The International Conference on Education, Social Sciences and Technology (ICESST)
Volume 3 Nomor 2 July - December 2024
E-ISSN: 2964-2671; P-ISSN : 2964-2701, Hal 01-21
DOI: 10.55606/icesst.v3i2.412
Available online at: https://ijconf.org/index.php/icesst/issue/view/26

Effect of Various Biochar Materials and Levels of Chicken Manure on Growth and Yield of Soybean

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Abstract*. This study aims to determine the effect of various biochar materials and doses of chicken manure on soybean growth and yield. The research method used a 2 factorial Randomized Group Design. The first factor is the treatment of various biochar materials consisting of 4 levels, namely: no treatment, corn cob biochar, jengkol skin biochar, rice husk biochar. Factor II is chicken manure consisting of 0 ton/ha, 5 ton/ha, 10 ton/ha and 15 ton/ha. The results showed that the provision of biochar on the growth and yield of soybean plants had a significant effect on the parameters of stem diameter, number of pods, dry weight of seeds/plant, dry weight of 100 seeds. The provision of jengkol skin biochar gave the highest effect on stem diameter (1.750 cm), number of pods (181.60 pods), dry weight of seeds/plant (45.64 gr), weight of seed/m2 (442,98 g). The application of chicken manure on the growth and yield of soybean plants gives a significant effect on stem diameter, number of pods, dry weight of seeds/plant, dry weight of 100 seeds. The dose of chicken manure 15 tons/ha showed the highest effect on stem diameter, number of pods, dry weight of seeds/plant, dry weight of 100 seeds. The interaction of biochar and chicken manure fertilizer did not give a significant effect on all treatments.*

Keywords: biomass, biochar, chicken manure, soybean

INTRODUCTION

The development of Indonesia's soybean import volume over 3 decades (1987-2019) shows an increasing trend of 13.50% per year, which means that Indonesia imports an average of 2.59 million tons of soybeans per year. In 1987, Indonesia's soybean imports were only 543.70 thousand tons and reached 7.15 million tons thirty years later (2019). Indonesian soybean import data also shows that there was a surge in imports twice from the previous year in 1999 and 2012 by 116.00% and 189.65%. In the last five years, the volume of soybean imports averaged 6.88 million tons or increased by 2.56% per year. In 2016 soybean imports decreased by 1.29% or 83.04 thousand tons from 2015 of 6.42 million tons to 6.33 million tons. In 2019, it decreased by 3.42% or 253.62 thousand tons from 2018 of 7.41 million tons to 7.15 million tons.

The average soybean productivity is highest in the world is America (3.1 tons/ha), followed by Oceania and Europe at 2.14 tons/ha and 2.08 tons/ha. Meanwhile, the average soybean productivity in Asian countries only reaches 1.45 tons/ha. According to the Data and Information System Center of the Ministry of Agriculture (2019), that over the past 5 years soybean production has fluctuated quite sharply. Soybean production in 2015 was

Received on Juli 7th, 2024; Revised on Agustus 2nd, 2024; September 5nd, 2024
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the highest with a value of 963,183 tons. In 2016, it decreased to 859,653 tons Furthermore, in 2017, it dropped dramatically to 538,728 tons of hanys only. This decline is very influential considering the high demand for domestic soybeans, so efforts to increase production are urgently needed.

Three countries in the Americas have been importing soybeans to Indonesia over the past five years (2015-2019) with the import value reaching 95.96% per year or an average of 6.53 million tons per year. The three are USA with the highest import share of 36.51% per year or an import volume of 2.50 million tons per year, followed by Argentina with a share of 36.18% or an average import quantity of 2.42 million tons per year, and Brazil with a share of 23.27% or 1.61 million tons per year.

The development of soybean crops in Indonesia is hampered by land use competition with other strategic commodities such as rice and corn and increasing land conversion in potential land areas. Most of the soybean production centers in Indonesia, there are almost no producer farmers who make soybeans as the main crop. The government continues to increase soybean production through intensification and extensification. Given the vast area in Indonesia, Indonesia can actually grow soybeans in large quantities but the condition of the land that can be planted is mostly nutrient poor soil with low pH and acidic soil reaction ((Dariah *et al., 2015*).

LITERATURE REVIEW

The problem is that most of the land is acidic soil with low pH, high Aluminum content. Conditions in such soils cause Ca and P to be fixed by Al and Fe so that they are not available in the soil. This makes plant growth not optimal (Sudaryono *et al*, 2011).

Organic and anorganic fertilizer function as nutrient providers for plants to achieve optimal production. Conditions in 2022 show that the government only allocates subsidized fertilizers 37-42% of Indonesia's total fertilizer needs as a result farmers must buy non-subsidized fertilizers at high prices and in limited quantities. Farmers have to spend more production costs in soybean cultivation with soybean prices also competing with imported soybeans, which makes soybean farmers' profits significantly reduced.

Although the use of anorganic fertilizer has a positive effect on plant growth and production, the continuous use of anorganic fertilizer at excessive doses has a negative effect on the soil, including the soil becoming hard and storing less water. Relying on inorganic fertilizer causes the provision of organic matter to the soil to be forgotten so that the soil becomes hard, not loose, soil microorganisms are drastically reduced so that the soil becomes infertile and results in not optimal plant growth**.**

One of the efforts to overcome these problems is the use of organic plant biomass waste as biochar and chicken farm waste, namely chicken coops that are fermented into chicken manure. Biochar is a carbon-rich solid that is the result of conversion of agricultural waste biomass that is difficult to decompose through the pyrolysis process. In Indonesia, the potential for biochar use is quite large because raw materials such as rice husk residues, coconut shells, wood residues, cocoa pod shells are quite available. The application of biochar to agricultural soils is beneficial for (a) increasing nutrient availability (b) increasing nutrient and water retention (Glaser *et al.* 2002; Liang *et al*. 2006) (c) creating a good habitat for symbiotic microorganisms (d) increasing crop production (Lehmann *et al*. 2006; Chan *et al*. 2007) and (e) reducing the rate of CO2 emissions (Laird 2008; Sohi *et al* 2010).

