RESPON PEMBERIAN BIOCHAR SEKAM PADI DAN PUPUK KALIUM FOSFAT TERHADAP PERTUMBUHAN DAN PRODUKSI TANAMAN KEDELAI (*Glycine max* (L.) Merril)

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ABSTRACT

Muhammad Ridhwan Nasution. Response of Rice Husk Biochar and Potassium Phosphate Fertilizer on Growth and Production of Soybean (*Glycine max* (L.) Merril). This thesis under the guidance of Mr. Ir. Gusmeizal, MP as the head of the supervisor and Mrs. Dr. Ir. Sumihar Hutapea, MS as the supervising member. This research was conducted in the experimental field of the Faculty of Agriculture, University of Medan Area, which is located at Jalan PBSI No. 1 Medan Estate, Percut Sei Tuan Subdistrict with an altitude of about ± 22 m above sea level (asl), from September to January 2021. This research was conducted using a Factorial Randomized Block Design (RAK) consisting of 2 treatment factors, namely: 1). Provision of Rice Husk Biochar (notation B) with 4 levels of treatment, namely: B0 = No rice husk biochar; B1= Rice husk biochar at a dose of 10 tons/ha; B2= Rice husk biochar at a dose of 20 tons/ha; B3= Rice husk biochar at a dose of 30 tons/ha. 2). Provision of Potassium Phosphate Fertilizer (P notation) with 4 treatment levels, namely: P0 = No Potassium Phosphate fertilizer; P1= Potassium phosphate fertilizer application at a concentration of 0.3%; P2= Potassium phosphate fertilizer application at a concentration of 0.6%; P3= Potassium phosphate fertilizer application at a concentration of 0.9%. The parameters observed in this study were plant height, number of leaves, number of branches, flowering days, root length, fresh root weight, dry root weight, plant biomass, number of pods, number of seeds, seed weight, and weight of 100 seeds. in this study, namely: 1). The application of rice husk biochar had a very significant effect on the parameters of plant height, age, number of leaves, number of branches, and seed weight, had a significant effect on parameters, root length, plant biomass, fresh root weight, dry root weight, and had no significant effect on flowering day parameters. , number of pods, number of seeds, and weight of 100 seeds. The treatment of rice husk biochar at a dose of 30 tons/ha was the best result. 2). The application of potassium phosphate fertilizer had a very significant effect on the parameters of plant height, number of leaves, number of branches, number of pods, number of seeds, and weight of seeds, significantly affected parameters of plant biomass, and weight of 100 seeds, and had no significant effect on parameters of flowering day, length roots, fresh root weight, and dry root weight. The treatment of potassium phosphate fertilizer at a concentration of 0.9% was the best result. 3). The interaction of rice husk biochar and potassium phosphate fertilizer had no significant effect on all parameters.

Keywords: *Soybean, rice husk biochar, fertilizer potassium phosphate*

CHAPTER I
INTRODUCTION

1.1 Background of Study

Soybean is the most important commodity after rice and corn because soybean is rich in vegetable protein which is needed to meet daily nutrition. This kind of vegetable is not only good for health, but it is also relatively cheap compared to other sources of animal protein. In line with the growing number of citizens every year, the need for soybean seeds is increasing to be used as raw material for Tofu, Tempeh, soy sauce, soybean milk, *tauco* (a paste made from preserved fermented yellow soybeans), and so on (Permadi, 2014).

In Indonesia, the demand for soybeans has not been met, according to The Central Bureau of Statistics, soybean production in 2014 was 955.00 thousand tons, but in the next three years, the production of soybean plants had decreased to 538.73 thousand tons. In 2018, the demand for soybean seeds had reached as much as 2.54 million tons of dried seeds per year. Therefore, soybeans must be imported to meet the needs of the population. Since 2013 until 2019, Indonesia's import of soybean had increased. In recent years, Indonesia's imports of soybean had reached 2.58 million tons in 2018, and 2.67 million tons in 2019 (The Central Bureau of Statistics, 2020)

Indonesia is facing productivity problems of soybeans, and this is caused by several factors, including the availability of low-quality seeds, lack of fertility in the soil, and the lack of available nutrients.

