Study on the Effect of Organic Fertilizer in the Growth Performance of Lettuce (*Lactuca sativa L.)* In MARDI, Cameron Highland.

By

Nor Amilia Binti Din

F15A0113

A report submitted in fulfilment of the requirements for Degree of Bachelor of Applied Science (Agrotechnology) With Honours.

Faculty Of Agro Based Industry

UNIVERSITI MALAYSIA KELANTAN

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DECLARATION

I hereby declare that the work emboied in this report is the result of the original research and has not been submitted for a higher degree to any universities or instituitions.

_____

Student

Name : Nor Amilia Binti Din

Date :

I certified that the report of this final year project entitled "Study on the Effect of Organic Fertilizer in the Growth Performance of Lettuce (*Lactuca sativa L).* In MARDI, Cameron Highland by Nor Amilia Binti Din, given matric number F15A0113 has been examined and all the correction and recommended by examiners have been done for the degree of Bachelor of Applied Science (Agrotechnology) with Honours, Faculty Agro Based Industry, University Malaysia Kelantan.

Approved by:

_____

Supervisor

Name : Dr. Mohammad Amizi Bin Ayob

Date :

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Study on the Effect of Organic Fertilizer in the Growth Performance of Lettuce (*Lactuca sativa L.) in MARDI, Cameron Highland.*

ABSTRACT

This research was conducted due to the current demanding towards the production of organic agricultural product especially in vegetable crops. The aim of this research is to prove that the organic fertilizer(harvester-amino 5:5:5) which contain in organic matter may give same quality with the conventional method that using inorganic fertilizer. The objectives of this study was done to study the effect of organic fertilizer harvester-amino 5:5:5 in growth performance of Lettuce (*Lactuca sativa L.)* and to investigate the most preferable and suitable rate of organic matter in fertilizer that uses in fertilizing system of lettuce. This experimental study was conducted at MARDI Cameron Highland where this place was known as the low temperature land that may grow well the crops whereby Lettuce are also known as the hardy annual and suitable with the condition that are preferred. As for the control method which is using the fertigation system that are also known as the conventional method because almost 70% of Lettuce or vegetables crops nowday are using the fertigation method especially in Cameron Highland. This shows that the technology have been reach upon the time by introducing a lot of methods in agricultural industries. As for the data analysis the means, standard deviation and post hoc has been tabulated in a figure which shows the differences of the result. In addition the ANOVA two-way-test are also being used for this study as well to conclude the collected data. At the end of the study it can be conclude that the organic fertilizer are also giving a same result with the conventional method. Where the lettuce for both investigation giving almost the same rate in growth performance but still it shows that the organic fertilizer that contain in the fertilizer for organic fertilizer uses are more qualified where the freshness of Lettuce are clearly stated in the result. In addition, stated that all the findings and significant for this study were prove in a positive relationship with the objective of the study. As a conclusion, it can be conclude that all the objectives of the study were achieved.

Keywords: *organic fertilizer, harvester-amino 5:5:5, lettuce, Lactuca sativa L., conventional method, growth performance, vegetables crops.*

Kajian Kesan Baja Organik dalam Pertumbuhan Prestasi salad *(Lactuca sativa L.)* di MARDI, Cameron Highland.

ABSTRAK

Penyelidikan ini dijalankan kerana menuntut ke arah pengeluaran produk pertanian organik terutamanya dalam tanaman sayur-sayuran. Tujuan kajian ini adalah untuk membuktikan bahawa baja organik yang mengandungi bahan organik boleh memberikan kualiti yang sama dengan kaedah konvensional yang menggunakan baja bukan organik. Objektif kajian ini dilakukan untuk mengkaji kesan bahan organik(penuai-amino 5:5:5) dalam pertumbuhan prestasi salad *(Lactuca sativa L.)* dan untuk mengkaji kadar bahan organik pada baja organik penuai-amino 5:5:5 yang paling disukai dan sesuai digunakan dalam sistem pemupukan salad. Kajian eksperimen ini yang dijalankan di MARDI Cameron Highland di mana tempat ini dikenali sebagai tanah suhu rendah yang boleh tumbuh dengan baik tanaman di mana salad juga dikenali sebagai tahan lasak tahunan dan sesuai dengan keadaan yang lebih disukai. Kaedah kawalan yang menggunakan sistem fertigasi yang juga dikenali sebagai kaedah konvensional kerana hampir 70% tanaman salad atau sayur-sayuran sekarang menggunakan kaedah fertigasi terutamanya di Cameron Highland. Ini menunjukkan bahawa teknologi telah dicapai pada masa itu dengan memperkenalkan banyak kaedah dalam industri pertanian. Bagi analisis data, sisihan piawai dan post hoc telah ditabulasi dalam angka yang menunjukkan perbezaan hasil. Di samping itu, ujian dua hala ANOVA juga digunakan untuk kajian ini dan juga menyimpulkan data yang dikumpulkan. Pada akhir kajian itu dapat disimpulkan bahawa baja organik juga memberi hasil yang sama dengan kaedah konvensional. Di mana salad untuk kedua-dua siasatan memberikan kadar yang hampir sama dalam pertumbuhan prestasi tetapi masih menunjukkan bahawa bahan organik yang mengandungi dalam baja untuk penggunaan baja organik lebih layak di mana kesegaran salad dinyatakan dengan jelas dalam hasilnya. Di samping itu, menyatakan bahawa semua penemuan dan ketara bagi kajian ini terbukti dalam hubungan positif dengan objektif kajian. Sebagai kesimpulan, dapat disimpulkan bahawa semua objektif kajian telah dicapai.

Kata kunci: *baja organik, penuai-amino 5:5:5, salad, Lactuca sativa L., kaedah konvensional, pertumbuhan prestasi, tanaman sayuran.*

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LIST OF SYMBOLS/ ABBREVIATIONS

Symbols/Abbreviations	Refers Meaning
Tan/ha	Tan per hectare
Ha	Hectare
G	Gram
ANOVA	Analysis of varience
MARDI	Malaysian Agricultural Research Development Institute
Cm	Centimetre
%	Percentage
N	Nitrogen
P	Phosphorus
K	Potassium

CHAPTER 1

INTRODUCTION

1.1 Research Background

This research is focusing on one of the vegetable crop in Malaysia which is scientifically named *Lactuca Sativa L.* or also known as lettuce, where as lettuce is also a major world of salad. Nowdays,a cultivated lettuce was identified that it does not have uncertain origin because it was no longer exist in wild species of vegetable crops.In almost 200 countries are actually grown vegetables including Malaysia. Vegetables can make up a major portion in dietary of human in many part in this world. It is because vegetables crops are actually played a significant role in most of human nutrition because they contains lot of Vitamins, including vitamin A, C, E, B6, B1 and B9 (Lebeda and Boukema, 2001)

Beside they are also providing sources of minerals, phytochemicals and dietary fiber. Moreover, lettuce is a vegetables which a major sources of protein for the poor in worldwide. Since they may get lot of protein if they consume vegetable crops in daily life. In daily diet, it have been stated with strongly associated that, if we are taking vegetables it will give improvement of gastrointestinal health, good vision, and may reduce risk of several cronic diseases, including stroke, heart disease, diebetes and not exceptable to get a cancer (Ryder, 1999).

In this cases, among the vegetables, lettuce is a popular vegetables that is contain high in vitamin and various of benificial plant compound which can work well in medicinal significance and can offer health benefit for human health. Besides, Lettuce (*Lactuca sativa L.*) is an annual plant of the daisy family, Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches and wraps; it can also be grilled (Lebeda and Boukema, 2001).

