DETERMINATION OF *Oryza sativa* L. (MR 220) GROWTH PERFORMANCE TOWARD DIFFERENTS CONCENTRATION OF EFFECTIVE MICROORGANISM (EM)

WAN MUHAMMAD FITRI BIN BAHARI

Final Year Project Report Submitted in
Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science (Hons.) Technology and Plantation Management in
the Faculty of Plantation and Agrotechnology
Universiti Teknologi MARA

JULY 2015

DECLARATION

This Final Year Project is a partial fulfillment of the requirements for a degree of Bachelor of Science (Hons.) Technology and Plantation 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.

I hereby assign all and every right in the copyright to this Work to the Universiti Teknologi MARA ("UiTM"), which henceforth shall be the owner of copyright in this Work and that, any reproduction or use in any form or by any means whatsoever is prohibited without a written consent of UiTM.

Candidate's signature: ..... Date: 11 AUGUST 2015

Name: WAN MUHAMMAD FITRI BIN BAHARI

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.) Technology and Plantation Management, Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA.

Signature: .....

Name of Supervisor: MADAM NOER HARTINI BINTI DOLHAJI

Position: LECTURER

Date: 11 AUGUST 2015

ACKNOWLEDGEMENT

In the name of Allah s.w.t, the Most Gracious and the Most Merciful.

First of all, Alhamdullilah, all praise to Allah s.w.t. for the strength and His blessing in completing this research project. I also want to grateful to Allah the ALMIGHTY that give me the opportunities to completing this research project with flying colours.

I very thankful to Madam Noer Hartini Binti Dolhaji as my supervisor that support, give guidance, encouragement and commitment that have contributed to the success of my final year project and give me opportunity to gain new knowledge during my course of study.

In addition, gratitude to Madam Sarah Binti Jumali, lecturer in biotechnology course that have given guidance for me to finish my laboratory work. I would also like to thanks to all laboratory assistance in UiTM Jasin who had taught and giving some helped during project in progress.

My last gratitude and deepest appreciate to my lovely mom, Wan Jaharah Binti Yussof and my family, for their encouragement, prayers and support. Sincere thanks to all my friends for theirs moral support. Finally, to those who directly and indirectly involved and contributed to completing my final year project and course of study. Thank you very much to all of you.

WAN MUHAMMAD FITRI BIN BAHARI

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATION

^{o}C	Degree Celsius
MR	MARDI Rice
EM	Effective microorganism
cm	Centimeter
cm^2	Square centimeter
m	Meter
m^2	Square meter
ml	Millimete
g	Gram
Kg	Kilogram
Ha	Hectare
N	Nitrogen
P	Phosphorus
K	Potassium
MOP	Muriate of Potash
PDA	Potato dextrose agar
CRD	Completely Randomized Design
CFU	Colony-forming unit
ANOVA	Analysis of variance
SPSS	Statistical Package for the Social Science
MARDI	Malaysian Agricultural Research and Development Institute

ABSTRACT

DETERMINATION OF *Oryza sativa* L. (MR 220) GROWTH PERFORMANCE TOWARD DIFFERENT CONCENTRATION OF EFFECTIVE MICROORGANISM (EM)

Malaysia is one of the countries that produce rice to be used as a staple food to the people in this country. Malaysia had to import rice from other countries such as Thailand to fulfill the demand of the people although the country has vast areas of paddy crops, particularly in the northern regions. There are several factors that have been identified as the cause of the problem which is lack of technology in agriculture sector that has caused a bit of rice production per hectare. Therefore, the study of effective microorganism (EM) was conducted to increase the paddy production at lower cost and can reduce environmental pollution instead use of chemicals. Effective microorganism (EM) solution was used as a substitute for chemical fertilizer to support nutrient for paddy crops. The study was conducted in a greenhouse in UiTM Jasin by making 6 treatment of T1, T2, T3, T4, T5 and T6 (NPK = T1, T2 = EM 1: 400, T3 = EM 1: 600, T4 = EM 1: 800 , T5 = EM 1: 1000 and T6 = untreated). Observation on this study was conducted over 12 weeks until the plant reach heading stage (90-120 days). In addition, identification of the fungal population in effective microorganism (EM) solution has also been conducted to identify the different of CFU in each different EM treatments. The results of the study showed that the efficacy of NPK fertilizer show better growth rates than EM. All EM treatment showed no significant difference between all of them in terms of height, leaf number and tiller number. Even though effectiveness of EM treatments is not as great as NPK fertilizer treatment but progress is seen trees can grow properly and healthy when compared with no treatment.

ABSTRAK

PENENTUAN PRESTASI PERTUMBUHAN *Oryza sativa* L. (MR 220) TERHADAP BERLAINAN KEPEKATAN MIKROORGANISMA BERKESAN (EM)

Malaysia merupakan salah satu negara yang menghasilkan beras yang digunakan sebagai makanan asasi kepada rakyat di negara ini. Malaysia terpaksa mengimport beras dari negara-negara lain seperti Thailand untuk memenuhi permintaan rakyat walaupun negara ini mempunyai kawasan yang luas tanaman padi, terutamanya di kawasan utara. Terdapat beberapa faktor yang telah dikenal pasti sebagai punca masalah yang kekurangan teknologi dalam sektor pertanian yang telah menyebabkan pengeluaran padi yang sedikit per hektar. Oleh itu, kajian tentang mikroorganisma berkesan (EM) telah dijalankan untuk meningkatkan pengeluaran padi pada kos yang lebih rendah dan dapat mengurangkan pencemaran alam sekitar disebalik menggunakan bahan kimia. Cecair mikroorganisma berkesan (EM) telah digunakan sebagai ganti kepada baja kimia untuk menyokong nutrien untuk tanaman padi. Kajian ini telah dijalankan di dalam rumah hijau di UiTM Jasin dengan membuat 6 rawatan T1, T2, T3, T4, T5 dan T6 (NPK = T1, T2 = EM 1: 400, T3 = EM 1: 600, T4 = EM 1: 800, T5 = EM 1: 1000 dan T6 = dirawat). Pemerhatian terhadap kajian ini dijalankan selama 12 minggu sehingga tumbuhan mencapai peringkat menghala (90-120 hari). Di samping itu, pengenalpastian populasi kulat pada cecair mikroorganisma berkesan (EM) juga telah dijalankan untuk mengenal pasti berbeza CFU dalam setiap rawatan EM yang berbeza. Keputusan kajian menunjukkan bahawa keberkesanan baja NPK menunjukkan kadar pertumbuhan yang lebih baik daripada EM. Semua rawatan EM menunjukkan tiada perbezaan yang signifikan di antara semua daripada mereka dari segi ketinggian, bilangan daun dan bilangan anak bilah padi. Walaupun keberkesanan rawatan EM tidak sehebat rawatan baja NPK tetapi perkembangan dilihat pokok dapat membesar dengan sempurna dan sihat berbanding tanpa rawatan.

CHAPTER 1

INTRODUCTION

1.1 Background study

Paddy industry is one of the most protected industries in Malaysia acts as a main source of food to the people (Nadia *et al.,* 2012). Grown in 673 745 ha of land, industry of paddy has producing 2.6 million tons annually with value RM 2 billion. In last five years, average growth rate of paddy grain production has grown to 3.7%. However, even average growth rate increasing year by year, the production of rice still not sufficient to people and only can accommodating 71.4% of Malaysian population and the rest will be imported from others country (Chamburi *et al.,* 2014). Majority of rice cultivation are dominated by smallholder's farmers. When these situations occur in industry it will effect on 172,000 farmers and impact to the economy of country (Nadia *et al.*, 2012).

