STUDY ON THE GROWTH PERFORMANCE OF RUBBER SEEDLINGS USING BIO-ORGANIC FERTILIZER

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Partial Fulfilment of the Requirements for the
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DECLARATION

This Final Year Project is a partial fulfillment of the requirements for a degree of Bachelor of Science (Hons.) Plantation Technology and Management, Faculty of Plantation and Agrotechnology, Universiti Teknologi Mara.

It is entirely my own work and has not been submitted to any other University or higher education institution, or for any other academic award in this University. Where use has been made of the work of other people it has been fully acknowledged and fully referenced.

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I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Science (Hons.) Plantation Technology and Management, Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA.

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MOHAMAD SYAZWAN BIN M.ROSLEY

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
H0	Null Hypothesis
H1	Alternative Hypothesis
Cm	Centimeter
G	Gram
M	Meter
N	Nitrogen
P	Phosphorus
K	Potassium
Mg	Magnesium
%	Percent
pH	Potential Hydrogen
L	Liter
Ml	Mililiter
CRD	Complete Randomized Design
T0	Treatment Control
T1	Treatment One
T2	Treatment Two
T3	Treatment Three
T4	Treatment Four
UiTM	Universiti Teknologi MARA
AL	Alfa Life

ABSTRACT

STUDY ON THE GROWTH PERFORMANCE OF RUBBER SEEDLINGS USING BIO-ORGANIC FERTILIZER

The precise use of fertilizers is very important in a rubber nursery establishment to ensure quality production of planting materials and optimizations of the fertilizing cost. This study was conducted for two month periods to see the growth performance of rubber seedlings using different type of fertilizers and different percentage rate of combination fertilizer. The objective of this study is to observe whether bio-organic fertilizer can replace NPK yellow (control) fertilizer and to identify the best combination of bio-organic fertilizer with NPK Yellow fertilizer. Alfa Life fertilizer was used to represent bio-organic fertilizer while NPK Yellow fertilizer as the control fertilizer that been recommended by Malaysia Rubber Board (MRB). The study was carried out at greenhouse in UiTM Jasin, Melaka. The experiment was laid out in a Complete Randomized Design (CRD) with five treatments and four replications.T0 (100% NPK Yellow) and T1 (100% AL) was compared to see whether bio-organic can replace NPK yellow while T2 (75% NPK Yellow + 25% AL), T3 (50% NPK Yellow + 50% AL) and T4 (25 % NPK Yellow + 75% AL) have been identified as the best combination of treatments. Data on growth such as seedling height, stem girth, leaves dry weight, stem dry weight and root dry weight were collected. The data was tested with Analysis of Variances (ANOVA) and grouping information using Tukey method by using Minitab 16.1. Result showed that there were no significant differences among the five treatments and all treatments have been shared the same group "A" for five parameters. T0 have better mean in seedling height, stem girth, leaves dry weight and root dry weight than T1. So, this result showed Alfa Life (bio-organic) fertilizer is not able to compete with NPK Yellow (control) due to no significant difference between both of them. The best combinations of the three treatments were T4 which consist of 25% of NPK Yellow and 75% of Alfa Life fertilizer. The highest mean for all parameters were T4 which is the best treatment among the five treatments. The fertilizer combinations of T4 have the better result than the control fertilizer. Thus, fertilizer combination of T4 is recommended to replace T0 (control fertilizer).

ABSTRAK

KAJIAN TERHADAP PRESTASI PERTUMBUHAN ANAK BENIH GETAH MENGGUNAKAN BAJA BIO-ORGANIK

Penggunaan baja tepat adalah sangat penting dalam penubuhan tapak semaian getah untuk memastikan pengeluaran kualiti bahan tanaman dan pengoptimuman kos membaja itu. Kajian ini dijalankan bagi tempoh dua bulan untuk melihat prestasi pertumbuhan anak benih getah apabila menggunakan jenis baja dan peratusan kadar baja gabungan yang berbeza. Objektif kajian ini adalah untuk melihat sama ada baja bio-organik boleh menggantikan baja NPK Yelow (kawalan) dan untuk mengenal pasti kombinasi terbaik baja bio-organik dengan baja NPK Yellow. Alfa Life baja digunakan untuk mewakili baja bio-organik NPK manakala baja NPK Yellow sebagai baja kawalan yang telah disyorkan oleh Lembaga Getah Malaysia (LGM). Kajian ini telah dijalankan di rumah hijau UiTM Jasin, Melaka. Eksperimen telah ditetapkan dalam Complete Randomized Design (CRD) dengan lima rawatan dan empat pengulangan.T0 (100% NPK Yellow) dan T1 (100% AL) telah dibandingkan untuk melihat sama ada bio-organik boleh menggantikan NPK Yellow manakala T2 (75% NPK Yellow + 25% AL), T3 (50% NPK Yellow + 50% AL) dan T4 (25% NPK Yellow + 75% AL) telah dikenal pasti rawatan kombinasi yang terbaik. Data mengenai pertumbuhan seperti ketinggian anak benih, batang lilitan, berat kering daun, berat kering batang dan berat kering akar telah dikumpul sebagai parameter dalam kajian ini. Data telah diuji dengan Varian Analisis (ANOVA) dan maklumat kumpulan menggunakan kaedah Turki dengan menggunakan Minitab 16.1. Keputusan menunjukkan bahawa tidak terdapat perbezaan yang signifikan antara lima rawatan dan rawatan telah berkongsi kumpulan yang sama "A" untuk lima parameter. T0 mempunyai purata yang lebih baik seperti ketinggian anak benih, lilitan batang, daun berat kering dan akar berat kering daripada T1. Oleh itu, keputusan ini menunjukkan baja Alfa Life (bio-organik) tidak dapat bersaing dengan baja NPK Yellow (kawalan) walaupun ia boleh menggantikan baja NPK Yellow kerana tidak ada perbezaan yang signifikan kedua-dua mereka. Kombinasi terbaik daripada tiga rawatan ialah T4 yang terdiri daripada 25% daripada baja NPK Yellow dan 75% baja Alfa Life. Purata tertinggi bagi kesemua parameter ialah T4 yang merupakan rawatan yang terbaik di antara lima rawatan. Kombinasi baja daripada T4 mempunyai keputusan yang lebih baik daripada baja kawalan. Oleh itu, gabungan baja daripada T4 adalah disyorkan untuk menggantikan T0 (baja kawalan).

CHAPTER 1

INTRODUCTION

1.1 Background of study

In 1877, Sir Henry Wickham was the person that introduced natural rubber (*Hevea brasiliensis)* to Malaysia and the Residency Garden was the first to plant rubber seedlings in Kuala Kangsar (Alias Othman, 2008).In 1970, the most important industry crop in Malaysia is the rubber. The first rubber producer in the world in 1980 is Malaysia. While, the biggest rubber cultivator in the world is Indonesia and Thailand. Industrial technology development changed the role of rubber plantation besides producing raw materials of rubber based product, the rubber wood can also be used in wood production industries (Azmi Shahrin, 2007).

In general, plants required 17 essentials nutrient to survive and it was separated into two classes of nutrients which were known as macronutrients and micronutrients. In rubber, there are four major essential nutrients needed which are Nitrogen, Phosphorus, Potassium and Magnesium with different fertilizer rate requirement in each growth stages (Shafar Jefri *et al.*, 2012). Improper application rate of fertilizer used can lead to the decreasing in yield and low crop growth performance. Beside that, it can also harm the environment due to over fertilizing. Hence, to increase yield and to decrease the pollution of environment, we need to identify the optimum fertilizer rate for crop (Dharmakeerthi et *al.*, 2006).

