I. INTRODUCTION

1.1 Background

Long beans are seasonal vegetable crops widely used by people in Indonesia and are one of the types of vegetables sold daily. Long beans are very diverse, served for various dishes ranging from raw up to cooked forms. The edible parts of the long bean plant are the leaves and pods. Long bean pods contain lots of vitamin of A, B, and C and protein (Haryanto et al, 2013).

Based on national agricultural statistics, the average production of long bean plants in Indonesia in 2015 was 489,449 tons, and decreased by 31.142% in 2016 with an average output of 458,307 tons (Ministry of Agriculture, 2018). Various factors cause the instability of long bean production in Indonesia, including: (1) There is a decrease in long bean's harvested area, which is not matched by an increase in long bean productivity. (2) The use of chemical fertilizers, which farmers continuously use, causes a decrease in soil fertility (Malian, 2014). (3) Low input of organic matter (Adijaya, et al, 2011)

Cultivation of long bean plants in Indonesia still uses a fertilization system by using inorganic fertilizers. So that the resulted plant will leave a residue effect that is not good for the human body if consumed in large quantities. The use of chemicals and inorganic fertilizers will cause an excellent residual effect in the soil, which will be absorbed by plants, (Zaevie, et al. 2014).

The use of inorganic fertilizers in Indonesia is able to increase agricultural yields, but without realizing it, the continuous use of inorganic fertilizers has an adverse impact on the physical, chemical and biological properties of the soil. This causes the ability of the soil to support the availability of water, nutrients and the life of microorganisms in the soil decreases. This condition occurs because the level of fertility and soil organic matter has decreased, therefore if it is not immediately addressed then in a not too long period of time, these lands will no longer be able to produce optimally and sustainably (Pratiwi et al, 2013).

One of the efforts to increase soil fertility is the application of organic matter, which sourced from agricultural waste. Banana stem is a source of organic material that has not been widely used, even though it contains a lot of organic matter. Based on pre-survey observations in the Farmers Group Farmers Group (KTMB) of Sampali Village, data was obtained, that the average weight of the waste of one Barangan banana plant at harvest at the age of 9 months is ±40.78 kg consisting of leaves 5.06 kg (12.40%); banana stems (pseudo stems) 19.91 kg (48.82%); hump 7.33 kg (17.97%); heart 1.18 kg (2.89%); fruit bunches 7.3 kg (17.9 %). If the Barangan banana plant is planted with a double row system with an area of 1 hectare then there are 2600 plants, then the pseudo stem waste produced is 51,766 tons/ha (Nasution, 2019). The number of pseudo stems is very potential to be used as compost. In addition, the nutrient content of banana stems is very supportive to be used as a source of plant nutrients.

According to Eka Ernawati (2016) the compost content of banana stem and banana weevil waste is as shown in Table 1.

Table 1. Nutrient Content of Barangan Banana Stem and Barangan Banana's Hump

No	Banana stem		Banana Hump	
	Chemical Properties	**Value**	**Chemical Properties**	**Value**
1	pH	7.4	pH	7.5
2	C-Organic	12.80%	C-Organik	1.06%
3	N	1.24%	N	1.09%
4	Ratio C/N	10.3	Rasio C/N	2.2
5	P	1.50%	P	1.37%
6	K	2.70%	K	2.87%

(Source: Eka Ernawati 2016)

Based on Table 1. banana stem waste (pseudo stem) has a good C-Organic when compared to the C-Organic in banana hump's waste, banana stem waste (pseudo stem) has a C-Organic value of 12.80%, while banana hump's waste of 1.06%. Then the C/N ratio in banana stem waste (pseudo stem) also has a better value when compared to banana hump waste. Banana stem waste has a C/N ratio of 10.3, while banana hump waste has a C/N ratio of 2.2, while nitrogen, phosphorus and potassium have almost the same value.

