PENGARUH PEMBERIAN PUPUK KOMPOS DAUN LAMTORO DAN ARANG SEKAM PADI TERHADAP PERTUMBUHAN DAN PRODUKSI TANAMAN KACANG PANJANG (*Vigna sinensis L.*)

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ABSTRACT

Rido Anugrah Lubis. 168210061. Long beans (*Vigna Sinensis* L) is a type of legume vegetable that is widely cultivated in Indonesia. In recent years, there has been a lot of demand both at home and abroad, where the demand has not been fulfilled, but the cultivation of long bean vegetables has not been carried out intensively even though public demand for this commodity is increasing and even export opportunities are increasingly open. Provision of organic matter is an effort to increase plant productivity. Lamtoro leaves and rice husk charcoal can increase the growth and production of long beans. Using a randomized block design with 2 factors. The first factor is the administration of lamtoro leaves at a dose (0, 10, 20, 30 tons/ha) and the second factor is the administration of rice husk charcoal at a dose (0, 10, 20, 30 tons/ha). Parameters observed were plant height, stem diameter, flowering age, sample weight, plot weight. Lamtoro leaf compost treatment had a very significant effect on the parameters of plant height, stem diameter, while the parameters of flowering age and production showed no significant results. Rice husk charcoal treatment had a significant effect on plant height parameters, while stem diameter, flowering, production showed no significant results. The interaction of lamtoro leaf compost and rice husk charcoal did not significantly affect all treatments.

Key words: *Long bean plants, Lamtoro leaves and rice husk carcoal*

CHAPTER I

INTRODUCTION

1.1. Background of Study

Long bean (*Vigna Sinensis L*) is a type of legume widely cultivated in Indonesia. Yardlong beans are non-native to Indonesia but from India and Central Africa and have been cultivated in Indonesia for centuries (Arinong, 2013).

In recent years, there has been plenty demand both domestic and abroad, unfortunately, the demand has not been fulfilled. However, the cultivation of yardlong beans have not been carried out intensively regardless of the increasing public's demand for this commodity and, moreover, export opportunities are progressively open. Yardlong beans are vegetables widely known in Indonesia. Yardlong beans contain quite complete nutrients; for every 100 grams contains 50 kcal, 3.40 g protein, 0.40 g fat, 8.50 mg carbohydrates, 106 mg calcium, 63 mg phosphorus, 1.40 mg iron, and 295 mg Vitamin A (Cahyono, 2014).

Yardlong beans can be developed as a farming commodity since apart from being easy to cultivate, their market share is rather high. Based on data from the Statistics Indonesia (September 04, 2018), the average production of yardlong beans in Indonesia during 2016 was 114.01 tons, while in 2017 the average yield was 120.33 tons.

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	Plant	2013	2014	2015	2016	2017
1	Shallot	79,25	77,87	80,54	86,92	77,05
2	Garlic	72,40	54,29	51,68	41,18	39,79
3	Spring Onion	76,55	71,55	71,28	70,48	65,19
4	Potato	178,83	175,79	180,00	167,12	156,71
5	Cabbage	237,98	242,2	225,18	236,74	229,13
6	Napa Cabbage	117,70	114,35	119,04	120,42	116,31
7	Carrot	190,37	198,16	202,22	200,10	196,45
8	Radish	131,13	129,84	124,43	94,49	128,55
9	Read Bean	60,30	58,87	41,83	12,18	24,41
10	Yardlong Bean	92,52	107,48	109,48	114,01	120,33
11	Chilli	93,57	93,21	113,22	99,57	96,97
12	Tomato	244,26	206,97	239,16	212,47	212,71
13	Eggplant	164,69	161,92	175,54	213,46	224,34
14	Green Beans	130,76	156,9	138,25	115,84	135,27
15	Cucumber	123,78	136,34	146,41	136,36	145,38
16	Chayote	582,55	506,38	679,26	400,18	446,61
17	Water Spinach	81,92	82,56	102,15	63,38	64,18
18	Spinach	44,37	50,33	60,44	66,17	68,57
19	Cauliflower	139,84	145,94	114,10	149,73	142,02