Mawardiana *et al.*, 2013 stated that biochar does not undergo further weathering so that when applied in the soil can last for a long period of time so that the soil that has been applied biochar can be utilized until the next planting season. The residue of biochar application with a dose of 10 tons ha-1 can increase the growth and production of rice plants.

Biochar can improve soil conditions and increase crop production, especially on poor soils. Biochar's ability to bind water and nutrients in the soil helps prevent fertilizer loss due to surface erosion (run off) and leaching (leaching), thus enabling fertilizer savings and reducing residual fertilizer pollution in the surrounding environment. Biochar's ability to retain moisture can help plants in periods of drought, can act as a plant growth promoter and retain nutrients in the soil so that nutrients in the soil are not easily lost in the process of leaching in the soil and will ultimately affect the increase in crop yields.

In soybean crops, especially in Indonesia, the effect of biochar residues has not been widely reported, both as a soil improver and for plant growth and yield. Biochar residues can be reused for soybean planting media. Biochar application has a positive effect on acid soil properties and plant productivity (Atkinson *et al.* 2010). The application of agricultural waste biochar formula with 25-50% compost, increased the height of corn plants on non-acid mineral soil. While on acid mineral soils, biochar can be applied with or without compost (Nurida *et al.* 2013). Soil in which there is biochar residue has a lot of microorganism activity because biochar has the ability to retain water, reduce soil density in soils with clay texture, and increase soil C content (Sonia *et.al.* 2014). Soil that has biochar residue is a good planting medium because biochar has pores that can keep nutrients available when plants need them.

Livestock waste is an important organic material for soil fertility. Application of chicken manure can improve soil fertility by changing soil physical properties such as soil structure, stabilizing soil aggregates so that the soil has the ability to retain water, improving soil aeration which allows soil microorganisms to have a good habitat so that they can carry out the process of soil mineralization and lead to an increase in soil chemical properties such as cation exchange capacity so that nutrients are available in the soil.

Utilizing chicken manure into compost is the right way in terms of processing waste into a new form of organic fertilizer that can be applied to the soil to improve soil fertility. The application of chicken manure as much as 20 tons/ha can give the highest results on the parameters: plant height, leaf area index, number of branches, number of internodes, root dry weight, crown dry weight, weight of harvest pods/plot, weight of filled pods on soybean plants (Maya, 2005). Research by Sajar (2023), stated that the application of 30 tons/ha of chicken manure to the soil gave a positive response to the growth of plant height, stem diameter, crown dry weight and root dry weight of soybean.

The results of research by Saparso *et al*, 2017 showed that the frequency of applying soil conditioners every planting period affected the fresh weight of cabbage. The type of soil conditioner mixture of vertisol and chicken manure affects leaf length and fresh flower weight. The frequency of applying fertilizers every planting period and fertilization interval of 14 days affects the weight of fresh flowers. Lutfyrakhman et al. 2013 stated that the optimal dose of chicken manure is 24.375 tons/ha dose gives the best effect on tomato yield.

Application of chicken manure at a dose of 17.5 tonnes/ha showed a better increase in the growth and production of spring onions (Maisa and Yeti, 2018).

The content of nutrients in chicken manure is not too high, but the application of this organic fertilizer can improve soil permeability, porosity, soil structure, water holding capacity and soil cation content (Andi *et al,* 2023; Melati, 1990l; Sajar, 2022). Chicken manure can improve soil fertility by improving soil physical properties, such as increasing water holding capacity, stabilizing soil aggregates and structure and improving soil aeration, improving soil chemical properties such as the ability of soil to exchange cations, availability of nutrients for plants (Sajar 2023).

Applying fertilizers and soil amendments to marginal lands is one way to improve nutrient-poor soil conditions. Procurement of inorganic fertilizers and synthetic soil amendments requires considerable funds, while there are alternatives that can be done to replace them by using plant biomass waste and chicken manure.

METHODS

Research Location

This research was carried out in Sampecita Village, Kutalimbaru District, Deli Serdang Regency with an altitude of +/- 30 meters above sea level. November 2023 to March 2024.

Materials and Tools

The materials and tools used in this study are corn cobs, durian shells, jengkol shells, rice husks, chicken manure, molasses, tarpaulins, hoes, burlap, machetes, ropes, meters, handsprayers, small shovels, bamboo, calculators, scales, ovens, rulers, notebooks, padlocks

Type and Scope of Research

The scope of the study focused on the application of organic fertilizer. This research is an experimental study that uses a Factorial Randomized Group Design (RAK) consisting of 2 treatment factors and 3 blocks.