Efforts to increase the productivity of soybeans can be done by applying appropriate cultivation techniques. One of the proper cultivation techniques is by applying fertilizers both organic and inorganic fertilizers (Rahman, Sumardi, and Nuraini, 2014).

The use of fertilizers must be considered carefully, especially in the selection of organic fertilizers because not all organic fertilizers are able to bind nutrients available in the soil so that plants are not sufficiently supplied by nutrients. Therefore, it is necessary to add soil enhancers to the use of organic fertilizers.

To overcome the gap between soybean production and consumption, the community can make some efforts to increase the production of soybean, for example, through the application of Rice Husk Biochar and Potassium Phosphate Fertilizer. The application of Biochar is expected to provide good soil fertility and provide available nutrients in the soil, and the application of Potassium Phosphate Fertilizer is expected to support the nutrients needed by soybean plants to improve growth and production.

1.2 Formulation of Study

In Indonesia, soybean is the most important food commodity for households, industry, and plantations. However, soybean production cannot meet the needs of the community. This is caused by several factors, such as the use of seeds, lack of soil fertility, and the need for nutrients. As the treatment, the application of Biochar and Potassium Phosphate Fertilizer is expected to overcome the problems in growing soybean plants. Biochar can overcome the problems in the soil by improving the physical, chemical, and biological properties of the soil, and the application of Potassium Phosphate Fertilizer is needed as the main nutrients for soybean growth and production.

1.3 The objective of Study

1. To know the effect of giving Rice Husk Biochar on the growth and production of soybean plants (*Glycine max* (L.) Merril).
2. To know the effect of Potassium Phosphate Fertilizer application on the growth and production of soybean plants (*Glycine max* (L.) Merril).
3. To know the interaction and the effect of giving Rice Husk Biochar and Potassium Phosphate Fertilizer on the growth and production of soybean plants (*Glycine max* (L.) Merril).

3.1 Hypothesis

1. The application of rice husk Biochar significantly increases the growth and production of soybean plants (*Glycine max* (L.) Merril).
2. The application of Potassium Phosphate fertilizer significantly increases the growth and production of soybean plants (*Glycine max* (L.) Merril).

   The application of Rice Husk Biochar and Potassium Phosphate Fertilizer significantly increases the growth and production of soybean plants (*Glycine max* (L.) Merril).

3.2 Significance of Study

1. To fulfill the requirements for obtaining a Bachelor's degree (S1) in the Agrotechnology study program, at the Faculty of Agriculture, the Universitas Medan Area.
2. To be used as a reference for farmers in an effort to increase the growth and production of soybeans (*Glycine max* (L.) Merril).

CHAPTER II
LITERATURE REVIEW

2.1 The Classification and Morphology of Soybean Plants

According to Verdcourt (1966) in Adie and Krisnawati (2016), soybean is classified systematically as follows: Kingdom: Plantae, Division: Spermatophyta, Class: Dicotyledoneae, Order: Rosales, Family: Leguminoceae, Genus: Glycine, Species: Glycine max (L). Merr.

The morphology of the soybean plant is divided into several parts, namely roots, stems, leaves, flowers, pods, and seeds which are described as follows:

Soybean plants have roots that emerge from the cleavage of the seed coat around the microphyll. Prospective roots grow rapidly into the soil while the cotyledons consisting of two pieces will be lifted to the soil surface due to the rapid growth of the purple hypocotyl. The soybean root system consists of two types, namely taproots and secondary roots that grow from taproots. In addition, soybean also often from adventitious roots that grow from the bottom of the hypocotyl. In general, adventitious roots occur due to certain stresses, such as too high soil moisture (Adisarwanto, 2014).

There are two types of stem growth in soybeans, namely determinate and indeterminate stems. Soybean plants with determinate stems have stem ends with flower arrangements whose branches grow without being twisted, but straight up. The growth of indeterminate stems consists of a stem tip that does not end with a flower arrangement, and the branches of the stem grow wrapped around it. The number of books on the stem will increase according to the age of the plant, but in normal conditions, the number of books ranges from 15 to 20 books with a book spacing ranging from 2 – 9 cm. Soybean stems are branched and some are unbranched depending on the soybean varieties, but in general, the number of branches on soybean plants is between 1 – 5 branches (Ricca, 2015).