Table 1. Average Vegetable Yield by Type of Plant (cwt/ha) 2013 – 2017

Source: Department of Food Crops and Horticulture, North Sumatra Province

Yardlong beans are also promoted as protein and minerals. Thus, this vegetable gathers the attention of consumers who understand the true nutritional value and quality of foods rich in vitamins. Yardlong bean (*Vigna sinensis* L.) is one of the vegetable commodities that can be developed since it has a fairly high economic value. In an effort to improve the nutrition of people, this type of bean is important as a source of vitamins. Yardlong beans contain carbohydrates (70.00%), protein (17.30%), fat (1.50%), and water (12.20%) so this commodity is a source of plant-based protein (Haryanto, 2003 in Hakim, 2013). Besides being an important vegetable, the young leaves of yardlong beans are also very good for consumption that have rich in fiber and vitamin content,

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and the seeds are a great source of plant-based protein. Further, this plant can fertilize the soil because the roots of long beans entail nodules containing the bacterium *Rhizobium* sp. which can bind free nitrogen from the air and convert it into the form that plants require.

The technique of using inorganic fertilizers such as Urea, Kcl, and Tsp accommodating various chemical compounds can bring a negative impact on the soil. if used for a relatively long period of time, it will cause the soil to harden quickly and the ability to store water is reduced, making the plant productivity decrease as the soil becomes acidic (Parman, 2013).

River tamarind (*Leucaena leucocephala*) carries 2.0-4.3% nitrogen, 0.2-0.4% phosphorus, and 1.3-4.0% potassium. River tamarind is also one of the legumes that contain high protein and very potential carotenoids. The content of lamtoro is 91.02% dry matter, 23.69% crude protein, 2.54% fat, 16.78% crude fiber, 11.23% ash, 1.91 Ca, and 0.26% P. The river tamarind leaf can be used as a source of organic matter in organic agriculture (Anonymous, 2010).

Husk charcoal is a planting medium that is practical to use as it does not need to be sterilized. The process occurs because pathogenic microbes have died during the combustion process. Husk charcoal contains 0.3% N nutrients, 15% P_2O_5, 31% K_2O, and several other nutrients with a pH of 6.8. subsequently, husk charcoal can preserve high water, has a crumb texture, has a high CEC, and can absorb sunlight effectively (Fahmi, 2013).

Based on this description, the author conducted a study entitled The Effect of River Tamarind Leaf Compost (*Leucaena Leucocephala*) and Rice Husk Charcoal on the Growth and Yield of Yardlong Bean Plants (*Vigna sinensi* L.).

1.2. Formulation of Study

1. What is the effect of administering river tamarind leaf compost on the growth and yield of yardlong beans
2. What is the effect of administering rice husk charcoal on the growth and yield of yardlong beans
3. What is the effect of administering river tamarind leaf compost and rice husk charcoal on the growth and yield of yardlong beans

1.3. Objective of Study

1. To understand the effect of administering river tamarind leaf compost on the growth and yield of yardlong bean (*Vigna sinensi* L.)
2. To understand the effect of administering rice husk charcoal on the growth and yield of yardlong bean (*Vigna sinensi* L.)
3. To determine the most fitting dose of river tamarind leaf compost and rice husk charcoal for the growth and yield of yardlong bean (*Vigna sinensi* L.)

1.4. Hypothesis

1. Administration of river tamarind leaf compost has a significant effect on the growth and yield of yardlong bean (*Vigna sinensis* L.)
2. Administration of rice husk charcoal has a significant effect on the growth and yield of yardlong bean (*Vigna sinensis* L.)
3. Interaction of administering river tamarind leaf compost and rice husk charcoal has a significant effect on the growth and yield of yardlong bean (*Vigna sinensis* L.)

1.5. Significance of Study

1. As one of the requirements for Bachelor's degree in Agriculture, Faculty of Agriculture, Universitas Medan Area.
2. As information source for farmers in cultivating yardlong bean (*Vigna sinensis* L.) organically using river tamarind leaf compost and rice husk charcoal.

CHAPTER II

LITERATURE REVIEW

2.1. Botany of Yardlong Beans (*Vigna sinensis* L.)

Yardlong bean is one of the horticultural plants widely used by the community as a vegetable. In Indonesia, this plant is consumed as cooked vegetables and fresh vegetables due to its delicacy. Yardlong beans are included in the vegetable plant group of Familia *Fabaceae*. Besides its good taste, yardlong beans contain many nutrients, including protein, thiamine, riboflavin, iron, phosphorus, potassium, vitamin C, folate, magnesium, and manganese (Tim Karya Tani Mandiri, 2011).