Chemical fertilizers used can give the bad impact in long term towards soil fertility, crop yield and it can disturb the ecological system. While, the application of organic manures help in soil humus as well as to promote the growth of more beneficial microbes and improving soil properties. Unfortunately, major nutrient content of organic manure have small amount of nutrient quantities and high in transportation cost (Somashekharappa *et al.*, 2014). However, foliar nutrition that applies to plant organs can give the macro and minor nutrient which are needed by plants. In addition, foliar nutrition can minimize the environmental hazard such as water pollution in the ground (S. A. Haji *et al.*, 2014).

1.2 Problem Statement

Active absorption of nutrient is crucial in ensuring a good plant growth. In rubber plantations sector, chemical fertilizer in granule form is commonly used at nursery and field. According to Sosilawati *et al.*, (2011), the improper use and long term application of chemical fertilizer will effect the soil fertility as well as the crop productivity due to deterioration of soil quality. The chemical fertilizer application must be dissolved in water with the help of rain water which is it will slow down the process of absorbing nutrient by roots. Bio-organic fertilizer is another alternative available to be incorporated in the soil to enhance crop growth. Bio-organic fertilizer has both superiorities of bio-fertilizer and organic fertilizer, which can not only increase production, improve product quality, but also regulate and improve the composition of soil microorganism, and then reduce the danger of crop disease to some extent (Huasheng *et al.,* 2014).

1.3 Objectives

The objectives of this study are as follows:

1) To observe whether Bio-organic fertilizer can replace NPK yellow.
2) To identify the best combination of Bio-organic fertilizer with NPK yellow.

1.4 Research Question

1) Does the Bio-organic fertilizer can replace NPK Yellow?
2) What is the best combination of Bio-organic fertilizer with NPK yellow?

1.5 Hypothesis

- **Bio-organic fertilizer can replace NPK yellow**

  H0: There is no significant different between the using of Bio-organic fertilizer and NPK yellow on the growth performance of rubber seedlings.

  H1: There is significant different between the use of Bio-organic fertilizer and NPK yellow on the growth performance of rubber seedlings.

- **The combination of Bio-organic fertilizer and NPK Yellow**

  H0: There is no significant different among the treatments used on the combination of Bio-organic fertilizer with NPK yellow.

  H1: At least one treatment is different compared to the others.

1.6 Significance of study

The significance of study is to evaluate whether Bio-organic fertilizer can replace NPK yellow and to identify the best combination of liquid organic fertilizer with NPK yellow for rubber seedlings in rootstock production stage.

CHAPTER 2

LITERITURE REVIEW

2.1 Background of rubber

2.1.1 Scientific classification

Table 2.1 *Showed the taxonomic classification for rubber.*

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Euphorbiales
Family	Euphorbiaceae
Genus	Hevea
Species	Brasiliensis
Scientific name	Heavea brasiliensis
Common name	Rubber

Sources: http://e.wikipedia.org/wiki/Heavea_brasiliensis

2.1.2 Origin of rubber Distribution

The Amazon Basin of South America is the origin place for rubber trees (Othman Yaakub, 2000). According to Hari and Bharat (2010), the name of "Cautchouc" was the first name of rubber tree which means weeping wood in

French language given by Amazonian Indians and British had changed that name to India Rubber Tree in 1770. *Hevea brasiliensis* or known as natural rubber was in the family of Eurphorbiaceae. Latex polymer is the product of natural rubber where it has special characteristics which are high elasticity, flexibility and resilience (Ahmad Yamin et al., 2013). Even though, it have an alternative such as synthetic rubber, but the qualities of synthetic rubber is it cannot compete with the product of natural rubber (Schmidt et al., 2010).

2.1.3 Characteristics of rubber tree

Rubber is a plant that can grow fast, the main stem rising in vertical direction and commonly dull in color with a soft bark. It can rise to more than 40 meters with the life span more than 100 years and it is the tallest of the genus. In plantation industry, the economic life of rubber tree is below than 25 years and the height of rubber tree is not usually more than 25 meters (Priyadarsyan, 2011). The requirement of rainfall is 180cm to 250cm per year and need 25°C to 35°C of temperature (Monsuru Salisu et al., 2013).The suitable soil pH range for rubber trees is 4.0-6.5. If soil pH is more than 8.0, it will disturb the growth of rubber such as stunted growth (Priyadirsyan, 2011).

2.1.4 Rootstock production

Seeds are the important component in nursery for rootstock production. In order to produce clone plant, rootstock will be used for bud grafting. After bud grafting, the growth performance of scion will be influenced by the rootstock.

The characteristics of rootstock which have a good rooting system have a high ability to absorb water and nutrient, and it will give a positive effect towards the growth performance and yield of budded plant (Noordin, 2011). Seed that will be chose as rootstock must have certain criteria which are fresh, heavy, shine, not wilted and do not have any blemish on the seed. Seed from clone RRIM 623, RRIM 901, RRIM 605, RRIM 712, PB 5/51, PB 217, PB 235, and GT 1 are recommended for rootstock production while seed from clone of RRIM 600 and PB 260 is not recommended as rootstock (Omar *et al.*, 2008). However, seed from clone that have been cultivated in large scale area can be used for rootstock production (Lembaga Getah Malaysia,2007).

2.2 Cultivation of Rubber in nursery

The benefit in cultivating the good planting material of rubber such as resistant to disease and easy to manage will contribute high yield from rubber latex and rubber wood as well as giving high profit to the cultivars. There are two methods of propagation of rubber seedling in nursery stage which is sexual and asexual propagation. Sexual propagation is the pollination process that occurs naturally or artificially. The weakness of this method is the characteristics of seedlings are different and difficult to identify. Asexual propagation is ensures the uniformity of characteristics of rubber. It was divided into 3 groups which are budding, grafting and cutting (Omar, 2008).

2.2.1 Nursery of rubber

Rubber nursery is a place or areas that develop for prepare and propagate the high quality of planting material of rubber that will be used in rubber plantation. The objective of developing of rubber nursery is to prepare high quality planting material, to ensure the percentage of planting materials that will transfer to rubber plantation is high, to increase rate of survival planting material, to provide healthy seedlings and resistant to disease, and reduce the cost of plantation development (Omar, 2008).

There are two categories of rubber nursery which is ground nursery and polybag nursery. Seedling that planted on the ground is ground nursery while seedling planted in the polybag is polybag nursery. There are several factors to be considered to select the nursery site which is well structured and textured of soil, near the water source, flat or slightly sloping of land, water table is below than 75cm from the surface (for ground nursery only), open area of land and free from root disease source (Malaysia Rubber Board, 2009).

2.3 Chemical fertilizer

There are threes type of inorganic fertilizer or chemical fertilizer which is straight, mixture and compound fertilizer. Straight fertilizer consists of one elements of nutrient while mixture or compound fertilizers have more than two elements of nutrient. Compound fertilizer is better than mix fertilizer due to it have the uniform ratio of elements required. Compound and mixture fertilizer can be applied to rubber if the ratio of N, P, K and others elements are suitable for rubber trees (Yew, 2007).

2.4 Organic fertilizer

The use of organic material is essential to supply diversity types of plant nutrient, to make the soil physical and chemical properties better, increase water holding capacity and enhance microbial activities (Myint, 2010). Agricultural waste residues can be used as organic fertilizer such as cow dung and municipal solid waste compost. To improve the yield and quality of plant, the proper amount of organic fertilizer should be done (Kochakhinezhad *et al*, 2012).

2.5 Bio-organic fertilizer

Bio-organic fertilizer is the combination of organic fertilizer and beneficial microorganisms, which plays an important role in controlling soil-borne disease and meets the demand of the sustainable development of modern agriculture (Kai *et al,* 2014). Bio-organic fertilizer has both superiorities of bio-fertilizer and organic fertilizer, which can improve product quality, but also regulate and improve the composition of soil microorganisms, and then reduce the danger of crop disease to some extent (HuaSheng et al., 2014). The Bio-organic fertilizer not only plays important in growth promotion, yield increase, quality improvement and pest control but also sustains the ecological balance and environment quality and are economically beneficial and efficiemt (Huamei H., 2011).