In addition to the use of banana stem waste compost, organic material that can increase soil fertility is the use of biochar. One of the wastes that can be used to make biochar is rice husk. Several studies reveal that rice husk biochar is able to improve soil, increase plant productivity and contain carbon. On the other hand, the addition of biochar in the soil can increase the availability of nutrients for plants, with the availability of nutrients in the soil, plant roots can increase nutrient uptake. In addition to be able to bind nutrients, biochar can also absorb toxins in the soil through an electric charge (Sukartono, et al 2011). Based on the description above, the author is interested in conducting research to determine the response of banana stem waste compost and rice husk biochar to the growth and production of long bean plants.

1.2 Problem Formulation

Cultivation of long beans still uses a fertilization system using inorganic materials. Plants are fertilized using inorganic fertilizers will leave a residual effect on plants. This makes consumers afraid of residual effects that will give negative effects to the human body. One effort to increase the production of long bean plants that are cultivated using organic fertilizers through the use of agricultural waste to meet the nutrient needs of long bean plants. Rice husk is an agricultural waste that can be made into biochar (activated charcoal) as a soil improvement agent, and can be useful for increasing soil fertility and absorbing nutrients in the soil in order to be absorbed by plants. In addition, banana stems, which are agricultural waste, can be used as compost to increase plant growth and production.

1.3 Research Objectives

1. Obtaining data on the growth response and production of long bean plants to the application of rice husk biochar.
2. Obtaining data on the growth response of long bean plant and production to the application of banana stem waste compost.
3. Obtaining data on growth response and production of long bean plants to the application of rice husk biochar and banana stem waste compost.

1.4 Research Hypothesis

1. Growth response and production of long bean plants were significantly different when rice husk biochar was applied with different doses.
2. Growth response and production of long bean plants were significantly different when banana stem waste compost was applied with different doses.
3. The response of growth and production of long bean plants was significantly different when applied with a combination of banana stem waste compost and rice husk biochar with a dose.

1.5 Research Benefits

1. As a requirement to be able to obtain a bachelor's degree in the Agrotechnology Study Program, Faculty of Agriculture, Medan Area University.
2. As information material for farmers in cultivating long bean plants using rice husk biochar and banana stem waste compost.

II. LITERATURE REVIEW

2.1 Classification of Long Bean Plants

The long bean plant (Vigna sinensis L.) has been cultivated by Indonesians for a long time. Actually, long beans come from India and Africa. Then spread to areas of tropical Asia to Indonesia. Long beans are dual-purpose, meaning as legumes and as soil fertilizer. Long bean plants as soil fertilizer because the roots have nodules of Rhizobium bacteria. These bacteria function to fix free nitrogen from the air. Therefore, long beans are widely planted by farmers in paddy fields, both monoculture and as intercrops, (Fachruddin and Lisdiana, 2013).

Long beans are classified as closed seed plants, the seeds consist of two seeds, constituting the type of legume plant. The taxonomy of long bean plants is as follows: Kingdom: Plantae, Division: Spermatophyta, Class: Angiospermae, Subclass: Dicotyledonae, Order: Rosales, Family: Papilionaceae, Genus: Vigna, Species: Vignasisensis L. (Robert H. Whittaker, 1969 in Haryanto, et al. 2013). Tavi Parade Variety.

2.2 Terms of Growing Long Bean Plants

2.2.1 Climate

Long bean plants grow well in warm climates, with temperatures ranging from 20-30 °C. In areas with low temperatures, below 20°C, its growth is relatively slow and only a small number of pods are formed. Long bean plants are sensitive to the influence of cold temperatures and can die if exposed to frost (temperature below 4 °C). Long bean plants need fertile and loose soil in order to grow well, contain organic matter and contain enough water. The best type of soil for this plant is clay and sand textured soil. Legumes are sensitive to alkaline or high acidity of the soil. The relative air temperature required is 18–32°C with the optimal temperature for growth of 25 °C. Long bean plants need a lot of sunlight and rainfall ranging from 600-2000 mm/year. Long beans can be planted every season, either the dry season or the rainy season (Arsyad, 2011).