According to the Karya Tani Mandiri Team (2011), the complete classification of yardlong beans is as follows:

Division : *Spermatophyta*

Class : *Angiospermae*

Subclass : *Dicotyledonae*

Order : *Rosales*

Family : *Papilionaceae*/Leguminosae

Genus : *Vigna*

Species : *Vigna sinensis* (L.) Savi ex Hassk

Vigna sinensis ssp. Sesquipedalis

Long beans are believed to have been selected and developed in Southeast Asia from cowpea (*Vigna unguiculata*), which is native to Africa. The center of the genetic diversity of yardlong beans is in Southeast Asia. This bean has been cultivated in Africa, North Asia (China, Korea, Korea, and Japan), Southeast Asia, and northern Australia (Northern Territory and northern Queensland) (Lim, 2012).

Yardlong beans are seasonal vegetable crops consumed by the community and one of the vegetables traded daily. The edible parts of the yardlong bean plant are the leaves and pods. Yardlong bean pods consist of abundant vitamins A, B, and C as well as protein (Sa'diyah, 2013).

Vegetables have an essential part in meeting food needs and increasing nutrition as they are a source of minerals and vitamins important to the human body. Vegetable consumption has begun to increase due to the awareness that consuming ones will nourish the body. Yardlong beans are important source of vitamins and minerals. This vegetable contains abundant vitamin A, vitamin B, and vitamin C, especially in young pods. These bean seeds bring plentiful protein, fat, and carbohydrates. Thus, yardlong beans are promoted as a source of vegetable protein for the population in an effort to improve community nutrition (Haryanto et al. 2015).

The economic and social prospects of yardlong beans are relatively promising. Apart from being traded domestically, they are also an export commodity. However, in general, yardlong bean cultivation is still a sideline, that is, it is farmed on a small scale without any intensive treatment. This is one of the obstacles in the production of long beans (Rukmana, 2012).

One solution to increase the production of yardlong beans is to improve fertilization techniques. To this day, farmers generally use synthetic fertilizers that cause the soil organic matter content to decrease, reduce soil support, and facilitate leaching of nutrients from the root environment, thereby reducing fertilizer efficiency (Karama et al., 2010).

2.2. Long Bean Plant Morphology

2.2.1. Root

Yardlong bean plants have a tap root system. Taproot is a root in which a large root is a continuation of the stem. Yardlong bean root system can penetrate the soil layer reaching 60 cm. The roots of the long bean plant can be in symbiosis with the bacterium *Rhizobium* sp, the characteristic of this symbiosis is nodules around the root base (Pitojo, 2011).

2.2.2. Stem

The stem of this yardlong bean is erect, cylindrical, soft, and green with a smooth surface. The stems grow upwards, twisting towards the right on the adjacent stands or stands. The trunk forms branches from the bottom of the trunk (Pitojo, 2011).

2.2.3. Leaf

The leaves of the yardlong bean plant are compound leaves, attached to the petiole rather long, oval, alternating, 6–8 cm long, 3–4.5 cm wide, flat edge, rounded base, pointed tip, pinnate bone, cylindrical stalk with a length of about 4 cm and green.

2.2.4. Flower

The long bean flower is in the shape of a butterfly. The nodes come out of the axil, and each node grows 3-5 flowers. The colors vary from white, blue, to purple. Yardlong bean flowers are self-pollinating but cross-pollination with the help of insects can also occur with a 10% chance of success (Haryanto, 2015).

2.2.5. Fruit

Yardlong beans are pods, round, slender, and 10-80 cm long. Young pods are green to whitish in color, while mature pods are yellowish. Each pod can accomodate 8-20 seeds (Samadi, 2013).

2.3. Growing Yardlong Beans

2.3.1. Soil

Upland vegetables are frequently cultivated intensively, marked by the growth of vegetable crops which are annual plants as it is supported by sufficient rainfall with an equal distribution. Various upland vegetable yields are harvested on dry, sloping lands on andisol, inceptisol, or entisol (Waluyo L, 2011).

The highland vegetable areas are dominantly in the area under the volcanic activity, be it active or inactive. The main soil types commonly found are andisol and entisol at altitudes above 1,000 meters above sea level (masl), soil structure is friable to loose with deep solum, good drainage, and high porosity.

Soil fertility in upland vegetable land is superior to other mineral soil types and is classified as high. This occurs since the soil is formed from volcanic material with high organic matter and phosphorus content, furthermore, the cation exchange capacity (CEC) of andisol soil is normally high, characterized by high organic C values (Khadijah et al., 2012).

