THESIS

PEMBERIAN KOTORAN AYAM UNTUK MENGEFESIENSI PENGGUNAAN NPK PADA PERTUMBUHAN KELAPA SAWIT (*Elaeis guineensis* Jacq.) DI PEMBIBITAN UTAMA

THE APPLICATION OF CHICKEN MANURE TO THE EFFICIENCY OF NPK USAGE ON OILPALM GROWTH (Elaeis guineensis* Jacq.*) IN MAIN NURSERY

FEBI LARAS
05091381722038

AGRONOMY STUDY PROGRAM
AGRICULTURAL CULTIVATION DEPARTMENT
FACULTY OF AGRICULTURE
SRIWIJAYA UNIVERSITY
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SUMMARY

FEBI LARAS. The Application of Chicken Manure to The Efficiency of NPK Usage on Oil Palm Growth (*Elaeis guineensis jacq.*) in *Main nursery* (Supervised by **Marlina** dan **Susilawati**).

This research was conducted to determine the effectivity of chicken manure application to the efficiency of NPK usage on oil palm growth in the *main nursery*. This research was conducted at the experimental field of Agriculture Faculty, Sriwijaya University. Conducted from January 2020 to June 2020. This research used simalungun oil palm seedlings that have gone through the pre-nursery stage. This research used randomized block design (RBD) method were 5 treatments, each treatment consisted of 4 replications, therefore there were 20 treatment units, each treatment unit consisted of 5 plants. The total sample plants were 100 plants. The treatments used in the study were P_0 = application of 100% NPK (recommended dose = 333 g/polybag), P_1 = application of 500 g chicken manure, P_2 = application of 1000 g chicken manure, P_3 = application 1500 g chicken manure, P_4 = application of 2000 g chicken manure. The parameters observed included the increase in plant height, increase in number of fronds, increase in stem diameter, root length, root volume, number of primary roots, leaf greenness, frond length, number of leaflet, and leaflet length. Based on the analysis of variance using the ANOVA test and 5% Tukeys's HSD test, it showed the treatment of chicken manure with dose of 500 g/polybag was effective to increase the efficiency of NPK usage on oil palm growth in *main nursery*, as seen on the parameters of increasing in plant height, increase in stem diameter, and leaf greenness.

Keywords: *Chicken manure, Efficiency of NPK, Oil palm, Main nursery.*

RINGKASAN

FEBI LARAS. Pemberian Kotoran Ayam untuk Mengefesiensi Penggunaan NPK Pada Pertumbuhan Kelapa Sawit (*Elaeis guineensis* jacq.) di *Main nursery* (Dibimbing oleh **Marlina** dan **Susilawati**).

Penelitian ini dilakukan untuk mengetahui efektivitas kotoran ayam untuk mengefensiensi penggunaan NPK pada pertumbuhan bibit kelapa sawit di main-nursery. Penelitian ini dilaksanakan di kebun percobaan Fakultas Pertanian Universitas Sriwijaya. Dilaksanakan pada Januari 2020 sampai dengan Juni 2020. Penelitian ini menggunakan bibit kelapa sawit varietas simalungun yang telah melalui tahap *pre nursery*. Penelitian ini menggunakan metode Rancangan Acak Kelompok (RAK) dengan 5 perlakuan, setiap perlakuan terdapat 4 ulangan, sehingga didapat 20 unit perlakuan, setiap unit perlakuan terdiri dari 5 tanaman. Total tanaman sampel sebanyak 100 tanaman. Perlakuan yang digunakan dalam penelitian adalah P_0 = Pemberian 100% NPK (dosis anjuran = 333 g/polibag), P_1 = Pemberian 500g kotoran ayam, P_2 = Pemberian 1000g kotoran ayam, P_3 = Pemberian 1500g kotoran ayam, P_4 = Pemberian 2000g kotoran ayam. Parameter yang diamati meliputi pertambahan tinggi tanaman, pertambahan jumlah pelepah, pertambahan diameter batang, panjang akar, volume akar, jumlah akar primer, tingkat kehijauan daun, panjang pelepah, jumlah anak daun dan panjang anak daun. Berdasarkan analisis keragaman menggunakan uji anova dan uji BNJ 5%, menunjukkan bahwa perlakuan pemberian kotoran ayam dengan dosis 500g /polibag dapat mengefesiensi penggunaan NPK yang ditunjukan oleh parameter pertambahan tinggi tanaman, pertambahan diameter batang, dan tingkat kehijauan daun.

Kata Kunci : *Kotoran ayam, Efisiensi NPK, Kelapa Sawit, Pembibitan utama* .

THESIS

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This thesis was written to fulfill one of the requirements to accomplish a Bachelor's Degree in Agriculture at the Faculty of Agriculture, Sriwijaya University

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05091381722038

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APPROVAL SHEET

THE APPLICATION OF CHICKEN MANURE TO THE EFFICIENCY OF NPK USAGE ON OILPALM GROWTH *(Elaeis guineensis* Jacq.) IN MAIN NURSERY

THESIS

This thesis was written to fulfill one of the requirements to accomplish a Bachelor's Degree in Agriculture at the Faculty of Agriculture, Sriwijaya University

By:

FEBI LARAS
05091381722038

Indralaya, 2021

Advisor I	**Advisor II**
Dr. Ir. Marlina, M.Si.	**Dr. Susilawati, S.P., M.Si.**
NIP. 196106211986022005	**NIP. 196712081995032001**

Certified by,
Dean of the Faculty of Agriculture

Prof. Dr. Ir. Andy Mulyana, M.Sc.
NIP. 196012021986031003

Thesis entitled “The Application of Chicken Manure to The Efficiency of NPK Usage on Oil Palm Growth (*Elaeis guineensis* jacq.) in Main nursery*”* had been examined and defended before the Examination Commission Thesis of the Faculty of Agriculture, Sriwijaya University on January 11th, 2021 and had been revised based on the suggestions of the examiners.

Examination Committee

1.	Dr. Ir. Marlina, M.Si. NIP. 196106211986022005	Chairperson	( )
2.	Dr. Susilawati, S.P, M.Si. NIP. 196712081995032001	Secretary	( )
3.	Dr. Ir. Erizal Sodikin NIP. 196002111985031002	Member	( )
4.	Dr. Irmawati, S.P., M.Si. NIP. 197103600983005	Member	( )

Indralaya, 2021

Head of Agronomy Study Program

<u>Dr. Ir. Yakup, M.S.</u>
NIP. 196211211987031001

Head of Department
of Agricultural Cultivation
Faculty of Agriculture

<u>Dr.Ir.Firdaus Sulaiman, M.Si.</u>
NIP. 195908201986021001

INTEGRITY STATEMENT

The undersigned below:

Name : Febi Laras

Student Number : 05091381722038

Title : The Application of Chicken Manure to The Efficiency of NPK Usage on Oil Palm Growth (*Elaeis guineensis* jacq.) in Main nursery

Declare that all data and information contained in this thesis are the result of my own research activities under the supervision of my advisors, unless the sources are clearly mentioned. If in the future found any element of plagiarism in this thesis, then I am willing to accept academic sanctions from Sriwijaya University.

Thus, I make this statement consciously and without coercion from any party.

