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A Response Of Giving Rice Husk Charcoal And Goat Dung On Growth And Production Of Corn Plants (Zea Mays L.)

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ABSTRACT
This study aims to determine the response of rice husk charcoal and goat manure solid organic fertilizer to the growth and production of corn (Zea mays). This study used a Factorial Randomized Block Design (RAK) with 2 treatment factors and 3 blocks. The first factor is rice husk charcoal with each dose of A0 = 0 kg/plot, A1 = 1 kg/plot and A2 = 2 kg/plot. The second factor is the provision of goat manure solid organic fertilizer with each dose of K0 = 0 kg/plot, K1 = 1 kg/plot, K2 = 2 kg/plot and K3 = 3 kg/plot. Observation data were analyzed using analysis of variance and continued with the Duncant test. The parameters observed were plant height, stem diameter, number of cobs per sample, number of cobs per block, cob weight per sample and cob weight per block. The results of the study showed that the provision of rice husk charcoal and solid organic fertilizer of goat manure had a very significant effect on plant height, stem diameter, number of cobs per sample, number of cobs per block, weight of cobs per sample and weight of cobs per block. In the interaction of the combination of treatments between the provision of rice husk charcoal and solid organic fertilizer of goat manure did not have a significant effect on all parameters observed.

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INTRODUCTION

Corn as one of the main food crop commodities has a strategic role in the development of agriculture and the economy of Indonesia, considering the multi-purpose function of this commodity, both for direct public consumption and for use by the feed industry and food industry as the main raw material.

Table 1. Harvested Area and Corn Production in North Sumatra 2019-2021

Year	Harvest Area (Ha)	Production (Ton)
2019	319,507.00	1,960,424.00
2020	321,184.00	1,965,444.00
2021	273,703.00	1,724,398.00

Source: (Central Statistics Agency of North Sumatra Province, 2019).

Based on table 1, it can be seen that corn production in North Sumatra has always increased every year, where the highest production was in 2019 at 1,960,424 tons. The

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increase in corn production is also accompanied by an increase in the harvest area in North Sumatra. From this table, North Sumatra Province has great potential to develop and increase corn farming. Solid organic fertilizer is a type of fertilizer that is safe and suitable for use on any type of plant, besides being safe for plants, it is also safe for the environment because it does not contain chemical residues that can endanger the balance of the environment. There are two types of organic fertilizers, namely solid and liquid organic fertilizers. Solid organic fertilizers are fertilizers that come from plant residues, animal waste, and human waste in solid form, while liquid organic fertilizers are solutions that come from the decomposition of organic materials.

The provision of solid organic materials aims to improve the soil structure which is increasingly declining due to excessive chemical fertilizers. Solid organic materials have complete nutrient content needed by plants. Based on their form, organic materials are grouped into solid organic materials and liquid organic materials, and can improve soil structure.

Rice husk charcoal is a waste that is abundant and cheap, and is one of the efforts in utilizing organic materials that are quite potential to be used as an alternative medium for plant growth. There are various organic fertilizers, one of which is manure fertilizer, one of which is manure fertilizer derived from goat manure. Goat manure has been widely used by the community and is even traded in the form of fertilizer. The benefits of goat manure fertilizer are that it has a higher N and K content than cow manure, while the P element is equivalent to other manure fertilizers. Goat manure fertilizer has a nutrient content of 1.70% N, 1.40% P2O5, 0.25% K2O, C/N 20-25, and 31% organic matter (Danial et, al. 2024).

RESEARCH METHODS

This study used a factorial Randomized Block Design (RAK) method consisting of 2 factors with 3 replications. The first factor is organic fertilizer consisting of 4 treatments (K). The second factor is the time of application of organic fertilizer with 3 treatments (T).

Husk charcoal treatment factors consist of:

A0: No Treatment 0 kg/ plot
A1 : Rice husk charcoal 1 kg/plot
A2 : Rice husk charcoal 2 kg/plot

Goat manure, consists of:

K0: No treatment 0 kg/plot
K1 : Goat Manure 1kg/plot
K2 : Goat Manure 2kg/plot
K3: Goat manure 3 kg/ plot

RESULTS AND DISCUSSION

Plant Height (cm)

The measurement results data and the list of variance analysis of the average plant height (cm) of corn due to the provision of rice husk charcoal and solid organic fertilizer in the form of goat manure at the ages of 2, 4 and 6 MST are presented in Appendices 4, 5 and 6.