2.3.2. Climate

Yardlong beans are a tropical species that tolerate high temperatures, growing at 20^0 – 35^0C during the day and 15^0C at night. This plant grows well in well-drained, fertile soil from a pH of 5.5 to 7.5. Yardlong beans can proliferate on sandy soil if supported by good irrigation (Lim, 2012).

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2.3.3. Altitude

The altitude is one affecting factor in the growth and yield of plants because it is closely related to climatic conditions such as temperature, air, humidity, rainfall, and sunlight (Cahyono, 2014 in Andrianto 2018).

The ideal altitude for long bean cultivation is at a height of 22 meters above sea level (Kuswanto et al., 2015 in Andrianto 2018).

2.4. Long Bean Cultivation Techniques

2.4.1. Seed Selection

Seeds are those prepared for plant cultivation that has been undergone a selection process so they can grow into young plants (seedlings), then grow up and produce flowers, through pollination the flowers develop into fruit or pods. According to the Seed Center (2013), the characteristics of selecting high economic quality seeds are as follows:

a) Germination no less than 80%

Growing seeds planted should be at least 80%. This is controlled to avoid the use of too many seeds so as to increase production costs.

b) Pure seeds no less than 95%

The seeds available at each variety/clone are intended to avoid growth inconsistencies and resistance to pests/diseases which ultimately causes production to decline.

c) Unsoiled seeds

Standardized seeds require a high level of cleanliness against other plant seeds, weeds, dirt from the remains of other plant parts, soil grains, sand, and gravel.

d) Clean seed shape

The surface of the seed coat must be clean and polished, free from soil or wrinkled. Wrinkled seeds are a sign of unmatured harvest.

2.4.2. Soil Cultivation

a. Plowing

The land is tidied of weeds beforehand. Plowing is done by turning and crushing the chunks of soil into smaller grains. The soil is gouged to a depth of 20-30 cm and is left for 3-4 days before sowing.

b. Bed Planting

Beds are constructed with a width of 120-120 cm. Between the beds drainage channels are made with a width of 30 cm. the length of the bed is adjusted to the soil (Anas, 2012).

2.4.3. Liming

Liming is only done if the soil is too acidic. The acidity degree that is suitable for yardlong beans ranges from 5.5 to 6.5. The liming method is to spread lime evenly on the soil. Subsequently, it is left for 2-3 weeks until it is ready to be sowed (Anas, 2012).

2.4.4. Sowing

Sowing yardlong beans do not need to undergo the seed nursery. Yardlong bean seeds can be disseminated immediately. Sowing is done by providing a hole. The depth of the hole is approximately 3-5 cm. The distance between holes is about 30 cm and between rows is 60 cm. In each hole, 2 seeds are inserted, then covered with a little soil.

2.4.5. Maintenance

Yardlong beans will grow 3-5 days after sowing. Seeds that do not grow are immediately replaced. Weeding is carried out once the plant ages 2-3 weeks after planting, depending on the growth of the grass. Weeding is done by removing weeds or tidying with a cord or hoe. Installation of 2 meters high stakes or poles made of wood/bamboo is to keep the plants from collapsing. Every 4 pieces of bamboo end tied together. If the plant is too fertile, pruning can be opted for, while watering and ditching need to be done to diminish excess water (Syafri and Julistia, 2010).

2.4.6. Fertilization

Plants need to be fertilized to meet their nutrient needs. The fertilizer used can be either organic or inorganic. Organic fertilizers dispensed to vegetable plants are manure or mature compost. Mature organic fertilizer does not decompose and decay so it does not generate heat. The dose of organic fertilizer used is 1-2 tons/ha. Inorganic fertilizers commonly used are Urea, Kcl, and Tsp (Sunarjono, 2013).

2.5. River Tamarind (Lamtoro) Leaves

River tamarind (lamtoro) leaves comprise secondary metabolites in form of lignin, mimosine, alkaloid, flavonoid, and tannin. According to Widyastuti (2001), lignin content in lamtoro leaves is 7.90%, mimosine is 2.14%.), flavonoid is 0.018 mg/kg, and tannin is 10.14 mg/kg. Generally, tannins in plants are known to possess the ability to preserve (Laconi, 2010).

Organic fertilizers are composed of living things, such as manure, remains of plants and animal, or human feces. Organic fertilizers can be in form of solid or liquid incorporated to improve the physical, chemical, and biological properties of the soil. One source of organic matter is in form of green manure (Nugroho, 2012).

