Efficacy Of Tricompost On Maintenance Chilli Plant Growth

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A report submitted in fulfilment of the requirements for the degree of Bachelor of Applied Science (Agrotechnology) with Honours

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DECLARATION

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

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Date: 17 December 2018

I certified that the report of this final year project entitle "Efficacy of Tricompost on Maintenance Chili Plant Growth" planted in Jeli Kelantan by Nornadillanadia Binti Abdul Rapar, matric number F15A0120 has been examined and all the correction and recommended by examiners have been done for the degree of Bachelor of Applied Science (Agrotechnology) with Honours, Faculty Agro Based Industry, University Malaysia Kelantan.

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EFFICACY OF TRICOMPOST ON MAINTENANCE

CHILLI PLANT GROWTH

ABSTRACT

Agriculture nowadays is an important sector of Malaysia especially in production of chilies for domestic and international market. Thus, application of biological control is necessary to produce a good yield in especially to organic farmers on eco-friendly method for improvement .*Trichoderma sp.* is a soil fungus which showed as biocontrol. Thus, the objectives of the study was to determine the efficacy of Tricompost as biofertilizer as maintenance for the chilli plant growth and productivity in the net house at Agropark. The treatment were: T1 = 100 g Tricompost, T2 = 10 g chemical, T3 = control, T4 = 50 g Tricompost + 5 g chemical, T5 =15 g chemical and T6 = 150 Tricompost. A total of 53 chilli seedlings were planted in polybags contained soils. Plant growth were determine based of plant length, diameter of stem and number of leaves. The result showed that T6 = 150 Tricompost effective for highest growth of chili stem diameter and increase number of leaves while T5 =15 g chemical result highest length of chili growth among treatments. Using chemical fertilizer can increase the yield nevertheless chemical residues caused environment pollution, to overcome this problem to use biofertilizer. This project will be determine either the Tricompost have the efficacy for maintenance chilli plant growth or vice versa.

***Keywords**: Fungus, compost. bio control agent, antagonistic activity, yield*

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Keberkesanan Trikompost Dalam Penyelenggaraan Pertumbuhan Pokok Cili

ABSTRAK

Pertanian pada masa kini adalah sektor yang penting untuk Malaysia terutamanya dalam pengeluaran cili bagi pasaran tempatan dan antarabangsa. Oleh itu, penggunaan kawalan biologi adalah perlu untuk menghasilkan pengeluaran yang baik terutama kepada petani organik terhadap kaedah mesra yang alam bagi penambahbaikan. *Trichoderma sp.* adalah kulat tanah yang menunjukkan sebagai kawalan biologi. Oleh itu, objektif kajian ini adalah untuk menentukan keberkesanan penggunaan Tricompost terhadap pertumbuhan tanaman cili di Agropark UMK Kampus Jeli. Tricompost telah disediakan untuk menguji 54 polibag cili dengan 3 kali replikasi. Baja kimia dan Tricompost telah diuji kebersanaanya terhadap hasil pengeluaran. Projek ini akan dapat menentukan sama ada Tricompost yang mempunyai keberkesanan untuk pertumbuhan tanaman cili penyelenggaraan atau sebaliknya.

Kata kunci: Kulat, kompos, aktiviti antagonistik, hasil

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LIST OF SYMBOLS / ABBREVIATIONS

%	Percentage
±	Plus-minus
cm	Centimetres
g	Gram
kg	Kilogram
µm	Micrometre
ml	Millimetre
spp.	Species

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LIST OF EQUATION

No.

1 Number of spores = Number of spores / 25 boxes × 25 boxes × 1 / total volume

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CHAPTER 1

INTRODUCTION

1.0 Research Background

In Malaysia, there are three type of planting system of chili which are under sheltered rain and open sheltered rain and planting chili without rain sheltered. The net income per season on planting the chili under the sheltered rain and open sheltered rain and planting chili without rain sheltered are RM 105, 654, RM 77415 and RM 55, 900 per hectare respectively (Suhaimi, Mohammad & Hani, 2016). The cost on planting chili under the sheltered rain higher than planting chili in open sheltered rain and planting chili without rain sheltered due to technology apply by the system in improving the chili yield and high viability. Fertigation system become the effective technology to grow the chili in a optimum growth rate and yield of chili up to 3-4 fold more than conventional method (Suhaimi, Mohammad & Hani, 2016).

Nowadays, people are more interest in application of chemical fertilizer on their vegetables and fruits crops due to ability of chemical fertilizer in increasing yield productivity. Chemical fertilizer do increase the crop productivity but they also bring impact on human health. Excessive use of chemical nowadays created serious environmental problem (Hermosa, Rubio, Cardoza, Nicolas, Monte & Gutierrez, 2013). Mismanagement of chemical fertilizer brings the side impact to environment such as

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pollution of rivers, lakes and stream flows. Common examples chemical fertilizer used in chilli plant by farmers in Malaysia are NPK 30-10-10 Hydrponic Fertilizer (solid) and B fertilizer (liquid) while example of biocompost in market today for chilli planting such Garden Boost Sheep Wool Sheep Wool Pallet (sheep manure pallet) (Ali and Shaari, 2015).

Yield of chilli in Malaysia is 10- 24 mt/ha season with the gross income to farmers about RM 42 500 per hectare per season. Net income on growing chilli is RM 16 800 per hectare per season (Yaseer, Adzemi, Nur & Nurizah, 2016). Then, chilli become one of economical crops for farmers to cultivate in their land due to high profit return.

This study focused to observed efficacy of Tricompost on maintenance of chilli plant growth. As stated by (Blaszczyk, Siwulski, Sobieralski, Lisiecka & Jedryczka, 2014), *Trichoderma spp.* can promote the growth of crop by reducing the disease due to the ability on antibiotic production. Thus, Tricompost are favourable to be apply on the root system of chilli plant.

1.1 Problem Statement

Chemical fertilizer mostly used by farmers on planting chilli. Though chemical fertilizer able to increase the crop production of chilli, they are hazardous to human health and environment. A study by Alfred (2007) had discussed the properties of chemical fertilizer which have the ability in harden the soil and reduce soil fertility. Moreover, leeching of chemical fertilizer to water stream and environment surrounding can caused water and air pollution. So, biocompost is the best solution to avoid the

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pollution of soil, water and other environment threats. Continuous chemical fertilizer used are harmful on agriculture. Chemical fertilizer can depletes essential nutrient and minerals in soil. In fertile soil, nutrient are replenish but in chemical fertilizer application only replenish in nitrogen, phosphorus and potassium. Potassium are not soluble in water. Thus, it cause the hardened soil structure formation. Sodium nitrate the alkaline fertilizer can reduce the soil fertility and making it barren. Soil degradation due excessive use of chemical leads to the loss of equilibrium of a stable soil. Though the use of chemical fertilizer help in growing the plants faster, plant are not healthy and strong due to short time on the growth of root, stem and nutritious fruits.

In addition, chemical fertilizer contain heavy metal such as cadmium and chromium have high radionuclides concentration. Wide use of chemical fertilizer cause more serious in accumulation of inorganic pollutants. Amount of nitrite in drinking water rises due to wide used of nitrogen fertilizer (Serpil, 2012).