Soybean plants have two dominant leaf forms, namely the cotyledon stage which grows when the plant is still in the form of a sprout with two single leaves, and trifoliate leaves that grow after the growth period. Generally, there are two forms of soybean leaves, namely round (oval) and taper (lanceolate). Both leaf shapes are influenced by genetic factors. Leaf shape is estimated to be closely related to the potential for seed production (Irwan, 2006).

The flower of soybean forms a butterfly shape with two crowns and two petals. The flower of soybean is white, purple, or pale purple, and the flower is self-pollinating (Rubatzky, 1998). Soybean plants have perfect flowers (hermaphrodites), namely pistil and stamens can be found in each flower. The flower buds are arranged in flower arrangements, but not all flowers can become pods (fruits). About 60% of the flowers will fall off before they turn into pods (Rukamana, 1996 in Yonny 2016).

The first soybean pods are formed about 7 – 10 days after the appearance of the first flowers. The number of pods formed in each axillary periole is very diverse, between 1 – 10 pieces in each group. In each plant, the number of pods can reach more than 50 or even hundreds. The size and shape of the pods are maximized at the beginning of the seed ripening period. This may be followed by a change in the color of the pods from green to brownish-yellow when they ripe (Yulien, 2014).

Soybean seeds are divided into two main parts, namely the seed coat and the embryo. On the seed coat, there is a part called the hilum which is brown, black, or white. At the end of the hilum, there is a microphyll which is a small hole formed during the seed formation process. The color of the seed coat varies, ranging from yellow, green, brown, black, or a combination of these colors. Soybean seeds do not experience a period of dormancy so after the graining process is complete, soybean seeds can be planted immediately. However, the soybean seeds must have a moisture content ranging from 12 to 13% (Irwan, 2006 *in* Siregar 2016).

The morphology of soybean plants in general is almost the same as the nutrients characteristics of other varieties of soybean. Anajasmoro soybean had morphological nutrients of a determinate growth type. The stem growth will stop after the flowering period. The stem size is almost the same from the base to the tip, and it grows upright. The stem size is short or medium, and the leaf size is uniform and flowering simultaneously. Soybean had an oval leaf shape with a wide size, and the height of this plant can reach 64 – 68 cm with 2.9 – 5.6 branches. The age of flowering starts at 35.7 – 39.4 days with purple flowers, and the age of ripe pods is on 82.5 – 92.5 days (Balai Penelitian Tanaman Aneka Kacang and Umbi, 2016).

2.2 The Condition of Growing Soybean Plants

Soybean plants can grow well up to an altitude of 1.500 meters above sea level, but the best condition is up to 650 meters above the sea level because this affects the age of the plants, and soybean plants can live longer if planted in the highlands. Soybean plants require an area with a minimum rainfall of about 800 mm during the growth period of 3 – 4 months. This plant is resistant to slightly dried areas except during the flowering period (Rukmi, 2009).

Soybean plants have wide adaptability to various types of soil. Based on the suitability of the soil type for agriculture, soybeans are suitable for planting on alluvial, regosol, grumosol, latosol, and andosol soil types (Jayasumarta, 2012).

Another factor that affects the success of soybean planting is the depth of tillage which is a medium for supporting root growth. This means that the deeper the tillage, the more space will be available for free root growth so that the taproots that are formed will be stronger and deeper. On the type of soil with a crumb texture, with a tillage depth of more than 50 cm, the soybean roots can grow to a depth of 5 m. Meanwhile, in soil types with high clay content, root growth only reaches a depth of about 3 m (Irwan, 2006).

Soybeans can grow well on loose and moist soil that is not waterlogged, and with a pH of 6 – 6.8. At pH 5.5, soybeans can still grow and produce although the growth is not as well as at pH 6 – 6.8. At pH 5.5, the growth is severely stunted due to AI poisoning, and to overcome this situation, the soil needs to be limed (Jayasumarta, 2012).