2.2.2 Land

Long bean plant is an annual plant that can grow well on various types of soil provided that, the soil drainage is good enough and not flooded and the availability of sufficient water during the plant growth period. The best growth of long bean plants is sandy loam type, loose, rich in organic matter, good aeration and drainage, and has a soil acidity level at pH 5.5-6.5. Legumes are sensitive to high soil acidity. Soil that is too acidic with a pH below 3.5 can cause stunted growth due to poisoning with aluminium which dissolves in the soil. To overcome this, it is necessary to liming the land planted with long beans. Before planting the land, the land must be cultivated first with the aim of stopping weeds, improving drainage and soil aeration (Haryanto et al, 2013).

2.3. Morphology of Long Bean Plants

The long bean plant is an annual herbaceous plant. This plant is in the form of a shrub that grows spread. The morphology of the long bean plant is supported by its main components, namely roots, stems, leaves, flowers, fruits, seeds so that its growth can be optimal (Rahayu et al, 2011). The following is the morphology of the long bean plant.

2.3.1 Root

Long bean plants are taproots and have fibrous roots. The taproot grows straight inward until it reaches a depth of 30 cm, while the fibrous roots grow to the side (horizontally) and not deep. The length of the fibrous root reaches 26 cm. Plant roots are part of the body's organs that function for the establishment of plants and for the absorption of nutrients and water (Budi, 2013).

2.3.2 Stem

The stem of the long bean plant is erect, cylindrical, soft, green with a smooth surface. The branch of the long bean plant is slightly hairy, is a type of stem that propagates, and there are also long beans that do not reproduce. Both types have different places of cultivation (Zaevie, et al. 2014).

2.3.3 Leaves

Long bean leaves are compound leaves composed of 3 strands; the leaves are oval with pointed leaf tips. The edges of the leaves are flat, shapeless, and have pinnate veins. The position of the leaves is slightly horizontal and has a main stalk. The length of the leaves is between 10-12 cm and the length of the petiole is 0.6 cm. The leaves are compound composed of three strands, (Cahyaningrum, et al. 2014).

2.3.4 Flowers

Long bean flower has a shape of a butterfly. Mother flower stalks come out of leaf axils. Each mother flower stalk has 3-5 flowers. The flower colours are white, blue, and purple. Long bean's flowers are self-pollinating. Cross pollination with the help of insects can also occur with a possibility of 10% (Haryanto, et al. 2013).

2.3.5 Fruit

The fruit is pod-shaped with elliptical and slender. The length of the pod is about 66-67 cm, the colour of the young pod is green to whitish. After getting old, the colour of the pods is yellowish white. Young pods are crunchy and break easily. After old, the pods become tough. Each pod can contain 8-20 beans (Kamil, 2013).

2.3.6 Seeds

Long bean seeds are round, slightly elongated, but some are flat. In the centre of the seed, there is a stalk that connects the seed and the skin of the fruit. The older seeds will dry out. There are old seed coats with colours of white, whitish red, brown and black. In one pod there are usually about 15 seeds or more, depending on the length of the pod and influenced by the growth of the plant and the variety of the long bean (Hakim, 2013).

2.4 Cultivation of Long Beans

2.4.1 Seed Preparation

One of the important factors that determine the success of long bean farming is seed quality. Certified seeds can be obtained at farm stores, in addition, seeds can be obtained from long bean pods that are ripe on trees with the characteristics of dry pods on the tree and come from healthy and productive plants. Characteristics of high-quality seeds are as follows: 1. High growth power, more than 80%, 2. Not mixed with other varieties or can be said to have a high level of purity, which is between 98-100%, 3. Has a good speed of growth (Vigor), 4. The seeds are shiny, not wrinkled, pithy and free from insect bites, 5. Not mixed with dirt, weeds or other plant seeds. The number of seeds needed per land area is largely determined by the variety, soil fertility level, spacing, and the number of planting holes (Fachruddin, and Lisdiana, 2013).

2.4.2 Cultivation

Long beans should be planted at the beginning or end of the rainy season in the dry season, it can be planted with the condition that the water needs are sufficient. Before planting the seeds should be soaked in water for ± 2-4 hours. Planting holes were made using tugal as deep as 4-5 cm with a distance between planting holes of 25-30 cm and a distance between rows of 60-75 cm. Each planting hole is filled with two seeds, then covered with thin soil without compacting. Seeds usually germinate after 5 days (Budi, 2013).