1.2 Objectives Of The Study

i. To determine the effectiveness of Tricompost for maintenance of chilli growth.
ii. To compare the efficacy of Tricompost and NPK fertilizer on maintenance of chilli growth.
iii. To determine the most suitable rate of Tricompost on maintenance of chilli growth.

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1.3 Hypothesis

Application of Tricompost might be unable to enhance the growth of chilli plants and different treatments of Tricompost will have the different growth of chilli plant.

1.4 Scope Of The Study

The study is about to observe the efficacy of Tricompost on maintenance of chilli plant growth. The Tricompost is a compost derived from agriculture waste. It was been prepared by the combination of sugarcane waste, burn rice husk and cultured *Trichoderma parareesei* in lab. A good aseptic technique and proper handlings were practise to prevent contamination of microbes. After 2 weeks ferment, the growth of fungus were observed under microscope. Later, they were applied for different rate on the chilli plant, age of 36 days in polybags.

1.5 Significant of Study

The study able to create platform to encourage the use of Tricompost which can be more economically and environmentally on the agriculture sector. Instead of using the chemical fungicides.

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CHAPTER 2

LITERATURE REVIEW

2.1 Importance Of Chilly

Capsicum called as ‘chilli’ in the original term of Mexican. There are 40 cultivars are being cultivated throughout the world. In New Zealand and Australia, word of ‘capsicum’ refer to sweet or bell type of peppers. It was been named by Christopher Columbus as ‘chilies’ due to its taste of spicy after the taste of pepper (pepper nigrum) (Marjorie, 2014). The chilli, *Capsicum annum* comes from the family solanaceae. It grows in Malaysia tropical climate in range from 21^0C (70^0F) and to 32^0C (90^0F). Humidity in Malaysia is high 80 %. Highland area are 3about 15^0C (59^0F) and 25^0C (77^0F). Annual rainfall are from 2000 mm and the optimum soil for growing chilli is sandy loam with pH between 5.5 and 7.0 (FAO, 2006).

Chilly is one of most important crop recently used by people as the ingredient and spices in cooks. It being consumed in raw and now are processed in various products such as chill sauces (Chili Peppers 101: Nutrition Facts and Health Effects, 2015).Besides become foods, chillies acts as medicines for common heath case *(*Pawar, Bharude, Sonone, Deshmukh, Raut & Umarkar, 2011).

Chillies consumption can overcome skin problem, stomachic and high blood pressure. High cholesterol problem can be reduced by consumption of chillies. Chillies acts as a well beverages due to presence of capsaicin. Chilies can be counter-irritant in

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rheumatism from its extraction of herb. It helps to relief bronchitis and stiff joints. The problem of cough, chest cold and headache can be overcome slowly through the treatment (Pawar et al., 2011). Moreover,chillies can be processed to cream for control the pain of minor aches temporary. Consumpton of chillies can increase the stimulation of gastrc juice. Thus, appetite will enhanced and inflammation are reduced. People can increase metabolism by raw and cooked eat of chillies. In addition, chillies good for human organ such as kidneys,lungs, spleen,pancreas,heart and stomach (Pawar et al., 2011). As food flavourantt, grinding roasted dry chilly are addded to foods preparation to get a spicy taste. In the local anesthetic,cayenne peppers used to ulcelerated the stomachs' tissues. It be used to overcome the bleeding in the stomach. Consumption of of the pepper believed not being the causal of the stomach ulcer but instists of taking the chillies on meals is the main reason for stomach ulcer.It becomes the diabetes neuropathy as capsaicin cream. Besides, chilies can reduced the level of cholesterol. Capsaicin prevents the cholesterols associated heart disease. It has the ability to build the stomach tissue and boost blood transportation by enhancing the stimulation of enzyme. Application of capsaicin cream reduce the itchy from dermatitis eczema *(*Pawar et al., 2011).

2.2 Production of Chilli Scenario in Malaysia

Malaysia's consumption of Chilly per capita is about 66.6 % (2.5 kg/year) in year 2013 and 52% (2 kg/year) in year 2014 (Department Statistic of Malaysia, 2016).

In Malaysia, MC 10 variety is the most popular on the monocrop and mixed crop with melon. Chilies are harvested on green chillies and red chillies depend on

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market demand. Malaysia become favourable to cultivate the chilies due to tropical climate, 20^0C to 30^0C ,soil pH between 5.5 - 6.8 (peat or BRIS soil), rainfall distribution (1,500 mm – 2, 000 mm/ month). A total of 33,000 ton/year of fresh chilly are imported per year. About 23,000 tan/ year on the chilies production are local production. The market price of chillies in Malaysia, RM 2.50 per/kg (Anem, 2011). It estimated on the cost production of chilies in Malaysia in RM 0.72/kg. A total RM 37, 500 of the gross income results net incomes about RM 26 736.50 per hectare (Anem, 2011).

Chillies in Malaysia are been cultivated on methods of conventional and fertigation. There are two type of fertigation method applied in Malaysia on the fertigation which are chilies planting under the sheltered and planting chilies through the open fertigation with no rain sheltered. Cost production of chillies under rains shelter, RM 1.19/kg and RM 1.56 /kg for the open fertigation cost. Income per season of farmers estimated about RM105 654 (rain sheltered) and RM 77 415 (open rain fertigation). Fertigation method enables the chilli production to have the high viability. Lowland area became the most preferable location on farmers to do chilly fertigation in Malaysia. Fertigation not only minimize the time to fertilize the plants, it reduces the costs of labours (Yaseer etc al., 2016).

Government of Malaysia promotes on the increasing growth on local chilly production to reduce the country dependency toward imported chillies. Campaigns to promote local varieties of chilly to local people are taken to educate them in preferring the local varieties. There are 60% of the country chilly production are on red chillies to meet the local demand and the remaining 40% are imported from neighbouring countries. Cili Merah Minyak and Cili Merah Kulai are red chilly varieties that meets the local demand. Grade of local chilies of Malaysia is premium grade with price of RM

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8 to RM 9 per kg while for imported chilly, RM 2. 50 per kg (Anwarul and Mohamed, 2010).

2.3 Nutritional and Medicinal Value of Chilly

Chilly is a vegetables rich of nutrition contents. Chilly contain capsanthin, violaxanthin, capsaicin, sinapic acids, ferulic acid, vitamin c, vitamin B-6, vitamin K1, potassium, copper and vitamin A. In 100 g of raw red chilly pepper contain protein (1.9 g), carbs (8.8 g), sugar (5.3g), fibre (1.5g), fat(0.4 g), saturated (0.04g), monosaturated (0.02g), polysaturated (0.24g), omega-3 (0.01 g) and omega-6 (0.23 g) (Brhan et al., 2018). Consumption of chilly lower the level of blood sugar, enhance the release of endorphin, smoother digestion, promotes good circulatio in body, prevent stroke, promotes heathy prostate, maintain lung health and acts as infection preventer due to anti-inflammantory properties (Todd & Katka, 2015). Table 1 below is the composition of nutrient presence in 100 gram of chilies.