2.3 Pests Attacking Soybean Plants

The most common types of pests attacking soybean plants are bean seed flies (*Ophiomyia phadeoli*), flies attacking the stem of the plant (*Melanagromyza sojae*), flies attacking the shoot of plant (*Melanagromyza dolicostigma*), aphis (*Aphis glycines* Matsumura), bemisia lice (*Bemisia tabaci* Gennadius), red mite (*Tetranychus cinnabarius* Boisduval), soybean beetle (*Phaedonia inclusa* Stall), ulat grayak (*Spodoptera litura* Fabricius), ulat jengkal (*Chrysodeixis chalcites* Esper), leaf-rolling caterpillar(*Omiodes indicata* Fabricius), pod-eating caterpillar (*Helicoverpa* (*Heliothis*) *armigera* Hubner), pod sucker/ brown ladybug (*Riptortus linearis* Fabricius), and green ladybug (*Nezara viridula* Linnaeus) (Marwoto, Nutrients ndingsih, and Taufiq, 2017).

Meanwhile, in the field, the types of pests found in soybean plants are aphis (*Aphis glycines* Matsumura), bemisia lice (*Bemisia tabaci* Gennadius), soybean beetle (*Phaedonia inclusa* Stall), looper (*Chrysodeixis chalcites* Esper), leaf-rolling caterpillar (*Omiodes indicata* Fabricius), pod sucker / brown ladybug (*Riptortus linearis* Fabricius), and green ladybug (*Nezara viridula* Linnaeus).

2.4 Diseases Infecting Soybean Plants

The types of diseases that are generally found in soybean plants are rust (*Phakopsora pachyrhizi*), bacterial pustules (*Xanthomonas axonopodis* pv *glycines*), Antraknose (*Colletotrichum dematium* var *truncatum*), Downy Mildew (*Peronospora manshurica*), Target Spot (*Corynespora cassiicola*), falling of sprouts, rot of leaves, stems and pods (*Rhizoctonia solani*), stem blight/ root rot (*Sclerotium rolfsii*), blight, leaf spot, and purple seed spots (*Cercospora kikuchii*), and mosaic virus disease (Marwoto, et .al, 2017).

Meanwhile, in the field, the types of disease found in soybean plants is rust (*Phakopsora pachyrhizi*), Downy Mildew (*Peronospora manshurica*), Target Spot (*Corynespora cassiicola*), and mosaic virus disease.

2.5 Rice Husk Biochar

Biochar is black carbon of agricultural and forestry biomass residues produced through the pyrolysis process of biomass. The application of Biochar in the agricultural sector is a step to reduce greenhouse gas (GHG) emissions. Carbon sequestration in agricultural soils through improved management practices is one of the main options for reducing CO2 emissions to the atmosphere because Biochar persists in soils and had been reported for thousands of years. The benefit of Biochar in the soil is as a soil ameliorant. Biochar is not fertilizer because Biochar cannot add nutrients to the soil. Biochar is only used as the cation exchange capacity which is high enough to bind soil cations that can be utilized for plant growth (Badan Penelitian and Pengembangan Pertanian, 2013).

Cornhusk and corn cobs are materials that can be processed into Biochar (black gold for agriculture) which is used as the main ameliorant to increase organic matter in the soil, raise pH, and produce various crops. Biochar is a high carbon organic compound (40 – 60%) resulting from the pyrolysis (carbonization) process that is resistant to weathering so that it can function as an effective organic ameliorant to improve soil fertility and can last for hundreds of years in the soil (Sudjana, 2014).

Rice Husk Biochar had a metal-binding function. In addition, Rice Husk Biochar functions to loosen the soil, making it easier for plant roots to absorb nutrients. Husk as rice milling waste amounts to 20 – 23% of the grain. The rice husk had the potential to be used as Biochar to add nutrients to plants. Biochar had been known to improve soil quality and is used as an alternative for improvement. Applying Biochar to the soil had the potential to increase soil C levels, water retention, and nutrients in the soil. Another advantage of applying Biochar in the soil is that the carbon in Biochar is stable and can be stored for thousands of years in the soil (Gani 2010).

In long term, Biochar does not disturb the carbon-nitrogen balance in the soil, but it can retain and provide more water and nutrients for the plants. When used as a soil enhancer with organic and inorganic fertilizers, Biochar can increase the productivity and availability of nutrients for plants. The application of Biochar to the soil can increase crop production and soil fertility (Lehmann and Joseph, 2009).