Indralaya, 2021

Febi Laras

BIOGRAPHY

The writer named Febi Laras who is the eldest son of Mr. Juarsa and Mrs. Samsiah (deceased) (biological mother) as well as Mrs. Marhaili Surba (stepmother), born on February 6, 1998 in Palembang, South Sumatra. The writer has 4 younger siblings, named Femi Laras, Najua, Muhammad Ferdi Agsaba and Silvia Nadiratasya.

The write's educational background began in elementary school at State Elementary School No. 1 Karang Raja, South Lampung, until grade 4, then continued to State Elementary School No. 1 Pauh, South Sumatra, and graduated in 2010. Then the writer continued junior high school at PGRI Air Bening Junior High School and graduated in 2013. The writer stopped for one year before finally continuing his studies at Al-Ikhlas Modern Islamic Boarding School Lubuk Linggau High School until he graduated in 2017.

In 2017, the writer was enrolled as a student in the Agronomy Study Program, Department of Agricultural Cultivation, Faculty of Agriculture, Sriwijaya University, Palembang Campus through the 2017 Independent Entrance Screening Examination (USM). In 2017, the writer was trusted to be one of the teaching assistants for the Plant Botany course and in 2018 until 2019 he was trusted to be the Coordinator of Assistant Lecturers for Plant Physiology and Plant Physiology. In 2018, the writer was selected as a representative of South Sumatra to participate in the National Student Art Week (PEKSIMINAS) in Yogyakarta Province.

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Alhamdulillah, the writer prays to Allah SWT for His abundance of favours and gifts that can never be counted so that the writer is able to complete the thesis entitled "The Application of Chicken Manure to the Efficiency of NPK Usage on Oil Palm Growth ***(Elaeis guineensis* Jacq.*)*** in Main Nursery. Sholawat and greetings, the author does not forget to extend to the best role model of mankind "His Majesty the Prophet Muhammad SAW, along with his family, friends and Insya Allah, we as his Ummah".

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3. My beloved family: father, mother, and other extended family who cannot be mentioned one by one, for the prayers, moral motivation, material and infinite love that has been given.
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Hopefully this thesis can be useful for all of us. Indeed, perfection belongs only to Allah SWT alone, while humans are the place of error and mistake. Therefore, the writer hopes for criticism and suggestions if there are errors.

Indralaya, 2021

Writer

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CHAPTER 1
INTRODUCTION

1.1. Background

Oil palm (*Elaeis guinensis* Jacq.) is a CPO (Crude Palm Oil) and PKO (Palm Kernel Oil) producing plant that has become one of the prima donna plantation crops to be developed for commercial purposes. The world's need for palm oil is increasing day by day along with the increasing population. USDA (2017) revealed that in 2012 the world's demand for palm oil reached 52.1 million tons, and in 2020 it was expected to increase to 68 million tons. Indonesia in 2016 occupied the first position as a palm oil producer in the world with a total production of 34 million tons from the total world production of 62 million tons and a total export of 25 million tons from the total exports of other countries in the world which amounted to approximately 46 million tons with a total domestic consumption of 9.47 million tons.

Efforts to develop oil palm plantations in Indonesia continue to be made to meet the need for palm oil. In 2017, the total area of oil palm plantations in Indonesia reached 14,030,537 ha, an increase of almost 3 million hectares compared to 2016, which was 11,201,465 ha. For the South Sumatra region, the area of oil palm plantations reached 1,166,421 ha, making it the province with the fifth largest oil palm plantation area in Indonesia after Central Kalimantan (1,500,948 ha), West Kalimantan (1,553,932 ha), North Sumatra (1,595,572 ha), and Riau (2,776,440 ha) which was in first place (Agricultural Statistics, 2018).

According to Pahan (2011), the biggest investment for commercial plantations lies in the planting material. The development of commercial oil palm plantations must guarantee high production and optimal profits for the company. Therefore, the process of selecting quality seeds and a good nursery process are important things that must be done in the era of free trade. Oil palm as one of the plantation crops that produces production in the long term, requires high quality planting material to support oil palm plant development efforts to produce quality plants.

There are two oil palm nursery systems, the single stage system and the double stage system. In single-stage nurseries the sprouts are directly planted in large polybags so that they do not need to be raised first. Next is a two-stage nursery where in this system the sprouts are planted and maintained first in small polybags for 3 months, which is also called the initial stage or pre nursery and then the seedlings will be moved to large polybags for 9 months, this stage is also called the main nursery stage (Pardamean, 2012).

Quality oil palm seedlings can only be obtained through the selection of genetically superior seeds and good nursery maintenance. In oil palm nurseries, the main factor that must receive special attention is fertilization. Fertilizing oil palm seedlings can be done by adding inorganic and organic fertilizers, both solid and liquid (Andoko, 2005).

Inorganic fertilizers are one of the types of chemical fertilizers. Inorganic fertilizers that are often used on oil palm plants are compound fertilizers because they are more efficient and cheaper. According to Ramadhani *et al.* (2014), the optimum dose of NPK 15:15:15 compound fertilizer in oil palm nurseries in the main nursery is 333.00 g/ seedling. This dose is the dose of fertilizer from the beginning to the end of the nursery in the main nursery, which is given in stages with the dose at each month adjusted to the stem diameter and plant height as well as the needs of the seedlings.

A type of environmentally friendly fertilizer that is the result of decomposition of the remains of plant tissue, animal tissue, animal manure and other organic waste that has the potential to become fertilizer is called organic fertilizer. The application of organic fertilizers to the soil is beneficial to maintain the availability of nutrients and soil organic matter. In addition, organic fertilizers can also improve the physical, chemical, and biological properties of soil (Regulation of the Minister of Agriculture, 2011).

One of the livestock wastes that can be used as organic fertilizer is chicken manure. Muhsin (2003) stated that the use of chicken manure compost on plants, in addition to improving the physical, chemical and biological properties of soil, chicken manure compost also has a higher content of nutrients N, P, and K compared to fertilizers derived from poultry manure or other animals.

According to Devung's research (2014), the application of chicken manure to rosella plants *(Hibiscus sabdariffa L)* at a dose of 650.78 grams/ plant gave the best results in the growth of rosella plants, namely with a height of 168.80 cm when the plants were 90 days after planting. In addition, the application of chicken manure can also accelerate the harvest time of rosella flowers, which is 71 days after planting with an average flowering reaching 80% and the fresh weight of flowers reaching 4.14 kg/ plot.

In addition to horticultural crops, chicken manure can also be applied to annual crops. The results of research by Hertos (2013) on the effect of applying chicken manure and NPK pearl yaramila fertilizer on the growth of oil palm seedlings in pre nursery nurseries showed that the best dose was a combination of chicken manure fertilizer 100 g/ polybag and NPK fertilizer 10 g/ polybag with each increase in the parameters of seedling height at 4, 8 and 12 weeks after planting (17.9 cm, 34.4 cm, and 44.3 cm), stem diameter at 4.8 and 12 weeks of planting (0.57 cm, 0.60 cm, and 0.92 cm), primary root length (25.3 cm), and seedling fresh weight (16.87 grams).

1.2. Objectives

This research aimed to see the effectiveness of chicken manure application to streamline the use of NPK on oil palm growth in the main nursery.

1.3. Hypothesis

It was suspected that the application of chicken manure at a dose of 1000g/ polybag is effective in reducing the use of NPK on oil palm growth in the main nursery.