Green manure, namely natural fertilizers derived from plant residues, especially legumes/beans, leaves, stems, and roots. Legumes are plants prioritized as sources of green manure since these plants contain relatively high nutrients, especially nitrogen compared to other types of plants (Nugroho, 2012).

River tamarind is a tree shrub with small leaves of double pinnate. In addition, river tamarind can grow to 5-15 meters (Purwanto, 2011).

Leucaena plants including *Leguminosae* plants and those belonging to the *Mimosaceae* subfamily are multipurpose plants because all parts of the plant can be used for both human and animal.

Leguminosae plants are leguminous plants with a root system capable of symbiosis with *Rhizobium* bacteria and form root nodules that can bind nitrogen from the air (Purwanto, 2011). Based on previous research conducted by Ani Safitri, (2013), entitled "The Use of River Tamarind (*Leucaena leucocephala*) and Angsana (*Pterocarpus indicus*) Leaf Compost as Culture Media for Population Growth of *Chaetoceros calcitrans*". This study aimed to investigate the effect of administering compost containing river tamarind and Angsana leaves in culture media on population growth of *C. calcitrans* at various doses and to determine the correct compost dose for optimal growth of *C. calcitrans*. The method used in this research is experimental with Completely Randomized Design (CRD). The study applied one treatment factor, namely the dispensing composts; A (control), 10 mg urea + 5 mg TSP; B (63 mg); C (94 mg); and D (126 mg). Each treatment was repeated four times, making the total number of samples 16. Observations of this study were conducted for 8 days. The parameter measured was the growth of *C. calcitrans* cells. Subsequently, the data obtained were analyzed descriptively. Based on the results, it can be concluded that the application of a mixture of compost made from river tamarind leaves and Angsana leaves into the culture media showed an acceleration of growth in the growth of *C. calcitrans* and the dose of compost that had the optimal effect on population growth of *C. calcitrans* was in treatment D (2 times the dose of compost, namely 126 mg/ml).

2.6. Rice Husk Charcoal

Husk charcoal is the result of incomplete combustion of rice husk (grain's husk) of black color. The black appearance of husk charcoal due to the combustion process causes high heat absorption, thus increasing the temperature and accelerating germination. Husk charcoal contains elements of N, P, K, and Ca 0.18% each; 0.08%; 0.30%, and 0.14% as well as unmeasurable Mg with a 6-7 pH level after 2 days of immersion. Based on the analysis of the Japanese Society For Examining Fertilizers and Fodders, the composition of husk charcoal contains SiO_2 (52%), C (31%), Fe_2O_3, K_2O, MgO, CaO and Cu (in small proportion), therefore husk charcoal contains chemical properties similar to soil. (Wuryaningsih, 2010 in Saragih Jupiter 2016).

There are several benefits to incorporating rice husk charcoal into the soil, such as increasing plant growth, reducing methane emissions, reducing NO emissions (approximately 50%), minimizing fertilizer requirements (approximately 10%), diminishing nutrient leaching, storing carbon in the long term effectively and stable, reducing soil acidity/increasing soil pH, reducing aluminum toxicity, improving soil aggregates so as to improve soil water holding characteristics, increasing soil capacity to provide Ca, Mg, P and K, increasing soil microbial respiration, increasing soil microbial biomass, stimulating fixation symbiosis nitrogen in legumes, increasing arbuscular mycorrhizal fungi, and increasing cation exchange capacity.

The amount of rice husk charcoal added affects crop yields. in 2009, Laos reported the highest yield of upland rice with the addition of 4 tons/ha of rice husk charcoal. However, once rice husk charcoal was added up to 8 or 16 tons/ha, the results were comparable to the control (without rice husk charcoal). To this date, the basic components of rice husk charcoal and the best dosage to be applied to plants are still under the study according to specific soil management (Asai, et al. 2009).

Due to its recalcitrant properties to decomposition in soil, a single application of rice husk charcoal can provide beneficial effects over several growing seasons in the field. Hence, rice husk charcoal is not necessarily applied every growing season as the application of manure, compost, and artificial fertilizers. Depending on the target application level, the availability of rice husk charcoal reserves, and the soil management system, the addition of rice husk charcoal can be appended gradually. However, it is believed that the adventagous effects of applying rice husk charcoal to the soil will intensify over time, and it should be considered when distributing the application over time.

If the application of rice husk charcoal into the soil is intended to upgrade its fertility, then rice husk charcoal should ideally be placed near the soil surface in the root areas, where nutrient cycling and absorption by plants occur. Certain systems can benefit from the application of rice husk charcoal in the lower layers root area (Sapto.A. 2012).