Factor I. Biochar which consists of 4 treatment levels, namely:

B0 = No Treatment
B1 = Corn Cob Biochar
B2 = Jengkol Skin Biochar
B3 = Rice Husk Biochar (Suryana *et al*. 2016)

Factor II. Chicken manure which consists of 4 treatment levels, namely:

P0 = 0 ton/ha
P1 = 5 ton/ha
P2 = 10 ton/ha
P3 = 15 ton/ha (Rasyid, *et al*. 2020)

Research Procedure

The land for research was cleared of weeds and fenced to prevent damage to plants from animal disturbances around the research site. Tillage was done to make the soil loose and experimental plots were made as many as 48 plots divided into 3 blocks. Each block contained 16 experimental plots with a size of 100 cm x 100 cm with a distance between plots of 50 cm and a distance between replicates of 100 cm.

Biochar is made by simple open system pyrolysis. The organic materials of corn cob, rice husk, durian skin and jengkol skin were collected and dried in the sun for 3-4 days to reduce the moisture content. A charcoal burning pit was made with a size of 80 cm x 80 cm with a depth of 60 cm. Each organic material was burned one by one in the pit and the top was covered by leaving a small hole to reduce oxygen. Biochar is made with minimal oxygen combustion. Next, the hole is watered to kill the embers and sorting of ash charcoal and organic materials that have not become charcoal is carried out. The charcoal is crushed or ground to a size of 20 mesh.

Chicken manure is watered with a mixture of water and molasses, then covered with a tarp. Turning and stirring is done every 3 days for 2 weeks. The composting process is complete when the temperature is stable, odorless and color changes have occurred.
The application of biochar and chicken manure was mixed and mixed well with the soil according to the treatment and incubated for 2 weeks. Soybean seeds were planted with 2 seeds per planting hole that were drilled 2 - 3 cm deep with a spacing of 40 cm × 20 cm. At the age of 7 days after planting (HST), plant thinning was carried out and one plant was left per hole so that there were 8 plants per experimental plot.

The data were analyzed using variance analysis based on the following linear model:

$$Yijk = \mu + \rho i + \alpha jd + \beta k + (\alpha\beta)jk + \varepsilon ijk$$

Where:

$\hat{Y}ijk$ = Observation results in the i-th block that received biocar treatment from various j-th sources and chicken manure at the k-th level.

μ = Center Value Effect
pi = The effect of the i-th block
αj = Effect of applying biocar from different sources at level j
βk = Effect of applying ayan manure at the kth level
(αβ)jk = Interaction between the factors of biochar application of various sources at the jth level and chicken manure at the kth level.
Ɛijk = Error effect in the i-th block of various sources of biochar at the j-th level and chicken manure at the k-th level.
(Steel and Torrie, 1980)

All data were analyzed by analysis of variance at the 5% test level to determine the difference in the effect of treatment which can be seen in the significance of F count. In variables with F counts that show significance at the 5% test level, then a real difference test is carried out based on the Duncan Multiple Range Test at the 5% α level to determine differences between treatments.

RESULTS

Plant Height

Table 1 shows that the application of plant biomass biochar gave a significant effect on the height of soybean plants at the age of 2 weeks after planting, but was not significantly different at weeks 4 and 6 weeks after planting.The treatment of chicken manure had a significant effect on the height of soybean plants at the age of 2 weeks of planting while the 4th and 6th weeks of planting had no significant effect.

Table 1. Mean Plant Height (cm) due to the application of Plant Biomass Biochar and Chicken Manure at the Age of 2, 4 and 6 Weeks After Planting

Treatment	Plant Height		
	2 MST	4 MST	6 MST
B = Biochar	..........................cm.............................		
B0 = No treatment	9,41 b	27,56 a	74,56 a
B1 = Corn cob	9,88 b	27.75 a	72,50 a
B2 = Jengkol skin	10,38 b	30,47 a	75,59 a
B3 = Rice husk	9,19 a	25,28 a	72,25 a
P = Chicken manure	..........................cm.............................		
P0 = 0 ton/ha	10,25 b	26,22 a	69,00 a
P1 = 5 ton/ha	9,47 ab	28,94 a	73,38 a
P2 = 10 ton/ha	10,13 b	29,06 a	75,78 a
P3 = 15 ton/ha	9,00 a	26,84 a	76,75 a

Description: Numbers in the same column followed by the same letter mean significantly different at the 5% level.

The interaction between the application of biochar and chicken manure was not significantly different at weeks 2, 4, and 6 after planting on plant height. Plant height at the age of 6 weeks after planting showed the order of soybean plant height starting from the highest in the treatment of jengkol skin 75.59 cm, without treatment 74.56 cm, corn cob 75.59 cm, rice husk 72.25 cm.

Stem Diameter

The provision of plant biomass biochar is significantly different from the diameter of soybean stems, while the treatment of chicken manure is also significantly different from the diameter of soybean stems, but the interaction between the two is not significantly different (Table 2). It can be seen that the highest stem diameter is found in the treatment of jengkol skin biochar (1.750 cm) and the lowest is without biochar (1.54 cm). In the treatment of chicken manure application, the highest was at a dose of 15 tons/ha (1.79 cm) and the lowest was at a dose of 0 tons/ha which was 1.431 cm.

Table 2. Diameter of Soybean Stems due to the application of Plant Biomass Biochar and Chicken Manure at the Age of 6 Weeks After Planting

Plant biomass biochar	Chicken Manure								Average	
	0 ton/ha		5 ton/ha		10 ton/ha		15 ton/ha			
	..........................mm.....................									
No treatment	1.38	a	1.64	a	1.63	a	1.52	a	1.54	a
Corn cob	1.46	a	1.54	a	1.84	a	1.88	a	1.68	b
Jengkol skin	1.51	a	1.79	a	1.74	a	1.96	a	1.75	b
Rice husk	1.38	a	1.76	a	1.48	a	1.82	a	1.61	b
Average	1.43	a	1.68	b	1.67	b	1.79	b		

Description: Numbers in the same column followed by the same letter mean significantly different at the 5% level.