CHAPTER 2
LITERATURE REVIEW

2.1. Botany of Oil Palm

Oil palm plants have the following classification:

Division	: Embryophytha Siphonagama
Class	: Angiosperms
Order	: Monocotyledonae
Family	: Arecaceae
Subfamily	: Cocodeae
Genus	: Elaeis
Species	: *Elaeis guineensis* Jacq.
	Elaeis oleifera (H.B.K.) Cortes
	Elaeis odora

There are two main parts of the oil palm plant as a support for growth and development, namely the vegetative part and the generative part. The vegetative part of the oil palm includes roots, stems, and leaves. The generative part is a breeding tool consisting of flowers and fruit (Fauzi *et al*., 2012).

Oil palm roots are fibrous roots. At the beginning of germination, the first root emerges from the germinating seed (radicle). After that, the radicle will die and form the main or primary root. The primary root will then form secondary, tertiary and quaternary roots. Fully developed oil palm roots generally have primary roots with a diameter of 5-10 mm, secondary roots 2-4 mm, tertiary roots 1-2 mm, and quaternary roots 0.1-0.3. The most active roots absorbing water and nutrients are tertiary and quaternary roots at a depth of 0-60 cm with a distance of 2-3 meters from the base of the tree (Lubis *et al*., 2012).

In early growth after the young phase, there is the formation of a widened stem without internode elongation. The trunk of the oil palm plant functions as a supporting structure for the crown (leaves, flowers, and fruit). Then another function is as a vascular system that transports nutrients and food for the plant. Plant height usually increases optimally around 35-75 cm/ year according to favorable environmental conditions. The economic life of the plant is strongly influenced by the increase in stem height per year. The lower the stem height increase, the longer the economic life of oil palm plants (Sunarko, 2007).

Leaves are the center of energy and food production for plants. The shape of the leaves, the number of leaves, and their arrangement greatly affect their ability to capture sunlight. Palm leaves are pinnate in shape which gather in the midrib. Hartono (2011) revealed that oil palm fronds include leaf blades, each blade containing lamina and midrib, central racis, petiole and midrib petals. The leaf blade measures 55 cm to 65 cm and buds 2.5 cm to 4 cm wide. Each midrib has approximately 100 pairs of leaflets. The number of midribs produced increases to 30 to 40 when three to four years old and then decreases to 18 to 25 midribs. Stomata or leaf cavities open to receive light for photosynthesis on the leaf blade surface. Mature midribs measure up to 7.5 cm in length with petioles approximately one-quarter the length of the midrib and have spines.

Oil palm is a monoecious plant, where male and female flowers are located separately but still on the same tree. Male and female flowers have different maturation times so self-pollination is very rare. Male flowers are pointed and long, while female flowers are larger and blossom. The gender of male or female flowers is determined 9 months after initiation, and an interval of 24 months for fully developed flower inflor (Mangoensoekarjo, 2007).

Oil palm fruits vary in color from black, purple, to red depending on the seedling used. The fruits are clustered in bunches that emerge from each frond. The oil content increases according to the ripeness of the fruit after passing the ripe phase, the free fatty acid (FFA) content will increase and the fruit will fall off by itself. Palm fruit (*Elaeis guineensis* Jacq.) is the source of palm oil (Mukherjee and Mitra 2009).

2.2. Growing Requirements of Oil Palm

Oil palms can grow on podzolic, latosol, hydromorphic gray, alluvial or regosol soils, sapric peat soils, coastal plains, and river estuaries. The optimum acidity (pH) for oil palm is 5.0-5.5. Oil palms require loose, fertile, flat, welldrained (irrigated) soils with a deep enough solum layer (80 cm) without a solid layer. The slope of the land for oil palm planting should be no more than 15° (Kiswanto *et al*., 2008).

The average annual temperature for oil palm growth and production ranges from 24-29° C, with the best production between 25-27° C. In the tropics, air temperature is closely related to the height of the place meters above sea level (masl). The optimum altitude is 200 meters above sea level, and no higher than 400 meters above sea level is recommended, although in some areas such as in North Sumatra good oil palm plantings are found up to 500 meters above sea level. Minimum and maximum temperatures have not been widely studied, but it is reported that palms can grow well at a temperature range between 28° and 38° C (Allorerung *et al*., 2010).

2.3. Oil Palm Nursery

Seeding is the first step in the whole series of oil palm cultivation activities, which greatly determines the success of the planting. The nursery stage is expected to produce good quality seedlings. Good oil palm seedlings are seedlings that have optimal growth strength and appearance and have the ability to deal with environmental stress conditions during transplanting. To produce good quality seedlings, intensive processing is required during the nursery stage. Nursery management requires guidelines that can serve as a reference and control during implementation in the field (Sulistyo, 2010).

The nursery system that is widely used now is single stage nursery or double stage nursery. In the single stage system, the sprouts are directly planted in large plastic bags. Whereas in the double stage nursery, the sprouts are first planted and maintained in plastic bags for 3 months, which is also called the pre nursery. Next, the seedlings are transplanted into large lactic bags for 9 months. This last stage is called the main nursery.

2.3.1. Pre Nursery

Pre-nursery is a nursery activity aimed at obtaining seedlings with similar growth before being transferred to the main nursery. Pre-nursery can be done on the soil which has been elevated to 35 cm or seedlings planted in small polybags with cleaned top soil (Sastrosayono, 2008). The pre nursery stage is carried out at the beginning of seed planting until the seedlings are 3 months old.

2.3.2. Main Nursery

After the seedlings have gone through the pre nursery stage for 3 months by being planted in small polybags, then the seedlings are moved to large polybags and then placed in an open field, this process is called main nursery. The main nursery stage lasts for 9 months so that the age of the seedlings from these two nursery stages is 12 months. There are several maintenance processes in the main nursery including:

1. Preparation of the Nursery Area

The main nursery requires a large area of land because the seedlings are planted with a wider spacing. The nursery location must have a water source to fulfill the needs of the nursery. The nursery area should be open, free from weeds, and free from wild animals. The area for the main nursery is cleaned and leveled manually or mechanically. The area also needs a drainage ditch to prevent the seedlings from becoming stagnant and to minimize pest and disease infestation. According to Lubis (2008) at the main nursery stage, seedlings are placed with a spacing of 90 × 90 × 90 cm or 12,000 seedlings in one ha.

2. Filling the Soil into the Polybags

Filling the planting media in the main nursery must be completed one month before transplanting. The polybags used are the black polybags with a size of 42.5 cm × 50 cm, 0.2 mm thickness with 36 perforation holes. The polybags are filled with about 20 kg of soil. The soil used is top soil and not mixed with gravel. According to Darmosarkoro *et al.* (2008), the top layer of soil contains quite a lot of organic matter and is usually dark in color due to the accumulation of organic matter. Meanwhile, sub soil is soil that has undergone sufficient weathering, containing less organic matter. Its productivity is low because it is determined by the condition of the sub soil.

Sub soil is the soil layer below the top soil layer, generally has a lower level of fertility than top soil, especially its chemical properties are not good if used as a growing medium for oil palm seedlings. According to Gusta *et al.* (2015) top soil is very influential in optimizing the growth of oil palm seedlings because the fertility of this soil layer is difficult to replace.