2.5.1 Alfa life fertilizer

Alfa life fertilizer is liquid bio-organic fertilizer that content hundred percent of organic matter, free from chemical and environmental friendly. It consists of macro and micro nutrients that are rich in zeolite, guano, garam bukit and habbatus sauda. Beside that, this fertilizer content vitamin such as carotene, xanthenes, B1, B2, B6, C, E, K and niasin that are resistant to pest and disease. Alfa life content beneficial microorganism such rich are photosynthesis bacteria, yeast bacteria and acid lactic bacteria where they have host that provide complete sources for bacteria in order to survive and reproduce. This bacterium has high adoptability, resistant and can survive in any condition.

2.6 Fertilizer requirement of rubber seedling

All plants species need nutrient to grow and support in their development process. There are 16 elements at minimum that require or vital for the plants which is Carbon (C), hydrogen (H), oxygen (0), nitrogen (N),phosphorus (P),potassium (K),magnesium (Mg),calcium (Ca), sulfur (S), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), and chloride (Cl). Large amount of nutrient that required for plant called as primary, major or macronutrients such as nitrogen (N), phosphorus (P), potassium (K). For Secondary element, macronutrient or trace elements is required by plants in small amount such as sulfur (S), calcium (Ca) and magnesium (Mg). Plants get carbon, hydrogen and oxygen from atmosphere while water and others element of nutrient from soil (Priyadirsan, 2011).

According to Tuti and Angkapradipta., (1974) N application of rubber seedling will increased the plant girth and height. Nitrogen (N) is the component of chlorophyll which is promotes the plant growth and greenish the color of leaf. Phosphorus (P) has certain role in process of photosynthesis, respiration, energy storage, cell division and maturation. Potassium (P) involves in plant metabolism, protein synthesis and chlorophyll development. In other words, the function of nitrogen is to promote leaf growth, phosphorus important in development of root, flower and fruit, and potassium for stem and root growth and protein analysis (Samia Osman *et al.*, 2012).

Table 2.2 *Recommended rate and schedule of fertilizer application.*

Time of Application	Types of fertilizer	Quantity
Before transplant: Polybags	Natural Phosphate Dust	56 g per polybag
After transplant: 1-8 weeks (2 times a week)	Mixed of foliar fertilizer and fungicide : Bayfolan + Dithane M-45 + Daconil + water	5ml + 10g + 12g + 4.5 L
2 – 6 weeks (every week)	NPKMg fertilizer (15:15:6:4 + water)	56g + 4.5 L (5g per polybag)
Rootstock at 1 whorl stage of mature leaf (every month)	Granule of NPKMg fertilizer	7g per polybags
After looping the stem of rubber rootstock: 2 weeks and continue (2 times a week)	Bayfolan + Dithane M-45 + Daconil + Water	15ml + 10g + 12g + 4.5 liter

(Source: Teknologi dan Pengurusan Getah, 2008)

CHAPTER 3

METHODOLOGY

3.1 Location of Study

The study will be conducted at UiTM Melaka in Jasin Campus. It will be done in the greenhouse at Uitm Jasin.

3.2 Materials and Apparatus

3.2.1 Rubber rootstock seedlings

The polyethylene bags were 6 inches x 13inches in size. Top soil from Rengam soil series was used as planting media. The seed was sowed in the top soil and polyethylene bags. The planting material that will be used in this study was rubber rootstock seedling which will be selected at the age of four weeks after seed germination. Polyethylene bags, top soil and rootstock seedling were supplied by Risda Semaian Kesang during delivery.

3.2.2 Fertilizer

NPK Yellow fertilizer was used for control. Bio-organic fertilizer was used for the treatment. The brand name of product was Alfa Life.

3.2.3 Electronic weight balance

Electronic weight balance was used to measure the weight granule of the control fertilizer.

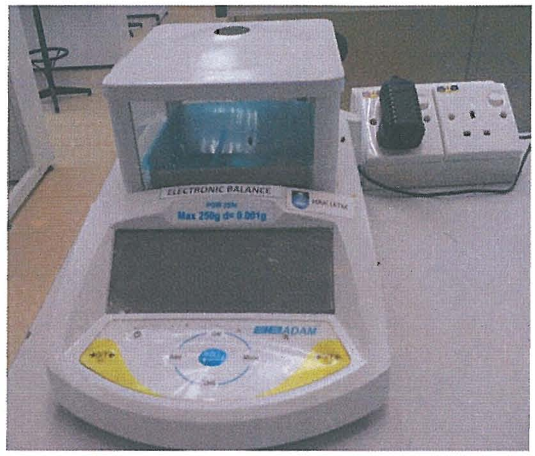


Figure 3.1 Electronic weight balance

3.2.4 Measuring cylinder

Measuring cylinder was used to measure the bio-organic fertilizer rate.

Figure 3.2 Measuring Cylinder

3.2.5 Beaker

Beaker was used to place liquid of bio-organic fertilizer before being transfer to measuring cylinder for measure rate of fertilizer.

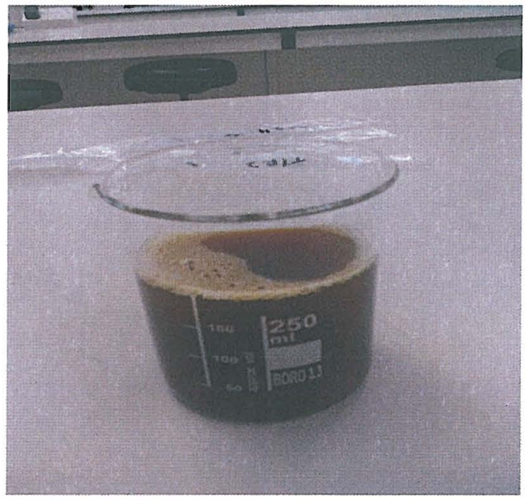


Figure 3.3 Beaker

3.2.6 Retractable measuring tape

The height and stem girth of rubber seedling were measured by using retractable measuring tape.

Figure 3.4 Retractable measuring tape

3.3 Irrigation

Watering the rubber rootstock seedlings two times a day until the experiment ended. Rubber rootstock seedlings needed water in the range of 0.5 – 1.0 L per day (Omar, 2008).

3.4 Preparation of treatments

3.4.1 Calculate the nutrient rate of rubber rootstock seedling

i. Recommended rate for rubber rootstock seedling was 7g per seedling for NPKMg (15: 15: 6:4)

Table 3.1 *Calculation of fertilizer rate.*

Items	NPK Yellow (15 : 15 : 6 : 4)	Alfa Life fertilizer (4.3 : 0.3 : 0.2 : 0.02)
% of N	15	4.3
Coefficient (Times)	1	3.4884
Equal (% of N)	15	15
Assumed	1g	1ml
Recommended	7g	X?
Times	1	3.4884
Equal	7g	(7g x 3.4884) =24.4 g@ 24.4 ml

ii. As recommended calculation of fertilizer rate for replace fertilizer:

$$\frac{Nutrient\ percentage\ of\ recommended\ fertilizer}{Nutrient\ percentage\ of\ substitute\ fertilizer}\ x\ rate\ of\ recommendent\ fertilizer$$

$$\frac{15}{4.3}\ x\ 7g = 24.4g\ @\ 24.4\ ml$$

3.4.2 The treatment at different rate of fertilizer:

Table 3.2 *Shows the rate of fertilizer for every treatment.*

Treatment	NPKYellow fertilizer	Alfa Life fertilizer	Ratio (%)
T0	7 g	-	100 : 0
T1	-	22.4 ml	0 : 100
T2	5.25 g	6.1 ml	75 : 25
T3	3.5 g	12.2 ml	50 : 50
T4	1.75 g	18.3 ml	25 75

3.5 Experimental design

Complete Randomized Design (CRD) was selected in this experiment with five treatments and four replications.