CHAPTER III
RESEARCH METHOD

3.1. Time and Site

This research was conducted in the experimental garden of the Faculty of Agriculture, Universitas Medan Area situated on Jalan PBSI Medan Estate, Percut Sei Tuan Subdistrict, with an altitude of 22 meters above sea level, soil type is sub soil with pH 7 and has flat topography. This research was conducted from September 2020 to November 2020.

3.2. Material and Tool

The materials used in this study were yardlong bean seeds of the Parade Tavi variety, river tamarind leaves, rice husks, cow manure, EM4 bioactivator, brown sugar, chemical fertilizers as basic ingredients, chemical insecticides, and water.

The tools used in this study were tripe, hoe, bucket, tarpaulin, watering can, nameplate test, knife, bamboo/wood, plastic rope, hose, camera, tape measure, stationery, and scale.

3.3. Research methods

This research was conducted using a factorial randomized block design (RBD) which consisted of 2 treatment factors, namely:

1. Factor 1: Administering various doses of river tamarind leaf compost consisting of 4 treatment levels, including:

   L0 : No river tamarind leaf compost

   L1 : River tamarind leaf compost at a dose of 10 tons/ha (1440g/plot)

   L2 : River tamarind leaf compost at a dose of 20 tons/ha (2880g/plot)

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L3 : River tamarind leaf compost at a dose of 30 tons/ha (4320g/plot))

2. Factor 2: Administering various doses of rice husk charcoal consisting of 4 treatment levels, including:

   A0 : No rice husk charcoal

   A1 : Rice husk charcoal at a dose of 10 tons/ha (1440 g/plot)

   A2 : Rice husk charcoal at a dose of 15 tons/ha (2160 g/plot)

   A3 : Rice husk charcoal at a dose of 20 tons/ha (2880 g/plot))

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

   L0A0 L1A0 L2A0 L3A0L0A1 L1A1 L2

Based on the treatment combinations, covering 16 treatment combinations, the replications used in this experiment were calculated according to the minimum repetition calculation in the randomized block factorial design as follows:

Information :

Number of replication	= 2 replications
Number of experimental plot	= 32 plots
Area of experimental plot	= 120 cm x 120 cm
Distance between beans	= 30 cm x 60 cm
Plants per plot	= 8 plants
Sample plants	= 3 samples
Total plants	= 256 plants
Total sample plants	= 96 plants
Distance between plots	= 50 cm
Distance between replication	= 100 cm

3.4. Analysis Method

After the research data were obtained, the data were analyzed using a randomized block factorial design with the following formula:

$$Yijk = \mu + Þi + \alpha j + \beta k + (\alpha\beta)jk + €ijk$$

Information :

Yijk = Observation results in the *n*th replication which received treatment with river tamarind leaf compost at the *j*-level and rice husk charcoal at the *k*-level

μ = General mean

Þi = Effect of *n*th test

αj = Effect of *j*-th level of river tamarind leaf compost

βk = *k*-th level of rice husk charcoal

(αβ)jk = Effect of river tamarind leaf compost on level *j*-th and rice husk charcoal *k*-th level

€ijk = Effect of the remainder of the *n*th replication which received river tamarind leaf compost at the *j*-th level and rice husk charcoal at *k*-th level

If the results of the variance are significantly different to very significant, it is continued with the Duncan range test (Montgomery, D. C. 2009).

3.5. Research Implementation

3.5.1. Composing River Tamarind Leaf Compost

In formulating river tamarind leaf compost, the first step is to prepare tools and materials, while the tools used are hoe, tarpaulin, and knife. Meanwhile, the materials to be used are 40 kg of river tamarind leaves, 10 kg of cow manure, 50 ml of EM4, 5 liters of water, and about 50 grams of brown sugar.

The process of making lamtoro leaf compost is to prepare the river tamarind leaves. First, dry or green river tamarind leaves and preferably those with slightly low water content. Then, cut the river tamarind leaves using a knife/machete to make smaller sizes, therefore easy to mix and the microbial decomposition process occurs faster. Subsequently, prepare a 50ml EM4 solution by dissolving brown sugar in water and pouring EM4 back until evenly mixed. Then, leave for 30 minutes and mix the cow manure, as well as river tamarind leaves until homogenous. Prior to mixing all the prepared ingredients, apply manure to the first layer, river tamarind leaves to the second layer, and slowly pour the EM4 solution into the pile of river tamarind leaves, turning it inside out so that the solution becomes evenly mixed and if additional water is required then additional water will be added. Then, put all the ingredients into the tarpaulin provided and tightly closed. Following that, wait until the 7 days and the river tamarind leaf compost is ready to be applied as organic plant fertilizer.