Lettuce is generally grown as a hardy annual and suitable for Malaysia Agro-ecology aspect, especially Cameron Highland. Where as, Cameron Highland is the most popular highland in Malaysia. It is very suitable for cultivating vegetables such as lettuce and other kinds of vegetables. Beside, lettuce is easily cultivated and lettuce is able to withstand in low temperature place. This condition may help to prevent it from flowering in time. In some other ways, it can possibly plagued by kind of numerous nutrient deficiencies, such as insect, mammal pests, fungal and bacterial diseases. *Lactuca sativa L.* was crossed easily within the species and with some other species within *Lactuca* genus (Chan and Barrow, 2006).

In Malaysia,this crop is covers several types of vegetable plantation which specificially produced in MARDI, Cameron Highland. Salad or lettuce was popularly known as cool-season vegetable but it was proved by the researchers that it can also adapted to the temperate regions. Cameron Highland is also one of the most suitable place to plant this kind of vegetable crops due to the only one place in low temperature which placed in Malaysia. As for Malaysia, MARDI is one of the biggest organization which conduct a research and development for providing information and consultation regarding agricultural industries in

Malaysia. Especially in providing fund, information and consultation for farmers that contribute in agricultural production for Malaysian market deals (Chan and Barrow, 2006).

Several studies, was conducted on organic and conventional (inorganic fertilizer) may effect on the growth performance of *Lactuca Sativa L.* It have been stated in the previous research that it was a slightly difference in performance growth of a crop if we are using organic and inorganic matter due to the fertilizing system for a crop, because maybe in present it was proving that the growth of inorganic conventional method is perform well but in future the nutrient contain in soil may be lower. Conventional way of production may be harmful for human health regarding to the uses of harmful chemical substance(Chan and Barrow, 2006).

Nowdays, lettuce production was succesfully made up by the fertigation system in Malaysia. So that, this research will be build to make a change in people though of organic matter that may help a lot in our healthy and dietary system in daily life. In this study, we will prepare several treatments which is organic matter and a comparison between conventional inorganic fertilizing method to make a simple comparison of both growth performance for lettuce in Mardi, Cameron Highland (Chan and Barrow, 2006).

1.2 Problem statement

Consumer demanding is high regarding to the production of organic agricultural product especially in vegetable crops. It is because an organic fertilizer may contribute to our health including nutrition and energy consumption for our body. It was a preferable where an organic product is widely high in demanding and market of agricultural production stage. In this current, there are several problems occur when lot of chemical usage in agricultural industries especial in fertilizer and pest disease of a cops. Due to this problem, people are aware of agricultural industries as if nowdays lot of raw materials in this industries are aware in uses of chemicals(Hossain and Ryu, 2017).

Whereas, the uses of chemical substance and materials in planting for fertilizer and pesticide may be harmful in long term. Chemical fertilizers have aided farmers in increasing crop production since the 1930's. While chemical fertilizers have their place increasing plant nutrients in adverse weather conditions or during times when plants need additional nutrients, there are also several harmful effects of chemical fertilizers. Some of the harm chemical fertilizers may cause include waterway pollution, chemical burn to crops, increased air pollution, acidification of the soil and mineral depletion of the soil (Hailu, Seyoum and Dechassa,2008).

Besides, chemical fertilizers can have harmful effect on human health. This may cause disturbance of human organs such as kidneys, lungs and even can cause cancer. This due to the toxic metals that fertilizers have. Additionally, their is very limited scientific study that has been conducted to replace this harmful chemicals usage in agriculture with organic fertilizer.

Therefore this research will be conducted to determine, compare and find the best organic matter in each treatment to obtain higher growth rate performance(Hossain and Ryu, 2017)

1.3 Objectives

1.3.1 To study the effect of organic fertilizer(harvester-amino 5:5:5) in growth performance of lettuce *(Lactuca sativa L).*

1.3.2. To investigate the most preferable and suitable rate of organic matter in fertilizer that uses in fertilizing system of *Lactuca sativa L*

1.4 Scope of study

The focus of the study is to determine the effect of organic fertilizer using harvester-amino 5:5:5 compared to control method which is conventional inorganic fertilizer which is NPK green that currently may have contribute in vegetative propagation and performance growth of a lettuce. This research is very important to improve our planting methods and materials that we have kindly use in our previous planting system especially in fertilizing and pesticide system. This is also a way to identify the suitable rate of growth performance of lettuce to observe in root fresh weight, height of the plant, leaf freshness, number of leaf and also dry mass of the plant. This may required the result of the most preferable part for the fertiling system for this vegetable crop. The best freshness, dry mass and lettuce size will be determined at the end of the experiment.

1.5 Significance of study

The study are significant towards the usage of organic fertilizer(Harvester-amino 5:5:5) and inorganic fertilizer(NPK green) in agricultural industries. This is because the main thing that is important in plantation is about how the fertilization of the plant be manage in term to let all human being consume it without any aspect that will harmful for them. This research will show the useful and beneficial of using organic fertilizer instead of using inorganic fertilizer which look healthy outside but very harmful for our body. As demanding the organic matter which contain in organic fertilizer may help a lot in human health and well being. This will maintain the nutrient contain in crops and may gain more availability of people to be more healthy in the future.

It is importance to know that the usage of inorganic may affected in performance growth of plant just in a small usage of it. In the future, the soil are also will be affected where the fertility of soil will drop and cannot be use for long term. In organic fertilizer also may affect human body and digestive system. It may also cause lot of health problem because of the metals contain in the fertilizer. While, the usage of organic fertilizer will not harmful to each thing either soils or human health. The reason why the demand is high is because organic matter which contain in fertilizer may help the soil to gain up the soil fertility in long term and it can be use repeated by do not affect the performance growth of the next crop stand. Moreover, organic fertilizer also promote high potential to gain healthy life style for those who likes to eat vegetables. This alternative of fertilizer usage may be proven in this research.

CHAPTER 2

LITERATURE REVIEW

2.1 Botany and life cycle

Lettuce (*Lactuca sativa L.)* is an erect smooth of herbaceous annual plant which grown for its cripsy edible leaves that is form continuosly during the stage of development in vegetative growth for a plant. The leaves of a lettuce arrange spirally in a dense rosette. In vegetable crops, lettuce is a plant where have a considerable diversity of margin, texture and leaf shape among many different forms. As an example, a glabrous leaves can be smooth, finely divided, savoy or even crumpled. Simple characteristics that can be observe in leaf margins is lobed, finely divided, smooth and leaf colors can vary from light to dark green with some of cultivars are having red or purple coloration (Rubatzky and Yamaguchi,1997)

Besides, the interior leaves of leafy cultivars are tend to be more lighter in color appearance, whereas those of other heading types are white in color. The stem of lettuce may cylindrical with the exception, while stem is short and compressed. Upon bolting, the stem elongates, becoming erect, tall and branched (Rubatzky and Yamaguchi, 1997). Whereas, the inflorescence or flower head Asteraceae is a structure thatcalled a capitulum. As a single flower it is actually many individual florets that appear have share many common receptacle in place to form a composite inflorencence. Beside, the capitulum is a contracteda raceme composed of some numerous individual sessile flower which called florets. It is a panicle

which consisting of 10-25 florets and each was opening in the morning. (Rubatzky and Yamaguchi,1997)

Mostly, lettuce is a self-pollination crop but sometimes pollination also occur through insect pollination. Lettuce flowering time may continue for 1-2 months after the time of induction. Many of modern cultivar including lettuce, have a varying thermodormancy, which can possibly prevent germination in above 24º C(75º F). It was stated that in an average 1000 lettuce seed weigh is equal to 1 gram (28571/oz). Taproot arerapidly occur in deep soils, it was develop after germination of seed along with an extensive laterally in root system. Although, the taproot can grow up to 1 m (3.3 ft) deep in some situations, which the lateral roots near the surface is absorb the most moisture and nutrients (Rubatzky and Yamaguchi, 1997).