T2R3	T2R1	T4R4	T1R4	T4R3
T3R4	T0R1	T2R2	T0R2	T2R4
T1R1	T1R3	T3R2	T0R3	T3R1
T0R4	T3R3	T4R2	T4R1	T1R2

Figure 3.5 The arrangement of treatments and replications in CRD.

3.6 Parameters

Five parameters were used in this study, to observe the growth performance of rubber seedlings treated with different treatments.

3.6.1 Seedling height

Retractable measuring tape was used to measure the height of rubber seedlings in centimeter (cm). The height of rubber seedlings were started to be measured after the rubber seedlings delivered.

Figure 3.6 Measuring the seedling height using retractable measuring tape

3.6.2 Stem girth

The girth of stem will be taken above 8 cm from soil surface. The girth was measured each week. Retractable measuring tape was used to measure the girth.

Figure 3.7 Measuring the stem girth using retractable measuring tape

3.6.3 Leaves dry weight

Leaf of rubber seedling was cut and was place in the 'hot air oven 60°C" for 48 to 72 hours. Leaf dry weight was determined when the weight becomes constant using another electronic balance.

Dry matter proportion for leaves, stem and root was analyzed by using the formula:

Dry matter proportion of LDY (Leaf Dry Weight) (%) =

$$\frac{Leaves\ dry\ matter}{Total\ dry\ matter}\ x\ 100$$

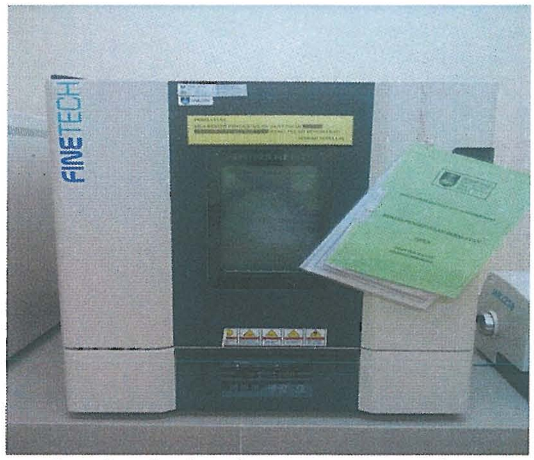


Figure 3.8 Oven dry for drying leaves, stem and root of rubber seedlings

3.6.4 Stem dry weight

Stem of rubber seedling was cut and was place in the 'hot air oven 60°C" for 48 to 72 hours. Stem dry weight was determined when the weight becomes constant using another electronic balance.

3.6.5 Root dry weight

Root of rubber seedling was cut and was place in the 'hot air oven 60°C" for 48 to 72 hours. Root dry weight was determined when the weight becomes constant using another electronic balance

3.7 Statistical Analysis

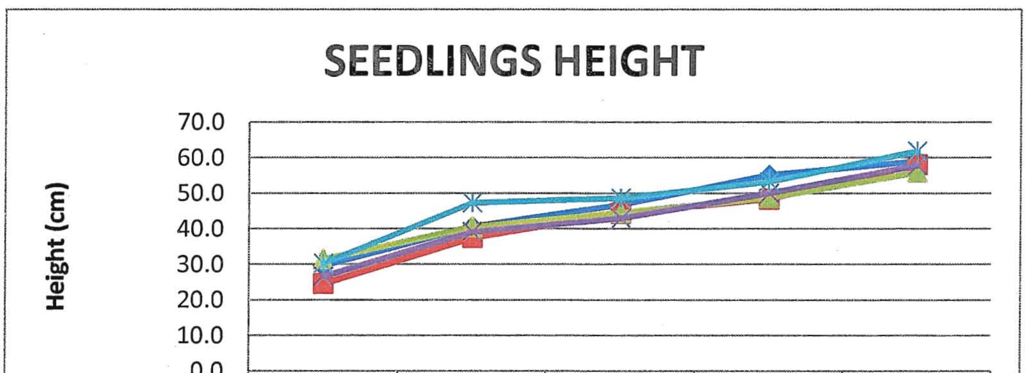
Data was analyzed by using Minitab software version 16. Analysis of Variance (ANOVA) method and treatment mean comparison will analyze using One way ANOVA. Tukey pair wise comparison will be used when the treatment effect in the ANOVA is significant.

CHAPTER 4

RESULTS

The data from the experiment has been collected in 8 weeks period of cultivating the rubber seedlings. The growth of rubber seedlings treated with different percentages of fertilizer was analyzed by measuring the seedling height, stem girth, leaves dry weight, stem dry weight and root dry weight.

4.1 Seedling height



	WEEK 0	WEEK 2	WEEK 4	WEEK 6	WEEK 8
T0 (control)	29.6	40.5	46.8	55.0	59.0
T1	24.5	37.4	44.4	48.4	58.0
T2	31.3	40.4	44.5	48.7	55.8
T3	26.5	39.1	42.9	50.0	57.8
T4	30.1	47.2	48.5	53.1	61.8

Figure 4.1 Average seedlings height

Figure 4.1 shows the average of seedlings height in different level of treatment by two weeks interval. The line graph shows the increasing of seedlings height from week 0 until week 8 for all treatments. From the week 0, it showed T2

(75% NPK Yellow + 25% AL) is the highest mean of seedling height for the initial experiment followed by T4 (25% NPK Yellow + 75% AL), T0 (100% NPK Yellow), T3 (50% NPK Yellow + 50% AL) and T1 (100% AL). High increasing growth rate of seedling height for all treatments was at initial week until week two and it showed moderate increase after week two until week eight. After eight weeks the experiment was conducted, the seedling heights among the five treatments changed where the highest seedling height was recorded by T4 (25% NPK Yellow + 75% AL) followed by T0 (100% NPK yellow), T1 (100% AL), T3 (50% NPK Yellow + 50% AL) and T2 (75% NPK Yellow + 25% AL).