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Table 1: Composition of Nutrient Presence in 100 gram of chilies

Parameter	Dry Chilies	Green Chilies56
Moisture	10.000 gm	85.700 gm
Protein	15.000 gm	2.900 gm
Fats	6.200 gm	0.600 gm
Minerals	6.100 gm	1.000 gm
Fibre	32.200 gm	6.800 gm
Carbohydrates	31.600 gm	3.000 gm
Energy	246.000 gm	29.000K.gm
Calcium	160.000 mg	30.000 mg
Phosphorues	370.000 mg	80.000 mg
Iron	2.300 mg	4.400 mg
Corotene	345.000 µg	175.000 µg
Thiamine	0.930 mg	0.190 mg
Niacin	9.500 mg	0.900 mg
Vitamin C	50.000 mg	111.000 mg
Sodium	14.000 mg	-
Potassium	530.000 mg	-
Phytin Phosphorus	71.000 mg	7.000 mg

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Source from: (Brhan, Abdella & Belay, 2018)

Vitamin C in 100 g of chilies is twice than in citrus and 30 % loss during cooks. Dried chilies has more vitamin A and greates betacorotene contents are red chilies. Riboflavinoids, antioxcidant presence in chilies is very useful as cancer prevention of human health. Capsiacin in chilies be anti-microbial and anti-carcinogenis. Therapeutic propreties presnce in chillies allow chilies to have medicational value in treating the rheumatism,joint stiffness and bronchitis. Chilies reduces rate of mortality due to dietary antioxcidant properties (Brhan et al., 2018).

2.4 Current Scenario of Chemical Used in Vegetables

Application of chemical to the vegetables crop are in term of pesticides. There are lot type of pesticides such as fungicides, herbicides and insecticides. Some of the chemical shown in Table 2. The use of pesticides is different on vegetables depend on the problem faced in field.

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Table 2: Chemical Fertilizer Used in Vegetables

Name of Chemical Fertilizer	Vegetables Crops
Bacillus Subtilis	French bean, herb, spinach
Pyrethrins	French bean, onions, parsnips
Benfluralin	French bean, herb, spinach
Pyrethrins	French bean, lettuce, peas, rhubarb, spinach
S-Metolachlor	French bean, Chinese cabbages, beetroot
Ropaquizafop	French bean
Iprodione	Herb, cauliflower, lettuce, onions,
Spinosad	Chinese cabbages, baby leaf
Ferric Phosphate	Chinese cabbages, peas, rhubarb, spinach
Benfluralin	Chinese cabbages,
Clomazone	Chinese cabbages, carrots, swedes
Cycloxydim	Chinese cabbages,
Azoxystrobin	Cauliflower, herb, leeks, lettuce, onions, parsnips ,spinach
Protioconazole	Cauliflower, leeks, swedes
Pyrimethanil	Herb
Methomorph + Mancozeb	Herb
Fenamidone + Fosetyl	Herb
Fluopicolide + Propamocarb	Herb, kale, green broccoli
Mancozeb	Herb, lettuce, onions, parsnips
Mandipropamid	Herb
Boscalid + Pyraclostrobin	Herb, baby leaf, kale
Dimethomorph	Herb,baby leaf

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Chlorothalonil	Leeks

Source from :(Stephen & Kinsealy, 2018)

The use of chemical, pesticides, fertilizer on crop of vegetables undergo volatilization immediately to the environment after being sprayed. Rate of vitalization is influenced by factor of environment such wind speed and temperature. Besides, photolysis chemical and microbial degradation may take place on the activities of pesticides application to crops. Photolysis happens when the molecules absorb the energy from the sun and lead to degradation pesticides. Use of chemical in vegetables faced rain wash out, volatilization, degradation and photolysis (Margarita, 2011).

2.5 Beneficial Microbes for Plant Growth Diseases

Microbes believe to be best resolution to produce degraded biocompost which are suitable for vegetables crop. There are many microbe had used to produce biocompost in market. Some beneficial microbes used in maintenance of vegetables growth and productivity shows in Table 3.

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Table 3: Beneficial microbes applied on type's crop to control plant disease

Beneficial Microbes	Crops
Bacillus subtilis	Tomato
Bacillus thuringiensis subsp. kurstaki	Apples, eggplant, pepper(sweet)
Pseudomonas fluorescens, A506	Cherry, apple, pear, almond
Agrobacterium radiobacter strain, K84	Apricot, cherry, nectarine, peach, plum
Agrobacterium radiobacter strain, K8	Raspberry, almond, walnut
Pseudomonas syringae strain, ESC-11	Pome fruit, potato
Pseudomonas syringae strain, ESC-10	Citrus, grapefruit, lemon, orange
Pseudomonas chlororaphis	Barley, oat
Bacillus subtilis, GB0	Ornamental flowering plants
Bacillus licheniformis strain, SB3086	Foliage plants
Bacillus subtilis, MBI 600	Ornamental gardens, ornamental plants,
Bacillus subtilis strain, QST 713	Ornamental turf, ornamental conifers
Bacillus subtilis, GB03	Alfalfa, peanut, soybean
Bacillus subtilis, GB03	Grape, tomato
Streptomyces griseoviridis, strain K61	Bean (navy, pinto, kidney, snap, green)
Paenibacillus polymyxa, AC-1	Plum, dill, melon, cucumber, pumpkin,
Coniothyrium minitans, strain CON/M/91-08	Cucumber

(Todd & Katka, 2005)

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2.6 Trichoderma as biocompost

Trichoderma spp. had been study to be a good compost on vegetables and plants and it able to be a bio stimulant for plant growth and biocontrol for disease. Yield of the plant increases to its positive effect of mechanisms. A study of the application of *Trichoderma harizianum* results a better antioxidant system in melon after been combined with citrus compost, there are the increasing of the ascorbate cycling enzymes and peroxidase. The activities antioxidant enzymes, ascorbate cycling increase by the presence of *Trichoderma spp*. (Bernal, Jose, Fabio & Pedro, 2015). A study by (Nehal, El-Mougy & Abdel-Kader, 2014) resulted 80% decreasing of rot disease incidence when the *T.Harizanum* been mixed with animals and plant compost compared the compost mixture without *Trichoderma spp.* Both treatment showed the decrease in disease incidence at post-emergence by 76.2% and 66.7 % respectively. The presence on *Trichoderma spp*. acts as growth formulation to control the infection on soil borne disease pathogens. *Trichoderma spp.* enhance the competitive abilities for plants against pathogens.

A study by (Ecija, 2017), *Trichoderma spp*. have the ability in enhancing the decomposition of organic compost .2kg of *Trichoderma harizianum* + carabao manure + banana bracts (30%) + kakawate + ipil-ipil leaves + rice straw (70 %) shortened number of days to be harvest .For the treatment compile with *Trichoderma harizianum*, 74 days took the plant to mature while without presence of Trichoderma spp. took 102 days. Percent recovery with rate of 2 kg per ton *Trichoderma harizianum* (63.34%) higher than 1 kg per ton *Trichoderma harizianum* application. Treatment without the presence of *Trichoderma spp*. was 55.19 % on the percentage recovery. Moreover,

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combination of *Trichoderma harizianum* increase the nutrient content of the compost by 4.48% that contributed to 67% of recovery percentage. *Trichoderma harizianum* have the ability to control the growth of *S.rolfsii* by inhibition the mechanisms activities by 34.92 % and 31.44 % in vitro condition respectively. *Trichoderma harizianum* inhibit the growth of *S.rolfsii* 10.46% to 29.03%in volatile state. At the non-volatile, state *Trichoderma harizianum* reduce the growth of *S.rolfsii* from 3.74% to5.59 % due to ability of *Trichoderma harizianum* in producing metabolites (Lani Lou, Lopez, Reyes, & Alvindia, 2015).