3. Transplanting

In the two-stage nursery system, transplanting is done from baby bags to large bags. Transplanting is done when the seedlings are 3 months old, preferably during the rainy season so that the seedlings do not experience transplanting shock. Transplanting in the two-stage system is done to provide larger polybags so that root development is not inhibited and to prevent the seedlings from etiolation due to the narrow growing space. Before transplanting, the polybags are first given planting holes to facilitate the transplanting process (Nugroho, 2017).

4. Fertilization

Fertilization is done simultaneously when the seedlings in the pre nursery are transplanted to the main nursery. Fertilizer is applied immediately after making the planting holes. The dose of NPK compound fertilizer for oil palm seedlings in the main nursery is 333g/ polybag and is applied gradually over eight months in the main nursery, with monthly doses as follows: 7.00, 7.00, 19.45, 59.25, 66.3, 61.55, 58.97 and 54.16g/ polybag.

5. Seedling Watering

Watering is done using a bulk irrigation system. The average water requirement in the main nursery is equivalent to 3.4 mm of rainfall per day or 2 liters per polybag (PPKS, 2003). The availability of sufficient water to meet the water needs of plants is very important. The role of water in plants as a solvent of various organic molecular compounds (nutrients) from the soil into the plant, transportation of photosynthate from the source to the sink, maintaining cell turgidity including in cell enlargement and opening stomata, as the main constituent of protoplasm and temperature regulator for plants.

6. Weed Control

Weed control in the main nursery consists of weed control inside the polybags and between the polybags. Weed control inside the polybags is done by pulling the grass inside the polybags while the weeds around the polybags are cleaned by mechanical control or chemical control. Chemical control must be done carefully so that the herbicide is right on target and does not cause pollution (Mangoensoekarjo, 2007).

7. Pest and Disease Control

Pests found in the main nursery are night beetles, fire caterpillars, ants, armyworms, and rats. Pest control is done manually if the intensity of the attack is still low. Pest control is done every 2 weeks using Sevin at a concentration of 2 g l-1 water for 300 seedlings. The disease found in the main nursery is leaf spot caused by *Curvularia maculans* and is controlled using Amistar Top with a concentration of 1 ml l-1 water for 300 seedlings with a 2-week rotation and using Dithane M-45 with a concentration of 2 g l-1 water and done every 2 weeks (Wijayanti, 2015).

8. Seedling Selection

At the nursery stage, the total number of plants selected was no more than 26%, which consisted of selection in the pre nursery as much as 12%, and in the main nursery as much as 14%. This is in line with the opinion of Darmosarkoro *et al.* (2008) that not all seeds sown in the pre nursery and maintained in the main nursery will develop into superior seedlings. About 25% of the seedlings will be discarded from the nursery due to abnormal growth. The presence of abnormal plants in the field is very detrimental. This is because they are unable to produce, and if they do, there will be only 25-50% of the production of normal plants.

2.4. Chicken Manure Fertilizer

Chicken manure is often considered a cause of pollution in the environment around chicken farming businesses. The existence of chicken farming businesses began to be felt to disturb local residents. This is due to the proximity of chicken farms to community settlements and the low awareness of farmers to process the waste produced. Problems that are often complained about by the community are the strong ammonia odor and the high population of flies.

Sustainable soil fertility can be improved by using manure as organic fertilizer applied to agricultural cultivation. Manure has a lot of nutrients because animals are not very efficient in absorbing nutrients from feed and then these nutrients are directly excreted in feces, so manure is fertile and contains 50% of the nutrients from feed. Manure contains large amounts of nitrogen (N), phosphorus (P), and potassium (K) but needs time to decompose in the soil to be available to plants (Maerere *et al*., 2001).

The use of manure as a nutrient supplier for plants has long been identified as one of the successes of fertilization programs for sustainable agriculture. This is because in addition to being a source of nutrients for plants, manure can also improve the physical, biological and chemical properties of soil so that it can encourage the formation of microorganisms (Sutedjo and Kartasapoertra, 2002).

Organic matter plays a significant role in the formation of a good and stable soil structure that increases infiltration and the ability to store water. The results of research conducted by Simatupang (2005), the provision of manure significantly reduces the amount of surface flow because manure improves the physical properties of the soil, especially the structure so that permeability increases. Added by Widodo (2008) organic matter as a binder of soil primary grains into secondary grains in the formation of strong aggregates that affect porosity, storage and supply of water as well as aeration and good soil temperature.

Chicken manure fertilizer is in the form of solid chicken manure (feces), which is mixed with food scraps, cage materials and a mixture of urine. This mixture makes chicken manure different from other manures or organic fertilizers (Lingga and Marsono, 2003). According to Musnawar (2005) chicken manure fertilizer contains complete macro and micro nutrients needed by plants.

According to Sahari (2005), plants treated with chicken manure grow taller and have more leaves than plants treated with cow manure or goat manure. This is because chicken manure has a high nitrogen content. The function of nitrogen, among others, is to increase vegetative growth and stimulate budding where these buds will produce leaves. The dominant nitrogen element contained in manure functions in increasing the vegetative growth of plants, especially to spur leaf growth. It is assumed that the larger the leaf area, the higher the photosynthate produced, so that the higher the photosynthate that is translocated to all plant tissues.

Raihan *et al*. (2000) stated that the use of chicken manure has several advantages, among others, as a supplier of soil nutrients and increase water retention. If the soil water content increases, the process of organic matter decomposition will produce a lot of organic acids. Anions from organic acids can urge phosphate bound by Fe and Al so that phosphate can be released and available to plants. The addition of chicken manure has a positive effect on acid soils with low organic matter content because organic fertilizers can increase the levels of available P, K, Ca and Mg.

The addition of chicken manure has a positive effect on acidic soil with low organic matter content. According to Widowati *et al.* 2005, organic fertilizer can increase the levels of available P, K, Ca and Mg. Some research results of chicken manure application always give the best plant response in the first season. This happens because chicken manure is more quickly decomposed and has sufficient nutrient levels as well when compared to the same number of units as other manures.

CHAPTER 3
RESEARCH METHODOLOGY

3.1. Place and Time

This research was conducted in the experimental garden of the Faculty of Agriculture, Sriwijaya University. It was conducted from January 2020 to June 2020.

3.2. Tools and Materials

The tools used in this research were 1) Stationery, 2) Measuring instruments include length and height measuring instruments (meter), weight measuring instruments (analytical balance in gram units), 3) Hoe, 4) Bucket, 5) Digital vernier, 6) Plastic folder, 7) Label, 8) Polybags, size 40 × 40 cm, 9) knife, and 10) nets.

The materials used in this study were: 1) Water, 2) Oil palm seedlings that have gone through the pre nursery stage, 2) Chicken manure, 3) Compound NPK (15:15:15), and 4) Soil.

3.3. Research Methods

The method used in this research was a Randomized Group Design (RGD) with 5 treatments. Each treatment had 4 replications, so that 20 treatment units were obtained, each treatment unit consisted of 5 plants. The total sample plants were 100 plants. The treatments used in this study were:

P_0: chicken manure 100% NPK compound (recommended dose = 333 g/polybag).

P_1: chicken manure 500 g/polybag.

P_2: chicken manure 1000 g/polybag.

P_3: chicken manure 1500 g/ polybag.

P_4: chicken manure 2000 g/ polybag.

Each treatment P_1-P_4 was added with 100 g of NPK (30% of the recommended dose).