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The results of the analysis of variance stated that the provision ofrice husk charcoal and solid organic fertilizer from goat manuregave a very real influence at the ages of 2, 4 and 6 MST. The interaction of givingrice husk charcoal and solid organic fertilizer from goat manuredid not have a significant effect on plant height (cm) at ages 2, 4 and 6 MST. The effect of giving rice husk charcoal and solid organic fertilizer of goat manure on plant height (cm) inages 2, 4 and 6 MSTThe Duncant distance tested can be seen in Table 2.

Table 2. Average Plant Height (cm) of Corn Due to the Provision of Rice Husk Charcoal and Goat Manure Solid Organic Fertilizer at Ages 2, 4 and 6 MST.

Treatment	Plant Height (cm)		
	2 MST	4 MST	6 MST
Rice Husk Charcoal (A)			
A0 = 0 kg/plot	32.58 bB	61.22 bB	193.28 bB
A1 = 1 kg/plot	32.89 bB	61.64 bB	194.01 bB
A2 = 2 kg/plot	36.86 aA	67.61 aA	227.35 aA
POP Goat Manure (K)			
K0 = 0 kg/plot	32.08 bB	61.00 bB	180.87 bB
K1 = 1 kg/plot	32.17 bB	61.38 bB	195.51 bB
K2 = 2 kg/plot	33.83 bB	61.63 bB	205.24 bB
K3 = 3 kg/plot	38.34 aA	69.95 aA	237.89 aA

Description: Numbers in the same column followed by different letters mean that they are significantly different at the 5% level (lower case letters) and very significantly different at the 1% level (capital case letters). The effect of providing rice husk charcoal on the plant height (cm) of corn plants at the age of 6 MST can be seen in Figure 1.

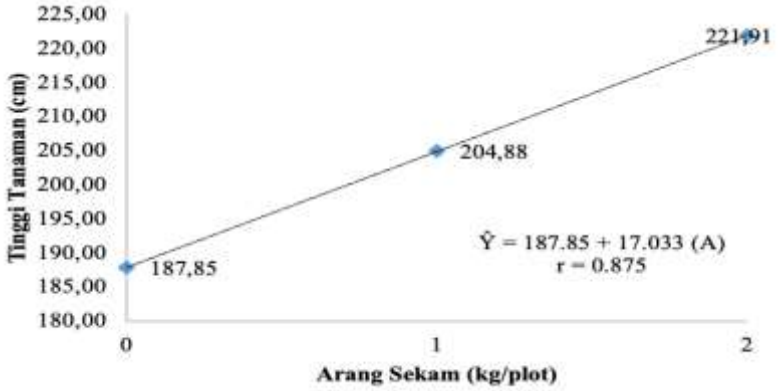

Figure 1. Graph of the Relationship between Corn Plant Height (cm) Due to the Provision of Rice Husk Charcoal at 6 MST.

The effect of providing solid organic fertilizer in the form of goat manure on the plant height (cm) of corn plants at the age of 6 MST can be seen in Figure 2.

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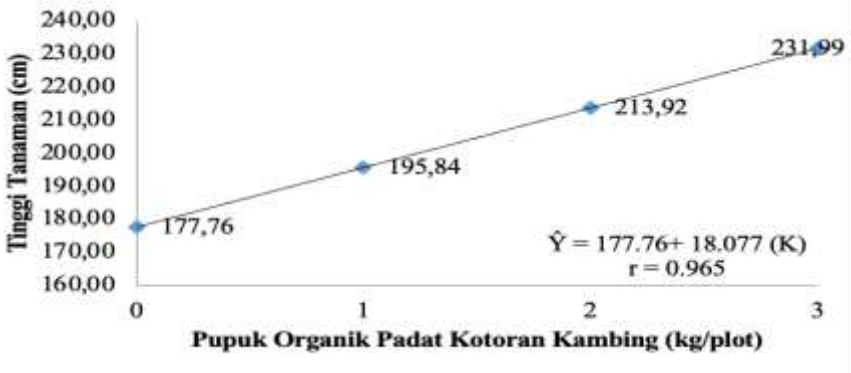

Figure 2. Graph of the Relationship between Corn Plant Height (cm) and the Application of Goat Manure Solid Organic Fertilizer at 6 MST.