2.4.3 Maintenance

Maintenance of long bean plants includes replanting, watering, making stakes, weeding, fertilizing. In addition to basic fertilizers, plants need inorganic fertilizers for their growth. The application of inorganic fertilizers is carried out once, namely at the age of one week. The type of fertilizer given is urea 100 kg/ha, TSP 200 kg/ha, KCl 100 kg/ha. Fertilizer is given in an array that is between the two sides of the row of plants and then covered again with soil. In addition, foliar fertilizers can also be given, carried out prior to be the time of flowering about 4 weeks after planting (Haryanto, et al. 2013).

2.5 Rice Husk Biochar

Rice husk is a material with a relatively high silica content, which is about 87-97% by weight of rice husk charcoal. This is due to the dominant silicon composition in rice husks (Hartono, 2010). Rice husk is composed of various metallic and non-metallic elements. The elemental content of carbon, oxygen, and silicon in rice husk is more dominant than other elements (Steiner, 2007 in Latuponu et al., 2011).

About 20% by weight of rice, is rice husk. The main composition of rice husk consists of cellulose 33-34% by weight, lignin 19-47% by weight, if burned with oxygen it will produce husk ash 13-29% by weight, rice husk which contains quite high silica, namely 87-97% by weight of rice husk charcoal. From the data from BPS SUMUT in 2015 the production of rice plants was 4,044.82 tons, if the weight of rice production was 20% of rice husks, then the rice husks produced in 2015 was 27908.2 tons. By viewing this potential, rice husk is very easy to be obtained (Daifullah, 2010).

Biochar is charcoal resulting from combustion without oxygen/low (pyrolysis) at a temperature of <700 °C (Cheng et al., 2007). Biochar comes from agricultural, plantation, livestock and forestry waste. The use of the term biochar is to avoid understanding charcoal originated from coal, the function of charcoal as fuel, the use of charcoal as an adsorbent in the food and pharmaceutical industries, the use of charcoal aims of dealing with waste in contaminated solutions or water, and others (Latuponu et al, 2011). .

Biochar can be produced in a short time through a combustion process for about 0.5–3 hours. The combustion products can be directly used as a soil ameliorant. Ameliorant is a material that can increase soil fertility by improving the physical and chemical conditions of the soil. Biochar generally has a basic pH (normal 7.0), cation exchange capacity (CEC), organic C and high surface area (Latuponu et al, 2011). The water absorption of biochar is high and resistant to the decomposition of microorganisms. These properties cause this material to have high nutrient retention, thereby reducing nutrient leaching (Steiner, 2007 in Latuponu et al., 2011).

Nutrient-enriched rice husk biochar is rice husk biochar soaked in a nutrient solution. The area and high surface charge of biochar are projected to retain nutrients during immersion in nutrient solution. When rice husk biochar is added to the soil, it is hoped that the bound nutrients are released slowly into the soil and can be absorbed by plants. This is supported by research results that the application of biochar into the soil can reduce nutrient loss (Major, 2012). Several studies reveal that rice husk biochar is able to improve soil and increase crop productivity. On the other hand, the addition of biochar in the soil can increase the availability of nutrients for plants. With the availability of nutrients in the soil, plant roots can increase nutrient uptake. According to Sukartono, et al (2011), after given the application of biochar, then the availability of nutrients N, P, and Ca increased. The advantages of giving charcoal to the soil include improving water and air circulation in the soil, so that it can stimulate root growth and provide a habitat for plant seedling growth (Gusmailina et al, 2002 in Lempang and Hermin, 2013).

The application of biochar into the soil has an effect on increasing soil fertility. This is possible because the porous biochar becomes a breeding ground for soil organisms that are useful for absorbing organic matter in the soil, and the high durability of biochar in the soil, which can reach 100 years to decompose, triggering an increase in the population of soil organisms so that the availability of nutrients can be maintained. over a long period of time (Laird et al., 2010).