The relationship between the application of plant biomass biochar to stem diameter in Figure 1 shows that the application of jengkol skin biochar gives the highest effect on stem diameter, followed by corn cob biochar, rice husk.

Figure 2 shows that the application of chicken manure to stem diameter is positive linear with the equation $y = 0.2146x + 1.4848$ with a coefficient of determination of 0.8244. or has a relationship of 0.908 or 90.80% between the application of chicken manure and stem diameter and there are still 9.20% variables that influence. Each increase in the dose of chicken manure by 0.5 kg/m2 increases the stem diameter by 0.2146 cm.

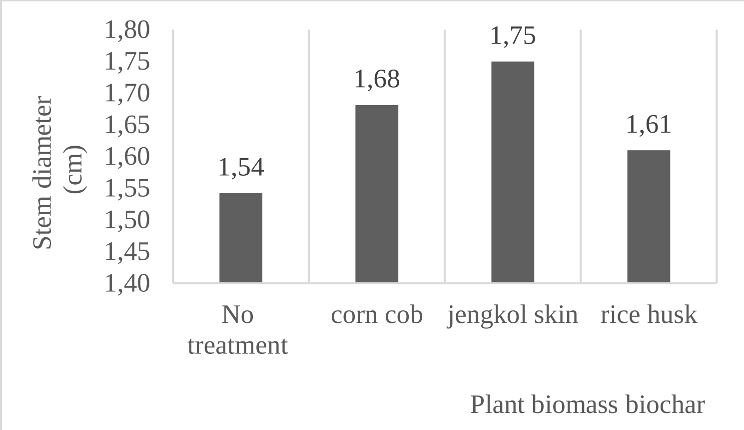

Figure 1. Relationship between the Effect of Plant Biomass Biochar on Stem Diameter at Age 6 MST

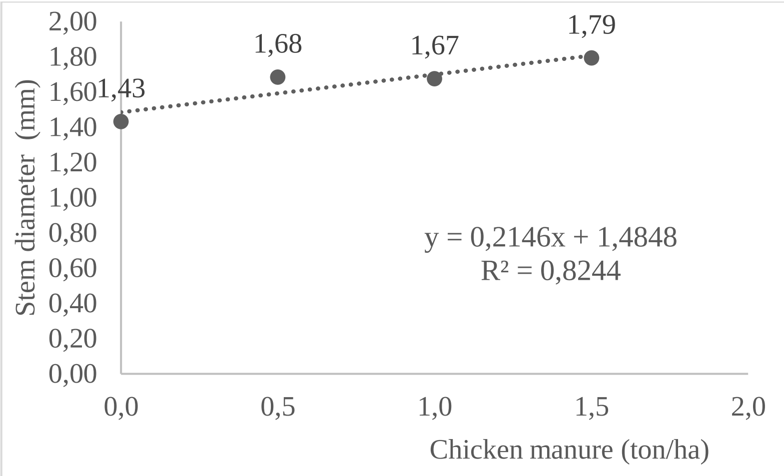

Figure 2. Relationship between chicken manure application and stem diameter

The constant value of 0.2146 indicates that without chicken manure, the stem diameter is only 1.4848 cm. This indicates that the higher the dose of chicken manure given, the stem diameter of soybean plants will increase by 0.2146 cm.

Number of Soybean Poda/Plant

Biochar application was significantly different on the number of pods. The chicken manure treatment showed a significant difference in the number of soybean pods. The interaction between the provision of plant biomass biochar and chicken manure was not significantly different on the number of soybean pods.

The average number of soybean pods due to the application of biochar and chicken manure can be seen in Table 3. The highest number of soybean pods was on the application of jengkol skin biochar (181.64 pods) which was significantly different from rice husk biochar (175.47 pods), corn cob (156.31 pods) and no treatment (143.66 pods). In the chicken manure treatment, the highest number was found at a dose of 1.5 kg/m2 which was 184.22 pods which was not significantly different from the dose of 1.0 kg/m2 (179.20 pods) but significantly different from the dose of 0.5kg/m2 (149.25 pods) and no treatment (144.42 pods).

Table 3. Average Number of Soybean Pods With Plant Biomass Biochar And Chicken Manure Treatments

Plant biomass biochar	Chicken Manure								Average	
	0 ton/ha		5 ton/ha		10 ton/ha		15 ton/ha			
	..........................polong....................									
No treatment	110.88	a	132.44	a	178.96	a	152.38	a	143.66	a
Corn cob	132.52	a	156.25	a	177.48	a	159.00	a	156.31	ab
Jengkol skin	176.77	a	152.38	a	182.19	a	215.23	a	181.64	b
Rice husk	157.51	a	155.93	a	178.19	a	210.26	a	175.47	ab
Average	144.42	a	149.25	b	179.20	c	184.22	c		

Description: Numbers in the same column followed by the same letter mean significantly different at the 5% level.

The relationship between the application of plant biomass biochar to the number of soybean pods in Figure 3 shows that the application of jengkol skin biochar gave the highest effect on the number of soybean pods, followed by rice husk biochar and corn cob biochar.