There are all several types of lettuce which widely recognizedin a morphological form. It is butterhead, romaine or cos, crisphead, and butterhead. There is some of the type of lettuce that can be refers in the table below:

Table 2.1.1 : Major forms of lettuce(Lebeda *et.al* ,2009)

Botanical variety or Groupnames	Common names	Description or characteristic
L. sativum bot. Var. asparagina	Stem or asparagus lettuce, celtuce	Grown for its erect thickned edible stem 30-40 cm(12-16 in)long.
L. sativum bot. Var.	Batavian, summer crisp,	Smaller, less firm more open head than

capitata	french crisp	crisphead.
L. sativum bot. Var. capitata	Crisphead, iceberg	Very dense rosette with cabbage-like structure and crisp texture.
L. sativum bot. Var. capitata	Butterhead,boston, bibb	Smaller, flattened less compact head, leaves are broad and tender, with a soft oily texture.
L. serriola	Oil seed	Leaves are not eaten, seeds contain 35% oil historically used for cooking.
L. sativum	Latin lettuce	A rosette of loose, elongated and soft cos-like leaves that may form a partly close head.
L. sativum bot. Var. Longifolia	Cos or romaine	Upright head and narrow or columnar,leaves ovate to oblong, obtuse with broad midrib.
L. sativum bot. Var. crispa	Loose-leaf, bunching	Loose rosette of cut, fringed or crisped leaves varying in color.

SOURCES: (Lebeda *et.al* ,2009)

2.2 The Nutritional value of Lettuce.

The nutritional value of this crops is including protein, carbohydrate, fat, vitamin K, A, C and minerals. The leafy tissues of a lettuce is high in water content and very low in dry matter. This crops are mostly eaten for their flavor and texture because they are outstandingly rich in nutrition as stated. Below is a list regarding each nutrition value for various lettuce types(Lebeda *et. al.,* 2009):

Table 2.2.1 Nutrition value of various lettuce types(Lebeda *et.al* ,2009).

Lettuce 100g fresh	Units	Butterhead	Romaine	Red leaf	Green leaf	Iceberg
Vit. A	IU	3312	8710	7492	7405	502
Vit. B-6	MG	0.082	0.074	0.100	0.09	0.042
Vit. C	MG	3.7	4	3.7	9.2	2.8
Vit. K	MG	102	103	140	126	24
Folic acid	MG	73	136	36	38	29
Niacin	MG	0.357	0.313	0.321	0.375	0.123
Riboflavin	MG	0.062	0.067	0.077	0.080	0.025
Iron	MG	1.24	0.97	1.2	0.86	0.41
Potassium	MG	238	247	187	194	141
Beta-carotene	MG	1987	5226	4495	4443	229
Lutein + zeaxanthin	MG	1223	2312	1724	1730	277

SOURCES: (Lebeda *et.al* ,2009)

2.3 Importance of lettuce.

Lettuce is belongs to the compositae family. Lettuce has characteristics such as the shape of the flowers gather in bunches form a series. Lettuce is usually served as a refreshing

vegetable. The vitamin content contained in the lettuce is very useful for the health of the body.(Mou, 2008)

There is several types of lettuce , it consists of three types, namely butterhead lettuce, loose lettuce, and lettuce cut. The butterhead lettuce or egg lettuce (kropsla) is round, but porous (loose). This type of lettuce feels soft and tasty, therefore this type of lettuce most popular. The superiority of lettuce type of butter compared with other types of lettuce is this lettuce is not easily damaged so it can be sent to distant places. While the lettuce is closed the crop is round, somewhat dense and tastes crunchy. While the cut lettuce the crop is oval or round in shape, it feels good but somewhat it is clay (Mou, 2008).

In addition to the above types, there are also plants that resemble either growing lettuce. However, the taste is a bit bitter. The type of lettuce in question is Andewi (*Cichorium endevia L.).* Leaves of Andewi is a curly and also smooth and wide, but more famous andewi is a leafy. Another type of lettuce is watercress (*Nasturtium officinale R.Br*.), but this watercress belongs to the family Cruciferae *(Bressicaceae*). The growth spread like a kangkung plant and can be planted in the swamp.(Mou, 2008)

2.4 Planting technique for lettuce.

Lettuce plants can grow well, both in the highlands (mountains) and in the lowlands. The area that is the center of lettuce producers are Asia country including Malaysia. In the mountains, the leaves can form large crops. Conversely in the lowlands, these plants only form a small but rapidly flowering crop. The essential requirement for lettuce plants to grow properly is that the soil should contain sand or mud (fertile), air temperature 15 - 20o C, and soil acidity (pH) 5-6.5.The best time for planting is at the end of the rainy season (March /

April). However, lettuce can also be planted in the dry season, provided that enough water. (Johnson, Jackson, Ochoa, Peleman, Clair and Michelmore, 2000).

To plant the lettuce is, at first step the Lettuce is bred with seeds. In 1 ha of land required 600 - 800 lettuce seeds. According to the theory, one ha required 300 g of seeds with 75% germination. Physically lettuce seeds are small, oval, flat (sprawl), and hairy sharp (Johnson *et. al.,* 2000).

Land that will be used to plant lettuce, must first be hoeed as deep as 20-30 cm then given the manure as much as 10 tons per ha. In addition, the land is made beds with a width of 1 meter and extends from east to west. After the beds are formed, then make the grooves using a rake. The direction of straight groove to the east with the distance between grooves 25 cm. Making the groove is not very deep because the roots of lettuce collect in the layer resistant (Johnson *et. al.,* 2000).

Moreover, Lettuce seeds can be planted directly in the garden without first. When the seeds are sown, the moisture is kept in the nursery so that the lettuce grows fast and well. After a month (approximately 4 leaves), the seedlings can be moved to the garden with a spacing of 20 cm x 25 cm or 25 cm x 25 cm.Lettuce seeds are planted directly, spread evenly along the groove and then covered with thin soil. Lettuce seeds will grow 5 days later. After about 1 month (approximately 3 to 5 leaves), the plants begin to be cut off. Thinning is done to the dwarf seed until the distance between plants to 20-25 cm.After 2 weeks of planting, the plant is given 100 kg of urea fertilizer per ha or 1 g per plant. Fertilizer placed between the rows of plants(Johnson *et. al.,* 2000).

2.5 Planting maintainance

Lettuce plants often face the threat of disease attacks. An important disease is root rot disease caused by Rhizoctonia fungus. This disease often attacks young plants (time in the nursery). However, this disease can be solved by spraying a solution of 0.2-0.5% of the Benlate solution on the soil (Koopman, Guetta, VandeWiel, Vosman and VandeBerg 1998).

In addition to disease, there are also pests that threaten the growth of plants. Pests that need to be eradicated are the aphids (Mysuspersicae Sulzer). The pest is an insect vector of viral diseases that cause loss and failure of the whole plant. These aphids can be eradicated by a 0.2% Kalthane spray (Koopman *et. al.*,1998).

2.6 Field preparation

There are two major groups of lettuce cultivation lettuce that developed in Malaysia. First, the lettuce leaves its corp shape rounded off, green leaves expands. Second, the lettuce corp (heading lettuce) form of his corp round or oval and his corp is solid. The two types above the most widely cultivated are leaf lettuce type, the shape of the wavy leaves tend to wrinkle, or popular with the name of curly lettuce. Curly curly lettuce is grown in tropical and hot areas though. This type of curly lettuce can even grow fertile in the lowlands and hot temperate season as other place in Malaysia (Hunt, 1978).

Basically the optimum temperature for cage littering criteria ranges from 15-25 ° C with an altitude of 900 meters to 1,200 meters above sea level. Preferred soil types of criticized lettuce are dusty clay, sandy clay, and soil that still contains humus. However, curly lettuce is still tolerant of nutrient-poor soil provided it is provided with adequate irrigation and organic fertilizer (Hunt, 1978).