Bar Diameter (mm)

The measurement results data and the list of variance analysis of the average stem diameter (mm) of corn due to the provision of rice husk charcoal and solid organic fertilizer in the form of goat manure at the ages of 2, 4 and 6 MST are presented in Appendices 7, 8 and 9.

The results of the analysis of variance stated that the provision ofrice husk charcoal and solid organic fertilizer from goat manuregave a very significant effect on the stem diameter (mm) at the ages of 2, 4 and 6 MST. The interaction between the administration ofrice husk charcoal and solid organic fertilizer from goat manuredid not have a significant effect on stem diameter (mm) at ages 2, 4 and 6 MST.

The effect of providing rice husk charcoal and solid organic fertilizer in the form of goat manure onstem diameter (mm)onages 2, 4 and 6 MSTThe Duncant distance that has been tested can be seen in Table 3.

Table 3. Average Stem Diameter (mm) of Corn Due to Provision of Rice Husk Charcoal and Goat Dung Solid Organic Fertilizer at Ages 2, 4 and 6 MST.

Treatment	Bar Diameter (mm)		
	2 MST	4 MST	6 MST
Rice Husk Charcoal (A)			
A0 = 0 kg/plot	25.86 bB	33.69 bB	38.74 bB
A1 = 1 kg/plot	26.07 bB	36.75 bAB	41.62 bB
A2 = 2 kg/plot	30.68 aA	40.28 aA	45.73 aA
POP Goat Manure (K)			
K0 = 0 kg/plot	24.32 bB	32.96 cC	38.32 bB
K1 = 1 kg/plot	24.56 bB	33.89 cC	40.61 bB
K2 = 2 kg/plot	28.13 bAB	37.26 bB	41.60 bB
K3 = 3 kg/plot	33.13 aA	43.52 aA	47.59 aA

Description: Numbers in the same column followed by different letters mean that they are significantly different at the 5% level (lower case letters) and very significantly different at the 1% level (capital case letters).

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The effect of providing rice husk charcoal on the stem diameter (mm) of corn plants at the age of 6 MST can be seen in Figure 3.

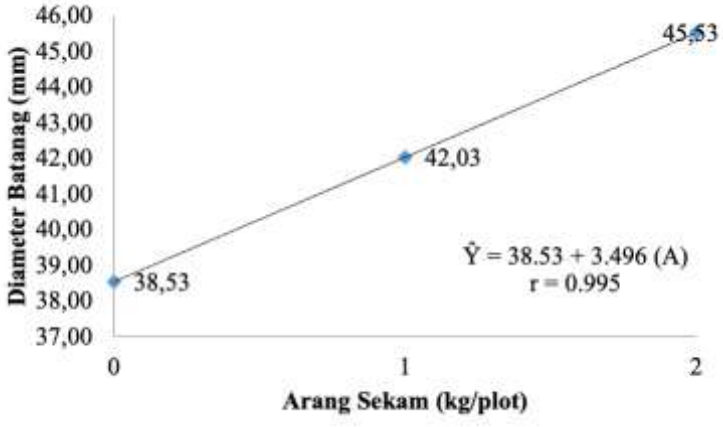

Figure 3. Graph of the Relationship between Corn Stem Diameter (mm) Due to Rice Husk Charcoal Application at 6 MST.

The effect of providing solid organic fertilizer in the form of goat manure on the stem diameter (mm) of corn plants at the age of 6 MST can be seen in Figure 4.

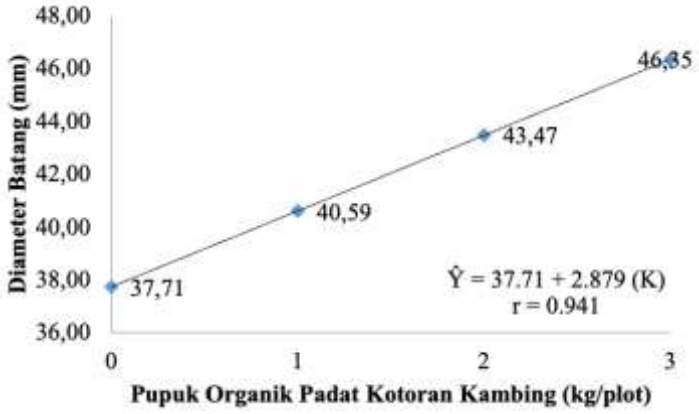

Figure 4. Graph of the Relationship between Corn Plant Height (cm) and the Application of Goat Manure Solid Organic Fertilizer at 6 MST.