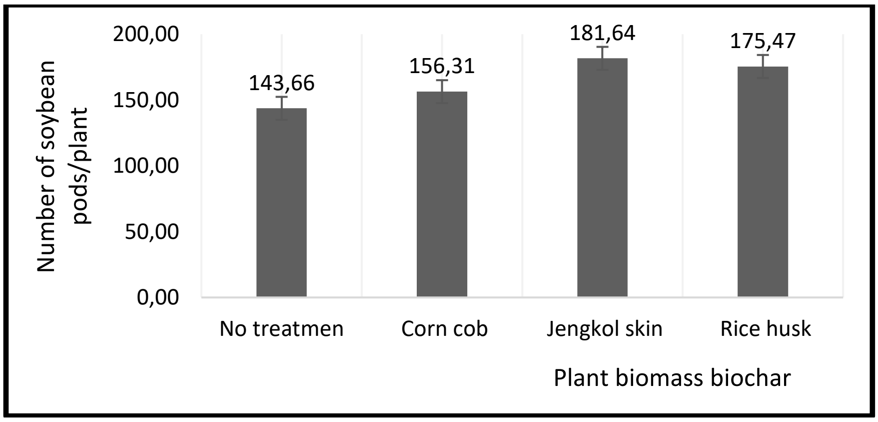

Figure 3. Relationship between the Effect of Plant Biomass Biochar on the Number of Soybean Pods

Figure 4 shows that the application of chicken manure is in linear line with the increase in the number of soybean pods with the coefficient of determination (r2) is 0.899 and the value of r = 0.9481 or has a relationship of 94.81% between the application of chicken manure and the number of pods and there are still 5.19% other variables that affect the equation y = y = 29.87x + 141.87. Each increase in the dose of chicken manure by 0.5 kg/m2 increases the number of soybean pods by 29.87 pods. The constant value of 29.87 indicates that without chicken manure, the number of soybean pods is only 141.87 pods.

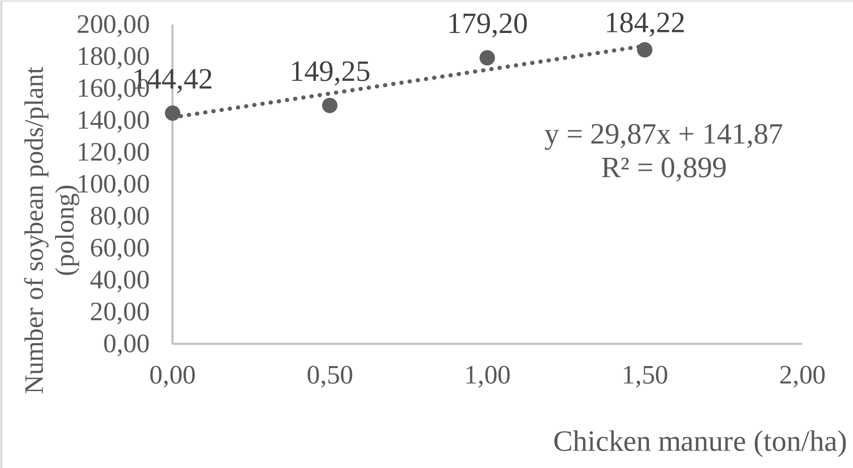

Figure 4. Relationship Between Application of Chicken Manure and Number Of Soybean Pods

Dry Weight of Seeds/Plant

The average dry weight of seeds per soybean plant due to the application of biochar and chicken manure can be seen in Table 4.

Table 4. Average Dry Weight of Seeds Per Soybean Plant with Biochar and Chicken Manure Treatment

Plant biomass biochar	Chicken Manure								Average	
	0 ton/ha		5 ton/ha		10 ton/ha		15 ton/ha			
	..........................mm....................									
No treatment	31.04	a	44.84	a	45.73	a	52.75	a	46.11	a
Corn cob	31.62	a	45.20	a	64.22	a	61.06	a	53.00	a
Jengkol skin	48.81	a	49.91	a	61.41	a	59.19	a	59.21	b
Rice husk	37.01	a	55.43	a	37.32	a	47.30	a	45.64	a
Average	44.37	a	47.70	a	53.71	ab	58.18	b		

Description: Numbers followed by the same letter in the same column show no significant difference at the 5% level.

Biochar application was significantly different on the dry weight of seeds per soybean sample. The chicken manure treatment showed a significant difference on the dry weight of seeds per plant The interaction between biochar and chicken manure did not affect the number of filled pods. Table 4 and Figure 5 show the order of the heaviest seed dry weight in the treatment of jengkol skin biochar (59.19 g), corn cob (53.00 g), no treatment (46.11 g) and rice husk (45.64 g). In the chicken manure treatment, the order starting from the heaviest was at a dose of 1.5 kg/m2 (58.18 g), 1 kg/m2 (53.17 g), 0.5 kg/m2 (47.70 g) and without chicken manure (44.37 g).

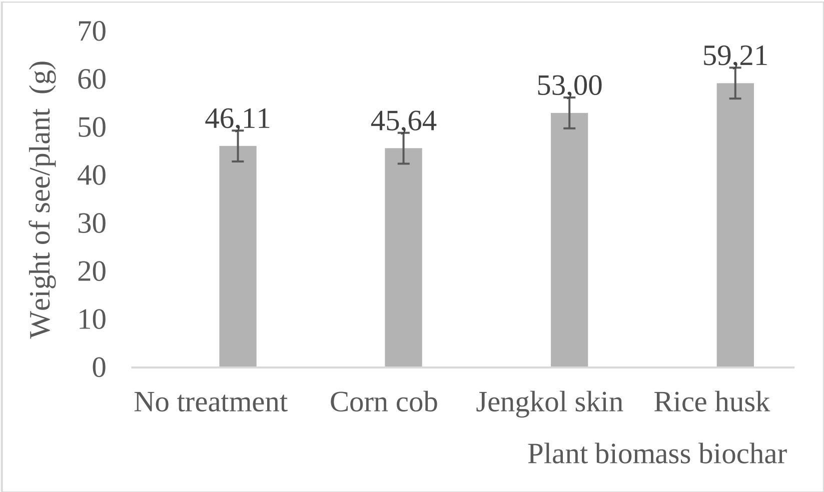

Figure 5. Relationship Between The Application of Plant Biomass Biochar and Dry Weight of Seeds Per Plant

The results of regression analysis of chicken manure application on the parameter of dry weight of seeds/plant showed a linear relationship, as presented in Figure 5.