2.7 Seed selection and seeding process

Lettuce reproduced itself with seeds. Seed or lettuce seed is obtained by growing the lettuce plants until flowering and fruitful. After the old newly taken seed. When seeds are purchased from stores, popular varieties today include penn great lakes, imperials and new york. The need for lettuce seeds per one hectare of land is 250 grams. To get optimal results, seeds should be sowed curly lettuce first before planted in a vast expanse of land (Hill, Witsenboer, Zabeau, Vos, Kesseli and Michelmore, 1996).

There are various types of seeding media for the cultivation of lettuce, such as in polybags, banana leaves, tray system, printed soil or on the bed. On this occasion we will describe is the media planting on the bed.First, we need to prepare the bed with a width of one meter and height of about 15 cm, the length of the bed adjusted to the needs. The position of the bed should be open and far from animal disturbance. Mix the manure, soil and charcoal husk with a ratio of 1: 1: 1. The manure used must be fully ripe to avoid the growth of unexpected microorganisms. The use of manure to enrich nutrients and nutrients. Chaff charcoal is needed to soil the soil to remove the seeds from damaging plant roots. If the soil is too acidic, give also lime farm or dolomite sufficiently. The ideal acidity degree for lettuce cultivation is pH 5 to 6.8 (Hill *et. al.*, 1996).

Flush the seeding medium with water to give moisture to the seeds to be sown. Try not to wet pooled because it can rot the plant. Spread the lettuce seeds evenly over the bed. Solid seed stocking is 100 grams per 10 square meters of seedlings. If the seeding is done in the dry season, it is better to give mulch in the form of grass, straw or dry leaves on it. It is useful to reduce the evaporation of the sun (Jeuken, Peleman and Lindhout,2001).

Make shade on the bed. Point, in the rainy season to protect newly grown seed from overflow of rain water directly. In the dry season, to overshadow the bibt from the scorch of the sun is too hot. Cover beds can use paranet, plastic bag or clear plastic. Try to create a cover that can be closed open, so that in the morning and afternoon the cover can be opened in order to get maximum radiation. And, during the day can be closed to protect from the sun (Jeuken *et. al*, 2001).

Treatment at this seeding stage is routine watering, weed weeding and pest and disease control. In the cultivation of organic curly lettuce, it is not permitted spraying synthetic pesticides. What if there is a pest can be expelled by closing the seeding, if the disease can be given additional manure and spraying of vegetable pesticides when necessary. Curly lettuce seeds can be removed after leaf 4-5 strands or 3-4 weeks since seeds are stocked (Ryder, 1999).

2.8 Soil processing and seed sowing

The processing of land for the cultivation of lettuce depends on the type, structure and texture of the soil. If the soil to be used is very hard, do a simple tillage process first, after that just done by hoe burrowing. Then, the shape of the bed with a width of 1 meter height 15 cm and length of approximately 10 meters or depending on the condition of the land. To keep the beds dry, especially in wetlands such as former rice fields, soil for raised beds 20 cm, left and right beds are made aisle for drainage channels. The width of the bed is not allowed too wide for easy maintenance (Hossain and Ryu, 2017).

Raising lettuce required a neutral acidity environment with an ideal pH of 5-6.8. If acid soil conditions should be done first neutralization process with lime. Whereas, if the soil is too

alkaline base with sulfur. For example, to neutralize the soil that has a pH of 5.5 is required lime of 0.1 kg per square meter so that the degree of acidity rises to a pH of 6.5. Conversely, to lower soil pH can be given sulfur as much as 0.6 kg per square meter (Hossain and Ryu, 2017).

However, to enrich the soil needed to be mixed with mature manure or compost. The recommended amount of manure for chicken manure is 20 tons per hectare. If we use compost fertilizer, the recommended amount of compost is 2 kg per square meter. Provision of organic fertilizer aims to spoilage the land and enhance the activity of microorganisms in the soil. After the soil is mixed with manure or compost, let stand for 2 days, then puree the soil again with the digging process(Hossain and Ryu, 2017).

After the land is ready move the seedlings lettuce from the seeding. In process of transplanting the plants, you should lift with the soil that supports the root zone. Planting done by removing or perforated by hand only. Large and in planting holes adapted to rooting of curly lettuce seeds to be removed. Set the spacing of 10 x 15 cm (Hossain and Ryu, 2017).

2.9 Treatment of lettuce cultivation.

For lettuce crop, the treatment will be done in the cultivation of lettuce several characteristics include watering, fertilizing and weeding. Watering is done in accordance with the existing weather. If there is no rain, do 2 times watering in one day every morning and afternoon. Watering can be done during the day but with enough water intensity to avoid the sudden wilting of the plants (Lebeda and Boukema, 2001).

After the seedlings are planted 2 weeks old, if less fertile plants are marked with a faded green color, give additional 2 tons of manure per hectare. Manure used should contain

high nitrogen elements such as chicken manure. At the age of the plant reaches 20 days since, do spraying organic liquid fertilizer with a dose of 3 liters per hectare (Koopman, 2000)

Despite the fast harvest cycle, weeding is still needed because this critical lettuce plant has a shallow root so that its competitiveness is very low compared to the pest. For that there needs regular weeding by removing the pest. In the cultivation of lettuce is usually required at least one weeding weed during the cultivation period (Koopman, 2000).

The way weed weeds are different in the dry and dry season. In the dry season weeds are removed or cut, then left on the ground. Use as an additional green manure and form mulch to reduce evaporation. So water for watering can be saved. In the rainy season, weeds should be removed and the beds should be clean from forage. This is to avoid the growth of pest and diseases around the lettuce plant due to high humidity (Koopman, 2000).

2.10 Harvest cultivation of lettuce

Cultivation of curly lettuce can be harvested 20-30 days after the seedlings are planted. So, when calculated from seeding to harvest, it takes approximately 40-60 days. The productivity of curly lettuce can reach 15-20 tons per hectare. Harvesting is done by removing the plants to the roots. After harvesting, the root part of the critical lettuce is washed and the damaged leaves are removed. Group curly lettuce based on size. Post-harvest work must be done quickly and quickly because the curly lettuce plants can not stand the heat and evaporation. When transport to the market there is a long time journey to be taken by, so that, keep the vegetables in a humid place near the water or routinely splattered with water. (Ryder, 1999)

2.11 Control of pest and disease

Pests and diseases that usually attack the cultivation of lettuce are as follows which is *Bradybaena similaris ferussac* it is a visual shaped like a snail measuring 2 cm. These pests attack plants at any age. Usually hide at the base of the inner leaf. This pest attack makes the leaves hollow. Next, *Parmalion pupilaris humb* is where the shape is similar to previous disease but does not have a snail shape (Walker and Norman, 1970).

As a result of the same attack make a hole in the leaf. This pest is more attacking in the dry season than the rainy season. While, the soft rot is causes of bacteria *Erwinia Carotovora*. This disease attacks the leaf. The attack starts from the leaf edge, the color leaves to brown then wither. In addition to attacking plants that are still planted, this disease can also attack the lettuce that is ready to be transported to the market.Leaf rot is causes by the *Felicularia Filamentosa*. This disease attacks the leaf base, the usual attack occurs before the harvest. (Walker and Norman, 1970)

In the cultivation of organic lettuce, it is not allowed to spray pests and diseases with synthetic pesticides. Pest and disease control is done by paying attention to fertilization, garden cleanliness, crop rotation and if forced to do spraying with vegetable pesticides.Regular watering and proper fertilization proved effective in controlling pests. However, the most effective pest control is to cultivate healthy plants, regulate environmental hygiene such as maintaining irrigation and drainage as well as ensuring sufficient nutrition for plants especially for plant immune itself as potassium element. Potassium elements can be obtained by adding bamboo leaf materials at the time of composting.(Walker and Norman, 1970)

2.12 Organic fertilizer and inorganic fertilizer

Fertilizer can be grouped into two types namely chemical fertilizer and organic fertilizer. Organic fertilizer is made of one type of material or some other material. Organic fertilizer is made of material from animals, plants or minerals including Harvester-amino 5:5:5. To obtain a quality organic source and memorable select enough organic fertilizer in composting. Organic fertilizers may also be categorized to the pallet fertilizer, powder, and also liquid. It is up to the small farmers which are needed for their garden (Hailu, Seyoum, and Dechassa, 2008).