Figure 4 above shows that the stem diameter (mm) of corn with the provision of solid organic fertilizer of goat manure forms a positive linear relationship with the equation $\hat{Y}$ = 37.71 + 2.879 (K) with a value of r = 0.941. This shows that the stem diameter (mm) increases in width along with the increasing dose of solid organic fertilizer of goat manure.

Number of Cobs Per Sample (cobs)

The measurement results data and the list of variance analysis of the average number of corn cobs per sample (cobs) due to the provision of rice husk charcoal and solid organic fertilizer from goat manure are presented in Appendix 10.

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The results of the analysis of variance stated that the provision ofrice husk charcoal and solid organic fertilizer from goat manurehave a very real impact onnumber of cobs per sample (cobs). Interaction of givingrice husk charcoal and solid organic fertilizer from goat manuredoes not have any real impact onnumber of cobs per sample (cobs). The effect of providing rice husk charcoal and solid organic fertilizer of goat manure on the number of cobs per sample (cobs) that have been tested for Duncant's distance can be seen in Table 4.

Table 4. Average Number of Corn Cobs Per Sample (cobs) Due to the Application of Rice Husk Charcoal and Goat Manure Solid Organic Fertilizer.

Treatment	Number of Cobs Per Sample (cobs)
Rice Husk Charcoal (A)	
A0 = 0 kg/plot	1.94 bB
A1 = 1 kg/plot	2.48 abAB
A2 = 2 kg/plot	2.85 aA
POP Goat Manure (K)	
K0 = 0 kg/plot	1.94 bB
K1 = 1 kg/plot	2.25 bB
K2 = 2 kg/plot	2.53 abAB
K3 = 3 kg/plot	2.97 aA

Description: Numbers in the same column followed by different letters mean that they are significantly different at the 5% level (lower case letters) and very significantly different at the 1% level (capital case letters). The effect of giving rice husk charcoal on the number of cobs per sample (cobs)Corn plants can be seen in Figure 5.

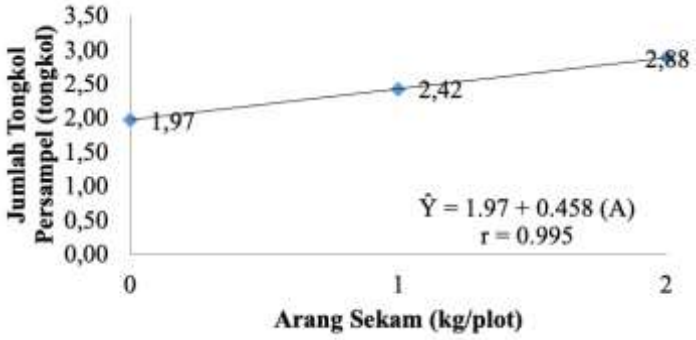

Figure 5. Graph of the Relationship between the Number of Corn Cobs Per Sample (cobs) Due to the Provision of Rice Husk Charcoal.

The effect of providing solid organic fertilizer in the form of goat manure on the number of cobs per sample (ears) of corn plants can be seen in Figure 6.

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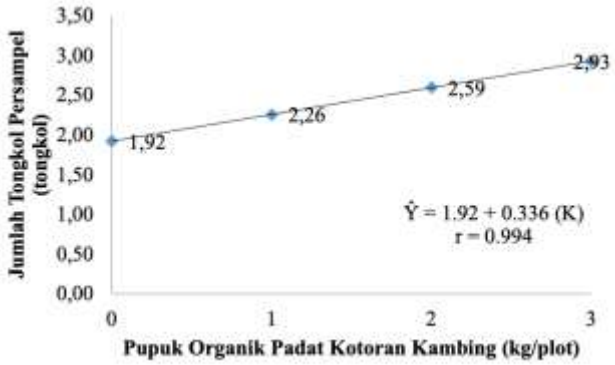

Figure 6. Graph of the Relationship between the Number of Corn Cobs Per Sample (cobs) Due to the Application of Solid Organic Goat Manure Fertilizer.