The application of chicken manure on the parameter of soybean seed weight per plant formed a positive linear relationship with the equation $y = 9.4894x + 43.871$ with a value of $R = 0.9893$. Figure 6 shows that the application of chicken manure increases the weight of seeds per plant by 98,93%. The constant value of 43.871 indicates that without chicken manure, the number of productive branches is only 43.871 gram. Each increase in the level of chicken manure by 0.5 kg/m2 will increase the number of soybean pods by 9.4894 gram.

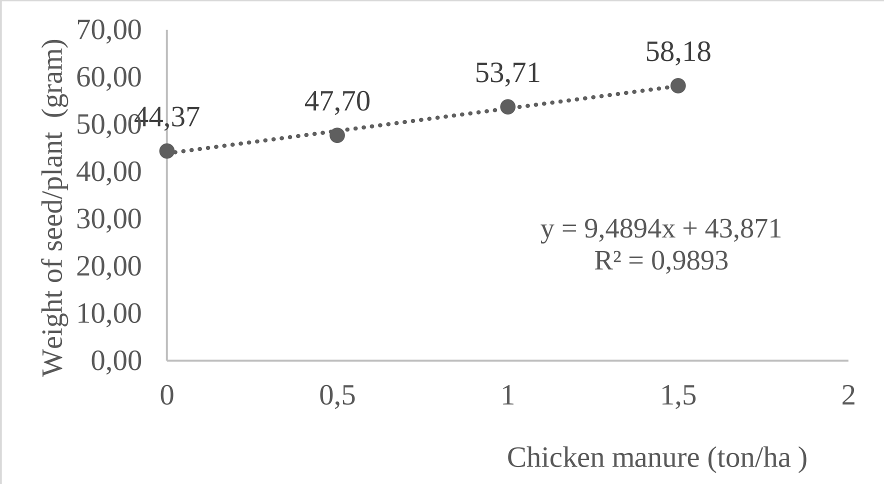

Figure 6. Relationship Between Chicken Manure Application And Seed Dry Weight

Seed Dry Weight/m2

Biochar application was significantly different on the dry weight of seeds per m2 of soybean. The treatment of chicken manure was significantly different on the dry weight of seeds per m2 of soybean. The interaction between biochar and chicken manure was not significantly different on the dry weight of seeds per m2.

Table 5. Average Dry Weight of Seeds/M2 Of Soybean Plants With Biochar And Chicken Manure Treatment.

Plant biomass biochar	Chicken Manure								Average	
	0 ton/ha		5 ton/ha		10 ton/ha		15 ton/ha			
	..........................mm....................									
No treatment	226.95	a	317.15	a	382.05	a	414.45	a	335.15	a
Corn cob	255.45	a	312.65	a	442.90	a	373.95	a	422.66	b
Jengkol skin	516.55	a	391.65	a	462.45	a	401.25	a	442.98	b
Rice husk	395.50	a	408.70	a	424.00	a	462.45	a	346.24	b
Average	348.61	a	357.54	a	427.85	b	413.03	b		

Description: Numbers followed by the same letter in the same column show no significant difference at the 5% level.

The average dry weight of seeds per m2 of soybean due to the application of biochar and chicken manure can be seen in Table 5. The heaviest dry weight of seeds per plot in biochar treatment was found in the treatment of jengkol skin biochar (442.98 g), corn cob (422.66 g), rice husk (345.24 g). without treatment (335.15 g). In the treatment of chicken manure, the heaviest was at a dose of 1.5 kg/m2 (398.50 g), a dose of 1 kg/m2 (391.08 kg/m2), a dose of 0.5 kg/m2 (343.49 kg/m2) and no treatment (280.49 g).

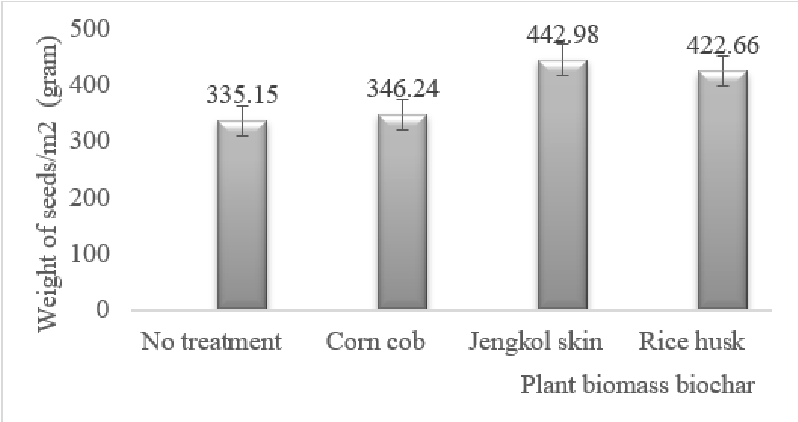

Figure 7. The Relationship Between the Application of Plant Biomass Biochar And The Dry Weight Of Seeds/M2