There are several challenges and problem faced by farmers in term of to produce higher production of rice. The type of soil, chemical and fertilizer used are affecting the production of paddy. Other than that, uncontrolled of derivative process and too much irrigation activities can cause loss of nutrient and organic matter in the soil which is can generate to decreasing of rice production (Tahir *et al.,* 1999). Farmers cannot reach maximum production of paddy yield if soil fertility decreasing. Normally the farmers will apply large amount of pesticide and chemical fertilizer to ensure a good quality and high

production of rice (Kathick and Kirithiga, 2010). These actions it is not only could effect to the plant in term of food poisoning and contamination but it also related with high cost. Paddy cultivation is one of the most cultivation required high costs. Farmers need to spend too much capital to aids paddy growth such as fertilizer.

Effective microorganism (EM) has been introduced in agriculture sector to help farmers which is acts as supplement for plant growth. This concept of effective microorganism was developed by Professor Teruo Higa from University of the Ryukyus Okinawa, Japan. The purposes of this concept are to improve soil quality, soil fertility, increasing yield and quality of crops. Using effective microorganism (EM) in paddy industry is one of the ways to farmers to produce high yield and good quality of yield without using large capital and labor (Kathick and Kirithigan, 2010). Higa reported (1994), utilizing of effective microorganism could help environment contamination and soil degradation because of excessive and misuse of chemical fertilizer and pesticide.

1.2 Problem statement

Some soils in Malaysia become unsuitable for crops because of widely used of chemical fertilizer and pesticide in paddy cultivation. The excessive use of agro-chemical could kill microorganism content in soil which acts as beneficial microorganism to plant growth (Higa, 1999). For example, N-fixing nitrogen bacteria act as nutrient uptake to the plant. The plant cannot take the nitrogen in the atmosphere, so this microorganism capable to transforming atmospheric nitrogen into fixed nitrogen, inorganic compounds usable by plants. Other than that, lignocellulosic component of paddy straw able to degrade by microorganism bacteria, fungi enzyme which is are used to improve the availability of nutrient for the usage of rumen microorganism (Samsudin *et al.,* 2013). Paddy cultivation required high costs such as in fertilizer usage. Farmers need to pay high cost to buy fertilizers for support plant growth. It may contribute more cost input than output; therefore farmers can shortage in their profits.

1.3 Significant of study

The importance of this study is to identify effectiveness of effective microorganism (EM) which is can increase the population of bacteria, nitrogen-fixing bacteria and actinomycetes by applying effective microorganism (EM) on soil. Other than that, effective microorganism (EM) also can make the soluble of nutrient, phosphorus and potassium increase in soil (Lim *et al.,* 1997). The beneficial effectiveness of the EM solution has ability to breakdown organic matter, providing nutrient and enhance physical and chemical properties (Yadav, n.d). This concept will help the farmers to

increase the yield production and at the same time can reduce the cost. The farmers do not need to spend much money to buy chemical fertilizer instead can use effective microorganism concept.

1.4 Objective of study

i. To evaluate the growth performance of paddy on different concentration of effective microorganism (EM) application.

ii. To determine the population of fungal contain in different concentration of effective microorganism (EM) application.

CHAPTER 2

LITERATURE REVIEW

2.1 Effective microorganism

Effective microorganism concept was created by Teruo Higa to overcome the problem of continue cultivation and perversion on plant yield (Higa, 1999). Using the effective microorganism (EM) can accelerate the growth of paddy plant, improving the root system, increasing seed germination process, increasing antioxidant ability, increasing chlorophyll and protein formation by accelerate plants photosynthetic ability (Konopiya and Higa, 2010). Other than that, it also act to improve soil quality and reducing pesticide used and chemical fertilizer input in this industry (Tahir *et al.*, 1999). Karthick and Kirithiga (2010) mentioned there are around 80 types of microorganism active in effective microorganism. However the dominant organism contains in effective microorganism are actinomycetes, yeast, lantic acid and photosynthetic bacteria and ray fungi (Tahir *et al.,* 1999). Each organism has its own beneficial role that can provide benefits to the paddy plant.

2.1.1 Fungi

Fungi is a single celled or very complex multicellular organisms which is found in any habitat such on the land, mainly in soil or on plant material rather than in sea or fresh water (Josep *et al.*, 1999). They are many functions of fungi in improving plant growth such as decomposers grow in the soil or on dead plant matter where they are play an important role in the cycling of

carbon and other elements. Fungi also used to overcome some are parasites of plants causing diseases such as mildews, rusts, scabs or canker. For example, *Gliocladium virens, Trichoderma virens, T. harzaianum* and *Aspergillus niger* are used in experiment to enhance the effect of plant germination, root and the shoot length seedling weight of rice (Febri *et al.* 2014). In EM solution there also have fungi organism that is ray fungi (Sivanan, n.d.).

2.1.2 Increase number of microbes in soil

Lim *et al.* (1997) stated the number of effective microorganism in soil such as aerobic bacteria, actonomycetes and nitrogen-fixing bacteria are increasing after EM treatment. This microorganism could accelerate the nutrient solubilization in soil. The EM itself contains large number of effective microorganism and when they produce the biologically active substance, it would increase the number of effective microorganism in natural soil. The high or low concentration of EM application indicates to number of population of effective microorganism.

2.1.3 Soil preservation

Effective microorganism (EM) could improve soil which increase water holding capacity, soil tilth and drainage (Lin, 1991). Besides that, the EM could turn the farmland to better drained, less compaction and more friable compare to conventionally farmed land. The soil will make the soil become favorable condition for plant growth. There is no harmful residue will left in soil that could effect to the plant growth, so it's better to replaces conventional

cropping use chemical and fertilizer. The concept not only bring benefits for soil and plant, it also cleaning up the environment and protecting nature (Higa, 1999).EM acted as improver to improve soil structure, organics matter management and help for nutrient cycling.

2.2 Description of *Oryza sativa* L.

2.2.1 Morphology of *Oryza sativa* L.

Kingdom : Plantae

Division : Magnoliophyta

Class : Liliopsida

Order : Poales

Family : Gramineae or Poaceae

Tribe : Oryzeae

Genus : Oryza

Species : Sativa

Scientific name : *Oryza sativa* (Wikipedia, 2014)

The paddy plant is classified to Gramnneae or Poaceae family which is the family that classified as grasses. Based on originated, this species is come from India, Thailand, and southern China. Paddy plant is cultivated in wet tropical, semi-tropical, and warm temperate areas around the world for the production of its cereal grain. More than 90% of paddy is cultivated in Asia (Viji and Neelanarayanan, 2014), and the rest in Middle Eastern, South America, African countries, Europian Union and North America. Viji and Neelanarayanan (2014) also stated based on their research, paddy are cultivate in 154 million hectare area and producing yield 636 million tons per year.

Nowadays, agriculture organization around the world has producing many of paddy variety including Malaysia Agriculture Research and Development (Mardi) in Seberang Perai MARDI station in Pulau Pinang.