According to Sampurno (2015), giving Rice Husk Biochar at a dose of 12 tons/ha can increase plant height 2 – 4 weeks after planting. Meanwhile, according to Widodo (2014), giving Rice Husk Biochar at a dose of 15 tons/ha can give the best results for the production of carrot and kale cultivated in an intercropping manner field. Giving Biochar with materials from FMY (Farm Yard Manure) as much as 15 tons/ha was able to significantly increase the productivity of cassava intercropped with peanuts by 21.44 tons/ha compared to the control which resulted in cassava productivity of 18.44 tons/ha (Islami, Bambang, Nur, and Agus, 2011).

2.6 Potassium Phosphate Fertilizer

Potassium Phosphate Fertilizer is one type of artificial fertilizer. Artificial fertilizers are made by factories from inorganic chemicals. Potassium Phosphate

Fertilizer in Multi KP fertilizer contains two main components, namely potassium and phosphate. As potassium phosphate had a fairly high content, namely potassium (K2O) of 32% and phosphate (P205) of 51%. High levels of Phosphorus (P) as orthophosphate play an important role in the multiplication of enzyme reactions that depend on phosphorylase because phosphorus is part of the nucleus cell and is very important in cell division and meristem tissue development (Hardjoloekito, 2009).

Fertilization using Potassium Phosphate Fertilizer functions as a catalyst, especially in the reshuffle of protein into amino acids. Further, it was stated that potassium had the task of dismantling and compiling carbohydrates. Thus, if the plant is deficient in potassium, the photosynthesis and respiration processes will be hampered. In addition to its role in photosynthesis and respiration potassium also plays a role in the formation of starch, an activator of enzymes, opening the stomata, helping the physiological processes in plants, the metabolic processes in cells, influencing the absorption of other elements, enhancing the resistance to drought and disease, improving the root system, forming stronger stems, and affecting the crop production (Hardjowigeno, 2007 *in* 2013).

In soybean plants, balanced potassium is needed, so if there is a lack of potassium, it can be seen from the dried bottom leaves or there are scorched spots. The flowers fall off easily, the edges of the leaves are charred, and the leaves curl down and are susceptible to disease. If the potassium in the plant is too much, this can cause the absorption of Ca and Mg to be disturbed. The growth of the plant is stunted, so the plant is deficient (Nursyamsi, Idris, Sabiham, Rachim, and Sofyan, 2008).

Meanwhile, phosphate is very useful for stimulating the growth of new roots from young plant seeds, which also become raw materials for the formation of a number of proteins and helps assimilation and respiration. The advantage of using liquid fertilizer is its ability to provide nutrients according to plant needs. Fertilizer application can also be done more evenly and its concentration can be adjusted easily according to the needs of the plant (Hardjoloekito, 2009).

Phosphate had a beneficial effect on things such as fertilization including seed fertilization. If the plant bears fruits, the effects of excessive nitrogen administration will be lost. The strength of the stems in plants will avoid the plant from falling off and increase the plant's immunity to certain diseases (Soegiman, 1982 *in* Fuadi 2013).

Excess P can cause the absorption of other elements, especially microelements, such as Iron (Fe), Copper (Cu), and Zinc (Zn) to be disturbed. However, the symptoms are not physically visible on the plant. If phosphate is needed, this can be seen from the old leaves to purplish and gray. The edges of the leaves turn brown, and the stems of the young leaves turn dark green. The leaf growth is stunted and eventually falls off. The growing phase is slow and the plant is stunted (Adisarwanto,2008).

Adequate and balanced fertilization given according to plant needs will encourage more fertile growth and increase production optimally. Fertilization in the use of Multi KP fertilizer is recommended at a dose of 2-3 grams/liter. Meanwhile, the recommendation for fertilization on soybean plants are at 75 – 100 kg/ha urea, 100 – 150 kg/ha SP – 36, 100 – 150 kg/ha KCI, and 4 tons/ha organic fertilizer (Balai for the Assessment of Agricultural Technology Jambi, 2011).

CHAPTER III
RESEARCH METHODS

3.1 The Place and Time of Study

This study was conducted in the experimental field at the Faculty of Agriculture, the Universitas Medan Area which is located at PBSI Street Number 1 Medan Estate, Percut Sei Tuan with an altitude of about ± 22 m above the sea level. This study was conducted from September 2020 – to January 2021.