A total 30 g/l of *Trichoderma harizianum* contributes to the elongation of the peachy root length by mean 3.33 cm after 20 days. Root area and cumulative root length increase by the treatment with Trichoderma spp. mixed in compost. Presence of *Trichoderma harizianum.* identified on having the abilities in reduce the growth of *Rhizoctonia sp*. (Lou, Lopez, Aganon, & Juico, 2014). Compost of *Trichoderma harizianum* have to apply early to control the disease. *Trichoderma harizianum* more favourable to acts as preventive element compare to treat the infection at the middle phase of growing plants (Suheri, Isnaini & Rohyadi, 2014).

2.7 Sugarcane Waste in Malaysia

Cultivation of sugarcane in Malaysia are more focused in Northwest of Malaysia mainly Perlis and Kedah (Mohd & Mazlin, 2014). There are 20 000 to 24 000 hectares in average are used in cultivation of sugarcane in Kedah and Perlis. A total of 1.68 million tonnes of biomass in Malaysia are from sugarcane waste (Salman, 2018). A

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study by (Shaharudin, Muhamad & Abd Razak, 2014) *explained on the sugarcane waste as excellent biomaterial for immobilizing bacteria, Lactobacillus rhammosus*. Sugarcane waste have the ability to preserve 98 % 0f high cell viability.

2.8 Rice Straw Waste in Malaysia

A total of 3.66 million tonnes of paddy residues are produced annually and being waste in Malaysia. This value in forecasting will be increasing to 7 million tonnes per year due to agricultural technology development in year 2020. In order to eliminate the paddy straw and rice husk, farmers do the open burning in their field. Open burning of paddy and rice husk contributes in rising of global gases emission. Continuous open burning donate to climate change, acidification, eutrophication and ecological harm (Shafie, 2015). Thus, producing biocompost from the paddy residues is an excellent solution to reduce open burning on paddy straw and rice husk while promoting organic farming in Malaysia.

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CHAPTER 3

MATERIALS AND METHODS

3.1 Collection of Samples

Sugarcane waste (6 kg) were collected from farmers in Kedah. Citrus leaves were purchased from Jeli market for 500 g (RM5). *Antigonon leptopus* leaves were collected from UMK Jeli Campus tunnel garden. *Trichoderma parareesei* was collected from the stock culture (Biology laboratory, UMK Jeli Campus).

3.2 Preparation of Potato Dextrose Agar Media

Potato dextrose agar media was weighed on 18.5 g and put into an autoclave bottles. Distilled water, 500 ml was added into autoclave bottle and was shake slowly to dissolve the suspension. It was autoclaved for 121^0C 2 hours. Later, streptomycin was added up to the suspension. It was stirred using rod and poured into petri dish occupy ¾ of the plate volume. Agar plates were kept in chiller for further study.

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3.3 Pure Culture of *Trichoderma parareesei*

The pure culture of *Trichoderma parareesei* was performed from the stock culture of Trichoderma parareesei which was isolated and identified in another study. *Trichoderma parareesei* from the stock culture was transferred on PDA containing plate of mycelia. The culture was carried in fume chamber to prevent the contamination. All the culture were sealed neatly by parafilm. The plate were incubated for full growth colony in the room temperature at 30^0C for 7 - 8 days. The full growth of the culture of *Trichoderma parareesei* plates were kept for further study.

3.4 Suspension Preparation of *Trichoderma Parareesei*

Trichoderma parareesei was diluted with 10 ml of treated distilled water to prepare *Trichoderma parareesei* suspension. The culture was mixed by using a glass rod. Suspension process was carried in fume chamber. All prepared suspension were kept in test tubes with closely tightly. They were used for Tricompost preparation.

3.5 Counting Spores by Haemocytometer

A drop of *Trichoderma parareesei* suspension was counted on spores by haemocytometer. The *Trichoderma parareesei* spores counted on formulas below:

Number of spores = Number of spores / 25 boxes × 25 boxes × 1 / total volume (10 ml)

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3.6 Preparation of Tricompost

Sugarcane, leaves of *Antigonon leptopus* and citrus leaves were washed thoroughly with water and then the sample were dried under the hot sun for 4 days. The sample were crushed into small size by miller. A total of 80 g of sugarcane, 10 g of rice husk and 5 g of dried leaves of *Antigonon leptopus,* 5 g of citrus leaves and 1 plate of *Trichoderma parareesei* suspension (10 ml) were the composition in a pack of 100 g of Tricompost. A total of 2.25 kg were kept in a closed box not near the light sources for microbial growth inside packs for 2 weeks.

3.7 Soil Filing to polybags and tagging

A total of 54 polybags were filled with sandy and loamy soil from Agropark, Universiti Malaysia Kelantan, Jeli Campus. They were been weighed to achieve 4 kg of soil for each polybags before transplanting the seedlings. Polybags of soil were arranged randomly in nursery.

3.8 Plant Treatments

Tricompost were used to maintenance of the chilli plant growth and yield production. A total of 54 seedlings of chilli on the age of 30 days were transferred from the trays to the polybag filled with 4 kg of soil. They were been watered every morning at 8.00 a.m and evening 6.00 p.m to keep the moisture for the seedlings growth

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condition. The reason to do the early watering on the chilli plant to prevent the extreme water loss on the high temperature during the day. Six different treatment were used on chilli plant to observe the effectiveness of Tricompost which shown in Table 4.

Table 4: Layout of Treatments on Chilli Plant

Treatment	Composition	Total Plant
T1	100 g of Tricompost	9
T2	10 g of Chemical Fertilizer, NPK	9
T3	Control	9
T4	50 g of Tricompost + 5 g of Chemical Fertilizer,	9
T5	10 10 g NPK	9
T6	150 g Tricompost	9
	15 g of Chemical Fertilizer, NPK	

3.9 Data Collection

Growth of chilli plant were observed on the parameter of length, stem diameter, number of leaves, presence of branch and flower formation. Data was collected for 6 weeks from transplanting the seedlings of chilli to polybag.

3.10 Data Analysis ANOVA Test

Data collected were analysed by ANOVA test to see the efficacy of Tricompost in maintenance of growth for chilli plant. The result on the study of efficacy of Tricompost on maintenance of chilli plant growth was discussed in chapter 4.

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Chapter 4

Result and Discussion

4.1 Counting Number of *Trichoderma parareesei*

A plate of cultured *Trichoderma parareesei* (Figure 4.1.1) was diluted with 10 ml of distilled water. Before Tricompost preparation the number of spore of T. parareesei was counted to observe the spore density. One drop of *Trichoderma parareesei* suspension was taken and observed under electron microscope by using haemocytometer. The observation on spores' suspension (Figure 4.1.2) for a drop of Trichoderma parareesei suspension was 19×10^7 spores. Then, a plate of Trichoderma was poured into a packet of Tricompost and mixed thoroughly. The observation on the spores' growth of Trichoderma parareesei was counted in 2 week further.