3.4. Data Analysis

The data obtained were processed statistically using analysis of variance (ANOVA) which compares F count with F table. If F count is smaller than F table 5% then the treatment has no significant effect. If F count is greater than F table 5% then the treatment has a real effect and if F count is greater than F table 1% then the treatment has a very real effect. If the F count is real or very real, it is continued with the honestly significant difference (HSD) test.

3.5. Procedures

3.5.1. Preparation of Planting Materials

The preparation of planting materials began with the preparation of oil palm seedlings that were 3 months old (pre nursery). The seedlings used were oil palm seedlings commonly grown in commercial plantations, namely the Dura × Pisifera (D × P) cross or called Tenera variety Simalungun produced by PPKS Medan.

3.5.2. Land Preparation and Planting Media

The required land area of 9 × 11 m^2 was first cleaned and then fenced using nets. Preparation of planting media for oil palm seedlings consisted of top soil (top layer) obtained from the experimental land of the Faculty of Agriculture, Sriwijaya University.

3.5.3. Polybag Filling and Treatment

Polybag filling used 40 × 40 cm polybags (10 kg). At the time of filling the soil, the application of chicken manure fertilization was immediately carried out with the dosage according to the treatment. After filling the soil into the polybags, the polybags were arranged according to the recommendations with a spacing of 90 × 90 × 90 cm or 12,000 seedlings in one ha. Polybags were arranged with the recommended distance based on the research plan and treatment labels were attached to the polybags.

3.5.4. Transplanting

In the two-stage nursery system, transplanting or transplanting activities were held. Before transplanting activities were carried out, planting holes were first given to the polybags using crowbars or pipes, then the plants were dismantled in the old (small) polybags. Seedlings were watered first then tear the bottom of the polybag and pull the plastic out, then compact the soil around the seedling roots then moved the seedlings to a new (large) polybag.

3.6. Maintenance

3.6.1. Watering

Watering was done in the afternoon, once a day, each watering required water up to the field capacity or about 2 liters of water per seedling.

3.6.2. Weed Control

Weed control was done by manual and mechanical weeding. By pulling weeds from the soil in the polybags and cleaning with a hoe the weeds that grew around the nursery with weeding intervals depending on the speed of weed growth.

3.6.3. Fertilization

Fertilization was done at the time of transplanting with a rotation of 4 weeks. NPK fertilization was applied by sowing at a distance of 5 cm around the stem of the seedling. Chicken manure was applied when filling the polybags. In each chicken manure treatment, 30% NPK fertilizer = 100 g/polybag was added which was given gradually at 4-week intervals, the dosage for each fertilization was available in the following table.

Table 3.1. Dosage of NPK and Chicken Manure (CM).

Treatment	Fertilizer Dosage (g/ seedling)									
	at Transplanting		4 WAP		8 WAP		12 WAP		16 WAP	
	NPK	**CM**	**NPK**	**CM**	**NPK**	**CM**	**NPK**	**CM**	**NPK**	**CM**
P_0	20	-	43	-	70	-	90	-	110	-
P_1	5,9	500	15	-	24	-	25	-	30	-
P_2	5,9	1000	15	-	24	-	25	-	30	-
P_3	5,9	1500	15	-	24	-	25	-	30	-
P_4	5,9	2000	15	-	24	-	25	-	30	-

3.7. Observed Variables

3.7.1. Plant Height Increase (cm)

The observation of plant height increase started from the age of 1 week after planting with an interval of 4 weeks until the seedlings were 20 weeks old using a roll meter. Seedling height was measured from the base of the stem to the tip of the longest leaf by collecting all the leaf midribs and then determining the longest leaf, then pulling the meter from the base of the stem to the longest leaf.

3.7.2. Increase in the Number of Fronds

Observations of the increase in the number of fronds started from 1 week old seedlings with an interval of 4 weeks until 20 weeks old seedlings. The observation of the number of fronds was done by counting the midribs that had opened 80 - 100% on each plant sample.

3.7.3. Leaf Greenness Level

The observation of leaf greenness level was conducted at the end of the study when the seedlings were 20 weeks old. The level of greenness of the leaves was done by using a chlorophyll meter (SPAD). The leaves measured were the youngest leaves with fully bloomed leaf blades. The method was done by placing the SPAD sensor at three points, namely the top, middle and base of the leaf then the measurement results obtained were taken on average.

3.7.4. Stem Diameter Increase (mm)

Observations of stem diameter started from 1 week old seedlings with an interval of 4 weeks until the seedlings were 20 weeks old using a digital vernier caliper, by inserting the stem of the seedlings approximately 2 cm above the ground surface in an upright state into the jaws of the caliper and then clamping the two jaws and automatically the stem diameter value data would be available on the screen of the caliper.

3.7.5. Number of Primary Roots

Primary roots are roots that grow directly from the stem of the seedling. Observation of the number of primary roots was carried out at the end of the study, by disassembling the polybags on the seedlings and removing the seedlings then cleaning the seedling roots using running water, then counting the primary roots that appeared on the seedling roots.

3.7.6. Root Length (cm)

Root length observations were made at the end of the study when the seedlings were 20 weeks old using a meter (cm). Root length was measured from the base of the root to the tip of the longest root.

3.7.7. Root Volume (cm^3)

Root volume was calculated at the end of the study when the seedlings were 20 weeks old. After cleaning the roots of the seedlings, then put the roots into a measuring cup filled with water. Root volume is the difference between the volume of water that rises after the roots are inserted into the measuring cup and the previous volume of water. Root volume is obtained using the formula: Root volume (cm^3) = Volume2 (cm^3) - Volume1 (cm^3). Description: Volume1 (cm^3): volume before the roots are put into the water and Volume2 (cm^3): volume after the roots are put into the water.

3.7.8. Frond Length (cm)

The frond length was calculated at the end of the study when the seedlings were 20 weeks old using a roll meter (cm) by measuring from the base of the frond to the tip of the frond. The length of the frond measured was the length of the first frond that splits.

3.7.9. Leaflet Length (cm)

The length of the leaflets was calculated at the end of the study when the seedlings were 20 weeks old using a roll meter (cm) by measuring from the base of the leaflets to the tip of the leaflets. The length of the leaflets calculated was the length of the longest leaflets.

3.7.10. Number of Leaflets (Strands)

The number of leaflets was calculated at the end of the study when the seedlings were 20 weeks old by counting the number of leaflets that appeared on the frond that first split.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1. Results

Based on the results of the analysis of variance using the ANOVA test, it showed that the treatment of chicken manure had a very significant effect on the variable of height increment at the age of 16 weeks, diameter increment at the age of 16 weeks and 20 weeks, root volume and leaf greenness, significantly affecting the variable of height increment at 12 weeks and 20 weeks and root length (Table 4.1).