3.2 Tools and Materials

The materials used in this study are soybean of the Anjasmoro variety, Goat Manure, Rice Husk obtained from the DMJ Sampali rice mills and Percut Sei Tuan which is a type of lowland rice, hydrochloric acid solution, and multi KP fertilizer as Potassium Phosphate Fertilizer.

The tools used in this study are a hoe, tripe, watering can, knife, measuring cup, ruler/meter, modified pyrolysis tube, scales, plastic rope, and other supporting tools.

3.3 Research method

This research was conducted using a factorial randomized block design (Indonesian: Rancangan Acak Kelompok [RAK]) consisting of two treatment factors, namely:

1. Factors of applying Rice Husk Biochar with 4 levels, namely:

   B_0 = without applying Rice Husk Biochar (control)

   B_1 = applying Rice Husk Biochar at a dose of 10 tons/ha (1.44 kg/plot)

   B_2 = applying Rice Husk Biochar at a dose of 20 tons/ha (2.88 kg/plot)

   B_3 = applying Rice Husk Biochar at a dose of 30 tons/ha (4.32 kg/plot)

2. Factors of applying Potassium Phosphate Fertilizer with 4 levels, namely:

P_0 = without applying Potassium Phosphate Fertilizer (control)

P_1 = applying Potassium Phosphate Fertilizer at a concentration of 0.3%

P_2 = applying Potassium Phosphate Fertilizer at a concentration of 0.6%

P_3 = applying Potassium Phosphate Fertilizer at a concentration of 0.9%

Based on the treatment combinations, there are 16 treatment combinations with 3 replicates, 48 experimental plots, 9 plants per plot, 3 plants sampled per plot, 144 plants in total, 432 plants in total, experimental planting distance 40 cm x 40 cm, experimental area 120 cm x 120 cm, distance between plots 40 cm and distance between replicates 80 cm.

3.4 Data Analysis

After collecting the data, the data analysis was conducted by using Randomized Block Design (Indonesian: Rancangan Acak Kelompok [RAK]) with the following formula:

$$\mathbf{Yijk = \mu + pi + \alpha j + \beta k + (\alpha\beta)jk + \Sigma ijk}$$

Description:

Yijk = The results of observations in the i-th replication treated with Rice Husk Biochar at the j-level and Potassium Phosphate Fertilizer at the k-level

μ = the effect of median (the mean of

repetition)

pi = the effect of the i-th test

αj = Response of applying Rice Husk Biochar at the j-level

βk = the response of applying Potassium Phosphate Fertilizer at the k-level

(αβ)jk = the response of the combination treatment of Rice Husk Biochar at level j and Potassium Phosphate Fertilizer at level k

Σijk = the effect of experimental error due to various doses of Rice Husk Biochar at a level I and Potassium Phosphate Fertilizer at level j.

If the results of the treatment in this study have a significant and very significant effect, further testing will be carried out with Duncan's distance test.

3.5 Implementation of the Study

3.5.1 Producing Rice Husk Biochar

The production of Rice Husk Biochar is carried out in two stages, namely the carbonation process of the raw material and the activation process. Rice husk is first dried under the sun for 3 days to reduce the moisture so that it facilitates the manufacturing process. The carbonation process of raw materials is carried out by adding raw materials (rice husks) into a pyrolysis tube that had been modified to carry out the combustion process or carbonation at high temperatures. This process takes 2 hours. After that, the material that has become charcoal is sorted (selected). Then, the activation process is carried out with a solution of hydrochloric acid (HCI) at a concentration of 10%. The charcoal is soaked for 24 hours, drained, and dried. After that, the activation of rice husk charcoal is milled to produce Rice Husk Biochar. The production of Rice Husk Biochar refers to the research conducted by Hutapea, et .al., (2015).

3.5.2 Preparing the Land

The land used in the experimental garden of the Faculty of Agriculture, Universitas Medan Area. The land was first measured for research purposes. Then, the land is cleaned of weeds and debris using manual tools such as tripe, hoe, and other tools needed. Land clearing aims to prevent competition between the main crop and the weeds and to avoid pests and diseases.