All organic matter added to the soil can significantly increase the resistance of various essential nutrients for plant growth. However, biochar is more effective in retaining nutrients for their availability to plants compared to other organic materials such as compost and manure. The high availability of nutrients for plants is the result of increased nutrients directly from biochar, such as increased nutrient retention, and changes in soil microbial dynamics (Gani, 2010).

According to Novak et al., (2010), besides high-water retention, biochar contains nutrients N, P, K, which can be absorbed by plants. The highest loss of available nutrients in the soil is leached with water out of the plant's soil environment. The available nutrient content is limited by the amount of water being very low or very high. There are many ways to reduce the amount of nutrients that are lost when leached in water, one of which is the use of biochar (Hutapea et al, 2015).

2.6 Banana Stem Waste Compost

Banana stems have not been widely used for compost, even though banana stems contain important elements needed by plants such as nitrogen (N), phosphorus (P), and potassium (K). Composting can be used as an alternative way out to manage waste.

In 2017 the banana plant area was 89,615 ha; this shows that banana stem waste in 2017 reached 1,784,234.6 kg (BPS 2017). Percentage of banana leaves 10.07% (1178.98 tons), banana stems 66.87% (4639.01 tons), bananas 21.71% (1700.89 tons), and banana heart 1.33% (274.94 tons). This data was obtained through direct testing on the Barangan banana plant which had just been harvested on the land of the Kelompok Tani Masyarakat Bersatu, Sampali Village, Percut Sei Tuan Subdistric, Deli Serdang Regency, North Sumatra.

Based on the pre-survey data on the amount of waste of Barangan Banana's stems in the Kelompok Tani Masyarakat Bersatu, which are planted using the double row method (population 2600 plants ha^{-1}), the trash generated at the time of harvesting the Barangan banana plant was 51.7 tons ha^{-1}. Barangan's waste in 2017-2018 of 5 provinces with outside banana plantations can be seen in Table 2. In 2018 the banana plant area for North Sumatra Province was 195,270 ha. So that the waste of banana stems in 2018 with a land area of 195,270 ha in North Sumatra Province was 10,108,346.8 tons.

Table 2. Data on Banana Plants in Various Provinces in 2017-2018

No	Provinsi	Area (ha)		Production (Ton)		Banana Stem's Waste (Ton)	
		2017	**2018**	**2017**	**2018**	2017	2018
1	West Java	199,875	188,920	1,128,666	1,125,889	10..346,729.2	9,779,632.7
2	North Sumatra	186,573	195.270	150,691	118,648	9,658,137.9	10,108,346.8
3	Aceh	105,361	82.043	67,308	63,354	5,454,117.5	4,247,037.9
4	Riau	23,067	22,348	38,809	46.587	1,194,086.32	1,156,866.5
5	West Sumatra	5,857	5,995	143.796	92.703	302,193.4	310,337.1

III RESEARCH METHODS

3.1 Place and Time of Research

This research will be carried out on Jalan PBSI, Experimental Land, Faculty of Agriculture, University of Medan Area, Percut Sei Tuan Subdistrict, with an altitude of ±23 m above sea level. This research was conducted in October - December 2019.

3.2 Materials and Tools

The materials used in this study were long bean seeds of parade tavi variety, rice husk biochar, 33% technical HCl and Barangan banana stem waste compost (brown sugar, EM4, aquadest, banana leaf waste).

The tools used in this study were a modified pyrolysis tube (a place for making biochar), a bucket, a measuring cup, a hoe, a tripe, a rake, a meter, gembor, measuring instruments, scales, writing instruments.

3.3 Research Method

3.3.1 Experimental Design

This research was conducted using a factorial randomized block design (RAK) consisting of 2 treatment factors, namely:

1. Rice husk biochar consisting of 4 levels of treatment, namely:

   B0 = Control (Without Biochar)

   B1 = Rice husk biochar of 5 tons ha−1 (0.954 kg/m²)

   B2 = Rice husk biochar of 10 tons ha−1 (1.89 kg/m²)

   B3 = Rice husk biochar of 15 tons ha−1 (2.835 kg/m²)

2. Barangan banana stem compost consisting of 4 levels, namely:

   K0 = Control (Do not use banana stem compost fertilizer)