Organic fertilizer is not like chemical fertilizer in which its impression quickly acts against the roots. Organic fertilizer sown at the perimeter or around the base of a plant requires several types of microorganisms to decompose it before it is absorbed by the roots of the plant and should the soil / medium have to be moist to allow the microorganism to perform the decomposition activity. During this decomposition process nutrients are liberated. In general, a piece of organic fertilizer is useful at the beginning of the year after it is sown at the boundary and gradually releases nutrients after being decomposed by microorganisms that may be used in the future. The splitting or decomposition of organic fertilizer does not apply simultaneously in which it also gives the task of restoring to your soil or limits (Hailu *et. al.*, 2008).

There is also a type of organic fertilizer that can only survive at certain periods and often put it at the limit of at least 2 weeks to ensure the nutritional stock in the plant is always enough and balanced to allow the plant seed to grow healthy where known as harvester amino. Whereas, inorganic fertilizer (also called chemical fertilizer or synthetic fertilizer) are

generated through chemical counter of measures and contain minerals or synthetic chemicals. The inorganic s also contain nutrients at a certain level, corresponding to the purpose of the fertilizer being used. Examples of inorganic fertilizer are MOP (Muriate of Potash) and TSP (Triple Superphosphate). Others is like, Green NPK Steel, Blue and so on are also examples of inorganic fertilizer and have Nitrogen (N), Phosphorus (P) and Potassium (K) elements at a certain level (Hailu *et. al.*, 2008).

The advantage of inorganic fertilizer is that the inner nutrient is available in a form that can be used continuously by plants. In fact, the principal can absorb the necessary nutrients immediately and immediately after the steels are granted so that the original principal reveals the change within days of the empire(Hailu *et. al.*, 2008).

In addition, the levels of nutrients that are known clearly on the chemical fertilizer labels can help us provide sufficient nutrients to the principal. Appropriate scheduling systems and systems can be created to get the desired results. Another advantage of inorganic fertilizer is the cheaper price than organic fertilizer.Meanwhile, the lack of fertilizer is not organic or either is it generated rather than a source that should not be renewed so as to give the impression of a long-term nature to nature. Cultivators also can not produce their own chemical armor, causing them to be dependent on outside sources for empowerment. However, unsupplied organic fertilizer is available in a form that can be absorbed constantly, the problem is more steel may apply to kill our plants. Nutrients in fertilizer are also tend to dissolve into the soil so that it is not achieved by the root (Hailu *et. al.*, 2008).

Beside, the continued use of chemical fertilizer is risky to form toxic residues such as arsenic in the soil. Other than that,Continuous use also contributes to changes in soil pH and gives a negative impression to the plant. (Hailu *et. al.,* 2008).

CHAPTER 3

MATERIALS AND METHODS

3.1 Description of study area

For this research experimental site, this experiment was conducted at Malaysian Agriculture Research and Development Institute (MARDI), Cameron Highland which is situated in Pahang. Cameron Highland is also known as Tanah Rata which is a low temperature place the one and only situated in Malaysia. The temperature there contribute more vegetable crops to be planted there. The most high demanding is about the production of agricultural production that comes from Cameron Highland which know as the high quality and more nutritious crops made up for Malaysia market. MARDI Cameron Highland takes 5 hours journey from Universiti Malaysia Kelantan, Jeli Campus. During experimental date until getting the end result, Mardi will provide facilities like accomodation and also provide technical assistance to assist the project.

This field study was conducted at vegetables crop research plot which located at near to the nursery and glass house at MARDI. This may help a lot because the area given are enough to place 200 samples of lettuce plant. Given that the area of the experiment site is (48ft length x 23ft) width which required for (9ft x 3ft) for each planting that are required for about 10 plants of each planting bed.

3.2 Preparation of media

3.2.1 Preparation of sowing media

Sowing media for lettuce was prepared on three polystrene trays which each of tray contain 104 seedings to be sown. The media are only peat grow without and mixing of other growing media treatment. After a week of sowing days. The root of plant will strong enough so that the application of bayfolan were used to make sure that the fertility and maturity of plant germination are in control.

3.2.2 Preparation of land and soil tillage for media of transplanting on planting bed.

For land preparation, it was started at first point which is clearing grassess and weeds, clearing all the previous plastic bed and piece of metals that have been used in the previous research. Soil tillage was occured to make sure that the soil texture are suitable enough for the next project where the nutrient of the soil will be in control after the soil tillage. Stated that the soil pH have been observe and determine using composite methods where thesoil sample from each part of the edge of the area will be taken and mix it until it was perfectly mixed. Then, the soil pH will be determine using electronic soil ph detector. Given that the soil ph is 7.4 and suitable for planting.

Before transplanting occurs, right after 2 weeks of seeding process and 2 weeks of the land preparation the land were ready to be attached for the first fertilizer treatment which called basal treatment, where the basal treatment used to make sure that the nutrient contain in the soil will gain fertility for the soil to grow the plant after transplanting occurs. Before transplanting make sure that the soil are full ready to maintain the soil humidity and fertility to make sure that performance growth of plant are in moderate.

3.3 Preparation of lettuce seeding

For this research the Green Coral lettuce seed are used. The seed was prepared by the Research Officer in MARDI. As it cost about RM75 for one packet which cointain 1000 seeds. By using the forcep each of the seed will be transfer to the sowing trays. After 3 days the germination will occurs if the seed is fertile. If the is no germination after 3 days the seeding and sowing process will be repeated again. After 7 weeks of seeding the plant are ready to be transplant to the planting bed.

3.4 Experimental design

For this research, the experimental design was carried out by using a Randomized Complete Block Design (RCBD). In this study, each treatment were undergoes by four replications. Followed by Treatment 0 (control), Treatment 1(10g), Treatment 2 (20g), Treatment 3 (30g) and Treatment 4 (NPK) act as the first treatment that was carried out by the amount of organic matter in media preparation as been stated in the methodology part. The rate of growth performance was observed right after 45 days after the transplanting is done and the succession will also be determined by the rate of performance growth for both tretament in lettuce.The parameters that are measured is, root fresh, height of the plant, leaf area, leaf freshness, number of leaf and also dry mass of the plant will be recorded after the day of transplanting occur in accurately after 7 weeks. As if was transplanted to both side using a polybag. All the responses variables and significant variation that future analyzed were subjected in two-way ANOVA for this research as a term in collecting tabulated data record using IBM SPSS Statistics version 21.

Table 3.4.1: The arrangement of planting bed using RCBD method.

T4R1	T1R2	T2R3	T3R4
T2R1	T3R2	T4R3	T4R4
T3R1	T2R2	T3R3	T1R4
T1R1	T4R2	T1R3	T2R4

Refers for this research, treatment 0 are conducted as a control method where there is no fertilizer apply for that treatment and it was possibly not situated at the same place as the other planting bed. Where on the planting bed it was only consist of T1, T2,T3 and T4. It is because to make sure that the T0 will not contaminate with any fertilizer. The treatment of the organic matter for organic and inorganic fertilizer are refers as table below:

Table 3.4.2: The amount of fertilizer applied per plant for each treatment refers

Treatment	Amount of fertilizer per plant(g)	Amount of fertilizer per hectare(tan/ha)
Treatment 0 (control)	0	0
Treatment 1	10	400
Treatment 2	20	500
Treatment 3	30	600
Treatment 4 (NPK)	10	400

In this research the accurate amount of fertilzer needed for each organic and inorganic fertilizer for kilogram per hectare are maximum at 600tan per hectare. So that, refers for this in per hectare amount are refers as table below:

3.5 Schedule for fertilizer application

The application for fertilizer in this experiment was on week first for basal treatment, week 4, and week 6 after transplanting. The application of fertilizer was done right after collecting data. To make sure that it may not distruct the performance growth of plant in current time. Then after one week of fertilizer application it will be followed with the data recording. Additionlly, the time taken for a fertilizer to be absorbed in soil is depend on the texture andabsorben of the fertilizer make sure to take a good observer upon the soil and fertilizer often.