Then, the land is processed after cleaning the weeds. Tillage is carried out by hoeing the soil to make the land loosened and to increase filtration and aeration in the soil.

3.5.3 Plotting

After completing the land preparation, plots were made with a length of 120 cm and a width of 120 cm. The distance between plots is 40 cm and the distance between replications is 80 cm and the height of the plots is 30 cm. Plotting with the height of 30 cm aims to avoid waterlogging in the planting plot area which can damage the plant roots because of water saturation.

3.5.4 Applying Rice Husk Biochar

Rice Husk Biochar was given a week before planting and different doses were applied, namely B0 = control/ without applying Rice Husk Biochar, B1 = 1.44 kg/plot, B2 = 2.88 kg/plot, and B3 = 4.32 kg/plot. Rice Husk Biochar was applied by leveling the Biochar into each plot in each predetermined dose.

3.5.5 Applying Fertilizers

The basic fertilizer used was manure obtained from goat manure. Basic fertilizer was given a week before planting and applied evenly to the entire plot. Basic fertilizer was given as much as 10 tons/ha with a dose of 50% of the recommended dose, which is 0.72 grams per entire plot.

3.5.6 Planting

Before planting soybean, holes for plantation should be made, and the holes should be made ± 3 cm by using a "tugal" or a tool that can be used to make a small hole in the soil. The planting distance should be 40 cm x 40 cm. After that, the soybean seeds were planted with 2 seeds per planting hole. According to Marliah, Hidayat, and Husna (2012), for the best results, the distance of planting soybean seeds should be 40 cm x 40 cm.

3.5.7 Applying Potassium Phosphate Fertilizer

The Potassium Phosphate Fertilizer applied was Multi KP fertilizer. This fertilizer was applied by spraying it onto the leaves of soybean plants using a hand sprayer evenly. This fertilizer was given once a week with different concentrations, namely P0 = Control / without Potassium Phosphate Fertilizer, P1 = 0.3%, P2 = 0.6%, and P3 = 0.9%. The fertilizer should be given from 2 to 7 weeks after planting because Potassium Phosphate Fertilizer provides the nutrients needed for soybean plants in the vegetative phase for plant growth up to the fertilization phase to produce high production.

3.6 The Maintenance of Soybean Plants

3.6.1 Watering the soybean plants

Watering was done using a watering can, and this was done two times a day which is in the morning and in the afternoon. Watering was also adjusted to weather conditions. If it rains in the morning, watering soybean is done in the afternoon and vice versa.

3.6.2 Replacing soybean plants

The soybean plants are replaced from the 3^{rd} to the 15^{th} days after planting. This process was carried out as a maintenance measure to increase the percentage of live plants by replacing soybean plants which were died or grew abnormally with the new soybean plants in the same planting hole.

3.6.3 Spacing

Spacing was done to reduce the number of plants, and this was done by choosing plants that grow well and were healthy to maintain. The spacing process aims to reduce competition between plants in gaining nutrients. Spacing was done at the age of 2 weeks after planting, leaving the best plant at each planting plot.

3.6.4 Weeding

Weeding was one to clean the weeds around the plants manually, namely by pulling the grass that grew around the plant area so that there is no competition between the main plant and disturbing plants, and at the same time this process would loosen the soil.

3.6.5 Controlling Pest and Disease

Pest and disease control with small impact were done manually or physically, namely by removing the plant parts that were attached to pests and diseases. If the pest and disease have a large impact on the plants, this can be controlled chemically by using the insecticide decis 25 EC and the fungicide dithene M-45. The main pests that attack soybeans are bemisia aphids (Bemisia tabaci Gennadius), span caterpilars (Chrysodeixis chalcites esper), leaf-rolling caterpillars (omiodes indicate fabricius), and green ladybugs (nezara viridula Linnaeus).

3.6.6 Harvesting soybean plants

Harvesting soybean plants is carried out if the criteria for harvesting have been fulfilled, such as most of the leaves of the soybean plants have turned yellow, but this is not because of pests or diseases. The harvesting age for the Anjasmoro variety would be 82 – 93 days, the soybean pods will be light brown in color, the soybean seeds change color from green to brownish yellow, and the stem of the plant will be slightly brownish-yellow. This can be seen in appendix 1. The Description of Anjasmoro soybean plants.