A packet of Tricompost on age of 2 weeks was diluted (10 g) by 10 ml of distilled water and the spores was observed by electron microscope (Figure 4.1.3) had 179×10^7 spores for a drop of suspension. From the result obtained, there was an increase in the number of spores counted of *Trichoderma parareesei* after been in Tricompost for 2 weeks. It proved the ability of Tricompost increased the Trichoderma parareesei spore which good medium for microbial growth.

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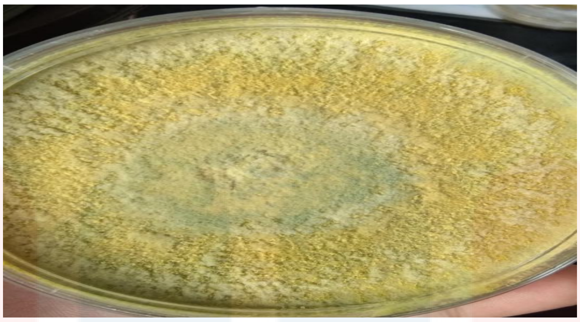

Figure 1: Pure culture of *Trichoderma parareesei*

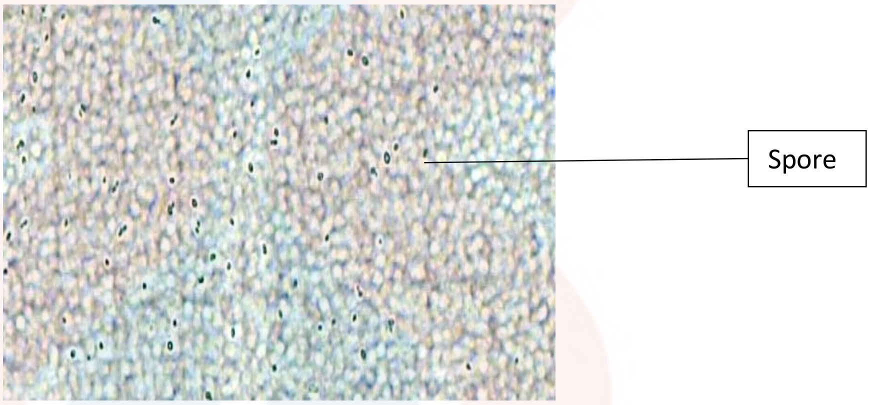

Figure 2: Spore observed under 10 × 1000 magnification

From the observation, number of spores was calculated as formulas:

Number of spores = Number of spores / 5 boxes × 5 boxes × 1 / total volume (10 ml)

Number of spores = 19/ 5 × 5 × 1/ 10,000

Number of spores = $19 \times 10^4 \times 10^3$

Number of spores = 19×10^7

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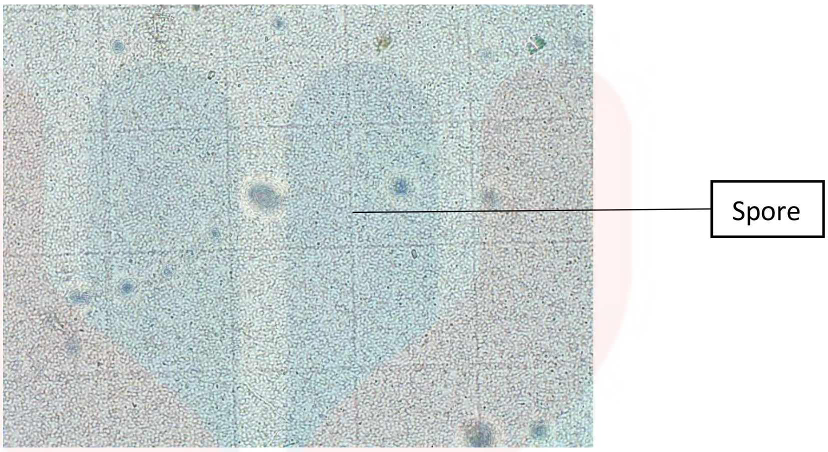

Figure 3: Spore observed under 10 × 1000 magnification

Number of spores = Number of spores / 5 boxes × 5 boxes × 1 / total volume (10 ml)

Number of spores = 179/ 5 × 5 × 1/ 10,000

Number of spores = $179 \times 10^4 \times 10^3$

Number of spores = 179×10^7

4.2 Efficacy of Tricompost for Growth of Chili

All the conditions such as sunlight, water, and 6.5 pH of sandy clay loam were kept constant in this nursery study.

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4.2.1 Growth of Chili Length

Tricompost depicted that different rate of application influence the effectiveness on chili plant growth. The differences are statistically significant as compared to the control treatment. This significant growth was also found in different literature studies (Ecija, 2017), They found there were the rapidly growth of 15 % on Trichoderma harizianum compared to control treatment. Table 4.1 shown the mean value of the chili growth by various Tricompost and NPK treatments (100 g Tricompost, 10 g Chemical, 50 g Tricompost + 5 g NPK, 15 g NPK and 150 Tricompost).

4.2.2 Shoot Elongation

The effects of various growth on chili plants are shown according to different treatment in Table 4.2.2 the result revealed that as there was progressive increase on Tricompost (100 g and 150 g), there was also increase in trend in shoot elongation. The length of the radicle of the chili plant was measured 64- day (state the week also) of period interval of 7- day to observe the development of the plant. The final reading which was taken on the 54^{th} day which used in the data analysis. The shoot elongation of the chili was promoted significantly by Tricompost application. All the treatments significantly promotes the growth of shoot growth for chili plant. The combined 50 g Tricompost + 5 g chemical held the highest percentages on promoting the number of the shoot growth compare to control plant or chemical alone treated plant which indicate the presence of T. parareesei in Tricompost influenced the number of shoot growth.

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The lowest treatment for the shoot elongation was T3 (control) while the highest was T6 (150 g Tricompost). This exacts phenomenon was studied by (Snjezana, Ivanka and Edyta, 2013) but what they found there was an interaction on *Trichoderma spp.* with the ability on tomato plant resistant disease. With the aid of supporting documents, it can be said that the present study suggested that the fungal biocompost have a growth effect on the growth for edible plant crops.

4.2.3 Stem Diameter

The results of the mean value on the stem diameter clearly stated that all three treatment involves the Tricompost (50 g, 100 g, 150 g either alone or combined with NPK) with different treatment have promoting growth properties and thus contain gibberellins substances for the plant growth. The results of the stem diameter showed the significant promoting level at the range almost 5 % in treatment of 50 g Tricompost and 5 g NPK (T6) recorded 0.3 + 0.05. Overall, the 100 g of Tricompost have a higher range of promoting on the stem diameter growth than other treatments. The growth of chilli plant under nursery condition discovered the healthy stem treated with Tricompost and NPK whereas the stem diameter of chilli with none treatment was restricted. Tukey HSD (Table 4.2.3) shown that all the treatments were significantly alike. Each treatment had different effects in r stem diameter growth of chili especially T6. This situation has been discussed by (Snjezana et al., 2014) study enhanced growth of cabbage and red beet by *Trichoderma viride*.