Table 4.1. Results of analysis of variance of observed variables on the use of chicken manure

No	Variable	F Count P	CV (%)
1.	Plant Height Increase		
	4 WAP	$0,02^{th}$	33,2
	8 WAP	$0,10^{tn}$	23,1
	12 WAP	$3,95^{*}$	26,9
	16 WAP	$6,20^{**}$	8,14
	20 WAP	$4,87^{*}$	8,52
2.	Increase in the number of midribs		
	4 WAP	$1,47^{th}$	31,95
	8 WAP	$0,72^{tn}$	34,85
	12 WAP	$3,20^{tn}$	35,05
	16 WAP	$0,99^{tn}$	21,24
	20 WAP	$0,76^{tn}$	20,18
3.	Stem Diameter Increase		
	4 WAP	$1,16^{th}$	18,59
	8 WAP	$0,33^{tn}$	25,97
	12 WAP	$3,22^{tn}$	20,67
	16 WAP	$8,10t^{*}$	13,06
	20 WAP	$9,59t^{**}$	13,30
4.	Root Length	$4,41^{*}$	14,06
5.	Root Volume	$5,45^{**}$	7,33
6.	Number of Primary Root	$1,90^{tn}$	15,77
7.	Leaf Greenness Level	$11,65^{**}$	8,25
8.	Frond Length	$2,10^{th}$	7,17
9.	Number of Leaflet	$2,47^{tn}$	22,21
10.	Leaflet Length	$2,74^{tn}$	5,88

F Table 5%	3,26
F Table 1%	5,41

Note CV = Coefficient of Variance, ** = Very Significantly Affected, * = Significantly Affected, tn = Not Significantly Affected

At the age of 20 weeks after planting, the P_0 treatment had an average height of 65.21 cm, an average number of midribs of 12.8 midribs, and an average diameter of 35.96 mm. The P_1 treatment had an average height of 76.36 cm, an average number of fronds of 13.95 fronds, and an average diameter of 45.44 mm. The P_2 treatment had an average height of 75.7 cm, an average number of fronds of 13.95 fronds, and an average diameter of 45.30 mm. P3 treatment had an average height of 76.81 cm, an average number of fronds 13.73 fronds, and an average diameter of 47.35 mm. The P4 treatment had an average height of 75.9 cm, an average number of fronds 14.05 fronds, and an average diameter of 45.76 mm.

1. Plant Height Increase (cm)

The results of the analysis of variance showed that the use of chicken manure had a very significant effect on the variable of plant height increase at the age of 16 weeks after planting, a significant effect on the variable of plant height increase at the age of 12 weeks after planting and 20 weeks after planting, and no significant effect on the variable of plant height increase at the age of 4 weeks after planting and 8 weeks after planting (Table 4.2).

Table 4.2. Plant height increase in various chicken manure treatments

Treatment	4WAP	8WAP	12WAP	16WAP	20WAP
P_0	3,96	6,35	3,10 a	9,18 a	14,04 a
P_1	3,96	6,11	5,90 a b	12,06 b	18,01 b
P_2	4,00	6,40	5,98 a b	11,68 b	17,59 b
P_3	3,95	6,40	6,15 a b	11,20 b	17,00 a b
P_4	3,75	6,75	7,15 b	11,40 b	17,25 b
HSD 5%			3,20	1,90	3,00

Numbers followed by the same letter in the same column mean not significantly different in the 5% HSD test.

2. Number of Fronds Increase (fronds)

The results of the analysis of variance showed that the use of chicken manure had no significant effect on the variable of the increase in the number of fronds at the age of 4 weeks, 8 weeks, 12 weeks, 16 weeks, and 20 weeks. At the age of 4 weeks after planting, the highest number of fronds was obtained in the P_1 and P_3 treatments with an average value of 1.15 fronds and the lowest was obtained in the P_0 treatment with an average value of 0.68 fronds. At the age of 8 weeks after planting, the highest number of fronds was obtained in the P_2 treatment with an average value of 1.74 fronds and the lowest was obtained in the P_1 treatment with an average value of 1.24 fronds. At the age of 12 weeks after planting, the highest number of fronds was obtained in the P_3 treatment with an average value of 1.75 fronds and the lowest was obtained in the P_0 treatment with an average value of 0.71 fronds. At the age of 16 weeks after planting, the highest number of fronds was obtained in the P_1 treatment with an average value of 1.54 fronds and the lowest was obtained in the P_3 treatment with an average value of 1.16 fronds. At the age of 20 weeks after planting, the highest number of fronds was obtained in the P_0 treatment with an average value of 2.08 fronds and the lowest was obtained in the P_3 treatment with an average value of 1.69 fronds (Figure 4.1). From the results obtained, the highest increase in the number of fronds was obtained in the dose of chicken manure P_0, and P_1.

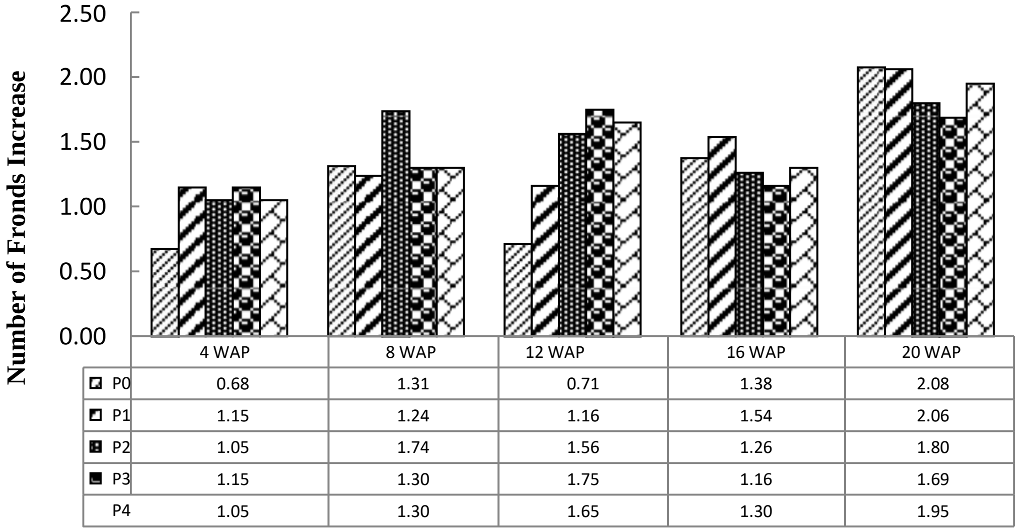

Figure 4.1. Frond number increase in various chicken manure treatments

3. Stem Diameter Increase (mm)

The results of the analysis of variance showed that the use of chicken manure had a very significant effect on the variable stem diameter increment at the age of 16 weeks and 20 weeks and had no significant effect on the variable stem diameter increment at the age of 4 weeks, 8 weeks, and 12 weeks. P_0 treatment at 16 and 20 weeks of planting was significantly different from P_1 treatment, P_2 treatment, P_3 treatment and P4 treatment (Table 4.3).

Table 4.3. Stem diameter increase in various chicken manure treatments

Treatment	4 WAP	8 WAP	12 WAP	16 WAP	20 WAP
P_0	5,32	5,03	4,25	3,63 a	5,13 a
P_1	5,43	4,45	6,13	5,89 b	9,12 b
P_2	6,37	4,71	6,92	5,92 b	8,25 b
P_3	6,69	5,40	6,29	5,93 b	8,96 b
P_4	5,80	4,76	7,14	5,82 b	8,70 b
HSD 5%				1,49	2,24

Numbers followed by the same letter in the same column meant not significantly different in the 5% HSD test.

4. Root Length (cm)

The results of the 5% HSD test. (Table 4.4) showed that the P_1 treatment and P_2 treatment were significantly different from the P_0 treatment and not significantly different from the P_3 and P_4 treatments. The results of the analysis of variance showed that the treatment of chicken manure on oil palm seedlings in the main-nursery variable root length of the highest average number was in the P_0 treatment with root length reaching 80,50 cm.