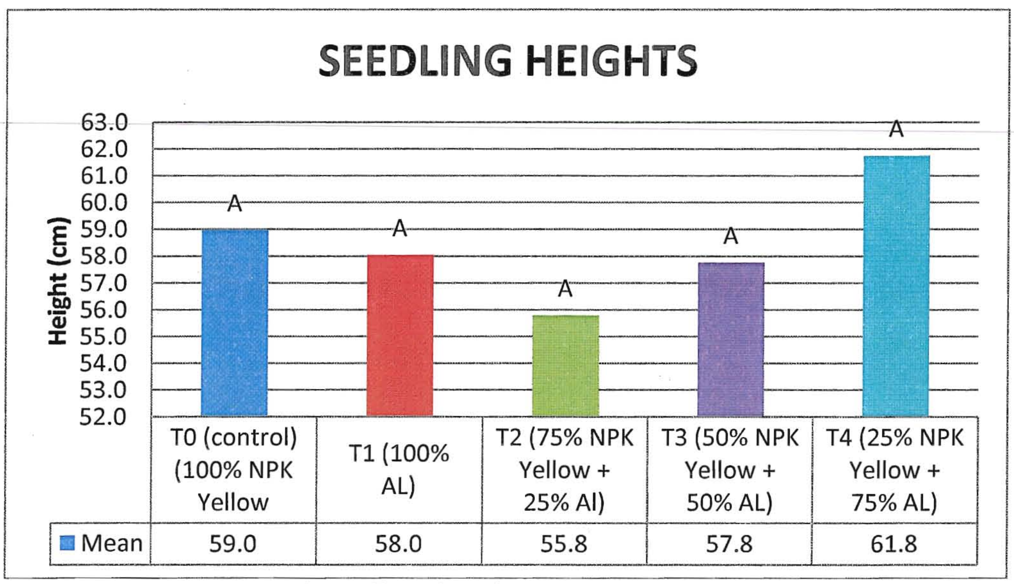
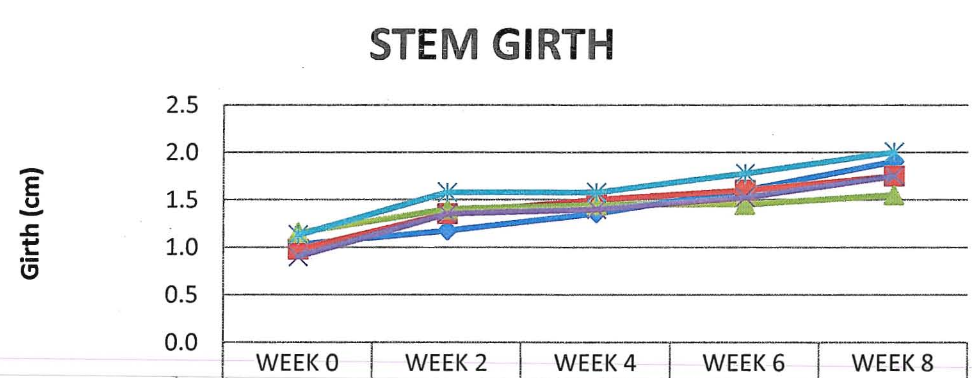


Figure 4.2 Mean of Seedling heights

Figure 4.2 shows the mean of seedling heights for five treatments after eight weeks the experiment was conducted. From the bar chart, rubber seedlings that treated under T4 (25% NPK Yellow + 75% AL) with 61.8 cm height was the highest mean of seedlings height among the five treatments followed by T0 (100% NPK Yellow), T1 (100% AL) and T3 (50% NPK Yellow + 50% AL) while lowest was T2 (25% NPK Yellow + 75% AL) with 55.8 cm height. The result from ANOVA table and grouping information using Tukey's method showed that there are no significant differences of the mean of the height of rubber seedlings among the five treatments where the P-value is 0.958 > 0.05 of confident intervals and all treatments are in the same group (A).

4.2 Stem girth



	WEEK 0	WEEK 2	WEEK 4	WEEK 6	WEEK 8
T0 (control)	1.0	1.2	1.4	1.6	1.9
T1	1.0	1.4	1.5	1.6	1.8
T2	1.1	1.4	1.4	1.5	1.5
T3	0.9	1.4	1.4	1.5	1.8
T4	1.1	1.6	1.6	1.8	2.0

Figure 4.3 Average of stem girth

Figure 4.3 show the average of stem girth of rubber seedlings for five treatments in different percentages of fertilizer. From the line graph, it shows the increasing in stem girth of rubber seedling from week 0 until week 8 for all treatments. High increasing growth rate for all treatments was at initial week until week 2 and the moderate increasing growth rate after week 2 until week 8. From week 0, the highest mean of stem girth was T2 (75% NPK Yellow + 25% AL) followed by T4 (25% NPK Yellow + 75% AL), TO (100% NPK Yellow) and T1 (100%) have the same value of stem girth and the lowest mean of stem girth was T3 (50% NPK Yellow + 50% AL). After 8 weeks, the stem girth of rubber seedlings was increased where the highest men of stem girth was T4 (25% NPK Yellow + 75% AL) followed by T0 (100% NPK Yellow), T1 (100% AL) share the same value of stem girth with T3 (50% NPK Yellow + 50% AL) and the lowest mean of stem girth was T2 (75% NPK Yellow + 25% AL).

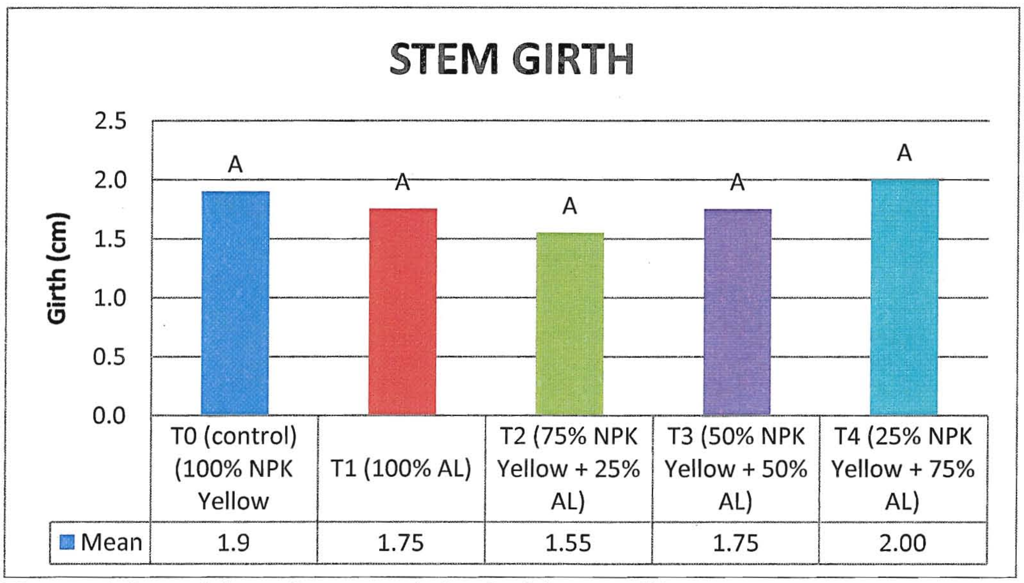


Figure 4.4 Mean for stem girth of rubber seedlings

Figure 4.4 shows the mean for stem girth of rubber seedlings on week 8 with different percentage of fertilizer for five treatments. From the bar graph, the biggest stem girth of rubber seedling was T4 (25% NPK Yellow + 75% AL) followed by T0 (100% NPK Yellow), T1 (100% AL) and T3 (50% NPK Yellow + 50% AL) have the same value of stem girth and the smallest stem girth was T2 (75% NPK Yellow + 25% AL). The result from ANOVA table and grouping information using Tukey's method showed that there are no significant differences of the mean of the stem girth of rubber seedlings among the five treatments where the P-value is 0.065 > 0.05 of confident intervals and all treatments are in the same group (A).