Number of Cobs Per Plot (cobs)

The measurement results data and the list of variance analysis of the average number of corn cobs per plot (ears) due to the provision of rice husk charcoal and solid organic fertilizer from goat manure are presented in Appendix 11. The results of the analysis of variance stated that the provision ofrice husk charcoal and solid organic fertilizer from goat manurehave a very real impact onnumber of cobs per plot (cobs). Interaction of givingrice husk charcoal and solid organic fertilizer from goat manuredoes not have any real impact onnumber of cobs per plot (cobs). The effect of providing rice husk charcoal and solid organic fertilizer of goat manure on the number of cobs per plot (cobs) that have been tested for Duncant's distance can be seen in Table 5.

Table 5. Average Number of Corn Cobs Per Plot (Ear Cobs) Due to Application of Rice Husk Charcoal and Goat Manure Solid Organic Fertilizer.

Treatment	Number of Cobs Per Plot (cobs)
Rice Husk Charcoal (A)	
A0 = 0 kg/plot	13.67 bB
A1 = 1 kg/plot	13.75 bB
A2 = 2 kg/plot	15.92 aA
POP Goat Manure (K)	
K0 = 0 kg/plot	12.11 cC
K1 = 1 kg/plot	13.00 cC
K2 = 2 kg/plot	15.89 abAB
K3 = 3 kg/plot	16.78 aA

Description: Numbers in the same column followed by different letters mean that they are significantly different at the 5% level (lower case letters) and very significantly different at the 1% level (capital case letters). The effect of giving rice husk charcoal on the number of cobs per block (cobs)Corn plants can be seen in Figure 7.

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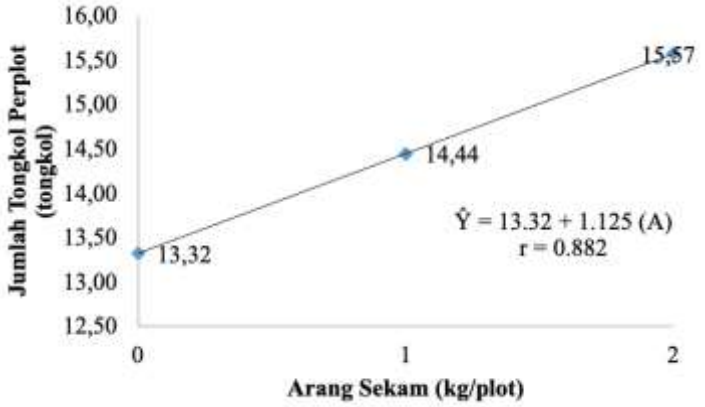

Figure 7. Graph of the Relationship between the Number of Corn Cobs Per Plot (cobs) Due to the Provision of Rice Husk Charcoal.

The effect of providing solid organic fertilizer in the form of goat manure on the number of corn cobs per plot (ears) can be seen in Figure 8.

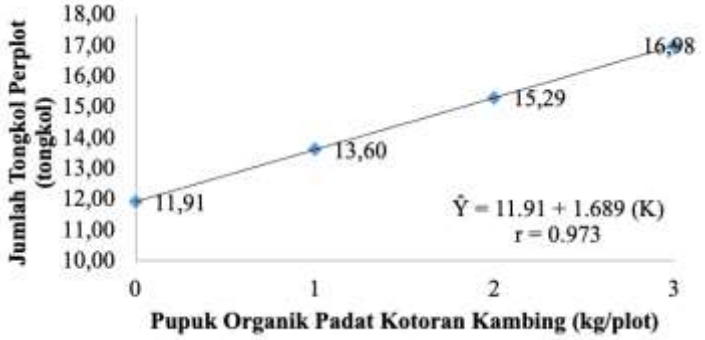

Figure 8. Graph of the Relationship between the Number of Corn Cobs Per Plot (cobs) Due to the Application of Solid Organic Goat Manure Fertilizer.

Weight of Cob Per Sample (g)

The measurement results data and a list of variance analysis of the average weight of corn cobs per sample (g) due to the provision of rice husk charcoal and solid organic fertilizer from goat manure are presented in Appendix 12. The results of the analysis of variance stated that the provision ofrice husk charcoal and solid organic fertilizer from goat manurehave a very real impact onweight of cob per sample (g). Interaction of givingrice husk charcoal and solid organic fertilizer from goat manuredoes not have any real impact onweight of corn per sample (g). The effect of providing rice husk charcoal and solid organic fertilizer of goat manure on the weight of cobs per sample (g) that have been tested for Duncant's distance can be seen in Table 6.