2.2.2 MR 220 variety

Paddy MR220 is produced by MARDI and become the most widely cultivation variety in paddy industry (Azmi *et al.*, 2012). MR220 also knew *Padi Mas* among the famers. This variety is the successful combination breeding between MR151 and MR 137 varieties by MARDI where has taking 12 years to produce it after through the process of researching and choosing a qualify characteristic until it officially launch for use by farmers replacing MR219 variety. The MR220 and MR219 have same period of time to complete a cycle which is 105 days to 133 days depends on climatic and condition. It is because MR220 come from the same kind of variety generation but have some improvement on MR220 compare to MR219. The different between both varieties is the grain where MR220 grain is more weight, wide and longer than MR219. The average height of this variety is 76cm to 78 cm measured from lower stem. This variety is has potential high yield (Razi *et al.*, 2013).

2.3 Microbial count

There are many ways that can be used for counting microorganism in given population (Winter *et al.*, 1971).Microbial counting is useful in biology to enumerate the population microbes in solution concentration. There are several needs for these studies which are to identify the growth rate of microorganisms in given time. It is to evaluate how fast time needed by microorganisms to develop become colony and frequency of growth rate (Salvesen and Vadstein, 2000). Other than that, this concept can be used to determine which concentration density with microorganism are the most effective related effectiveness and optimal cost such as application of EM to the plant. In different rate of concentration are resulted on different number of microbe's population.

2.3.1 Direct counting

Direct counting is the cheapest and easy method to counting microbes. The technique direct count is to identify the total population of microorganism (Warner, 1962). It widely used for enumerating natural microorganism in natural environment (David *et al.,* 1982). It is the manually process of counting total population of fungal through spread the sample from the solution on the agar plates (Salvesen, 2000). With 28°C of temperature in incubator, the sample is leaves for 18-24 hours to lets the fungal emerges. After a period, the colony of fungal will appear on the culture plate and can be counting directly.

2.3.2 Serial dilution

A serial dilution is a method used to dilute a solution from high concentration to the lowest concentration. The purpose of dilution is count the numerous numbers of microbes in solution after several repeated step of dilution. Microbiologist do a serial dilution as a step to produce liquid culture which is the step is constant. As example, if one 1ml solution contain of 10000 of bacteria, it cannot be count directly because there will be many of colony in the solution. The solution need to be dilute until the sample have 30-300 colony forming units on the plate (Benson, 2002). The accuracy quantity of solution is very importance during dilution process to get the nearest number population of microbes.

CHAPTER 3

METHODOLOGY

3.1 Location

This experiment has been conducted in biotechnology laboratory to identify fungal colony and in green house for grown the paddy plant.

3.2 Materials and equipment

3.2.1 Effective microorganism (EM-1)

Inactivated EM-1 is getting from supplier in Melaka.

3.2.2 Molasses

Molasses obtained from supplier in Melaka.

3.2.3 Paddy seeds

The seed of MR220 variety was bought from paddy seed supplier in Kepala Batas area in Penang.

3.2.4 Pots

The pots size used in this project are 23cm height and 314.16cm^2 surface area.

3.2.5 Apparatus

Test tube, petri dish, micro pipette, and seal tape are used during running the experiment.

3.3 Parameter

3.3.1 Measure Plant height

Plant heights were measured in centimeter (cm) measurement for every 2 week interval until week 12. Each pot is measured based on the highest paddy plant grown on the pot.

3.3.2 Number of leaves

The number of plant leaves for each pot was counted every 2 week interval start from week 2 until week 12.

3.3.3 Number of tillers

The number of plant tiller for each pot was observed and counted for every 2 week interval start from week 2 until week 12.

3.3.4 Counting fungal colonies

The population of the fungal colony was counted on each different level of EM concentration that has been applied to the plant sample.

3.4 Experimental procedures

3.4.1 Preparation of paddy seedling

The paddy seed are soaking into the water as a method to choose sunken seed only. Put the seed into the cotton bag and soaked it in the water for maximum 2 days. The radical of seed was emerged. After that, the seed were transferred into the pot for grown. The paddy plant was grown in green house for 12 week start from plant seedling.

3.4.2 Preparing EM Activated Solution (EMAS)

Fill the container with 20 part of water. In the other container, mix 1 part of molasses and 1 part of EM. Stir the mixture solution until it dissolve. The mixture solution of EM + molasses had been pour into 20 part of water. The ratio of solution had become 20:1:1. Seal the container tightly to avoid air flow through the container. Leave for 7-10 days for fermentation under 20°C -30°C. EM activated solution can be use when pH value is less than 4 (Jamaludin *et al.*, n.d).

3.4.3 Treatment preparation

The stock of activated solution had been diluted to prepared solution for applying to treatment. 6 treatment are used in this experiment which is T1, T2, T3, T4, T5 and T6 (T1=NPK, T2= 1:400, T3=1:600, T4=1:800, T5=1:1000 and T6=untreated). Each treatment were treated with different rate of solution which is 1 part of EM had been dilute in a given part of water. Application of EM applied for each 15 days interval (Najib *et al.*, 2014). T1 is the control treatment as a treatment used as to compare the effectiveness of growth with EM and NPK fertilizer. Fresh solution of EM will used immediately after preparation. The pots size that used in planted paddy is 23cm height and 314.15cm^2 surface area.

Table 3.1 Application rate of EM for paddy plants

Treatment	**Quantity of EM treatment**	**Rate (ml/pot)**
T1	Recommended NPK(Positive control)	-
T2	1:400	22ml
T3	1:600	22ml
T4	1:800	22ml
T5	1:1000	22ml
T6	Untreated(Negative control)	-

Calculation equation of EM concentration rate:

$$ml/pot = \frac{Area(m^2) \times Rate\ concentration(l/ha) \times 1000ml}{10{,}000m^2}$$

Calculation equation of NPK fertilizer rate:

$$g/pot = \frac{Area(m^2) \times Recommended\ fertilizer(kg/ha) \times 1000g}{10{,}000m^2}$$

Table 3.2 Application of fertilizer for T1 (control) as recommended

DAYS AFTER PLANTING	ACTIVITY	MATERIAL		
		Types	Rate (kg/ha)	Rate (g/pot)
0	Pot preparation -Sowing seed	-	-	-
15-20	First fertilizer	17.5:15.5:10 (Mixed fertilizer)	250 kg/ha	7.8g
35-40	Second fertilizer	Urea MOP (46%N)	100 kg/ha	3.14g
50-55	Third fertilizer	12:12:17:2 MgO+TE (NPK Blue)	250 kg/ha	7.8g
70-75	Fourth fertilizer	12:12:17:2 MgO+TE (NPK Blue)	250 kg/ha	7.8g
105-110	Harvest	-	-	-

Table 3.3 Application rate of EM on T2, T3, T4 and T5

DAYS AFTER PLANTING	ACTIVITY	EM CONCENTRATION RATE			
		T2	T3	T4	T5
0	Pot preparation -Sowing seed	-	-	-	-
15	First application	1:400	1:600	1:800	1:1000
30	Second application	1:400	1:600	1:800	1:1000
45	Third application	1:400	1:600	1:800	1:1000
60	Fourth application	1:400	1:600	1:800	1:1000
75	Fifth application	1:600	1:600	1:800	1:1000
105-110	Harvest	-	-	-	-

3.4.4 Serial dilution

Using sterile pipette to transfer 1ml of EM stock concentration into the 399ml, 599ml, 799ml and 999ml of distilled water based on application ratio 1:400, 1:600, 1:800 and 1:1000 that used to apply for plant samples. After that, 1ml from the application ratio was put into 9ml of distilled water in test tube. Seal the top test tube using tape and shake the test tube. The purpose is to disperse adequately the bacteria throughout the tube. The test tube was containing of EM microbe and water in ratio of 1:10 ($1:10^{-1}$). The sample in test tube was used to culture the fungi in the PDA media. If there still too many bacteria in second dilution, repeat the procedure until the population of the bacteria reduced and easy to count under microscope.