   K1 = Compost banana stems with a dose of 5 tons ha−1 (0.954 kg/m²)

   K2 = Compost banana stems with a dose of 10 tons ha−1 (1.89 kg/m²)

   K3 = Compost banana stems with a dose of 15 tons ha−1 (2.835 kg/m²)

Thus, the number of treatment combinations is 4 x 4 = 16 treatment combinations, namely:

B0K0	B1K0	B2K0	B3K0
B0K1	B1K1	B2K1	B3K1
B0K2	BIK2	B2K2	B3K2
B0K3	B1K3	B2K3	B3K3

Based on the combination of treatments that can be obtained, which is 16 combinations, the replication used in this experiment is according to the calculation of the minimum repetition in the Factorial Group Randomized Design.

Information

Research plot size = 105 cm X 180 cm

Planting distance = 35 cm X 60 cm

Distance between research plots = 50 cm

Distance between replications = 100 cm

Area of research area = 16 m x 9 m

Number of plots = 32 plots

Number of treatments = 16 treatments

Number of repetitions = 2 replications

Number of plants per plot = 9 plants

Number of samples per plot = 4 plants

Total number of plants = 288 plants

Total number of samples = 96 plants

3.3.2 Analysis Method

After the research data is obtained, data analysis will be carried out using a Factorial Group Randomized Design with the following formula:

$$\mathbf{Yijk = + i + j + k + (\alpha.\beta)\ jk + ijk}$$

Yijk = Observation results in the replication -i which received treatment of Barangan banana stem compost at the j-level and rice husk biochar at the k-level

μ = Population mean value

Ʈi = Effect of i-th test

αj = Effect of rice husk biochar level j

βk = Effect of Barangan banana stem compost k-level

(α.β) jk= Effect of interaction of rice husk biochar at the j-level and Barangan banana stem compost at the k-level

εijk = Effect of residual from the i-level which received j-level of rice husk biochar and k-level of Barangan banana stem compost

If the results of the treatment in this study have a significant effect, further testing will be carried out with the Duncan Distance Test (Montgomery, 2009).

3.4 Research Implementation

3.4.1 Collection of Barangan Banana Stem Waste

The waste of Barangan banana stems is obtained from banana plants that have just been harvested from the Experimental Garden of the Kelompok Tani Masyarakat Bersatu, Sampali Village, Percut Sei Tuan Subdistrict. The total compost of Barangan banana stem waste required is 12 kg, the number of banana stems used is 100 kg. The branches of Barangan bananas used are all Barangan banana stems with similar age and type.

3.4.2 Making Barangan Banana Stem Compost Waste

Banana stems are cut with a size of 1-2 cm, then weighed as much as 100 kg, then added 250 ml of EM4, 2.5 kg of brown sugar which has been dissolved in 20 litters of water. Pieces of banana stem waste are placed on a tarpaulin measuring 2 X 4 m then pouring EM4 which has been dissolved with water and brown sugar, then covered until there is no oxygen, every 3 days for 30 days stirring is done. If there is no increase in temperature during stirring, then EM4 is added.

3.4.3 Rice Husk Collection

The material needed in the manufacture of rice husk biochar is 200 kg of rice husk obtained from the rice mill in Tanjung Selamat village, Percut Sei Tuan Subdistrict, Deli Serdang Regency, North Sumatra. So that it is got rice husk biochar as much as 12 Kg.

3.4.4 Preparation of Rice Husk Biochar

Before burning in the pyrolysis tube, first turn on the fire in the pyrolysis tube using wood or bamboo, then put the rice husks into the pyrolysis tube for 3 hours, the husk charcoal burning is done 6 times. Next is sorting (choosing) rice husks that have become completely charcoal. Rice husks that have become charcoal are activated by dissolving 33% technical HCl which has been diluted to 5%, then soaking for 24 hours and then draining and drying. Immersion serves to activate the husk charcoal. Activated rice husk charcoal was ground and sifted until it passed with a size of 40 mesh. After the rice husk biochar has been made, the content analysis is carried out in the laboratory. The making of rice husk biochar refers to research (Hutapea et al, 2015).