3.6 Crop maintainance

Maintainance and management practices sure to be take in action for this experimental study because the usage of plastic shelter are not in use. So that, manual treatment should be done. Practice that needed to be done here is including weeding, cleaning planting bed, lushing soil/ground and also watering plant manually using clear water. Some observation was done on pest and disease for crops and do prevent it manually because in this research. The usage of any chemical substance are not contribute publicly just to make sure that it may not let the crops contaminated with the chemical substabces. And this was due to the step on promote healthy planting style for agro industrial.

3.7 The parameter or data collected

The growth performance of lettuce were observed by the followed parameters given:

I. root ,
II. stem,
III. head,
IV. height of the plant,
V. leaf freshness,
VI. dry mass
VII. Number of leaf.

All the refers parameter was measured by using appratus that are appropriate in measuring height, weight and mechanical dryer are used to undergoing process of measuring fresh and dry mass. Materials and appartus that are used in this experiment are including measuring tape, rulers, balancing, and dryer.

3.8 Data analysis

All the sample was analyzed by the Complete Randomized Block Design (CRBD). At last, data will be analyzed by using data collecter IBM SPSS Statistics Version 21 for the determination of those significant difference for each treatment were clearly analyzed to get an accurate results for this experiment.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 The Effect of different levels of organic matter on growth performance of lettuce

The result of this study were effect of different levels of organic matter on growth performance of lettuce. The result of this growth performance of lettuce that are effected by the different levels of fertilizer applications was based on objective 1.3.1.

Data regarding the effect of different level of organic fertilizer on leaf number, plant height and canopy size are summarized in Table 1. It was found that application of organic fertilizer doseat 600 tan ha^{-1} refers to 30g of organic fertilizer of a plant (T3) resulted in significantly greater number of leaf, plant height and canopy size. The highest number of leaf (62.01 ± 3.34) was observedin the T3, followed by 37.67 ± 4.02, 34.67 ± 3.54, 34.01 ± 1.01 and 24.58 ±2.51 in T2, T4, T1 and T0 respectively. Similarly, the highest plant height(35.05 ± 1.80 cm) was observed in the T3, followed by 25.25 ± 1.80 cm, 22.93 ± 3.14 cm, 20.14 ± 3.08 cm and 20.11 ± 1.06 cm in T4, T2, T1, and T0 respectively. The larger canopy size (35.15 ± 1.65 cm) was found in T3 followed by 28.55 ± 1.33 cm, 27.40 ± 0.58 cm, 24.05 ± 1.13 cm and 22.66 ± 1.55 cmin T4, T2, T1 and T0 respectively (Table 4.1.1).

The present finding also support Pavlou*et al*., (2007) study which concluded that the application of organic fertilizer could be recommended to increase the lettuce yield without the application of chemical fertilizer. Similarly, most recent studies have confirmed that

application of organic matter result significant higher lettuce plant growth as compared with inorganic fertilizer (Hossain and Ryu, 2017).Similar advantage of organic manures in terms of crop growth and nutrient uptake was reported (Haruna, 2011).

One of the more significant findings to emerge from this study is that the application of organic fertilizer was found to be better over chemical fertilizer (NPK) application.

Table 4.1.1 The effect of different levels of organic matter on growth performance of lettuce.

Treatments	Number of leaf	Plant height (cm)	Canopy (cm)
T0: (control)	24.58 ± 2.51^{d}	20.11 ± 1.06^{c}	22.66 ± 1.55^{c}
T1	34.01 ± 1.01^{c}	20.14 ± 3.08^{bc}	24.05 ± 1.13^{c}
T2	37.67 ± 4.02^{b}	22.93 ± 3.14^{bc}	27.40 ± 0.58^{b}
T3	62.01 ± 3.34^{a}	35.05 ± 1.80^{a}	35.15 ± 1.65^{a}
T4: (NPK)	34.67 ± 3.54^{bc}	25.25 ± 1.80^{b}	28.55 ± 1.33^{b}

*Means sharing the same letters within a column are not significantly different from each other at $P < 0.05$ after testing Duncan test.

4.2 The effect of different level of fertilizers treatment of lettuce on head, stem and root.

The results of the present study also suggest that, organic fertilizer harvester amino 5:5:5 at the dosage of 600 tan ha^{-1} without chemical fertilizer could be recommended to increase lettuce yield. Therefore organic matter is may be recommended to the growers for getting better yield of lettuce. The result of this growth performance of lettuce that are effected by the different levels of fertilizer applications was based on objective 1.3.2.

Effects of different level of harvester amino 5:5:5 doses on biomass of lettuce are summarized in table 4.2. Organic matter applied at 600 tan ha^{-1} which equivalent to 30g fertilizer per plant was significantly increased in fresh and dry weight of lettuce head over NPK green fertilizers applied. The highest fresh weight was 486.29 ± 14.63 g of lettuce head per single lettuce in T3 (30g per plant), followed by 374.29 ± 18.70 g, 350.59 ± 11.61 g, 278.35 ± 18.14 g and 192.98 ± 11.68g in the T4, T2, T1 and T0 respectively. Similarly, significant increased dry weight of lettuce head over the control and inorganic fertilizer treatments. The highest dry weight of lettuce head (25.79 ± 2.40g) was found in T3, followed by 16.59 ± 1.92 g, 15.61 ± 3.93 g, 10.54 ± 2.32 g and 8.54 ± 0.85 in T4, T2, T1 and T0 respectively (Table 4.2.1)

Next, the highest fresh weight stem was 42.91 ± 3.89 g of lettuce stem per single lettuce in T3 (30g per plant), followed by 30.80 ± 3.69 g, 30.43 ± 2.77 g, 19.12 ± 3.10 g and 13.11 ± 2.88g in the T4, T2, T1 and T0 respectively. Similarly, the significant are also increased in dry weight of lettuce stem over the control and inorganic fertilizer treatments. The highest dry weight of lettuce head (2.94 ± 2.58 g) which found in T3, followed by 2.13 ±

2.35 g, 2.11 ± 2.25 g, 1.65 ± 1.83 g and 1.21 ± 0.81 in T4, T2, T1 and T0 respectively (Table 4.2.1).

The results show that the highest stem were refer to Treatment 3 which required of 30g of organic fertilzer. It was due to the preferable amount of fertilizer that are needed of the plant. And it was given in a great amount of nutriet as the stem may shows that it can be more healthy and high in weigh more that others. In observation, it also shows that the weeds that are fight for the nutrient at the same area are also interupt the growth performance of lettuce. So, step on better weeding progress are done to make sure that the plant will receive an appropriate amount of nutrient to maintain the growth of the stem including the whole plant.

As for the highest fresh weight of root it was stated that the value is 37.18 ± 3.83 g of lettuce root per single lettuce in T3 (30g per plant), followed by 27.79 ± 2.83 g, 24.79 ± 3.00 g, 19.48 ± 2.25 g and 15.39 ± 3.92 g in the T4, T2, T1 and T0 respectively. Additionaly, the similarity of the significant was increased also in dry weight of lettuce roots over the control and inorganic fertilizer treatments. The highest dry weight of lettuce roots is that (7.26 ± 3.42g) was found in T3, followed by 3.46 ± 3.33 g, 4.25 ± 2.83 g, 2.79 ± 3.67 g and 2.15 ± 2.75 in T4, T2, T1 and T0 respectively (Table 4.2.1).