3.4.5 Direct counting method

The sample of EM activated solution is used after dilution process. The sample of 1ml solution EM + water was dropped into the petri dish that containing PDA media. After dropped the solution, close the petri dish and seals it by using tape. The sample was put into the incubator for 18 to 24 hours. After the period needed, the colony of fungal are appeared on the PDA media. The data of colony in each ratio is counted and collected to identify the different population of fungal in each different rate of EM application.

Calculating the number of bacteria per ml of serial diluted bacteria:

$$\frac{Number\ of\ CFU}{Volume\ plated(ml) \times Total\ dilution\ used} = Number\ of\ bacteria\ per\ ml$$

3.5 Experimental design

The experimental design that used in this experiment is completely randomized design (CRD) with 4 treatment including 1 control and 1 untreated. Each treatment has 4 replicate. There are 24 pots are used in this experiment for all treatment. Figure 3.1 show the arrangement of CRD design. Each of samples are located by using random number.

T1	T2	T6	T4
T3	T3	T4	T5
T6	T1	T3	T2
T2	T6	T5	T3
T4	T5	T2	T1
T1	T6	T4	T5

Figure 3.1 CRD design

3.6 Statistical analysis

The data that are collected from the experiment of paddy growth performance were analyzed by using analysis of variance (ANOVA). Analysis of variance are used to identify if there any significant different of paddy growth performance between different EM concentration and control. Analysis is done by using Statistical Package for the Social Sciences (SPSS).

CHAPTER 4

RESULT

4.1 Effect of different rate of EM concentration on paddy plant height

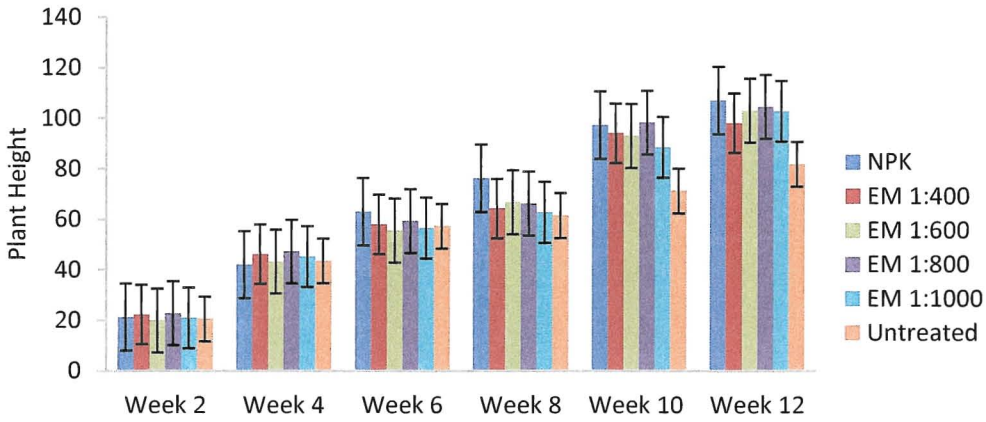

Figure 4.1 Effect of the different rate of EM concentration on paddy plant height

In 12 weeks the study was conducted, every 2 week interval the data was collected indicated all treatments do not shows too significant differences on the plant growth. Start form week 2, the treatments growth uniformly without affected by any plant input because plant input on T1 (NPK treatment), T2, T3, T4, and T5 (EM treatments) are applied on day 15 after week 2. After first application, week 4 shows the plant still growth with uniformly. The effect of plant input shows in 2 week.

On week 6 and week 8, T1 (NPK treatments) treatment growth with significantly compare to others treatment but there is no significant differences in terms of height even the EM solution has been applied 3 times. EM treatments plants growing well on week 10 and 12. EM treatments plant growth uniformly with T1 (NPK treatment) and T4 (EM 1:800) became the

highest plant on week 10. Unfortunately, the application of NPK fertilizer is more effectiveness on the paddy plant when the plant growing well on week last where study conducted. The highest T1 (NPK treatment) plants has reach 111cm on week 12. However, all NPK treatment (T1) and EM treatments (T2, T3, T4, and T5) are growth higher than untreated treatment (T6) for both week 10 and week 12.

In term of water requirement, NPK treatment (T1) require large amount of water compare to others. Even the EM treatments plant growth shows good competition but it was not like NPK treatment that require a lot of water. Untreated treatment (T6) requires the least water between all treatments.

4.2 Effect of different rate of EM concentration on number of leaves

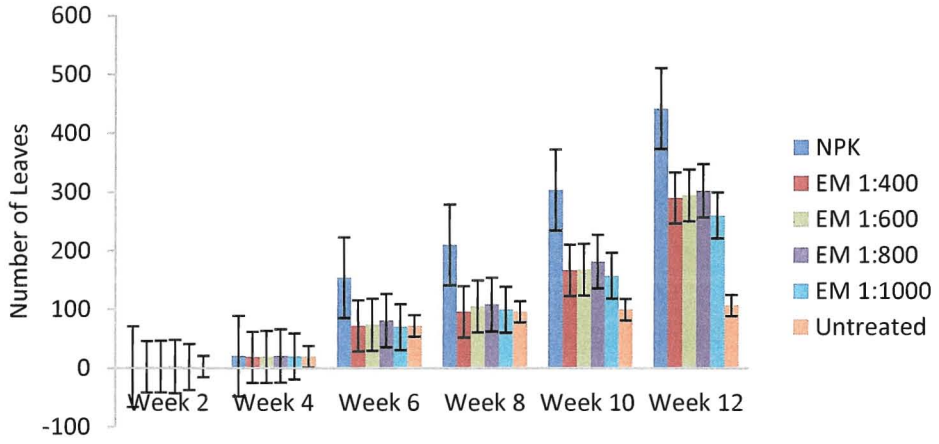

Figure 4.2 Effect of different rate of EM concentration on leaves number

On week 2 and week 4 shows it no significant differences in term of leaves number between all treatments. NPK fertilizer affects well on the number of leaves of T1 treatment (NPK treatment) start week 6 until week 12. NPK fertilizer affect a huge amount of leaves number where the highest leaves number on week 12 is 475 leaves and for the averages are 441 for each plant.

Even the plant height is growth uniformly, but the number of leaves shows significant differences with a large number between NPK treatment and EM treatments. However, the number of leaves on untreated treatment shows about the same with EM treatments (T2, T3, T4, T5) since week 2, 4, 6, and 8. After week 8, EM solution has given effect on EM treatments when these treatments produce leaves number with differently compared with untreated treatment. The color of untreated treatment leaves turn to yellowish start from week 6. T6 treatment (untreated treatment) produce the number leaves moderately on week 6, week 8, week 10 and week 12.