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4.2.4 Branch and Flower

The study on the efficacy of Tricompost for growth of chili plant requires days to see the development on branch and flowers from the chili plant. At the end of the data analysis time, the expression on branch and flower only found on very few plant because plant not reached for flowering state. Thus, it resulted on mean value of 0.00 for data on flower and branch. The study still ongoing even the end of collecting data for report to see on their productivity on yield for chili.

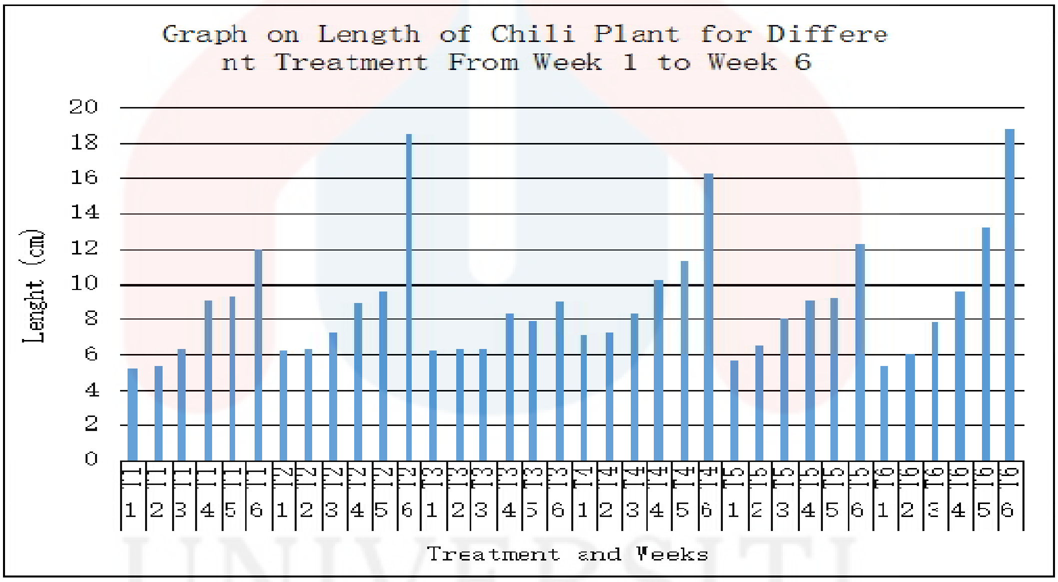

Figure 4: Graph on Length of Chili Plant for Different Treatments

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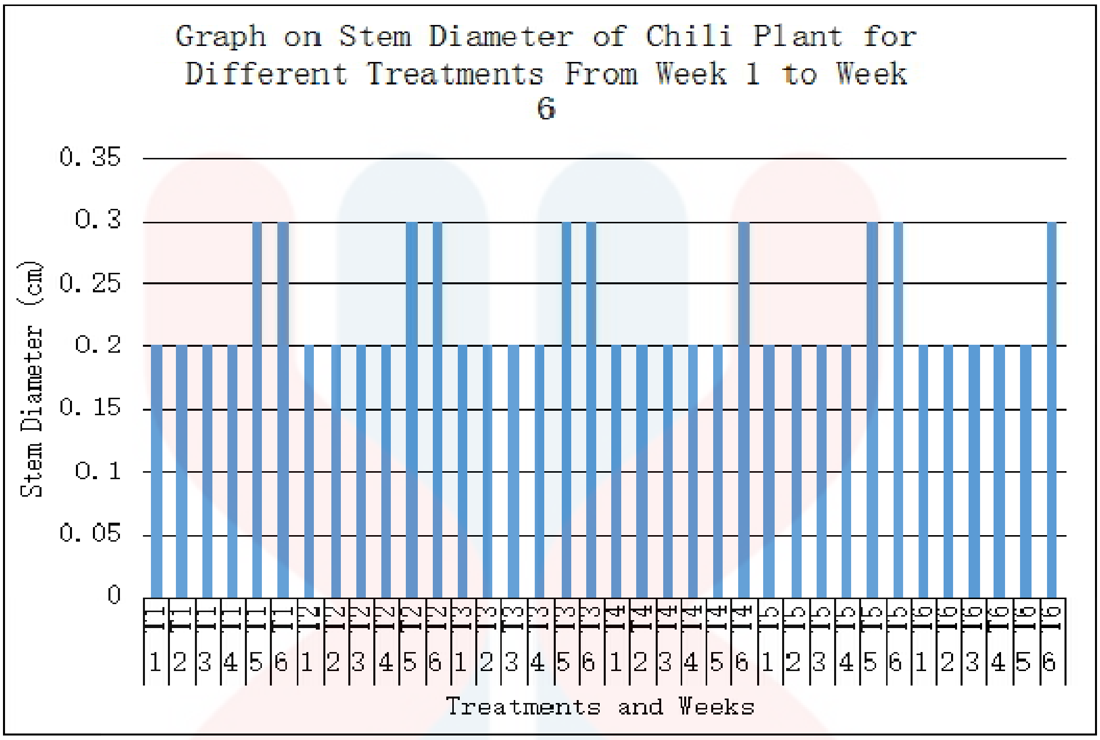