For roots, the results also show that the highest weigh of root are T3 , it is because it were given a prefered amount of fertilizer to grow. Moreover, in this study the area was surrounded with the other weeds and grass. But, by presented a better soil tillage and soil preparation before planting it were not distrupting the plant to grow well as usual plant.

This can be conclude here that the overall result was increased and shows the most highest value is at Treatment 3 which refers to the usage of 30g of organic fertilizer.The present

finding is consistent with findings of past studies by Villas Boase*et al*., (2004);Haruna, (2011) and Hossain and Ryu, (2017), that found the positive effect of organic on fresh weight. It could be observed that the organic compounds increased fresh weight of plant.

Similarly, Oliveira et al., (2010) provided an evidence that the application of organic fertilizers in lettuce increases the yield and nutrient content in plants. Knowing that leafy vegetables respond well to organic manure results obtained from an experiment with lettuce, concluded that organic matter mineralization contributed for nutrients to plants supplying their needs during development, because the area was managed with organic practices about for many years.

In this experiment, it shows that the best treatment among all treatment are Treatment 3. Where the preferable rate of organic matter harvester amino needed per plant are only at 30g. Besides, it does not shows that the other amount of fertilizer given are not giving a good rate for plant. It only shows here that other rate at T1 and T2 are not preferable to get a highest growth performance for a plant. Indeed, it also show here that the result of using NPK green are also perform as the highest among T1 and T2 but still treatment of organic fertilizer are recommended in this study. In this case, it shows that both objectives were answered by this study were the effect of organic fertilizer shows the most preferable and suitable rate of organic matter in fertilizer that uses in fertilizing system of lettuce were at level of Treatment 3.

Table 4.2.1 The effect of different level of fertilizers treatment of lettuce on head, stem and root.

Treatments	Head		Stem		Root	
	Fresh weight (g)	Dry weight (g)	Fresh weight (g)	Dry weight (g)	Fresh weight (g)	Dry weight (g)
T0: (control)	192.98 ± 11.68^{d}	8.54 ± 0.85^{c}	13.11 ± 2.88^{c}	1.21 ± 0.81^{c}	15.39 ± 3.92^{c}	2.15 ± 2.75^{c}
T1	278.35 ± 18.14^{c}	10.54 ± 2.32^{c}	19.12 ± 3.10^{c}	1.65 ± 1.83^{bc}	19.48 ± 2.25^{c}	2.79 ± 3.67^{bc}
T2	350.59 ± 11.61^{b}	15.61 ± 3.93^{b}	30.43 ± 2.77^{b}	2.11 ± 2.25^{b}	24.79 ± 3.00^{b}	4.25 ± 2.83^{b}
T3	486.29 ± 14.63^{a}	25.79 ± 2.40^{a}	42.91 ± 3.89^{a}	2.94 ± 2.58^{a}	37.18 ± 3.83^{a}	7.26 ± 3.42^{a}
T4: (NPK)	374.29 ± 18.70^{c}	16.59 ± 1.92^{b}	30.80 ± 3.69^{b}	2.13 ± 2.35^{b}	27.79 ± 2.83^{b}	3.46 ± 3.33^{bc}

*Means sharing the same letters within a column are not significantly different from each other at $P < 0.05$ after testing Duncan test

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

As a conclusion, this reserch was success where we can determine what is the effect of organic matter, harvester-amino 5:5:5 in growth performance of lettuce. Claimed that the organic matter in fertilizer consist a lot of useful matter to increase the growth performance of plant while to protect the soil condition to be more better in the future. Also, the usage of organic matter in fertilizer may also increase the soil fertility in long time.

Next, this research also show that the second objective of this experiment was achieve where T3 shows that it come in the most preferable and suitable rate as term of application of organic matter in fertilizing system for lettuce. So that, it was identified that the preferable rate amount of organic fertilizer is 30g per plant which required 600tan per hectare of organic fertilizer or also known as harvester-amino 5:5:5.

5.2 Recommendation

As for the recommendation, an organic matter harvester amino at the dosage of 600kg per hectare without chemical fertilizer and any other chemical substances including in pest and disease control could be recommended to increase the lettuce yield or any other posibble crops. Therefore the organic matter are also recommended to the growers of plant for getting better yield for lettuce. As for some other part, the oragnic matter also may help to reduce the pollution in environmental aspects. Moreover it also may help to control the soil conservation in long term for the future.

Beside, as for the step to overcome problem for in doing field experimental research. Make sure to prepare a great whole schedule for each activity that needed to be followed. For planting methods, do overcome weeding in open space by using plastic shelter to protect whole planting bed from affected by the grasses and weeds. To finish the research on time, make sure to have a great preparation before start and experiment especially field study.

Last but not least, do reduce the usage of inorganic matter in any of agriculture activity because a great product in agro based industry come out from a great soil which do not contain any harmful chemical inside. Human being needed to consume a safe food beverage.

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APPENDICES

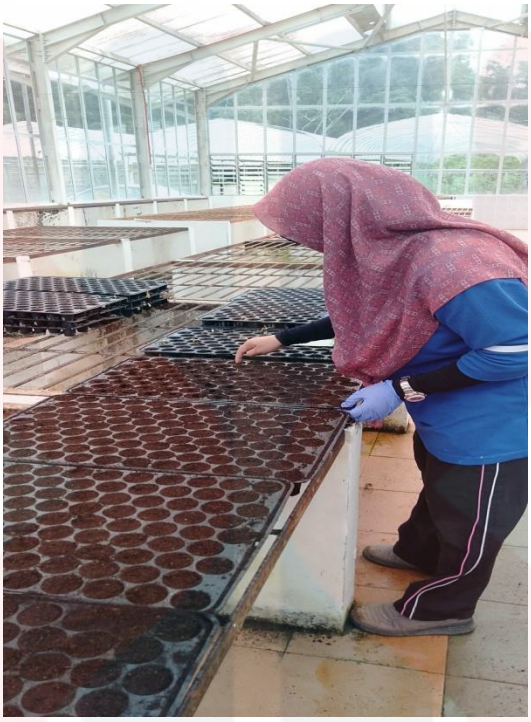

Figure 1: Process of sowing seedling in glass house at MARDI.

Figure 2: Preparation of land and soil tillage process.

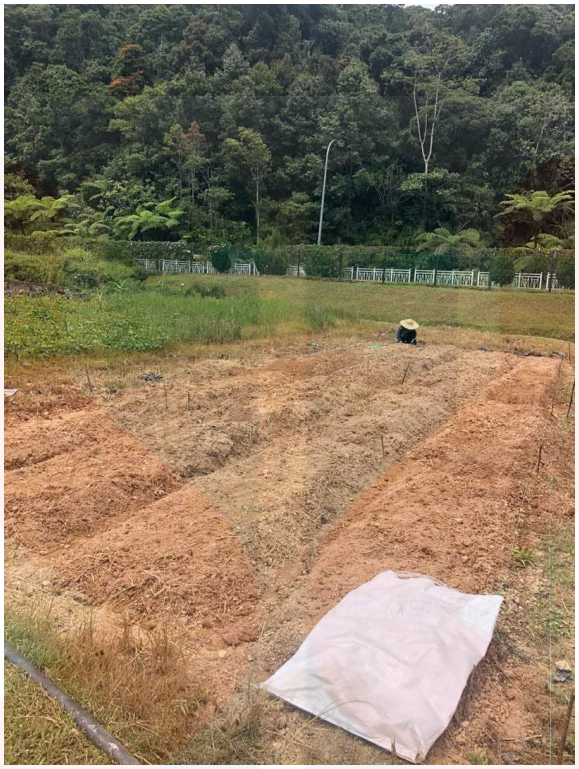

Figure 3: Process of measuring area of plantation and lining the boundaries of planting bed