4.3 Effect of different rate of EM concentration on number of tillers

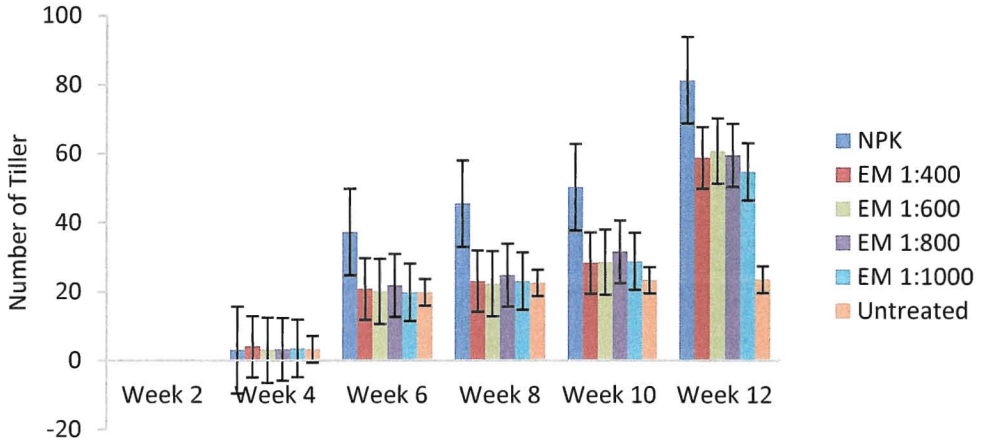

Figure 4.3 Effect of different rate of EM concentration on number of tillers

Plant tiller start to emerge on week 3, so on week 2 there is no value on data collected. Average of plant tiller on week 4 is 2 to 3 tillers for all treatment because plant still growth naturally at that time. Each tiller producing 3 to 4 number of leaves and when the plants reaches growing stage, some of tillers producing 5 leaves. Same scenario with number of plant leaves, plant tillers of T1 (NPK treatment) is producing high number tillers compared to the others. On week 12, NPK treatment producing highest tiller number which is 86 tillers. It shows that NPK fertilizer is very affecting on plant leaves and tillers.

Comparing EM treatments (T2, T3, T4, and T5) and untreated treatment (T6), there is not different between them on week 4, week 6 and week 8. On week 10, EM treatments start to shows improvement where the plant tiller has increasing more than untreated treatment. After week 12, untreated treatment still producing tillers with moderate number but EM treatments is producing doubled number of tillers more than week 8.

4.4 Population of fungi in different concentration of EM

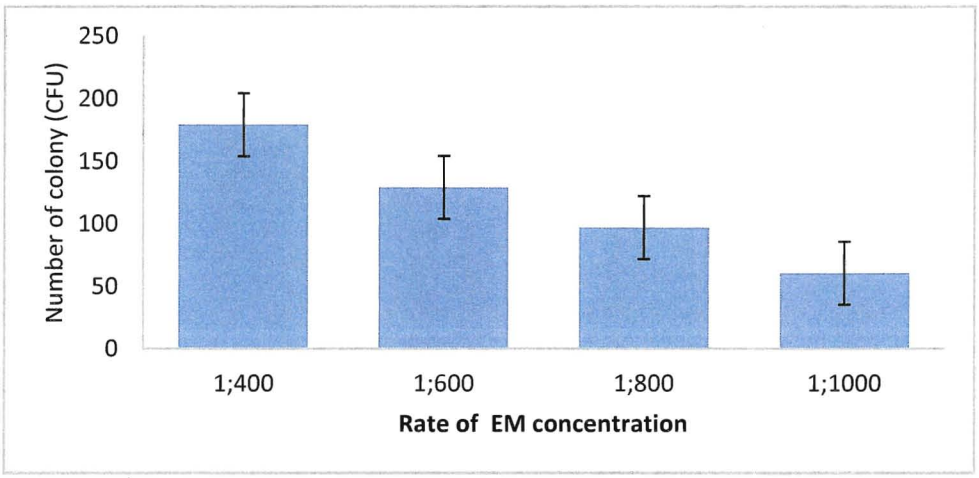

Figure 4.4 The population of fungi in different rate of EM concentration

The fungus counting has been identifying by direct counting on PDA plate. From the result obtained, the highest microbes contain in EM treatments 1:400, and followed by EM 1:600, EM 1:800 and EM 1:1000. Each rate of EM concentration has been culture 4 times with different time. On 1:400 concentrations, the highest colonies is 208, on 1:600 is 161 colonies, on 1:800 is 99 colonies and on 1:1000 is 97 colonies.

The colonies appear on plate in 24 hour with temperature 30°C. If there are delays for counting process, the data will not valid because fungi are spread rapidly.

CHAPTER 5

DISCUSSION

5.1 Effect of different rate of EM concentration on paddy plant height

The result shown in Figure 4.1 indicated that there are significant different ($p<0.05$) on week 8, week 10, and week 12. Even first application of plant input on day 15 (EM), and 18 (NPK) but there is no differences of growth performance on week 4 and week 6 compared to untreated treatment. Since all treatments grown uniformly, there is no significant difference ($p<0.05$) on week 2, week 4 and week 6. This is because of the effective microorganism solution affect the plant on week 10 and week 12.

The result shows that EM growth performance between EM treatments (T2, T3, T4 and T5) is increasing uniform below NPK treatment (T1) in week 8 even the rate of application is different for each of them. Shamshad, (2001) has conducted a research on maize by making variable of input including EM and NPK to the plant. The result shows that NPK growth performance on plant height and yield is better by using EM as input. Even half of EM combines with NPK, the result still could not give similar effect on plant growth like using NPK (Ghulam *et al.,* 2007). The height graph does not show obviously about the effectiveness of the paddy input.

On week 2 until week 8, all EM treatments (T2, T3, T4 and T5) shows no significant differences ($p<0.05$) with untreated treatment. These EM treatments growing up with naturally seems like the plant does not get support by EM.

This is because of climatic condition on week 2 until week 8 not suitable for microbes in EM to do their activities. Karthick and Kirithiga (2010) reported the successful use of EM depend on the environment condition and effort of protection against the unfavorable environmental condition. NPK treatments (T1) grow rapidly and have significant differences between all treatments on week 2 until week 8. Even the height of untreated plant (T6) growth uniformly with EM treatments but the color of untreated treatment leaves turn to yellowish and the number of leaves is smaller than the rest of treatments.

Effectiveness of the EM shows on week 10 and week 12 whereas there no significant differences ($p<0.05$) between all EM treatments (T2, T3, T4 and T5) and NPK treatment (T1). Even the effect of EM solution is slow compare to NPK but eventually the height of EM treatment is same. Significant differences ($p<0.05$) occur on untreated treatment (T6) compare to NPK treatment (T1) and EM treatments (T2, T3. T4 and T6).

5.2 Effect of different rate of EM concentration on number of leaves

Based on data analysis, there were significant different ($p<0.05$) in the number of leaves on week 6, week 8, week 10 and week 12. On week 2 and week 4 there are no significant differences ($p<0.05$) between all treatments. Significant differences occur between NPK treatment (T1) and the rest of treatment whereas NPK treatment (T1) producing the number of leaves more than EM treatments (T2, T3, T4 and T5) and untreated treatment (T6) on week 6, week 8, week 10 and week 12. Factor of P in NPK fertilize has enhanced to rapidly the production of leaves number for NPK treatment (T1). Using effective microorganism also can enhance the number of plant leaves but it can increase more than normal if combining with NPK fertilizer (Arshad, 2010). There is no significant differences ($p<0.05$) shown in Figure 4.2 on week 2 and week 4 in the number of leaves because of slow reaction of NPK fertilizer and EM solution.

Comparing EM treatments (T2, T3, T4 and T5) with untreated treatment (T6), the result shows there are no significant difference ($p<0.05$) on week 2, week 4, week 6 and week 8. These plant treatments growth naturally and slow without affected by EM solution. It is cause by unfavorable condition that affects the activity of microbes in EM. It including absence of nutrient is soil that the main sources of energy for some organism to do their activity (Javaid, 2010). The pattern of plant growth changes when the EM treatments drastically from week 10 until week 12. This scenario may occur because of accumulation of microbes and reproduce rapidly from EM solution after 5 applications. The statement was supported by Sahayaraj and Karthick, (2008) when they say a fungus is easy to making a process of mass reproduction if

there are suitable environment conditions for fungi to reproduce research, they state. At the same time, rapid growth by EM treatment led to significant differences ($p<0.05$) with untreated treatment.