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Table 6. Average Weight of Corn Cobs Per Sample (g) Due to Application of Rice Husk Charcoal and Goat Manure Solid Organic Fertilizer.

Treatment	Weight of Cob Per Sample (g)
Rice Husk Charcoal (A)	
A0 = 0 kg/plot	196.05 bB
A1 = 1 kg/plot	259.38 bAB
A2 = 2 kg/plot	302.33 aA
POP Goat Manure (K)	
K0 = 0 kg/plot	220.61 bB
K1 = 1 kg/plot	224.11 bB
K2 = 2 kg/plot	260.33 abAB
K3 = 3 kg/plot	305.89 aA

Description: Numbers in the same column followed by different letters mean that they are significantly different at the 5% level (lower case letters) and very significantly different at the 1% level (capital case letters). The effect of providing rice husk charcoal on the weight of corn cobs per sample (g) can be seen in Figure 9.

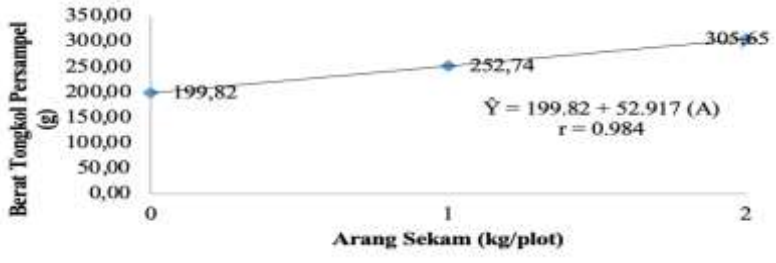

Figure 9. Graph of the Relationship between Weight of Corn Cobs Per Sample (g) Due to the Provision of Rice Husk Charcoal.

The effect of providing solid organic fertilizer in the form of goat manure on the weight of corn cobs per sample (g) can be seen in Figure 10.

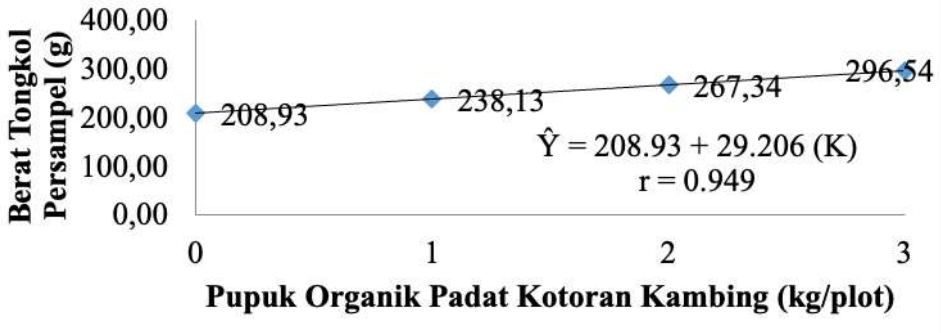

Figure 10. Graph of the Relationship between Corn Cob Weight Per Sample (g) Due to the Application of Solid Organic Goat Manure Fertilizer.

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Weight of Cob Per Plot (g)

The measurement results data and a list of variance analysis of the average weight of corn cobs per plot (g) due to the provision of rice husk charcoal and solid organic fertilizer from goat manure are presented in Appendix 13. The results of the analysis of variance stated that the provision ofrice husk charcoal and solid organic fertilizer from goat manurehave a very real impact onweight of cob per plot (g). Interaction of givingrice husk charcoal and solid organic fertilizer from goat manuredoes not have any real impact onweight of cob per plot (g). The effect of providing rice husk charcoal and solid organic fertilizer of goat manure on the weight of cobs per plot (g) which has been tested for Duncant's distance can be seen in Table 7.

Table 7. Average Weight of Corn Cobs Per Plot (g) Due to Application of Rice Husk Charcoal and Goat Manure Solid Organic Fertilizer.