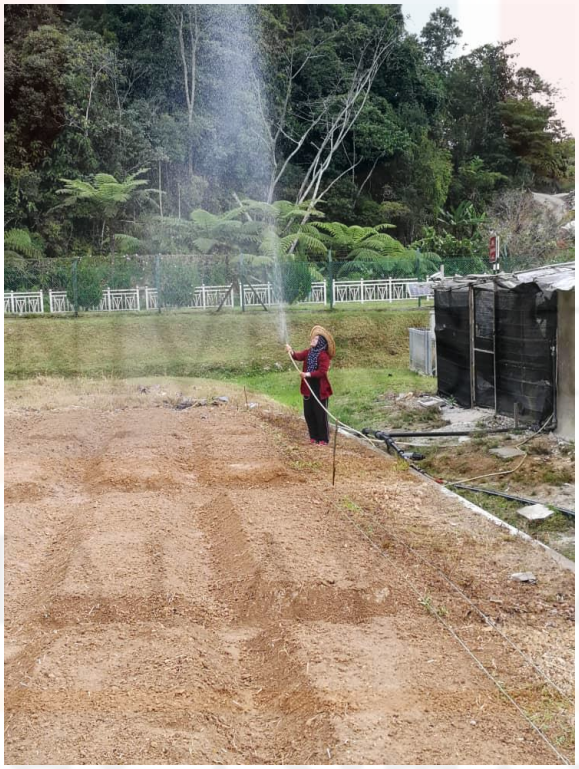

Figure 4: Process of watering lushes soil.

Figure 5: Plant arrangement. 2 weeks after transplanting

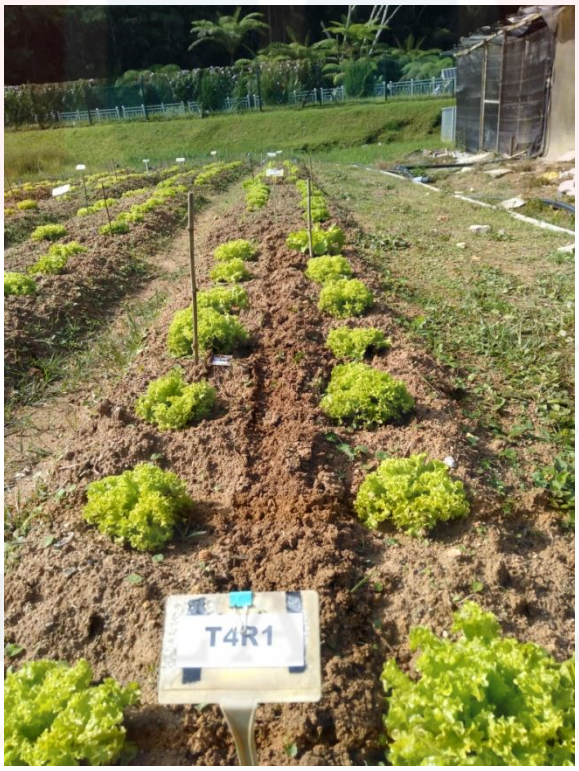

Figure 6: Fertilizing method on planting bed.

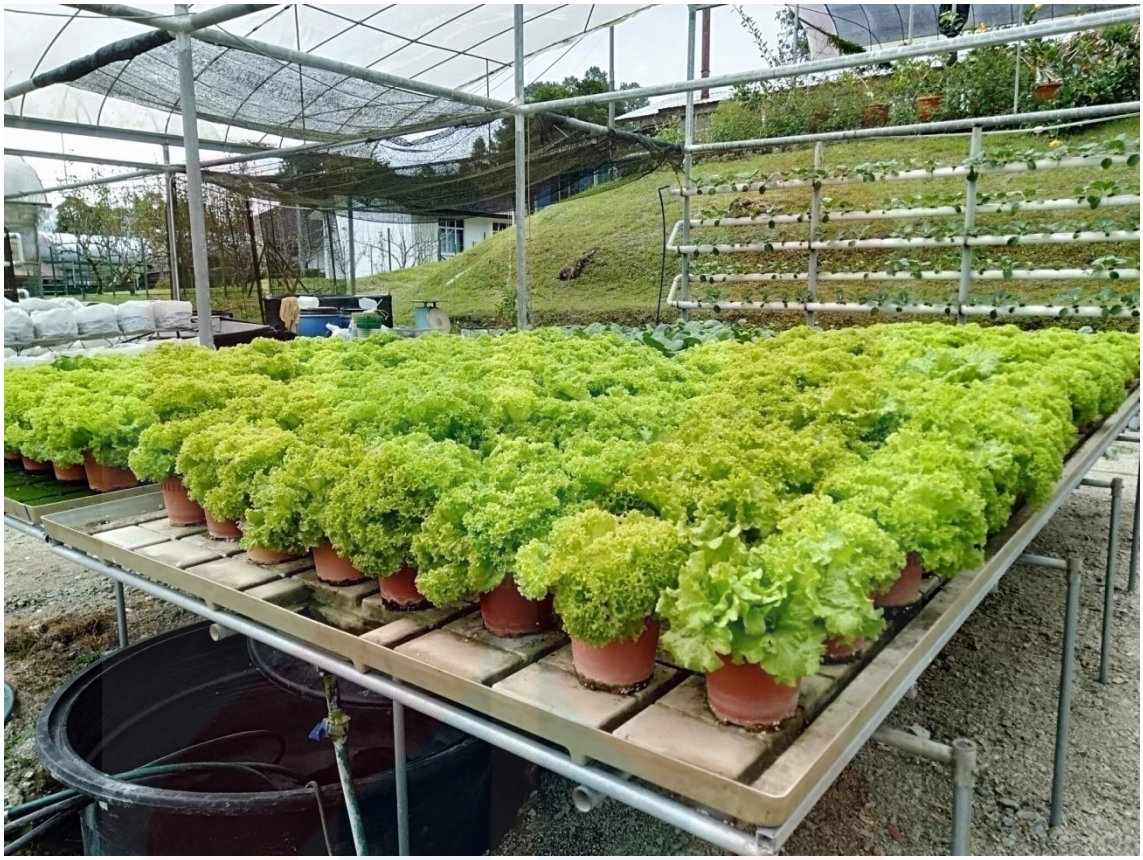

Figure7: Conventional method using deep flow system NFT(AB fertilizer) fertigation system.

Figure 8: Cleaning process after harvesting the lettuce.

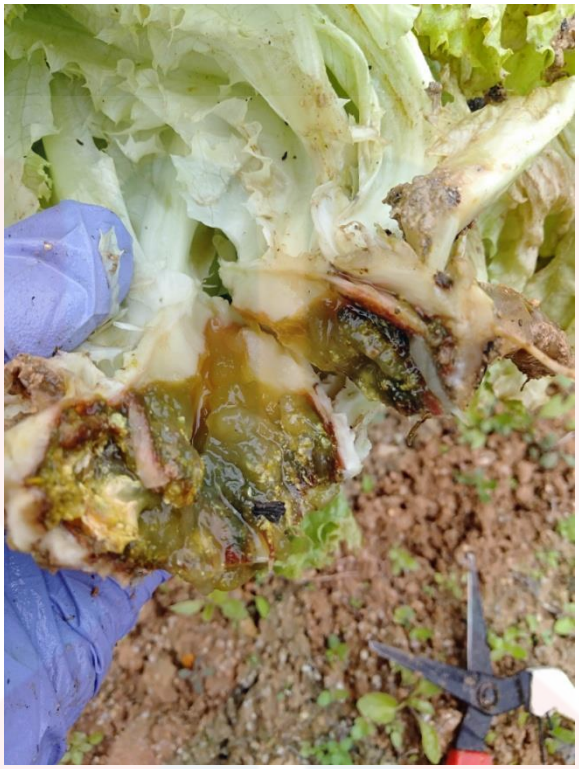

Figure 9: Plant disease(Fungi attack)

Figure 10: Data measurement part.(fresh and dry weight of head,stem and root)