5.3 Effect of different rate of EM concentration on number of tillers

The number of plants tiller is representative for the number of leaves. Based on study conducted has found that the number of tiller on all treatments still increasing until week 12 although the number of leaves decreasing reach heading stage (90-150 days). Plant tiller do not emerge yet on week 2. On week 4, there are no significant differences ($p<0.05$) between all treatments because of slow reaction of NPK fertilizer and EM on the treatments.

NPK treatment (T1) shows the significant differences on week 6, week 8, week 10 and week 12 when the plant produce more number of tiller compare to the rest. Meanwhile the EM treatments (T2, T3, T4 and T5) do not show any significant differences ($p<0.05$) if comparing with untreated treatment on week 4, week 6 and week 8. Other than that, based on result there are also no significant differences ($p<0.05$) between week 6 and week 8 on EM treatments (T2, T3, T4 and T5).

EM solution start to affect the number of plant tiller on week 10 when the significant differences ($p<0.05$) occur between EM treatments (T2, T3, T4 and T5) with untreated treatment (T6). The effectiveness of effective microorganism is reacting on week 10 and with increasing the parameter level of tillers (Neveen, 2014). When the plant ages start to reach week 12, the number of plant tiller drastically increasing consistent with NPK treatment (T1).

5.4 Population of fungi in different concentration of EM

The populations of fungi in EM are determining based on their concentration that used to apply to paddy. In this study (Figure 4) had shown that different rate of EM are containing of different number of the fungi population. From the data collected, the number of fungi population is different from each other but the effect of the each different concentration is not very significant on plant height, number of plant leaves and number of plant tiller. The EM concentration 1:400 has shown the densest of fungi number content. Based on Sahayaraj and Karthick (2008) research, they state the fungi are easy to making a process of mass multiplication if there are suitable conditions for fungi to reproduce. In this case, even the rate of EM application is small but the fungi can reproduce into many if there are favorable conditions. It similar to Conway (2012) study which is he used mycchorizal fungus to overcome soil repressed for mustard grown by applying the fungus into the soil for spread it rapidly.

Table 5.1 The number of fungi for each application to the plant

Rate of concentration	CFU (1ml)	Number of Fungus (22ml)
1:400	179	3938
1:600	129	2838
1:800	97	2134
11000	60	1320
$p<0.05$		

The table above the number of fungi (CFU) after cultured on the PDA. The highest content of fungus is in application rate 1:400. After recalculate the population of fungi in EM solution, it shows the CFU for each 1ml EM stock is around 7.5×10^5 CFU.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This study had found that environmental condition is a significant factor for effective microorganism to reacted and affect the paddy (*Oryza satiza* L.) growth. As a conclusion, the environmental condition have affected the study of effectiveness of EM on the first 8 week when the temperature in green house where the study conducted reaching over than 35°C. The higher temperature has caused the microbes in the EM solution cannot survive very well to do their activity. The color of leaves also turn to yellowish because there no supplement for plant.

The effectiveness of EM shows on last 4 weeks before the end of study when the plant gives positive development on the plant height, number of leaves and number of tillers. All EM treatment (T2, T3, T4 and T5) produce almost the same result even the concentration of EM solution is different for each of them. One of the objectives of this study is to identify the effectiveness of different concentration of EM application, so based on this study shows there are no significant different between all different concentration of EM application.

Even though the EM solution lower cost than NPK fertilizer but, the effectiveness on NPK fertilizer are more effective compare to EM solution. Many of previous study and research stated that the combination of EM and NPK can resulted more ideal production of paddy compare to using single of

EM solution because the cost still lower than using NPK. Other than that, combination of EM and NPK also still cannot challenge the effectiveness of using single NPK fertilizer for plant.

As overall conclusion, this study shows that using different concentration of EM does not give any significant different to the plant growth even the population of microbes in the solution is different. Application of EM is suitable for paddy when the growth of paddy reach more than 8 weeks because the shade from plant growth can reduce the temperature of soil and water.

6.2 Recommendation

From the study and conclusion, the following recommendation should be in term of the effectiveness of the EM application. This study should be conducted until the plant producing yield so we can make the overall conclusion on the effectiveness of EM solution toward plant growth. The environmental condition should be controlled if the study is conducted in green house. Make sure the surrounding temperature is suitable for study to ensure the study is successful.

Other than that, for further study should be test on concentration with lower than 1:1000 to determine the optimal concentration of EM solution for plant growth. If the lower concentration can give similar effectiveness, it could reduce the input cost.

References

Anem, M. (2011). MR220. Retrived From: *http://Animhosnan.Blogspot.Com/2011/09/Padi-Mr-220.Html.*

African Journal Of Biotechnology. (2008). *Mass Production Of Entomopathogenic Fungi Using Agricultural Products And By Products, 7 (12),*, 1907-1910.

Arshad Javaid And M. B. M. Shah. (2010). African Journal Of Biotechnology. *Growth And Yield Response Of Wheat To EM (Effective Microorganisms) And Parthenium Green Manure, 9(23)*, 3373-3381.

Azmi, M., S. Azlan, K.M. Yim, T.V. George And S.E. Chew. (2012). Weed Science Residue. *Control Of Weedy Rice In Direct-Seeded Rice Using The Clearfield Production System In Malaysia, 8*, 49-53.

Bauman, R. W. (2011). *Microbiology With Disease By Taxonimy* (3 Ed.). (L. Berriman, Ed.) San Francisco: Benjamin Cumming.

Benson. (2002). *H. J. Microbiological Applications* (8th Edition Ed.). New York: Mcgraw Hill.

Chamburi, S., M.I.N. Diana , M. Yaar And M.Golam . (2014). Research Journal Of Applied Science, Engineering And Technology. *Issue And Challenging Facing Rice Production And Food Security In The Granary Areas On East Coast Economic Region (ECER), Malaysia, 7*(4), 711-722.

Choudhry, A.T.M.A And I.R. Kennedy. (2004). Biological Fertility Soils. *Prospect And Potential For Systems Of Biological Nitrogen Fixation In Sustainable Rice Production, 39*, 219-277.

David Kirchman, John Sigda, Richard Kapuscinski, And Ralph Mitchell. (N.D.). Applied And Environmental Microbiology. *Statistical Analysis Of The Direct Count Method For Enumerating Bacteria, 44*(2), 376-382.

Febri Doni, Anizan Isahak, Che Radziah Che Mohd Zain And Wan Mohtar Wan Yusoff. (2014). AMB Express. *Physiological And Growth Response Of Rice Plants (Oryza Sativa L.) To Trichoderma Spp. Inoculants, 4 :45*, 2-7.

Ghulam Jilani, Abida Akram, Raja M. Ali, Fauzia Y. Hafeez, Imran H. Shamsi, Arshad N. Chaudhry, Abid G. Chaudhry. (2007). Annals Of Microbiology. *Enhancing Crop Growth, Nutrients Availability, Economics And Beneficial Rhizosphere Microflora Through Organic And Biofertilizers, 57 (2)*, 177-183.