Composting is a biologically controlled decomposition process of organic solid waste under aerobic (with oxygen) or anaerobic (without oxygen). The composting process can occur under both aerobic and anaerobic. Aerobic composting occurs in the presence of O_2, while anaerobic composting occurs in the absence of O_2. The aerobic process will generate CO_2, water, and heat. Meanwhile, anaerobic composting will produce methane (alcohol), CO_2, and intermediate compounds such as organic acids. Conditions that need to be maintained are water content, aeration, and temperature (Indriani, 2012).

3.5.2. Composing Rice Husk Charcoal

The material used in the manufacture of rice husk biochar was 40 kg of rice husks. Rice husks were first collected on the ground. To supply oxygen, a chimney with a diameter of 30-35 cm was used. This process is the cheapest means, low operating costs, and effective in making Biochar.

After the piles of rice husks were piled up, the rice husks can be placed into the hole by positioning a chimney in the middle of the husks and initiating the combustion from inside the chimney using combustible materials such as tree branches. The key to the success of making biochar using the above method lies in the chimney and the flame at the beginning of the combustion.

The husk charcoal was doused with clean water to avoid the husk charcoal to become ashes. The husk charcoal was dried completely then sort the husks that became complete charcoals. Making biochar encompasses a combination process of raw materials at high temperatures (Hutapea, 2015).

3.5.3. Seed Preparation

The good and quality yardlong bean seeds of Parade Tavi variety are those not wrinkled, pure (not mixed with other varieties), not infected by pests or diseases, and have high germination (at least 85%).

3.5.4. Land Processing

The land used in the experimental garden was situated at the Faculty of Agriculture, was measured, and then cleaned of weeds and plant debris using manual tools such as tripe, hoe, and other necessary tools. Furthermore, plowing was conducted twice, in which the first processing was done by loosening the soil utilizing hoe, and then the second processing was making plots or beds.

3.5.5. Plot Preparation

The research plot was made following the plowing. The size based on this research is 120 cm long and 120 cm wide, totalling 32 plots. There were 2 replications with the distance between replications was 100 cm. The distance between plots was 50 cm and the bed height was 30 cm.

3.5.6. Hole Preparation

The hole was made with a size of 3 cm. The tool used to make the excavate hole was made of wood shaped similar to dibbe with a distance of 30 cm x 60 cm.

3.5.7. Sowing Yardlong Bean Seeds

The yardlong bean seeds used in this study were those from the Parade Tavi variety. Before dispersing seeds, they were previously immersed in water for 15 minutes to stop the dormancy process and imbibition in the seeds. Yardlong beans were planted in the morning around 07.00 - 08.00 WIB. These seeds could be dibbled directly on the plot without the seedling step. Planting was done by providing holes. The depth of each was about 3 cm, with 30 x 60 cm distance. In each hole, two seeds were placed and covered with soil. One of the best plants was selected from the two seeds planted, the selection time was determined around 1 WAP.

3.6. Treatment Application

3.6.1. Application of River Tamarind Leaf Compost

River tamarind leaf Compost was applied 2 weeks after planting (WAP) and the application of river tamarind leaf compost was administered once by spreading compost evenly around the plant with a concentration as follows:

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L0 = No river tamarind leaf compost, L1 = River tamarind leaf compost at a dose of 10 tons/ha (1440g/plot), L2 = River tamarind leaf compost at a dose of 20 tons/ha (2880g/plot), L3 = River tamarind leaf compost at a dose 30 ton/ha (4320g/plot), with the broadcasting method, where compost is spread uniformly on each plot.

3.6.2. Application of Rice Husk Charcoal

Rice Husk Charcoal application was carried out 1 week after planting (WAP) and was applied once with a dose according to the treatment, namely A0 = No rice husk charcoal, A1 = Rice husk charcoal at a dose of 10 tons/ha (1440 g/plot), A2 = Rice husk charcoal at a dose of 15 tons/ha (2160 g/plot), A3 = Rice husk charcoal at a dose of 20 tons/ha (2880 g/plot), with spreading compost on each plot.

3.7. Plant Maintenance

3.7.1. Watering

Watering was carried out according to need, and it was scheduled every day at intervals of twice a day; morning at 08.00-09.00 and in the afternoon 16.00-17.00 WIB with the similar dose in each plot.