Figure 5: Graph on Stem Diameter of Chili Plant for Different Treatments

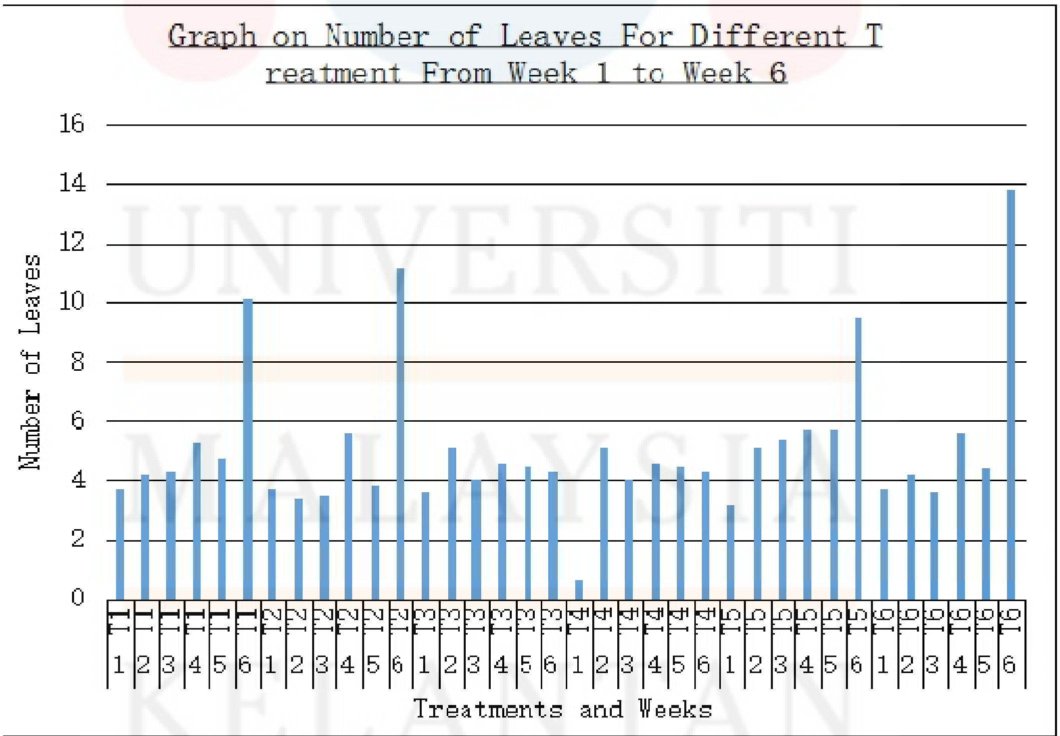

Figure 6: Graph on Number of Leaves on Chili Plant for Different Treatments

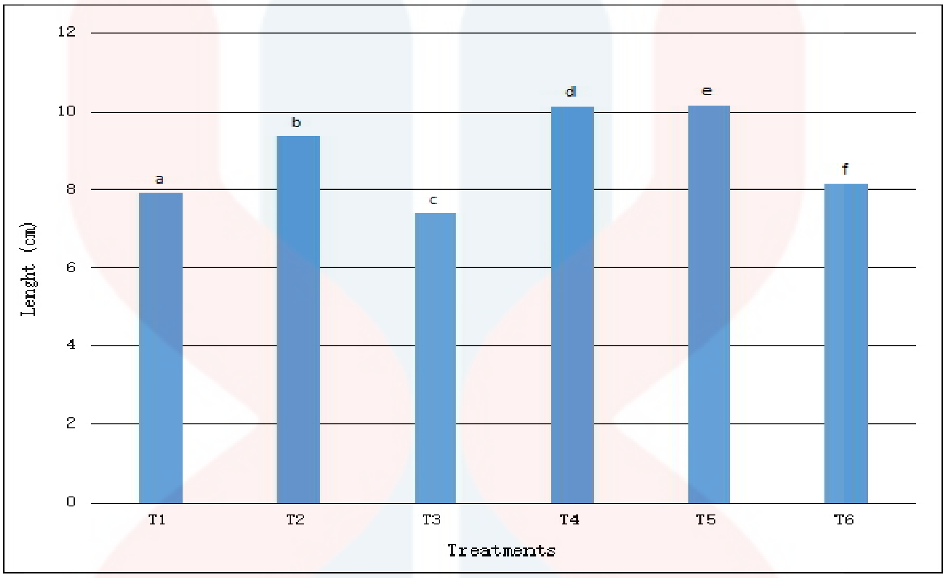

Figure 7: Tukey HSD test results length of chili plant growth (cm) under nursery condition showing the means for the group in homogeneous subsets.

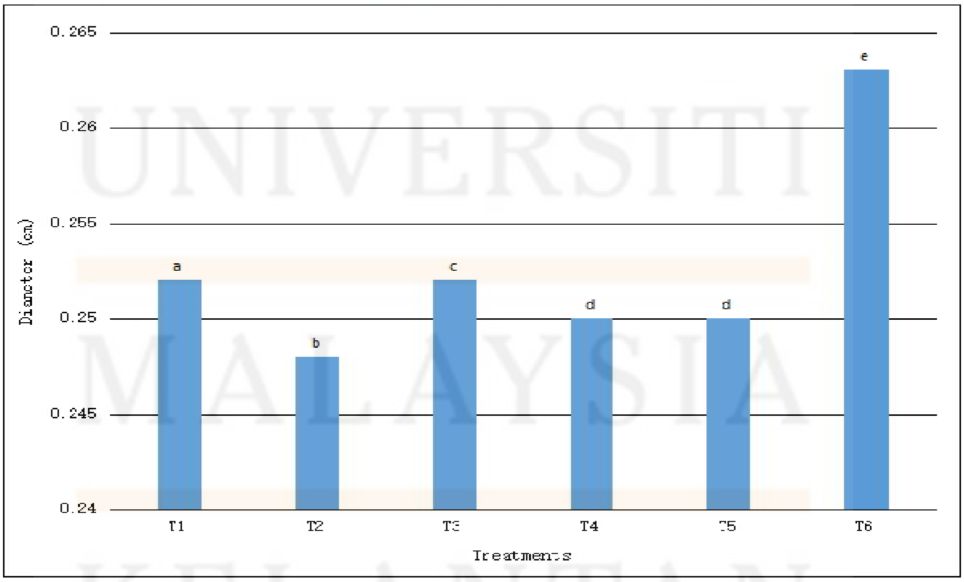

Figure 8 Tukey HSD test results diameter of chili plant growth (cm) under nursery condition showing the means for the group in homogeneous subsets

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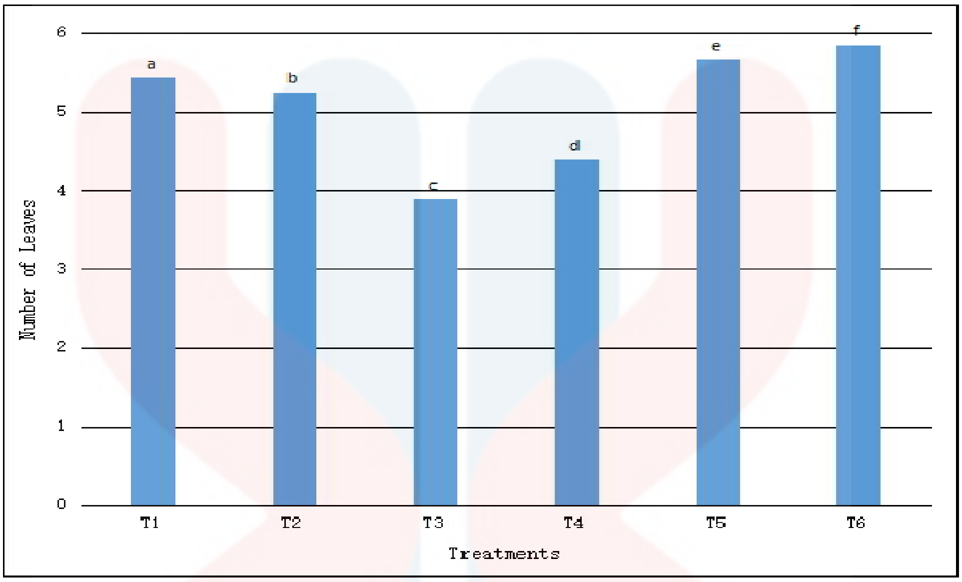

Figure 9: Tukey HSD test results number of leaves for chili plant growth (cm) under nursery condition showing the means for the group in homogeneous subsets

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CHAPTER 5

CONCLUSION

5.1 Conclusion

Chilli in an important vegetable crop throughout of the world. Thus, demand of chilli is increasing in day by day. Chemical fertilizer can increase the yield conversely it can caused environmental pollution due to the chemical residues. Biofertilizer can be an alternative option as for substitute of chemical fertilizer. Then, the aim of this study was to observe the efficacy of Tricompost as role for biofertilizer on maintenance of chilli plant growth. The yield performance also was another aim in this study, however, due to research time limitation which was not included. Tricompost was prepared by sugarcane, rice straw and T. parareesei composition.