The relationship of chicken manure treatment to the dry weight of soybean seeds per m2 can be seen in Figure 8. The provision of chicken manure is in linear line with the increase in dry seed weight of soybeans per m2 with the coefficient of determination (r2) is 0.7409 and the value of r = 0.8608 or has a relationship of 92.78% between the provision of kipahit organic fertilizer and dry seed weight and there are still 7.22% other variables that influence the equation y = 52.71x + 347.22 Each increase in the dose of kipahit organic fertilizer by 0.5 kg/m2 increases the dry weight of soybean seeds per m2 by 52.71 gram. The constant value of 52.71 indicates that without chicken manure, the dry seed weight per m2 is only 347.22 gram.

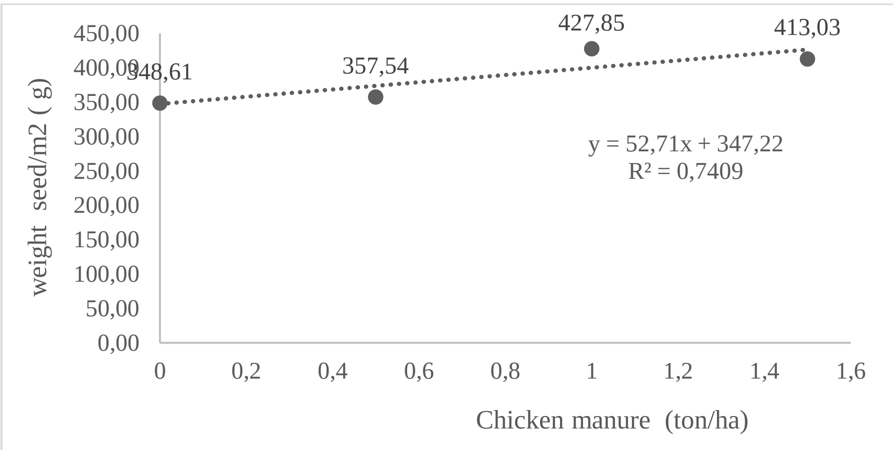

Figure 8. Relationship between application of chicken manure and dry weight of soybean seeds per m2

Weight 100 Seeds

Biochar application did not significantly affect the weight of 100 soybean seeds. The treatment of chicken manure had a significant effect on the weight of 100 soybean seeds. The interaction between biochar and chicken manure did not affect the weight of 100 soybean seeds (Table 6).

Table 6. Average Weight Of 100 Dry Seeds Of Soybean With Biochar And Chicken Manure Treatment

Plant biomass biochar	Chicken Manure								Average	
	0 ton/ha		5 ton/ha		10 ton/ha		15 ton/ha			
	..........................mm....................									
No treatment	14.52	a	17.28	a	16.19	a	16.40	a	16.10	a
Corn cob	15.71	a	15.76	a	18.24	a	17.91	a	16.91	a
Jengkol skin	16.29	a	17.60	a	19.34	a	16.40	a	17.41	a
Rice husk	16.51	a	18.50	a	17.69	a	17.50	a	17.55	a
Average	15.76	b	17.28	a	17.86	a	17.05	ab		

Description: Numbers followed by the same letter in the same column show no significant difference at the 5% level.

In Table 6 above, it can be seen that the heaviest weight of 100 seeds in the biochar treatment is found in the biochar treatment of rice husk (17.55 g), jengkol skin (17.41 g), corn cob (16.91 g) and without treatment (16.10 g). The heaviest chicken manure treatment was found in the dose of 1 kg/m2 (17.86 g), dose of 0.5 kg/m2 (17.28 g), dose of 1.5 kg/m2 (17.05 g) and without treatment (15.76 g).

The relationship of chicken manure treatment to the dry weight of soybean seeds per plot can be seen in Figure 9. The provision of chicken manure parameter of 100 soybean seed weight forms a positive linear relationship with the equation $y = 0.894x + 16.318$ with $R = 0.4201$. The application of chicken manure increases the dry weight of 100 seeds by 64.82% and there are 35.18% other variables that affect the dry weight of 100 seeds.

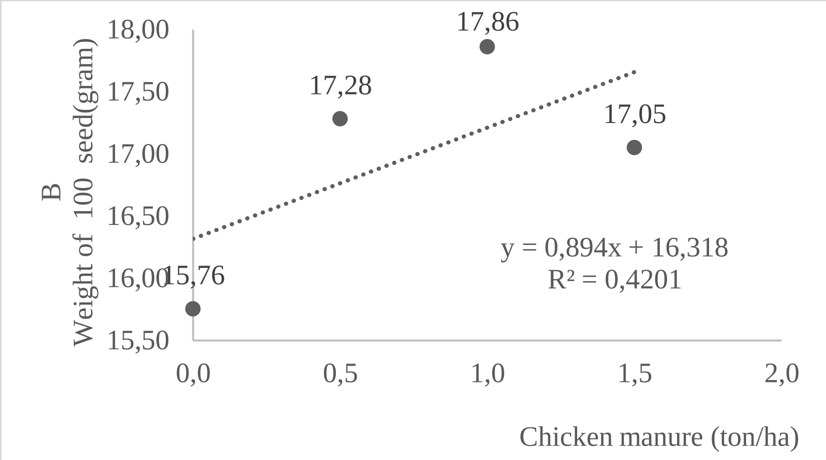

Figure 9. Relationship Between The Application Of Chicken Manure And The Weight Of 100 Seeds

The constant value of 0.894 indicates that without chicken manure, the weight of 100 seeds is only 16.318 g. Any increase in the level of chicken manure by 0.5 kg/m2 will increase the dry weight of seeds per plot by 0.894g.