Treatment	Weight of Cob Per Plot (g)
Rice Husk Charcoal (A)	
A0 = 0 kg/plot	7250.00 bB
A1 = 1 kg/plot	7950.00 bB
A2 = 2 kg/plot	9341.67 aA
POP Goat Manure (K)	
K0 = 0 kg/plot	7322.22 cB
K1 = 1 kg/plot	7511.11 cB
K2 = 2 kg/plot	8733.33 abAB
K3 = 3 kg/plot	9155.56 aA

Description: Numbers in the same column followed by different letters mean that they are significantly different at the 5% level (lower case letters) and very significantly different at the 1% level (capital case letters). The effect of providing rice husk charcoal on the weight of corn cobs per plot (g) can be seen in Figure 11.

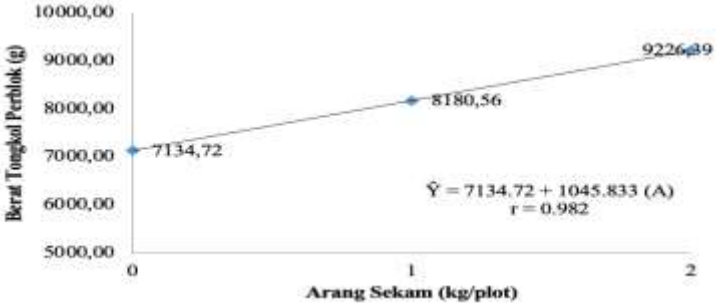

Figure 11. Graph of the Relationship between Corn Cob Weight Per Plot (g) Due to the Provision of Rice Husk Charcoal.

The effect of providing solid organic fertilizer in the form of goat manure on the weight of corn cobs per plot (g) can be seen in Figure 12.

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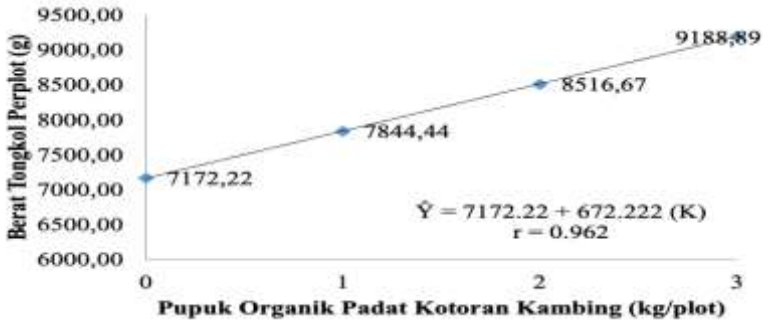

Figure 12. Graph of the Relationship between Corn Cob Weight Per Plot (g) Due to the Application of Solid Organic Goat Manure Fertilizer.

Effectiveness of Rice Husk Charcoal Application on Corn Growth and Production

The provision of rice husk charcoal has a very real effect on the height of corn plants. This is because...provision of rice husk charcoal in treatment A2 (3 kg/plot) according to the needs of corn plants, so that corn plants get optimal nutrients. Ramayana et al. (2021) stated that the provision of various fertilizer compositions will produce taller plants than plants without fertilizer, the NPK content contained in goat manure fertilizer. Especially with the availability of N nutrients will help the vegetative growth of plants because it stimulates the growth of stems, branches, and leaves. The N element is a component that helps photosynthesis activity so that vegetative growth in plants is stronger.

The treatment of giving rice husk charcoal has a very significant effect on the diameter of the old stem. This is thought to be because the high levels of nitrogen (N), potassium (K), and calcium (Ca) in rice husk charcoal will provide a boost to the growth of the stem diameter. In agreement with Sembiring et, al (2020) who said that one of the metabolic activities is photosynthesis with sufficient N, P, K, the rate of photosynthesis becomes more optimal so that the resulting asimalate is partly utilized for the formation and arrangement of plant organs, one of which is the stem organ.

In the observation of the number of fruits per sample and the number of fruits per plot, there was a very real effect due to the provision of rice husk charcoal. This is because the application of rice husk charcoal with the dosage level that has been determined in this study is able toin providing maximum fruit yields. Sufficiently available nutrients help the process of photosynthesis during productive growth which will be used for flower formation and fruit ripening. According to Rahayu et, al (2022) said that the number of fruits formed is influenced by the content of the element P (phosphorus) which will help the formation of flowers and fruit and K (potassium) helps in the development of strengthening tissue in the fruit stalk so as to reduce flower fall. Photosynthesis products will be immediately used for food reserves, formation of structural compounds, respiration and formation of active cells. The more active the plant is in carrying out photosynthesis activities, the more assimilates are produced in the form of carbohydrates, which are used by plants for the generative phase such as division, enlargement and differentiation of cells leading to the formation of flowers and fruit.