3.4.7 Land Preparation and Soil Processing

Land preparation where the research was carried out was done by measuring the land, the total land used was 232 m^2 (11 x 22 m), then cleaning the weeds on the land to be used, then hoeing the soil until it was loose. Then make beds with a size of 105 x 180 cm, bed height 30 cm with a distance between plots of 50 cm and a distance between replicates of 100 cm.

3.4.6 Fertilization

Before planting long beans, the experimental land was given basic fertilizer, namely urea at a dose of 100 kg/ha, TSP 200 kg/ha, and KCl 100 kg/ha (Setiawati et al, 2012). The amount used was 50% of what was suggested, namely urea 0.495 g/plot, TSP 1.89 g/plot, and KCl 0.945 g/plot.

3.4.7 Cultivation

The cultivation of long bean seeds is done by soaking the long bean seeds in water for 15 minutes. If there are seeds that float in the water, the seeds are not used. Then the soaked seeds are inserted into the planting hole. Each planting hole is filled with 2 seeds, this is done to minimize seeds that do not grow, if both seeds grow then cutting is done. This planting is done with a spacing of 35 x 60 cm.

3.4.8 Application of Banana Stem Waste Compost and Rice Husk Biochar

The application of Barangan banana stem compost was carried out in conjunction with rice husk biochar. Prior to application, mix the compost of Barangan banana stem waste with rice husk biochar. The application is made by making a circle around the planting hole at a distance of 10 cm from the planting point, and it is done a day before the long bean seeds are planted.

3.4.9 Maintenance

1. Watering

Although long bean plants can grow well in dry land, their water needs must still be met so that their growth is not hampered. After the seeds are planted, they are watered in the afternoon. Furthermore, routine watering is carried out every morning at 07.00-08.00 WIB and in the afternoon at 17.00-18.00 WIB. The volume of water used for irrigation is 3 litters/plot for 1-3 weeks after planting, then at the age of 4 up to the harvest period as much as 6 litters/plot. Watering can be done by using gembor or flowing water through channels around the beds. Watering is sufficiently done, until the soil is moist enough.

2. Embroidery

To replace seeds that do not grow or die, embroidery is done. Embroidery activities are carried out no later than 2 weeks after planting. The embroidery of long bean plants is taken from the inserted plants that had been prepared in baby bags which were planted at the same time as planting in the research plot, thus, when the age of the long bean plants was inserted, also had similar the age of the long bean plants in the research plot.

3. Stake Installation

After the plant begins to grow and reaches a height of 25 cm, a stake can be placed next to the plant. Stake/lanjaran is made of bamboo split with a length of 2 m and a width of 2 cm. The installation of the stake is intended as a place for plants to propagate. The stakes were installed 10 days after planting. Each stake is crossed, then given a rope to propagate the plants. Installation of ropes that bind plants with stakes is carried out twice, namely when the plant height is 70 cm and 150 cm.

4. Weeding

Weed control is done by weeding. Weeding can be done manually by pulling the grass that grows. Along with weeding can also be done pendangiran which serves to loosen the soil. In addition to manual weeding can also be done using herbicides, with a dose of 1-2 ml / liter of water.

3.4.10 Harvest

Harvesting is done at 44 days after planting, the right pods to be harvested are young pods, the colour is fresh green and still solid. Harvesting was done 3 times with an interval of 3 days. Harvesting is done in the morning. Harvesting is done by carefully picking long bean pods throughout the plant, then placing them in the provided place after observations are made for harvest parameters. Harvesting of long bean plants is carried out according to the harvest criteria.

3.5 Observation Parameters

3.5.1 Plant Height (cm)

Observation of plant height is done by measuring plant height. The long bean plant is a creeper. If the long bean plant is wrapped around the stake, a plastic rope is used to measure the size of the plant. After the plant height was measured using a plastic rope, then the plastic rope was measured using a meter. Observation of plant height was carried out when the plant’s age was 2 weeks after planting with an interval of 1 week. Plant height was observed until the age of 4 weeks after planting.