DISCUSSION

The provision of biochar on the growth and yield of soybean plants gives a significant effect on the parameters of stem diameter, number of pods, number of pods, dry weight of seeds/plant. The provision of jengkol skin biochar gave the highest effect on stem diameter (1.750 cm), number of pods (181.60 pods), number of pods (172.94 pods), dry weight of seeds/plant (45.64 gr). The application of biochar to agricultural land (dry and wet land) can increase the ability of soil to store water and nutrients, improve soil looseness, reduce water evaporation from the soil and suppress the development of certain plant diseases and create a good habitat for symbiotic microorganisms (Lehmann *et.al*, 2007).

Biochar has a highwater holding capacity, so it can keep N nutrients from being easily leached and make them more available to plants. The application of biochar can increase soil moisture and pH, thus stimulating the process of N mineralization and nitrification which causes plant uptake to increase (Ngu yen *et.al*, 2017).

The results of research by Pakpahan *et.al., 2002* that the N-total content contained in durian skin biochar can increase the growth of the number of tillers in onion plant clumps. Soil in which there is biochar residue has a lot of microorganism activity because biochar has the ability to retain water, reduce soil density in soil with clay texture, and increase soil C content (Tambunan 2014). Soil that has biochar residue is a good planting medium because biochar has pores that can keep nutrients available when plants need them.

Well-produced biochar will increase the field capacity of the soil so as to ensure the availability of soil water for plants. In agriculture, biochar functions 1) to increase nutrient availability; 2) to retain nutrients; 3) to retain water; 4) to increase pH and CEC in acidic drylands; 5) to create a good habitat for the development of symbiotic microorganisms such as mycorrhiza because of its ability to retain water and air and create a neutral environment, especially in acidic soils; 6) to increase food crop production; 7) to reduce the rate of CO2 emissions and accumulate carbon in large enough quantities. In addition, biochar can last a long time in the soil (> 400 years) because it is difficult to decompose.

Atkinson *et al.* (2010) point out that key characteristics of biochar are important for developing an understanding of its impact in agriculture. The chemical properties of biochar that play a role are that the surface of biochar has functional groups that can be hydrophilic hydrophobic, and can be acidic and basic, so that it can react with the surrounding solution. The physical properties of biochar that can be useful as a soil improver are the large surface area and the presence of micro pores, which make it have the ability to absorb. These physical and chemical properties of biochar have the potential to improve soil properties such as pore distribution, content weight, water holding capacity of soil (Liang *et al*., 2006).

The treatment of chicken manure showed that the height of soybean plants increased every week as the age of the plants increased. The application of 15 tons/ha of chicken manure showed the best plant height. This is thought to be because at this dose the available nutrients are better than other treatments. So that it can be absorbed by plants well to support their growth, especially plant height. The supply of nutrients from chicken manure can increase stem diameter, number of pods, dry weight of seeds/plant.

Organic matter will be broken down by microbes that live in the soil by releasing enzymes needed for the decomposition process of simple compounds, some of which are used by bacteria and fungi in the form of energy. The freed nutrients can be used for plant growth (Hanafiah, 2009; Najla *et al*, 2019).

Widowati *et al (2004)* that chicken manure gives the highest yield in lettuce plants grown on Cisarua andosol soil at a dose of 25 tons/ha. Chicken manure can improve soil physical properties so as to increase water storage capacity and soil microorganism activity. The provision of manure as organic fertilizer plays a role in increasing the content of nutrients so that plant growth runs well and the photosynthate produced is more and more. The results of growth will be stored in the form of carbohydrates in the form of soybean seeds. There are three roles of manure, namely increasing the ability to retain water, stabilizing aggregates and soil structure and soil aeration so that it will improve soil chemical properties in terms of cation exchange capacity and nutrient availability for plants (Zamriyeti et al, 2021; Devi *et al*, 2021)

According to Hartati *et al.* (2015) that the application of chicken manure to the soil will cause better plant growth through changes in soil structure to be more crumbly, aeration and water absorption capacity and better water reserves, which indicates that chicken manure will improve the physical, chemical and biological properties of the soil simultaneously. Zamzani *et al.,* 2016 stated that cow, goat and chicken manure provide growth and yield of black soybeans equally well and the fertilization time of 1, 2, 3 and 4 weeks before planting gives the same effect on the growth and yield of black soybeans. The results of research by Prastya *et al* (2016) stated that the application of chicken manure at a dose of 40 tons/ha had an effect in increasing nitrogen uptake in shallot plants.

CONCLUSION

1. The provision of biochar on the growth and yield of soybean plants has a significant effect on the parameters of stem diameter, number of pods, dry weight of seeds/plant. dry weight of seeds/m2. The provision of jengkol skin biochar gave the highest effect on stem diameter (1.750 cm), number of pods (181.60 pods), dry weight of seeds/plant (45.64 gr), weight of seed/m2 (442,98 g)
2. The application of chicken manure on the growth and yield of soybean plants gives a significant effect on stem diameter, number of pods, number of pods, dry weight of seeds/plant. The dose of chicken manure 15 tons/ha showed the highest effect on stem

diameter (1.79 cm), number of pods (184.22 pods), dry weight of seeds/plant (58.18 g).

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