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The administration of different doses of rice husk charcoal caused a very significant effect on the weight of the cob per sample and the weight of the cob per plot, the highest dose found in the A2 treatment with a dose of 2 kg/plot which was very significantly different from other treatments, due to the addition of organic matter that can cause the cob to develop as a result of the accumulation of organic matter produced by photosynthesis and absorption of nutrients in the soil. The size and weight of the cob will be influenced by the capacity of this plant to translocate photosynthate into it. The P element is the most important nutrient for increasing the weight of the cob. The photosynthesis process will be accelerated so that it produces photosynthate production which will increase the weight of the cob (Indriyanti et, al. 2022).

Effectiveness of Giving Solid Organic Fertilizer of Goat Manure on Corn Growth and Production.

This study shows that the effect of giving solid organic fertilizer of goat manure is very real on the parameters of the height of corn plants. This is due to the nitrogen element contained in solid organic fertilizer of goat manure. Nitrogen is very much needed at the stage of plant height growth, nitrogen is used by plants to form amino acids which will be converted into proteins and are also needed to form compounds such as chlorophyll, nucleic acids, and enzymes. The availability of nitrogen in manure fertilizer will accelerate the formation of vegetative parts of the plant because the meristem tissue will carry out cell division, elongation and enlargement of new cells, and protoplasm so that plant growth takes place properly (Aditya and Melati, 2019).

The results of the study showed that the provision of solid organic fertilizer from goat manure had a very significant effect on the stem diameter. The large stem diameter in the K3 treatment is thought to be the nutrients obtained by the plants that can increase the growth and development process of the plants, especially in increasing the stem diameter of the corn plant. According to Vidiatama and Elfis (2024), manure fertilizer has several properties that are better than other natural fertilizers. Among others, it is humus that can maintain/maintain soil structure, as a source of N, P and K nutrients which are very important for plant growth and development, increases water retention capacity and contains many microorganisms that can synthesize certain compounds that are useful for plants.

The results of the study showed that the provision of solid organic fertilizer from goat manure had a very significant effect on the number of cobs per sample and the number of cobs per plot. The nutrients obtained by plants from the soil in their growing environment are very important for the process of the number of cobs. According to Sholeh et, al (2021), nutrients in the soil that are absorbed by plants are transported to the leaves for the photosynthesis process and will produce materials for the formation of corn cobs. In addition to providing nutrients, the most important part of organic fertilizer is the assistive power in the activity of microorganisms in the soil so that they can maximize plant yields. The activity of microorganisms obtained in fertilizer can help form soil aggregates, thereby increasing the ability to hold water and making the soil structure better.

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Based on the results of the study, it can be explained that there is a very significant effect on the observation parameters of cob weight per sample and cob weight per plot due to the treatment of solid organic fertilizer doses of goat manure. This is thought to be due to increased growth activity of corn plants. The photosynthesis process can run well so that the translocation of photosynthate to the cob can be optimal. The role of potassium nutrients and goat manure fertilizer affects and can increase the growth of corn plants. This is in accordance with Wibowo et, al (2017) namely that potassium elements play a role in regulating water in cells and cation transfer through the membrane. The increase in cob weight is influenced by the effectiveness of the photosynthesis process and the translocation of photosynthate to the cob.

According toWibowo et, al (2017) the provision of manure fertilizer can increase the weight of the cob. The increase in cob weight is closely related to the results of photosynthate translocated to the corn cob. The greater the results of photosynthate translocated to the cob, the greater the fresh weight of the cob.

CONCLUSION

The application of rice husk charcoal and goat dung significantly influenced the growth and yield of corn plants. Both organic amendments improved soil structure, nutrient availability, and water retention, which in turn enhanced plant development and productivity. Corn plants treated with a combination of rice husk charcoal and goat dung exhibited better growth parameters, including height, leaf area, and root development, compared to untreated plants. In terms of yield, the addition of these organic materials increased the number of cobs, cob weight, and overall grain production. This study demonstrates that using rice husk charcoal and goat dung as organic fertilizers is an effective strategy for improving corn growth and yield. It offers a sustainable agricultural practice by utilizing locally available resources, reducing the dependency on chemical fertilizers, and promoting soil health for long-term productivity.

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