root nodules, namely in the treatment of chicken manure with 15 tons/ha, because since the roots are formed, rhizobium bacteria carry out the process of forming root nodules, which is around 4 -5 days after planting and root nodules can bind nitrogen from the air at the age of 10-12 HST (Adisarwanato, 2005) and the N element in chicken manure can be directly absorbed by plants without having to go through a decomposition process because chicken manure is more liquid and easily absorbed by the soil Compared to cow and goat manure, the manure of which is denser and takes relatively longer to settle.

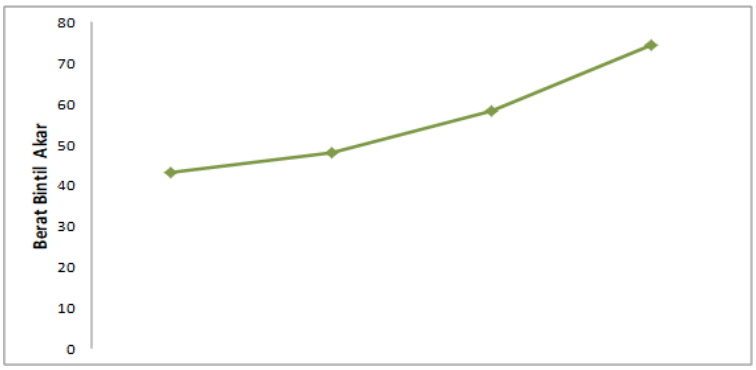


**Figure 13.** Influence graphapplication of fertilizer to the weight of root nodules

From the picture, it can be seen that the type of inorganic fertilizer given has a positive liner regression. The type of inorganic fertilizer that causesroot nodule weightThe highest is treatment A3It can be seen that the quality of inorganic fertilizer is the best followed by treatment A2and treatment A1This is because there are effective root nodules which can provide N nutrients to support plant growth. Where the rhizobium has started to infect the roots, since the formation of the roots so that the root nodules that form can bind nitrogen from the air so thatThe amount of nitrogen greatly influences whether or not the formation of root nodules will fail. This is in accordance with Novriani (2011) who stated that legume plants will fail to form root nodules if the soil contains more than 100 kg N, and Rhizobium sp inoculation has a significant effect on the number of effective nodules in soybeans, this is because Rhizobium sp bacteria are able to fix N.2into the roots so that these bacteria enter into symbiosis and form root nodules

Determining the research location was carried out purposively (purposive methods), where Siantar sub-district has 17 villages and 92 hamlets, and Pamatang Simalungun Village, Rambung Merah Village, Karang Bangun Village and Siantar Estate Village are villages that are thought to have a tendency to convert agricultural land quite large for residential, trade and industrial activities, where there has been a significant decline in the area of wetland rice farming in the areas mentioned above. This research was conducted for two months from the date the research permit was issued, namely May and June 2023.

## 4. CONCLUSION

1. Chicken, goat and cow drum fertilizer treatment had a significant effect on the number of primary branches, plant height, stem diameter, crown dry weight, number of root nodules, root nodule weight
2. The interaction between the types of mandanf and inorganic fertilizers had no significant effect on the number of plant branches, plant height and leaf N, P and K nutrient uptake.
3. Providing chicken manure at a dose of 15 tons ha produced the highest number of plant branches, tallest plants, largest stem diameter, plant dry weight, number of root nodules, highest weight of root nodules.

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