4.3 Leaves dry weight

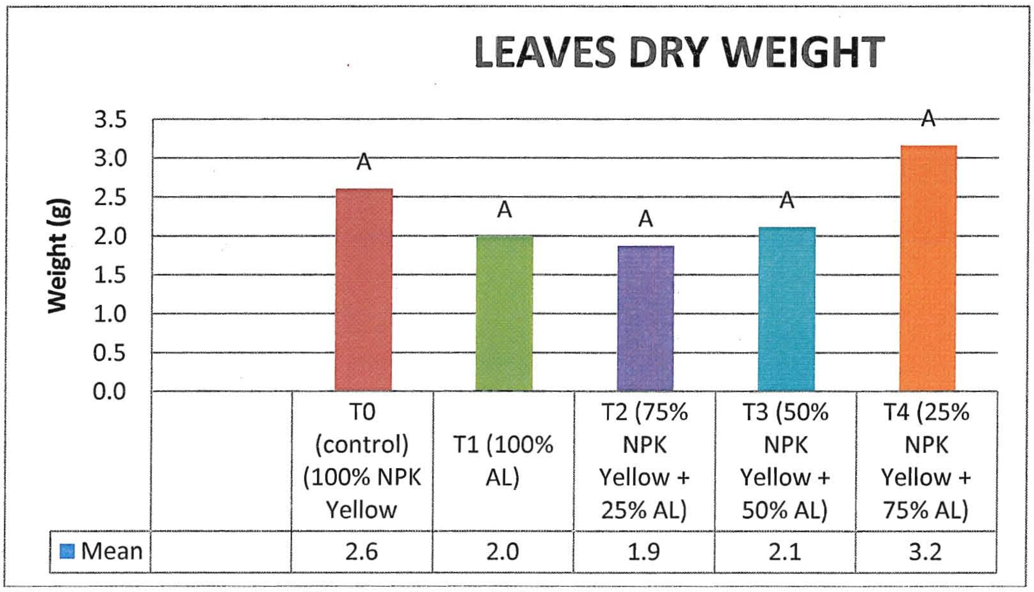


Figure 4.5 Mean of leaves dry weight

Figure 4.5 shows the mean of leaves dry weight for five treatments after eight weeks experiment was conducted. From the bar graph, it showed that T4 (25% NPK Yellow + 75% AL) is the highest mean of leaves dry weight followed by T0 (100% NPK Yellow), T3 (50% NPK Yellow + 50% AL), T1 (100% AL) and the lowest is T2 (75% NPK Yellow + 25% AL).

The result from ANOVA table and grouping information using Tukey's method showed that there are no significant differences of the mean of the leaves dry weight of rubber seedlings among the five treatments where the P-value is 0.536 > 0.05 of confident intervals and all treatments are in the same group (A).

4.4 Stem dry weight

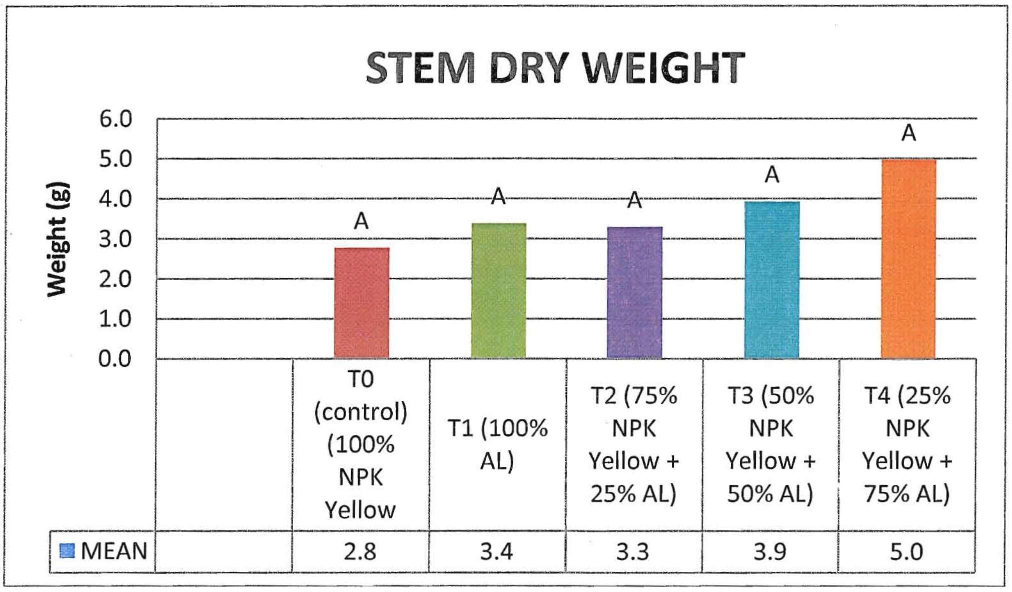


Figure 4.6 Mean of stem dry weight

Figure 4.6 shows the mean of stem dry weight of rubber seedlings for five treatments with different percentage of fertilizer after eight weeks of experimentation. From the bar graph shows that the highest mean of stem dry weight of rubber seedlings is T4 (25% NPK Yellow + 75% AL) followed by T3 (50% NPK Yellow + 50% AL), T1 (100% AL), T2 (75% NPK Yellow + 25% AL), and the lowest is T0 (100% NPK Yellow). The result from ANOVA table and grouping information using Tukey's method showed that there are no significant differences of the mean of the stem dry weight among the five treatments where the P-value is 0.392 > 0.05 of confident intervals and all treatments are in the same group (A).

4.5 Root dry weight

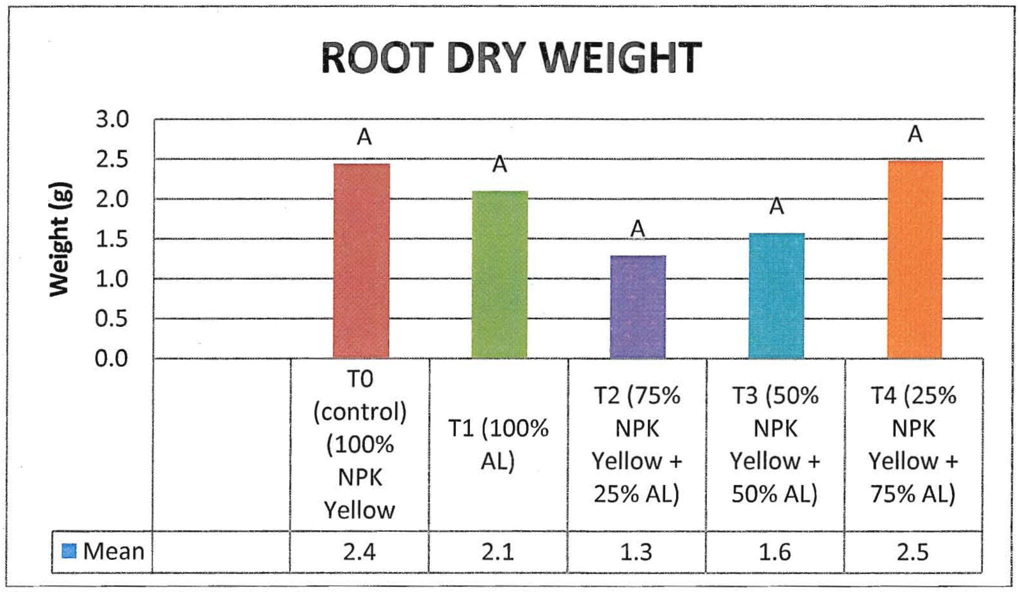


Figure 4.7 Mean of root dry weight

Figure 4.7 shows the mean of root dry weight of rubber seedlings for five treatments with different percentages of fertilizer after eight weeks of experimentation. From the bar graph, it shows the highest mean of root dry weight of rubber seedlings was T4 (25% NPK Yellow + 75% AL), followed by T0 (100% NPK yellow), T1 (100% AL), T3 (50% NPK Yellow + 50% AL) and the lowest is T2 (75% NPK Yellow + 25% AL). The result from ANOVA table and grouping information using Tukey's method showed that there are no significant differences of the mean of the root dry weight of rubber seedlings among the five treatments where the P-value is 0.131 > 0.05 of confident intervals and all treatments are in the same group (A).

CHAPTER 5

DISCUSSION

The raw data in this experiment was recorded every week on Sunday from 15 March 2015 (week 0) until 10 March 2015 (week 8). The maintenance for this research was watering and hand weeding. Watering was done twice a day, in morning and evening everyday. The parameter in this experiment was height, girth, leaves dry weight, stem dry weight and root dry weight (Shafar et al., 2012).

In this experiment, One Way of ANOVA was used. It was used to test the hypothesis of the parameter in this experiment. To indicate whether the treatment have significant difference or no significant difference, the P-value is used to test the treatment to compare with the confident interval in the ANOVA. According to Alan and David (2006), when there are more than two treatments, one way analysis of variance (ANOVA) was used and to compare the between –treatment variation with the within-treatment variation and assesses whether the differences in the means were due to chance or treatment effects and if the P-value is less than 0.05 we conclude there are significant treatment differences.