Higa, T. (1999). *Application Of Effective Microorganism For Sustainable Crop Production.*

Higa, T. And J. F. Parr. (1994). *Beneficial Effective Microorganism For A Sustainable Agriculture And Environment.*

Higa, T. (N.D.). EM Research Organization. *Microorganism In EM. Retrieved From : Http://Www.Emrojapan.Com/About-Em/Microorganisms-In-Em.Html.*

Hoque, M.Z., F. Akter, K.M. Hossain, M.S.M. Rahman, M.M. Billah And K.M.D. Islam. (2010). World Journal Of Dairy & Food Sciences. *Isolation, Identification And Analysis Of Probiotic Properties Of Lactobacillus Spp. From Selective Regional Yoghurts, 5* (1), 39-46.

Hussain, T., T. Javaid, J.F Parr, G. Jilani, And M.A. Haq. (1999). American Journal Of Alternative Agriculture. *Rice And Wheat Production In Pakistan With Effective Microorganisms, Volume 14*, 30-36.

I. Salvesen And O. Vadstein. (2000). Journal Of Applied Microbiology. *Evaluation Of Plate Count Methods For Determination Of Maximum Specific Growth Rate In Mixed Microbial Communities, And Its Possible Application For Diversity Assessment*, 442-448.

Jamaludin, M. Y., W. Aizan And M.S.A. Rahman. (N.D). *Characterization And Effects Of The Effective Micro-Organics (Em) And Industrial Waste (Iw) Material As Partial Mixture Of Concrete.*

Javaid, A. (2006). *Foliar Application Of Effective Microorganisms On Pea As An Alternative Fertilizer* (Vol. 26). Pakistan.

Josep Guarro*, Josepa Gené, And Alberto M. Stchigel. (1999). *Developments In Fungal Taxonomy* (Vol. 12(3)).

K. Sahayaraj And S. Karthick Raja Namasivayam. (2008). *African Journal Of Biotechnology:Mass Production Of Entomopathogenic Fungi Using Agricultural Products And By Products* (Vol. 7(12)). Chennai.

Karthick, R.N. And Kirithiga. (2010). Recent Research In Science And Technology. *Effect Of Formulation Of Effective Microorganism (EM) On Post Treatment Persistence, Microbial Density And Soil Macronutrients, 2*(5), 102-106.

Kock, J.L.F., E.E. Pretorious, And C.H. Pohl. (2008). Journal Of Sustainable Development In Africa. *Identification Of Yeasts Isolated From Mukumbi, A Zimbabwean Traditional Wine, 10*(3), 88-102.

Konopiya, E.F., And T.Higa. (2010). *Mechanism Of EM-1 Effect On The Growth And Development Of Plant And Its Application In Agricultural Production. Retrived From : Http://Www.Emrojapan.Com/Emdb/Content/98.Html.*

L. B. Yin, L. Z. Zhao, Y. Liu, D. Y. Zhang,. (2013). INTECH. *Isolation And Characterization Of Cypermethrin Degrading Bacteria Screened From Contaminated Soil.*

Lim Y.D., Pak T.W. And Jong C.B. . (1997). *Yields Of Rice And Maize As Affected By Effective Microorganisms.*

Nadia, R.,N.S. Mad , M. Zainalabidin, And A. Radam. (2012). International Journal Of Sicial And Humanity. *The Impact Of Fertilizer Subsidy On Malaysia Paddy/Rice Industry Using A System Dynamics Approach, 2*(3), 213-219.

Najib, M.Y., Z.M. Norziana , M. Haryati , M.S. Maisarah ,A. Asfaliza, Z. Illani, Ibrahim, M. Zulkefli, B.M. Abu . (2014). Jurnal Teknologi. *Penilaian Potensi Baja Organik Yang Diperkaya Terhadap Hasil Varieti Padi Wangi MRQ74, 70*(6), 49–51.

Oryza sativa,Wikipedia (2014). Retrived From : *https://en.wikipedia.org/wiki/Oryza_sativa*

Powell, C. L. (1979). *Journal Of Agricultural Research:Spread Of Mycorrhizal Fungi Through Soil* (Vol. 22).

Powell, C. L. (2012). New Zealand Journal Of Agricultural. *Spread Of Mycorrhizal Fungi Through, 22(2)*, 335-339.

Razi, I.M , Md. Kamal U. , W. Ahmad , Maziah M. And Ismail C.H. (2013). Journal Of Food, Agriculture & Environment. *Growth And Yield Reposnse Of Rice Variety MR220 To Different Water Regimes Under Direct Seeded Conditions, Vol.11* (2), 367-371.

Salvesen, I,. And O. Vadstein. (2000). Journal Of Applied Microbiology. *Evaluation Of Plate Count Methods For Determination Of Maximum Specific Growth Rate In Mixed Microbial Communities, And Its Possible Application For Diversity Assessment, 88*, 442–448.

Samsudin , A.A, Masori, M.F. And Ibrahim, A. (2013). *The Effects Of Effective Microorganisms (EM) On The Nutritive Values Of Fungal-Treated Rice Straw* (Vol. 16(1)). Serdang, Malaysia.

Shamshad H. Shah, M. Bashir And M. Shahid Ibni Zamir. (2001). *Quantitative And Qualitative Response Of Maize (Zea Mays L.) To EM Bioaab And Fertilizers* (Vol. 3). Pakistan.

Sharifeh, M., M.E. Udoudo , O.A. Felix E ,K.S. Kimbro, B. Judith. (2001). Biomolecular Engineering. *Identification And Characterization Of Rhodopseudomonas Spp.,A Purple, Non-Sulfur Bacterium From Microbial Mats, 18*, 49–56.

Sivanan D., L. N. (2011). *Isolated Effective Microorganism (EM : B. Subtilis) From Natural To Be Green Material For Environmental Management In Wastewater Treatment.*

Tahir Hussain, T. Javaid, J.F. Parr, G. Jilani, And M.A. Haq. (N.D.). American Journal Of Alternative Agriculture. *Rice And Wheat Production In*, 30-36.

Talaat, N. B. (2014). *Effective Microorganisms Enhance The Scavenging Capacity Of The Ascorbateeglutathione Cycle In Common Bean (Phaseolus Vulgaris L.) Plants Grown In Salty Soils* (Vol. 80).

Talaat, N. B. (2014). Plant Physiology And Biochemistry. *Effective Microorganisms Enhance The Scavenging Capacity Of The Ascorbateeglutathione Cycle In Common Bean (Phaseolus Vulgaris L.) Plants Grown In Salty Soils, 80*, 136-143.

Viji, J. And Neelanarayanan, P. (N.D.). Int. J. Environ. Res. *Efficacy Of Lignocellulolytic Fungi On The Biodegradation Of Paddy Straw, 9(1)*, 225-232.

Warner, A. C. (1962). J . Gen. Microbiol. *Enumeration Of Rumen Micro -Organisms*, 119-128.

Winter, F. H. , G. K. York, And E.N. Hamza . (1971). Applied MICROBIOLOGY. *Quick Counting Method For Estimating The Number Of Viable Microbes On Food And Food Processing Equipment, 22*(1), 89-92.

Yadav, S. (N.D.). *Performance Of Effective Microorganisms (EM) On Growth And Yields Of Selected Vegetables.* Katmandu.

Ziegler, N. R. And H. 0. Halvorson. (1934). Application Of Statistics To Problems In. *Experimental Comparison Of The Dilution Method, The Plate Count, And The Direct Count For The Determination Of Bacterial Populations*, 609-634.

APPENDICES

APENDIX A

\

Table effect of different rate of EM concentration on paddy plant height (cm).