In six differential treatment as follow: T1 (100 g Tricompost), T2 (10 g NPK), T3 (control), T4 (50 g Tricompost and 5 g NPK), T5 (150 g Tricompost) and T6 (150 g Tricompost) were used in this study. Plant growth data was collected until six weeks from planting. In this study, T5 (50 g Tricompost and 5 g NPK) was more effective on the growth of chilli plant length compared to other treatments and T6 (150 g of Tricompost) was more favourable on the growth of leaves number. It proved the high

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rate of Tricompost promotes differentiation on leaves part to produce more shoot while the present of additional NPK application promotes the elongation of plant length.

The study on the efficacy of Tricompost for growth of chilli showed T4 (15 g of NPK) was not significant with T5 (50 g Tricompost and 5 g NPK) proved there was no different on the treatment of T4 and T5 in the number of leaves. Thus, the T5 of the biocompost also suitable to be the leaves booster for increasing the shoot of chili growth rather on chemical. Moreover, T5 was most efficient in the elongation of length for chilli plant by the study of efficacy of Tricompost for growth of chilli plant. Therefore, the growth performance data showed that Tricompost role as similar pattern growth like chemical or even some parameter growth was higher than chemical fertilizer, however, it could be clear picture if achieved yield preformation data. Alternatively, singing of good growth as show good yield in plant so it can be say that Tricompost might enhance for yield or productivity of chilli in chilli plant.

As a recommendation, Tricompost have the high potential to be a commercialized biocompost products. Further research and development on the use of *Trichoderma spp.* for planting chili is one of best alternative to reduce the use of chemical on vegetable and fruiting crops. The combined on 50 g of Tricompost and 5 g of NPK (T5) resulted best in growing the length of chili plant in 54 days. Thus, Tricompost have potential be further study on their efficacy on others type of vegetables crops.

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APPENDICES

Appendix A

Table A: Nursery Planting of Chili Plant

	Treatment applied on Chilli Plant in nursery
	Completely Randomized Design (CRD) of Chilli Plant

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Appendix B

Table B: Test of Normality for Growth of Chilli Plants

Week	Treatment	Sig. (Kolmogorov- Smirnov		
		Length	Diameter	Leaves
1	100 g Tricompost	0.200	0.000	-
	10 g Chemical	0.200	0.000	-
	Control	0.200	0.000	-
	50 g Tricompost + 5 g Chemical	0.200	0.000	-
	15 g Chemical			
	150 Tricompost	0.89	0.000	-
		0.200	0.000	-
2	100 g Tricompost	0.200	0.000	-
	10 g Chemical	0.200	0.000	-
	Control	0.200	0.000	-
	50 g Tricompost + 5 g Chemical	0.200	0.000	-
	15 g Chemical			
	150 Tricompost	0.089	0.000	-
		0.200	0.000	-
3	100 g Tricompost	0.200	0.000	-
	10 g Chemical	0.200	0.000	-
	Control	0.200	0.000	-
	50 g Tricompost + 5 g Chemical	0.200	0.002	-
	15 g Chemical			
	150 Tricompost	0.200	0.002	-
		0.200	0.000	-
4	100 g Tricompost	0.080	0.000	-
	10 g Chemical	0.200	0.000	-
	Control	0.200	0.000	-
	50 g Tricompost + 5 g Chemical	0.200	0.002	-
	15 g Chemical			
	150 Tricompost	0.198	0.002	-
		0.117	0.000	-
5	100 g Tricompost	0.186	0.000	-
	10 g Chemical	0.200	0.000	-
	Control	0.004	0.000	-
	50 g Tricompost + 5 g chemical	0.200	0.054	-
	15 g Chemical			
	150 Tricompost	0.200	0.054	-
		0.020	0.000	-
6	100 g Tricompost	0.200	0.044	-
	10 g Chemical	0.175	0.000	-
	Control	0.200	0.000	-
	50 g Tricompost + 5 g Chemical	0.200	0.000	-
	15 g Chemical			
	150 Tricompost	0.002	0.056	-
		0.200	0.000	-

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Appendix C

Table C: Means of Growth Chilli Plant growth Performance for T1 (100 g of Tricompost), T2 (10 g Chemical), T3 (Control), T4 (150 g Tricompost + 5 g chemical), T5 (15 g Chemical) and T6 (150 Tricompost)

Week	Treatment	Length	Diameter	Leaves
1	T1 T2 T3 T4 T5 T6	5.2 ± 0.47 6.2 ± 0.9 6.2 ± 0.8 7.1 ± 0.6 5.6 ± 0.5 5.3 ± 0.8	0.2 0.2 0.2 0.2 0.2 0.2	3.7 ± 1.6 3.7 ± 2.5 3.5 ± 1.0 3.6 ± 1.2 3.2 ± 1.3 3.7 ± 1.5
2	T1 T2 T3 T4 T5 T6	5.3 ± 0.3 6.3 + 0.7 6.3 ± 0.5 7.2 ± 1.5 6.5 ± 1.4 6.0 ± 1.3	0.2 ± 0.00 0.2 ± 0.04 0.2 ± 0.05 0.2 ± 0.05 0.2 ± 0.05 0.2 ± 0.00	4.2 ± 1.9 3.4 ± 1.1 3.3 ± 1 5.1 ± 1.9 5.1 ± 1.2 4.2 ± 2.9
3	T1 T2 T3 T4 T5 T6	6.3 ± 0.2 7.2 ± 1.0 6.3 ± 0.6 8.3 ± 1.2 8.0 ± 1.1 7.8 ± 1.3	0.2 ± 0.03 0.2 ± 0.04 0.2 ± 0.04 0.2 ± 0.05 0.2 ± 0.05 0.2 ± 0.05	4.3 ± 2.1 3.5 ± 1.2 3.1 ± 1.4 4.0 ± 1.1 5.4 ± 1.3 3.6 ± 2.1
4	T1 T2 T3 T4 T5 T6	9.1 ± 0.5 8.9 ± 0.8 8.3 ± 0.7 10.2 ± 0.9 9.1 ± 0.7 9.6 ± 1.6	0.2 ± 0.04 0.2 ± 0.04 0.2 ± 0.04 0.2 ± 0.05 0.2 ± 0.05 0.2 ± 0.05	5.3 ± 1.7 5.6 ± 4.4 3.0 ± 1.2 4.6 ± 0.8 5.7 ± 1.2 5.6 ± 4.6
5	T T2 T3 T4 T5 T6	9.3 ± 0.6 8.6 ± 1.3 7.9 ± 0.7 11.3 ± 1.6 9.2 ± 0.4 13.2 ± 3.1	0.3 ± 0.04 0.3 ± 0.05 0.3 ± 0.05 0.2 ± 0.07 0.3 ± 0.07 0.2 ± 0.11	4.7 ± 1.7 3.8 ± 1.2 2.5 ± 1.5 4.5 ± 1.8 5.7 ± 1.4 4.4 ± 2.0
6	T1 T2 T3 T4 T5 T6	12.1 ± 1.9 18.5 ± 5.3 9.0 + 0.9 16.2 + 0.9 12.3 + 3.4 18.8 + 1.0	0.3 ± 0.07 0.3 ± 0.04 0.3 + 0.00 0.3 + 0.05 0.3 + 0.00 0.3 + 0.05	10.1 ± 4.3 11.1 ± 6.3 7.7 + 3.9 4.3 + 1.5 9.5 + 2.9 13.8 + 9.7

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