Table 4.4. HSD test results of root length variables on various chicken manure treatments

Treatment	Root Length (cm)
P_0	80,50 b
P_1	60,25 a
P_2	54,75 a
P_3	67,13 ab
P_4	64,25 ab
HSD 5%	19,30

The numbers followed by the same letter in the same column meant not significantly different in the 5% HSD test.

The results of the analysis of variance showed that the use of chicken manure had a significant effect on the root length variable. The longest root length was obtained in the P_0 treatment with an average root length of 80,50 cm, while the shortest root length was obtained in the P_2 treatment with an average root length of 54,75 cm.

5. Root Volume (cm^3)

The results of the 5% HSD test (Table 4.5) showed that the treatment of chicken manure on the growth of oil palm seedlings on the root volume variable, the P_0 treatment was significantly different from the P_1 and P_4 treatments while not significantly different from the P_2 and P_3 treatments.

Table 4.5. HSD test results of root volume variables in various chicken manure treatments

Treatment	Root Volume (cm^3)
P_0	168, 13 b
P_1	143,23 a
P_2	150,63 ab
P_3	145, 63 ab
P_4	133,75 a
HSD 5%	22,83

The numbers followed by the same letter in the same column meant not significantly different at 5% HSD test.

The results of the analysis of variance showed that the use of chicken manure had a very significant effect on the root volume variable. The largest root volume was obtained in the P_0 treatment with an average root volume of 168,3 cm^3, while the smallest root volume was obtained in the P_4 treatment with an average root volume of 133,75 cm^3.

6. Number of Primary Roots

The results of the analysis of variance showed that the use of chicken manure had no significant effect on the number of primary roots. The largest number of primary roots was obtained in treatment P_0 with an average value of the number of primary roots 20,38 while the smallest number of primary roots was obtained in the P_4 treatment with an average value of the number of primary roots of 15,63 (Figure 4.2).

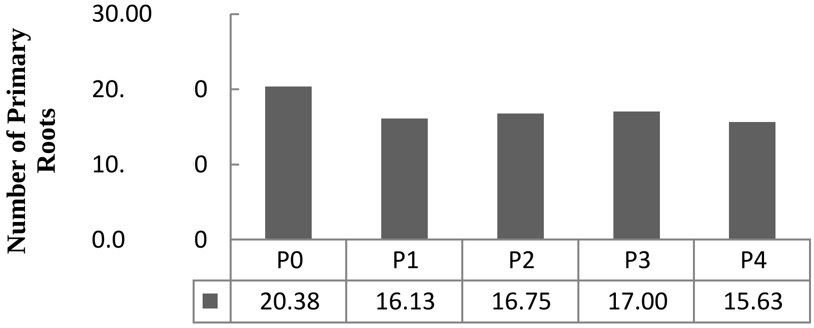

Figure 4.2. Number of primary roots in different chicken manure treatments

7. Leaf Greenness Level

The results of the 5% HSD test (Table 4.6) showed that the treatment of chicken manure had a very significant effect on the variable level of greenness of the leaves. P_0 treatment was significantly different from P_1 treatment, P_2 treatment, P_3 treatment, and P_4 treatment.

Table 4.6. Results of HSD test on greenness level of leaves in various treatments of chicken manure

Treatment	Leaf Greenness Level
P_0	37,69 a
P_1	55,39 b
P_2	52,46 b
P_3	51,39 b
P_4	53,13 b
HSD 5%	8,67

The numbers followed by the same letter in the same column meant not significantly different at 5% HSD test.

The results of the analysis of variance showed that the use of chicken manure had a very significant effect on the variable level of leaf greenness. The highest leaf greenness level was obtained in the P_1 treatment with an average leaf greenness level of 55,39, while the lowest leaf greenness level was obtained in the P_0 treatment with an average leaf greenness level of 37,69.

8. Frond Length (cm)

The results of the analysis of variance showed that the use of chicken manure had no significant effect on the frond length variable at the age of 20 weeks after planting. The highest frond length was obtained in the P_4 treatment with an average value of 47,38 cm and the lowest was obtained in the P_0 treatment with an average value of 41,69 cm (Figure 4.3).

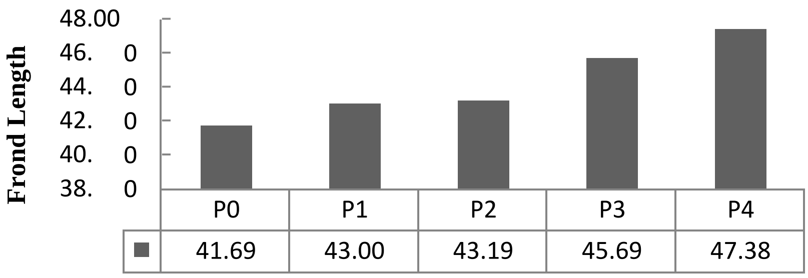

Figure 4.3. Frond length at various chicken manure treatments

9. Leaflet Length (cm)

The results of the analysis of variance showed that the use of chicken manure had no significant effect on the variable length of leaflets at the age of 20 weeks after planting. The highest leaf length was obtained in the P_0 treatment with an average value of 20,0 cm, and the lowest was obtained in the P_2 treatment with an average value of 17,50 cm (Figure 4.4).

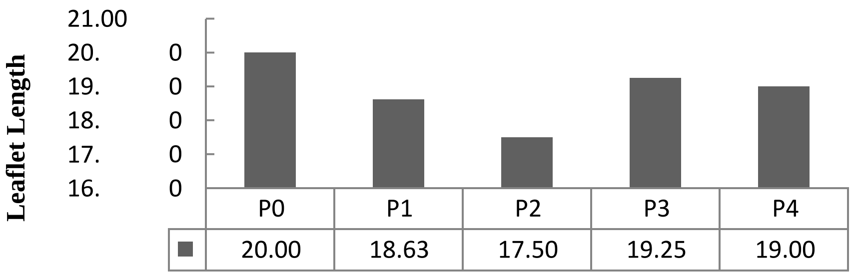

Figure 4.4. Leaflet length at different chicken manure treatments

10. Number of Leaflets (Strands)

The results of the analysis of variance showed that the use of chicken manure had no significant effect on the variable number of leaflets at the age of 20 weeks after planting. The highest number of leaves was obtained in the P_0 treatment with an average value of 13,63 strands and the lowest was obtained in the P_1 treatment with an average value of 8,88 strands (Figure 4.5).