3.5.2 Rod Diameter (cm)

Observation of stem diameter was carried out by measuring the circumference of the long bean plant stem on the soil surface. To measure the diameter of the long bean stem used a tool which is often called a calliper. Observation of the stem diameter of the long bean plant was carried out when the plant was 2 weeks old after planting with an interval of 1 week. The number of leaves was observed until the age of 4 weeks after planting.

3.5.3 Number of Leaves (pieces)

Observation of the number of leaves of long bean plants was carried out by counting the number of leaves that were completely open and still fresh. Observation of the number of leaves was carried out after the plant was 2 weeks after planting. The number of leaves was observed until the age of 4 weeks after planting.

3.5.4 Number of Branches

Observation of the number of branches was carried out when the long bean plant had started to appear branches. Long bean plants that have begun to appear branches are counted the number of branches, both primary and secondary branches. Observation of the number of branches was carried out at weekly intervals. The number of branches was observed until the age of 4 weeks after planting.

3.5.5 Number of Pods Per Sample (cm)

Observation of the number of pods per sample was carried out by picking the long bean pods from the stems of the long bean plant and then collecting them. Next, counting the total number of pods produced from each sample of long bean plants in one plot. The number of pods was observed about 3 times.

3.5.6 Pod Length Per Sample (cm)

Observation of pod length per sample was carried out by measuring the most extended pod using a ruler. How to measure pod length per sample of long bean plants by measuring the base of the long bean pod to the tip of the long bean plant pod. The number of pods was observed about 3 times.

3.5.7 Pod Weight Per Sample (g)

Observation of pod weight per sample plant was carried out when the long bean plants were harvested. The pods that have been harvested are taken and the pods are collected per sample plant, then weighed using an analytical balance. Pod weight per sample was observed about 3 times.

3.5.8 Pod Weight Per Plot (g)

Observation of pod weight per plot was carried out when the long bean plants were harvested. The long beans that have been harvested are taken its pods and the pods are collected per plot, then weighed using an analytical balance. Pod weight per plot was observed about 3 times.

V. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

Based on the results of the study it can be concluded that:

1. The application of rice husk biochar did not significantly affect the observed parameters of pod weight per plot and had a significant effect on other parameters.
2. The application of Barangan banana stem compost did not significantly affect the observation parameters of the number of branches, and the weight of pods per plot and had a significant effect on other parameters.
3. The application of Barangan banana stem compost had no significant effect on the observed parameters of the number of leaves, number of branches, pod

weight per sample and pod weight per plot as well as has a significant effect on other observation parameters.

5.2 Suggestions

It is recommended that farmers should use rice husk biochar and banana stem compost applications to increase the production of long bean plants in the B2K3 treatment (10 tons ha^{-1} rice husk biochar + 15 tons ha^{-1} of Barangan banana stem compost).

PROOFREADING

1.	crops that are widely	:	crops widely
2.	vegetables that are sold daily	:	vegetables sold daily
3.	The utilization of long beans is very diverse	:	Long beans are very diverse
4.	which are served	:	served
5.	A, B, and C as well as protein	:	A, B, and C and protein
6.	an average production	:	an average output
7.	The instability of long bean production in Indonesia is caused by various factors	:	Various factors cause the instability of long bean production in Indonesia
8.	which are continuously used by farmers	:	which farmers continuously use
9.	will cause a good residual	:	will cause an excellent residual
10.	The stem of the long	:	The branch of the long
11.	do not propagate	:	do not reproduce
12.	with a fairly high silica content	:	with a relatively high silica content
13.	the waste generated	:	
14.	charcoal was grinded and sifted	:	charcoal was ground and sifted
15.	The application is done by	:	The application is made by
16.	hole with a distance	:	hole at a distance
17.	soil is enough moist	:	soil is moist enough
18.	litter	:	liter
19.	measuring the longest pod	:	measuring the most extended pod
20.	have started to appear	:	have begun to appear
21.	the height of the plant	:	the size of the plant
22.	it is obtained rice	:	it is got rice
23.	The stems of Barangan	:	The branches of Barangan
24.	average height of long	:	average size of long
25.	and significantly different	:	and substantially different
26.	of a growth	:	of growth