From all parameters, it shows that there is no significant difference among the five treatments when using different type of fertilizer and combination fertilizer with the same percentages of fertilizer rate. The result showed that T4 was the best among the five treatments. T4 is the highest mean from all parameters of seedling height, stem girth, leaves dry weight, stem dry weight. According to Chen J.H., (2008), microorganism can be very efficient in dissolving nutrients and making them available to the plants if they find suitable condition for their growth. Hence, microorganism in the Treatment 4 gave positive response on the ability of plant to uptake nutrients. Nutrient content of NPK Yellow in T4 is quick to dissolve for plant uptake. The effect inorganic fertilizer is usually direct and fast due to nutrients are easy to solute and directly available to the plants (Chen, 2008). The combination of NPK Yellow and Alfa Life fertilizer in treatments 4 has improved the soil fertility. Organic manures integrated with inorganic fertilizers increased the soil health as compared to initial condition of the soil (Somashekarappa et al., 2014).

From the observation, the performance of T0 is better than T1 due to different nutrient percentages which is NPK Yellow fertilizer (control) has the highest nutrient percentages (N, P, K, and Mg) than Alfa Life fertilizer. However, the result shows that combination of T4 (25% NPK Yellow + 75% Alfa Life) is better than T0 (100% NPK Yellow) and T1 (100% Alfa Life). So, NPK Yellow and Alfa Life fertilizer cannot be alone without integration both of them to get best result in growing the rubber seedlings due to existence of microorganism help the plant to maximize the nutrient uptake. To ensuring the plant uptake nutrient is sufficient, the existence of soil organism is essential to supply the nutrient (Chen, 2008). The combination between organic manure and bio-fertilizer could be a successful tool to improve growth, yield and decrease environmental pollution (Abdelaziz and Pokluda, 2008).

The combination rate of T2 (75% NPK Yellow + 25% AL) and T3 (50% NPK Yellow + 50% AL) is not suitable to use due to both of them have low performance. The combination of chemical and organic fertilizer will give the effect to crop growth and soil fertility based on the application rates and the used of fertilizer nature (Chen, 2008). Bio-organic fertilizers have given the beneficial effects on the plant growth depended on soil condition, bacterial strain and environmental condition (Uyanoz, 2007).

CHAPTER 6

CONCLUSION AND RECOMMENDATION

As a conclusion, all the treatments have no significant difference for all the parameters such as seedling height, stem girth, leaves dry weight, stem dry weight and root dry weight that have been tested using ANOVA and Tukey method. The highest mean of parameter was used to choose the best treatment. From the result, the highest mean for all parameter was treatment 4 (25% NPK Yellow + 75% Alfa Life).

The first objective of this research have been achieved where there are no significant different between NPK Yellow (control) and Alfa Life (Bio organic) fertilizer. So, Alfa Life (Bio organic) can replace NPK Yellow (control) for rubber seedlings growth but it is not recommended due to the mean from four parameters of NPK Yellow (control) showed that it have the highest mean than Alfa Life (Bio organic) fertilizer . The second objective of this research is to find the best combination of NPK Yellow and Alfa Life fertilizer. Treatment 4 (25% NPK Yellow + 75% AL) was chosen as the best combination due to it have highest mean of all parameters from the three combinations (T2, T3 and T4). However, the combination of T2, T3 and T4 do not show any significant different after tested using ANOVA and Tukey method. In addition, the combination of T4 is better compared to T0 (control) after 8 weeks experimentation. Thus, combination of T4 which is 25%NPK Yellow and 75% Alfa Life fertilizer can replace T0 (control) which is 100% NPK Yellow alone.

For the recommendation of this research, combination of 25%NPK Yellow and 75% Alfa Life (Bio-organic) fertilizer is recommended to be practices in rubber nursery for the growing of rubber seedling. For the second recommendation, the research to find the best rate of combination of inorganic and bio-organic fertilizer should be continued due to give positive impact to rubber seedlings growth performance and environment.

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APPENDICES

Appendix A

Raw Data of Seedling Height and Stem Girth (cm):

WEEK	0		1		2		3		4	
	H	G	H	G	H	H	G	G	H	G
TREATMENT										
TOR1	33.0	0.9	42.2	1.0	52.2	57.4	1.3	1.2	45.2	1.0
TOR2	26.1	1.1	33.4	1.2	41.3	45.4	1.6	1.5	35.7	1.3
TOR3	26.3	0.9	33.7	1.0	41.6	45.8	1.3	1.2	36.0	1.0
TOR4	32.8	1.2	42.0	1.3	51.9	57.1	1.8	1.6	44.9	1.4
Mean	**29.6**	**1.0**	**37.8**	**1.1**	**46.8**	**51.4**	**1.5**	**1.4**	**40.5**	**1.2**
T1R1	17.0	0.8	30.7	1.0	45.0	47.4	1.5	1.4	34.1	1.2
T1R2	29.5	1.1	30.3	1.1	41.0	41.5	1.4	1.4	40.6	1.3
T1R3	25.2	0.9	25.7	1.0	46.2	47.8	1.5	1.5	34.5	1.3
T1R4	26.3	1.1	36.2	1.5	45.2	45.9	1.8	1.7	40.5	1.6
Mean	**24.5**	**1.0**	**30.7**	**1.2**	**44.4**	**45.7**	**1.6**	**1.5**	**37.4**	**1.4**
T2R1	29.3	1.0	31.8	1.0	36.6	37.7	1.4	1.4	35.8	1.4
T2R2	34.0	1.1	40.5	1.2	46.5	46.5	1.5	1.4	45.2	1.4
T2R3	27.5	1.2	28.5	1.2	42.5	45.0	1.4	1.4	29.0	1.4
T2R4	34.4	1.3	36.0	1.3	52.3	53.2	1.5	1.6	51.7	1.4
Mean	**31.3**	**1.2**	**34.2**	**1.2**	**44.5**	**45.6**	**1.5**	**1.5**	**40.4**	**1.4**
T3R1	19.7	0.9	23.6	0.9	28.5	37.7	1.4	1.3	28.0	1.2
T3R2	22.8	0.8	28.5	0.9	38.0	39.3	1.3	1.3	34.2	1.2
T3R3	38.4	1.0	39.6	1.2	66.6	65.3	1.6	1.6	60.5	1.5
T3R4	25.0	0.9	33.5	1.0	38.5	43.0	1.4	1.4	33.6	1.5
Mean	**26.5**	**0.9**	**31.3**	**1.0**	**42.9**	**46.3**	**1.4**	**1.4**	**39.1**	**1.4**
T4R1	29.2	1.0	37.0	1.2	46.5	53.8	1.7	1.5	46.0	1.5
T4R2	26.9	1.2	30.4	1.3	49.0	49.8	1.7	1.6	47.5	1.7
T4R3	34.8	1.1	36.9	1.3	55.0	54.5	1.6	1.6	54.6	1.6
T4R4	29.5	1.2	38.5	1.3	43.5	45.2	1.7	1.6	40.5	1.5
Mean	**30.1**	**1.1**	**35.7**	**1.3**	**48.5**	**50.8**	**1.7**	**1.6**	**47.2**	**1.6**