3.7.2. Replacement

Replacement aims to replace plants that do not grow or plants that grow stunted. Placement was done 2 weeks after planting.

3.7.3. Staking

The installation of the stakes was performed about 1 week after planting. These poles are usually made of bamboo halves with a height of 2 meters. The function of the stake is to propagate the yardlong bean plant so it can grow upright and support the hanging pods.

3.7.4. Weeding

Weeding was done 2 weeks after planting with an interval of 2 days. Weeding inside the plot was completed by removing the grass directly by hand and outside the plot by hoeing weeds around the plot.

3.7.5. Fertilization

Basic fertilization was dispensed during plowing by providing N, P, K fertilizers and the 50% recommendation was 50 kg/ha Urea, 75 kg/ha Tsp, 37.5 kg/ha Kcl, and an average of 7.2 g/plot Urea, 10.8 g/plot Tsp, 5.4 g/plot Kcl. The application was once given to the soil at the end of plowing step. Furthermore, fertilization was carried out 1 week after planting using rice husk charcoal, then fertilization was conducted 2 weeks after planting using river tamarind leaf compost.

3.7.6. Pest and disease control

Pest and plant disease control was carried out preventively through modification of the environment, starting with intensive land management, setting plant spacing, and planting on time, and providing trap crops.

Preventive pest management techniques were done using mechanical/manual control techniques, including direct removal of pests on plants. In the event many pests attacked and almost reached the threshold of attack intensity, chemical insecticides were sprayed. Spraying chemical insecticides is curative pest management which a pest attack treatment action has attack intensity value of 30% (Moekasan, et al., 2013). Disease control in yardlong bean plants applied a fungicide with the trademark Antracol 70 WP. It was applied by dissolving the substance in water with a concentration of 4 g/L.

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The application was facilitated by a handsprayer and sprayed to all parts of the plants.

3.7.7. Harvesting

Harvesting the proper pods was at the age of 43-45 DAP. In this study, the stage was carried out 6 times with an interval of 3 days. Harvesting should be done in dry and sunny conditions. The process was done by picking yardlong bean pods. It is better if the harvesting criteria are understood appropriately, such as by fruit has a whitish green color, the size of the pod is more optimal, the seeds in the pod do not look prominent and are easy to break or rigid.

3.8. Observation Parameter

Before observing the parameters, the samples were decided initially using the Probability Sampling method (Random Sampling), which is conducting random samples similar to drawing a lottery.

3.8.1. Plant Height (cm)

Measurements were started from the base of the stem (1 cm above ground level) and marked. Until the end of the growing point, measurements were performed once a week, commencing at 2 to 5 WAP.

3.8.2. Stem Diameter (cm)

The stem diameter was calculated at the base of the stem, which was 1 cm above the ground. Measurements are taken once a week, starting at 2 to 5 WAP using a calliper.

3.8.3. Flowerage (days)

Observations of flowerage were carried out when 80% of the plants had flowered and the flowerage of the parade tavi yardlong bean was around 34-36 DAP. The observations were begun when 6 out of 8 plants had flowered.

3.8.4. Yield Per Sample (g)

Yield per sample of yardlong bean pods was weighed using a scale after harvest.

3.8.5. Yield Per Plot (kg)

The yield of pods per plot was carried out by weighing the pods at each harvest from the plants per plot with a bench scale or vegetable/fruit scale.

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CHAPTER V

CONCLUSION AND SUGGESTION

5.1. Conclusion

1. Treatment of river tamarind leaf compost had a very significant effect on the parameters of plant height and stem diameter. Meanwhile, the parameters of flowerage, yield per sample, and yield per plot showed no significant results.
2. Rice husk charcoal treatment had a significant effect on plant height parameters, while stem diameter, flowerage, yield per sample, and yield per plot showed no significant results.
3. The interaction of river tamarind leaf compost and rice husk charcoal did not significantly affect all treatments.

5.2. Suggestion

Based on the results of research on the growth and yield of long bean plants, it was found that river tamarind leaf compost and rice husk charcoal could increase plant growth, but not optimally. The suggestions from the researchers are as follows:

1. Farmers should use river tamarind leaf compost at a dose of 2880g/plot to increase plant growth.
2. It is recommended that farmers append chemical fertilizers as basic fertilizers to fulfill nutrient sources in the generative phase.
3. It is encouraged that further research should be conducted on river tamarind leaf compost and rice husk charcoal.