DAY AFTER PLANTING	DATA																							
	T1				T2				T3				T4				T5				T6			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	21	18	21	25	19.5	34	22	23	17	21.5	19	22	22	20.5	22.5	26	19	21	21.5	22	19	23	19	21
28	46	35	41	46	43.5	50	44	47	41	44	44	44	47.5	45.5	47	49	45	45	49	42	42	43	44	45
42	64	58	70	61	53	62	61	56	59	57	53	53	55	58	59	65	56	59	54	57	54	60	57	58
56	77	68	82	78	60	68	67	62	67	69	69	62	70	61	65	69	63	65	58	65	59	62	61	64
70	107	91	95	96	94	100	100	82	99	99	89	85	94	97	101	101	85	94	87	88	73	74	67	71
84	111	102	107	108	95	101	100	97	107	108	100	97	101	105	108	108	102	105	101	103	80	87	79	61

Table effect of different rate of EM concentration on number of leaves (cm).

DAY AFTER PLANTING	DATA																							
	T1				T2				T3				T4				T5				T6			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	2	3	2	3	2	2	3	2	2	3	2	2	2	3	3	3	2	2	3	2	3	3	2	3
28	19	10	24	30	18	20	17	19	13	20	21	23	21	22	21	19	13	21	30	16	16	18	21	23
42	139	72	172	233	81	68	73	67	58	82	77	80	89	85	80	70	54	87	70	69	65	68	80	76
56	235	168	195	241	95	89	109	91	85	115	113	108	112	112	113	96	83	122	94	99	90	92	89	106
70	363	286	305	359	161	163	192	150	148	175	180	169	204	169	172	181	134	176	152	167	95	99	95	109
84	453	458	381	475	279	298	335	247	278	271	316	312	302	294	314	298	214	253	298	277	104	111	97	115

Table effect of different rate of EM concentration on number of tillers (cm).

DAY AFTER PLANTING	DATA																							
	T1				T2				T3				T4				T5				T6			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	5	2	4	1	4	4	2	4	2	3	3	4	3	3	4	4	2	5	4	4	3	4	4	4
42	38	25	38	48	25	17	22	19	17	24	18	21	26	18	23	20	17	23	23	17	20	19	19	21
56	45	39	46	52	26	18	24	24	18	26	22	23	27	27	25	20	20	28	25	22	23	22	24	21
70	52	43	50	56	29	28	25	29	26	32	28	28	33	32	34	27	27	34	34	28	24	22	26	21
84	85	86	69	85	61	58	58	53	59	56	59	66	57	60	65	46	46	62	65	54	24	23	26	21

The number of fungi colonies

Week	DATA (Number of Fungal Colonies/CFUs)			
	T2	T3	T4	T5
2	179	133	96	39
4	208	104	99	30
6	158	118	96	76
8	171	161	-	95
Mean	**179**	**129**	**97**	**60**

Significant difference ($p<0.05$) on plant height

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Week 2	Between Groups	22.427	5	4.485	.955	.471
	Within Groups	84.563	18	4.698		
	Total	106.990	23			
Week 4	Between Groups	80.552	5	16.110	1.887	.147
	Within Groups	153.688	18	8.538		
	Total	234.240	23			
Week 6	Between Groups	150.708	5	30.142	2.221	.097
	Within Groups	244.250	18	13.569		
	Total	394.958	23			
Week 8	Between Groups	556.208	5	111.242	7.183	.001
	Within Groups	278.750	18	15.486		
	Total	834.958	23			
Week 10	Between Groups	1994.375	5	398.875	11.632	.000
	Within Groups	617.250	18	34.292		
	Total	2611.625	23			
Week 12	Between Groups	1682.708	5	336.542	27.134	.000
	Within Groups	223.250	18	12.403		
	Total	1905.958	23			

Significant difference ($p<0.05$) on number of plant leaves

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Week 2	Between Groups	1.000	5	.200	.720	.617
	Within Groups	5.000	18	.278		
	Total	6.000	23			
Week 4	Between Groups	15.708	5	3.142	.119	.987
	Within Groups	476.250	18	26.458		
	Total	491.958	23			
Week 6	Between Groups	21644.708	5	4328.942	5.232	.004
	Within Groups	14894.250	18	827.458		
	Total	36538.958	23			
Week 8	Between Groups	40247.333	5	8049.467	25.920	.000
	Within Groups	5590.000	18	310.556		
	Total	45837.333	23			
Week 10	Between Groups	116923.500	5	23384.700	53.037	.000
	Within Groups	7936.500	18	440.917		
	Total	124860.000	23			
Week 12	Between Groups	229258.208	5	45851.642	54.149	.000
	Within Groups	15241.750	18	846.764		
	Total	244499.958	23			

Significant difference ($p<0.05$) on plant height

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Week 4	Between Groups	3.333	5	.667	.649	.666
	Within Groups	18.500	18	1.028		
	Total	21.833	23			
Week 6	Between Groups	965.333	5	193.067	8.645	.000
	Within Groups	402.000	18	22.333		
	Total	1367.333	23			
Week 8	Between Groups	1687.833	5	337.567	26.709	.000
	Within Groups	227.500	18	12.639		
	Total	1915.333	23			
Week 10	Between Groups	2260.333	5	452.067	15.210	.000
	Within Groups	535.000	18	29.722		
	Total	2795.333	23			
Week 12	Between Groups	6992.708	5	1398.542	44.300	.000
	Within Groups	568.250	18	31.569		
	Total	7560.958	23			

APPENDIX B

COCURICULUM VITAE

Personal Profile

Name	:	Wan Muhammad Fitri Bin Bahari
I/C Number	:	910417-07-5191
Race	:	Malay
Date of Birth	:	17 April 1991
Place of Birth	:	Butterworth
Number of Sibling	:	9
Address	:	1355 Padang Tembusu, 13100 Penaga, Seberang Perai Utara,Pulau Pinang

Telephone(Home)	:	-	(Office) :	-
Telephone	:	011-2645 2974	E-mail :	wanfitri91@gmail.com
Citizenship	:	Malaysian		
Marital Status	:	Single		
Gender	:	Male		

Academic Qualification

Level/College/University	Certificate/Diploma/Degree	Year
Universiti Teknologi MARA, Jasin Melaka	Bachelor in Plantation Technology and Management	2013
Universiti Teknologi MARA, Arau Perlis	Diploma in Plantation Technology and Management	2009
SMK Sri Muda	Sijil Pelajaran Malaysia (SPM)	2008
SMK Sri Muda	Pernilaian Menengah Rendah (PMR)	2006
SK Penaga	Ujian Penilaian Sekolah Rendah (UPSR)	2003

Working Experience

Industrial Training:

1. DuPont Malaysia Field Research Station, Lot 2385 Permatang Damar, 13200 Kepala Batas,Seberang Perai Utara, Pulau Pinang (Jan. 2014- 28 Feb. 2014)

2. Pusat Ikan Hiasan Enggor, Jabatan Perikanan Malaysia,Perak Darul Ridzuan
   (April 2012– Mei 2012)

3. BOUSTEAD Telok Sengat Sdn. Bhd., Bukit Mertajam Estate, Kulim Kedah
   (Sept. 2011 – Nov. 2011)

4. Stesen MARDI Seberang Perai, Pulau Pinang
   (Nov. 2010 – Dec. 2010)

5. Unit Ladang Universiti Teknologi MARA, Perlis
   (March 2010– April 2010)

Signature : _____ Date : 11 August 2015