WEEK	5		6		7		8	
	H	G	H	G	H	G	H	G
TREATMENT								
TOR1	49.3	1.1	61.5	1.4	63.9	1.5	65.8	1.7
TOR2	39.0	1.4	48.6	1.8	50.6	1.9	52.1	2.1
TOR3	39.3	1.1	49.0	1.4	50.9	1.5	52.5	1.7
TOR4	49.0	1.5	61.1	1.9	63.5	2.0	65.4	2.2
Mean	**44.1**	**1.3**	**55.0**	**1.6**	**57.2**	**1.7**	**59.0**	**1.9**
T1R1	39.6	1.3	52.2	1.5	57.7	1.6	58.8	1.6
T1R2	40.8	1.3	41.8	1.5	44.3	1.5	44.3	1.6
T1R3	38.4	1.3	48.0	1.5	57.6	1.7	58.6	1.7
T1R4	42.9	1.6	51.4	1.9	68.4	2.1	70.4	2.1
Mean	**40.4**	**1.4**	**48.4**	**1.6**	**57.0**	**1.7**	**58.0**	**1.8**
T2R1	35.9	1.4	39.0	1.4	44.5	1.4	44.7	1.5
T2R2	45.4	1.4	51.5	1.5	59.0	1.5	58.8	1.6
T2R3	35.4	1.4	49.7	1.4	51.7	1.5	52.0	1.5
T2R4	51.9	1.4	54.5	1.5	65.6	1.5	67.6	1.6
Mean	**42.2**	**1.4**	**48.7**	**1.5**	**55.2**	**1.5**	**55.8**	**1.6**
T3R1	28.2	1.2	42.2	1.5	42.2	1.5	43.0	1.6
T3R2	36.3	1.2	40.6	1.4	52.8	1.6	55.2	1.7
T3R3	63.4	1.5	66.7	1.7	75.5	2.0	81.0	2.1
T3R4	35.7	1.3	50.3	1.5	51.5	1.5	51.8	1.6
Mean	**40.9**	**1.3**	**50.0**	**1.5**	**55.5**	**1.7**	**57.8**	**1.8**
T4R1	46.3	1.5	57.7	1.8	58.6	1.8	59.1	1.9
T4R2	46.5	1.6	50.2	1.8	52.5	2.1	54.5	2.2
T4R3	54.8	1.6	55.5	1.7	68.9	2.0	74.5	2.0
T4R4	42.3	1.5	49.1	1.8	58.9	1.9	58.9	1.9
Mean	**47.5**	**1.6**	**53.1**	**1.8**	**59.7**	**2.0**	**61.8**	**2.0**

Appendix B

Raw data of leaves stem and root dry weight (g):

Leaves dry weight

Treatment	Dry weight (g)				Mean
	R1	R2	R3	R4	
T0	0.8	6.0	2.7	0.9	2.6
T1	2.2	1.1	2.5	2.2	2.0
T2	1.1	2.1	1.6	2.6	1.9
T3	2.1	1.7	2.8	1.8	2.1
T4	3.5	2.6	3.4	3.3	3.2

Stem dry weight

Treatment	Dry weight (g)				Mean
	R1	R2	R3	R4	
T0	1.6	4.9	2.2	2.4	2.8
T1	2.6	2.3	3.6	5.0	3.4
T2	1.7	2.7	2.5	6.2	3.3
T3	2.9	3.8	6.8	2.2	3.9
T4	4.8	5.5	6.0	3.7	5.0

Root dry weight

Treatment	Dry weight (g)				Mean
	R1	R2	R3	R4	
T0	1.9	2.9	1.6	3.4	2.4
T1	1.7	1.8	1.5	3.4	2.1
T2	0.4	1.1	2.3	1.5	1.3
T3	1.1	1.5	2.3	1.5	1.6
T4	2.2	2.8	3.2	1.8	2.5

Appendix C

ANOVA table of the five parameters:

ANOVA for seedling height

Source	DF	SS	MS	F	P
Treatment	4	76	19	0.15	0.958
Error	15	1837	122		
Total	19	1913			

ANOVA for stem girth

Source	DF	SS	MS	F	P
Treatment	4	0.4803	0.1201	2.79	0.065
Error	15	0.6452	0.0430		
Total	19	1.1255			

ANOVA for leaves dry weight

Source	DF	SS	MS	F	P
Treatment	4	4.53	1.13	0.81	0.536
Error	15	20.90	1.39		
Total	19	25.43			

ANOVA for stem dry weight

Source	DF	SS	MS	F	P
Treatment	4	11.19	2.80	1.10	0.392
Error	15	38.15	2.54		
Total	19	49.35			

ANOVA for root dry weight

Source	DF	SS	MS	F	P
Treatment	4	4.467	1.117	2.10	0.131
Error	15	7.975	0.532		
Total	19	12.442			

Appendix D

Grouping information using Turkey Method for five parameters:

Seedling height

Treatment	N	Mean	Grouping
4	4	61.75	A
0	4	58.96	A
1	4	58.02	A
3	4	57.75	A
2	4	55.77	A

Stem girth

Treatment	N	Mean	Grouping
4	4	2.0000	A
0	4	1.9133	A
3	4	1.7500	A
1	4	1.7500	A
2	4	1.5500	A

Leaves dry weight

Treatment	N	Mean	Grouping
4	4	3.163	A
0	4	2.603	A
3	4	2.115	A
1	4	1.993	A
2	4	1.875	A

Stem dry weight

Treatment	N	Mean	Grouping
4	4	4.968	A
3	4	3.933	A
1	4	3.383	A
2	4	3.293	A
0	4	2.764	A

Root dry weight

Treatment	N	Mean	Grouping
4	4	2.4775	A
0	4	2.4420	A
1	4	2.0975	A
3	4	1.5725	A
2	4	1.2900	A

Appendix E

To ranking the treatment:

Parameter	Treatment				
	T0	**T1**	**T2**	**T3**	**T4**
Seedling Height	2	3	5	4	1
Stem Girth	2	4	5	3	1
Leaves Dry Weight	2	4	5	3	1
Stem Dry Weight	5	3	4	2	1
Root Dry Weight	2	3	5	4	1
Total	**13**	**17**	**24**	**16**	**5**
Rank	**2**	**4**	**5**	**3**	**1**

*The highest to lowest mean was given a code for 5 treatments which is 1,2,3,4 and 5 (highest to lowest)

*The rank of treatment depends on total of 5 Parameter.

* The smallest total of 5 parameters is the highest rank.

Appendix F

YEAR/ MONTH ACTIVITIES	2014				2015						
	SEPT	OCT	NO V	DEC	JA N	FEB	MAC	APR	MAY	JUN	JULY
Identifying the topic of the research											
Preparing and presenting the proposal											
Samples collection											
Experiment in the field											
Data collection											
Data analysis											
Writing report											
Submit the report											

CURRICULUM VITAE

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2. EDUCATIONAL BACKGROUND

School/College/University	Certification/Diploma/Degree	Year
Universiti Teknologi MARA, Jasin, Melaka.	Bachelor of Science (Hons.) Plantation Technology and Management	2015
Universiti Teknologi MARA, Arau, Perlis.	Diploma in Planting Industry Management	2011
S.M.K Dato' Mohd Taha, N.Sembilan.	Sijil Pelajaran Malaysia (SPM)	2007
S.M.K Dato' Mohd Taha, N. Sembilan.	Penilaian Menegah Rendah (PMR)	2005
Sek. Keb. Datuk Abdullah, N. Sembilan	Ujian Penilaian Sekolah Rendah	2002

3. WORKING EXPERIENCE/TRAINING

1. **Field Supervisor :** IOI Pamol Barat Estate, Kluang, Johor — Dec 2012 – Feb 2013

2. Industrial Training :
   1. Ladang Fima Cendana, Kemaman, Terengganu. — July – Sept 2014 (8 weeks)
   2. IOI Regent Estate, Gemencheh, N. Sembilan — Nov – Dec 2010 (5 weeks)
   2. Tabung Haji Plantation, Ladang Sungai Mengah, Muadzam Shah, Pahang — May – June 2010 (5 weeks)
   3. MARDI Cameron Higlands, Tanah Rata, Pahang. — Nov – Dec 2009 (5 weeks)

Signature : ____________________ **Date** : ____________________