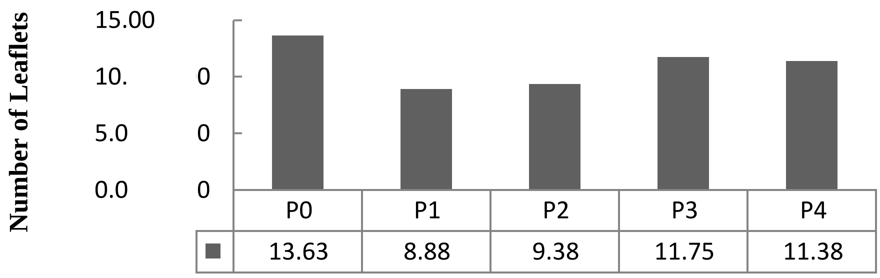

Figure 4.5. Number of leaflets in various chicken manure treatments

4.2. Discussions

Based on the results of the study, the average height when the seedlings were 8 months old (20 WAP), the total results of the average height, average number of fronds, and average stem diameter had met the physical quality standards of seedlings at the age of 8 months. The average height, average number of fronds, and average diameter of the P_0 treatment were 65,21 cm, 12,8 fronds, and 35,96 mm. The average height, average number of fronds, and average diameter of the P_1 treatment were 76,36 cm, 1,.95 fronds, and 45,44 mm. The average height, average number of fronds, and average diameter of the P_2 treatment were 75,7 cm, 13,95 fronds, and 45,30 mm. The average height, average number of fronds, and average diameter of P_3 treatment were 76,81 cm, 13,73 fronds, and 47,35 mm. The average height, average number of fronds, and average diameter of the P_4 treatment were 75,9 cm, 14,05 fronds, and 45,76 mm. In line with the physical quality standards of seedlings made by SPKS (2016) that the physical quality standards of oil palm seedlings at the age of 8 months have a height = 64.3 cm, the number of fronds = 11 fronds, and stem diameter = 35 mm, with the standard growth rate of the simalungun variety being 80 cm per year (PPKS, 2003).

Based on the results of the study, it showed that the use of chicken manure on the growth of oil palm seedlings on the variables of height increase and stem diameter had no effect when the seedlings were 4 weeks and 8 weeks old. The variables of height increase and stem diameter began to have a real or very real effect when the seedlings were 12 weeks of planting, 16 weeks of planting and 20 weeks of planting. This showed that the application of chicken manure fertilizer in oil palm nurseries in the main nursery had a long enough time to affect the growth of seedlings. This was in line with the statement of Hasibuan (2006), that the application of organic fertilizer to plants has several disadvantages, namely that it cannot be applied to plants directly but must go through the decomposition process first so that it has a longer time until the nutrients can be absorbed by plants, has a relatively lower nutrient content and costs incurred during transportation and application are more expensive.

The application of chicken manure gave a real effect on the variable of plant height. At the age of 12 weeks after planting, the highest increase in plant height was obtained in the P_4 treatment, then at 16 weeks after planting and 20 weeks after planting, the highest increase in plant height was obtained in the P_1 treatment while the lowest increase in plant height in a row from 12 weeks after planting, 16 weeks after planting, and 20 weeks after planting was obtained in the P_0 treatment. This showed that the provision of chicken manure to oil palm seedlings could increase the height gain of seedlings. According to Supartha (2012), chicken manure fertilizer is one of the organic fertilizers that contain folic acid, humic acid, and growth regulators that can accelerate plant growth.

In the variable of the increase in the number of fronds, frond length, number of leaflets and leaflet length, the results of the analysis of variance showed that the provision of chicken manure had no significant effect. The same results were also obtained by Effendi *et al.* (2019) where the application of coconut fiber and chicken manure bokasi fertilizer to the growth of oil palm seedlings in the pre nursery gave a real effect on the variable plant height and not real on the variable number of fronds. This was because the fronds of oil palm are dominantly controlled by genetic factors so that the four variables did not provide clear differences after being treated. This was in line with the opinion of Rudiansyah *et al*. (2017) that the increase in the number of fronds of oil palm is closely related to genetic factors in plants. Martoyo (2001) added that the response of the increase in the number of leaves to the provision of fertilizer does not provide a clear picture because the increase in leaves is closely related to the genetic elements of the plant. The average increase in the number of fronds of oil palm is 20-30 fronds/year.

The application of chicken manure to oil palm nurseries in the main nursery gave a very significant effect on the variable of stem diameter increase. This was because chicken manure could improve the physical, chemical and biological properties of soil that supported the availability of nutrients so that they could be absorbed by the roots of seedlings. According to Gunawan *et al.* (2014) The availability of nutrients that can be absorbed by plant roots is an important factor in influencing the work of the physiological system for plants, this can affect cell division so that the diameter of the stem grows larger.

The results of the analysis of variance showed that the provision of chicken manure gave a real effect on the variable root length and very real on the variable root volume. Root length and root volume in the P_0 treatment resulted in greater root length and volume than the other treatments, while in the variable number of primary roots although not significantly different, the P_0 treatment obtained the highest average number of primary roots from the treatments using chicken manure. The P_0 treatment with 100% NPK inorganic fertilizer could damage the structure and physical properties of the soil so that the nutrients given could not be absorbed by the roots optimally causing the roots to grow deviate from their normal conditions to look for nutrients. According to Lakitan (2015) several factors that affect root growth are mechanical barriers, soil temperature, aeration, water availability and nutrient availability so that if the soil conditions where plants grow are less than optimal based on some of these factors, the roots will grow deviate from their ideal conditions. The ideal condition of the plant is if the downward growth (roots) and upward growth (crown) are relatively the same.

The application of chicken manure can improve the physical, chemical and biological properties of the soil so that the root system grows normally and can absorb the nutrients provided to the maximum indicating a better microenvironment in plants. This is in line with the benefits of organic fertilizers that can increase soil CEC, and form complex compounds with toxic metal ions, such as Al, Fe, and Mn, and increase soil aggregation, porosity, aeration, infiltration capacity, and percolation besides organic matter plays a role in the formation of stable aggregates because it binds primary soil grains into secondary grains (Juarsah, 2014).

The results of the analysis of variance showed that the application of chicken manure to oil palm seedlings in the main nursery had a very significant effect on the variable level of leaf greenness. The level of leaf greenness was used to visually determine the presence or absence of symptoms of N deficiency or excess, where if N deficiency occurs, the leaves will be pale green and then become pale yellow or bright yellow (chlorosis). The decrease in leaf chlorophyll concentration is caused by the inhibition of nutrient absorption, especially N and Mg which play an important role in chlorophyll synthesis (Ai and Banyo, 2011). According to Saiful (2007), the application of chicken manure can increase the nitrogen content which can lead to increase chlorophyll levels in plants. This is because nitrogen plays a role in the formation of chlorophyll which is useful in the photosynthesis process so that the level of greenness of the leaves obtained is higher. Roidah (2013) added that the nutrient content in chicken manure is very high because urine and feces are mixed. The results of the analysis conducted by Tufaila *et al.* (2014) showed that chicken manure contained 12.23% organic C, 1.77% N-total, 27.45% P, and 3.21% K with a pH of 6.8.

Giving chicken manure to oil palm nurseries gave the best effect in treatment P1 with a dose of 500 g/ plant each on the variables of plant height increase, stem diameter increase, and leaf greenness level. The use of a dose of 500 g/ plant plus 30% inorganic fertilizer during the research time was considered to be able to save inorganic doses up to 70% so as to reduce the negative impact of using inorganic fertilizers on the soil. According to Lingga and Marsono (2003), the excessive use of excessive use of inorganic fertilizers is the cause of the decline in soil physical and chemical quality.

CHAPTER 5
CONCLUSIONS AND SUGGESTIONS

5.1. Conclusion

Based on the results of the study, it can be concluded that the application of chicken manure at a dose of 500 g/ polybag is effective for efficient use of NPK on oil palm growth in the main nursery which can be seen from the parameters of plant height increase, stem diameter increase, and leaf greenness level.

5.2. Suggestion

It is recommended to use chicken manure fertilizer at a dose of 500 g/ polybag for a polybag size of 40 × 40 cm in oil palm nurseries in the main nursery.

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