3.7 The Study Parameter

The parameters are used to show the results of the data obtained during the study. The parameters which were carried out can be seen as follows.

3.7.1 Height of soybean plants

The observation of plant height was carried out when the plant was two weeks after planting until six weeks after planting, namely in the vegetative phase of the plant, which is the phase of the plant growth starting from the first time it grows until it showed flowers, with an observation interval of once a week. The observation of plant height was measured from the soil surface or from the base of the stem to the highest growing point.

3.7.2 Number of leaves

The observation of the number of leaves was carried out when the plant reached the age of two weeks after planting until six weeks after planting, namely in the vegetative phase of the plant, which is the growth phase of the plant until it showed flowers, with an observation interval of once a week. The observations were made by counting the leaves of the soybean plants.

3.7.3 Number of branches

The number of branches was observed when the plant reached the age of two weeks after planting until six weeks after planting, namely in the vegetative phase of the plant, which is the phase of plant growth until the flowering phase, with an observation interval of once a week. The observation was carried out by counting each number of primary branches on the soybean plant.

3.7.4 Flowers

Observation of the flowering phase was carried out on each plot that produced flowers. Plants begin flowering at the age of 35 – 40 days after planting.

3.7.5 Length of Roots

The roots were cleaned from the planting medium. Then, the length was measured from the tip of the roots to the base of the roots using a ruler.

3.7.6 Weight of Fresh Roots

The observation of the weight of fresh roots was carried out after the harvesting phase. The fresh roots were removed, and cut from the base stem, cleaned from all dirt, and weight using an analytical balance.

3.7.7 Weight of Dried Roots

The weight of dried roots was observed after harvesting the plants. The dried roots were removed, cut from the stem, and cleaned from the dirt. Then, the roots were air-dried for 24 hours with a length of 3 days until the weight was constant. The weight of dried roots was observed by weighing the roots using an analytical balance.

3.7.8 Biomass of soybean plants

The biomass of the plant was observed after harvesting. The observation was carried out in two stages to obtain fresh plant biomass and dried plant biomass. Each sample of the upper plant was weighed, and the part that had been cut at the root was added to the weight of the upper plant in a fresh condition (observation of fresh plant biomass) and in a dried condition (observation of dried plant biomass).

3.7.9 Number of Pods

The number of pods per plant was calculated after harvesting, by counting the number of pods in each sample plant, adding them up, and determining the average.

3.7.10 Number of Seeds

The number of seeds was observed by counting the seeds in each plant sample. Observation of the number of seeds was carried out after the soybeans were peeled or the skin was opened and then added up and determined the average.

3.7.11 Weight of Seeds

The seeds were weighed after harvesting. All seeds were weighed and added up to determine the average.

3.7.12 Weight of 100 Seeds

The weight of 100 seeds was observed by taking 100 seeds randomly per plot, and they were weighed to know the average.

CHAPTER V

CONCLUSION AND SUGGESTION

5.1 Conclusion

1. The treatment of Rice Husk Biochar had very good results in that it had a significant impact on the parameters of plant height, age, number of leaves, number of branches, and seed weight. The parameters of root length, plant biomass, the weight of fresh roots, and the weight of dried roots also showed significant results. The parameter of flowering day, total pod, total seed, and heavy 100 seed was not significant. The treatment of Rice Husk Biochar at a dose of 30 tons/ha is the best.
2. The treatment of giving Potassium Phosphate Fertilizer had very good results in that it had a significant impact on the parameters of the plant, such as height, number of leaves, number of branches, number of pods, number of seeds, and weight of seeds. The parameters of plant biomass and weight of 100 seeds had significant results. The parameter of flowering days, root length, fresh root weight, and dried roots weight indicated no significant results. The treatment of Potassium Phosphate Fertilizer at a concentrationof 0.9 % is the best.
3. The combination of Rice Husk Biochar and Potassium Phosphate Fertilizer had no significant results in all of the parameters.

5.2 Suggestion

The study suggests that the cultivation of soybean plants requires Potassium Phosphate Fertilizer treatment with a concentration of 0.9% to produce a high yield. Then, further studies need to be carried out by giving different doses of rice husk Biochar to increase the production of soybean plants.