EFFECTS OF FISH AMINO ACID (FAA) AND BORON APPLICATION ON GROWTH AND YIELD OF *Solanum lycopersicum* (TOMATO) IN SOIL AND SOILLES MEDIA

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ABSTRACT

An application of chemical fertilizers to enhance crop yields by increasing the availability of nutrient has been raised in agriculture sector but excessive consumption of chemical fertilizers recently causing serious environmental problems. Therefore, the objectives of this study were to determine the effects of different liquid organic fertilizers and boron (B) application on growth and yield of tomato in soil and soilless media. There were 2 main experiments in this study. In Preliminary Experiment, therewere 16 treatments with 5 replications, including controls, liquid organic fertilizers (fish amino acid [FAA] and shrimp extract [SE]) and B application. In Experiment 2, there were 6 treatments with 4 replications were chosen from the previous experiment.The experiment was designed in a factorial RCBD and data were analyzed by using ANOVA, SPSS software and the differences between treatments mean were compared using Tukey HSD test with significant level ($P \leq 0.05$). The parameters observed were plant height, number of leaves, shoot and root biomass, pH media, organic matter content, fresh weight and number of fruits. Results on study of effects of FAA application on growth and yield of tomato in soilless media was successfully achieved.Treatment with 30 mL/L FAA (T3) were showed the significant effect on plant numberof leaves and the result were similar to the result using AB fertilizers (T4). Meanwhile, studies on effects of boron application on growth and yield of tomato in soilless media was also successful. Treatment 30 mL/L FAA + 1.87 mg/L boron (T4) gave similar result to treatment using inorganic fertilizer (T6) on plant number of leaves. This study proved that the application of FAA and B can contribute positive effects on plant growth developmentfor certain parameters. Thus, they can also be used as an alternative fertilizer to reducethe usage of chemical fertilizer.

KESAN PENGGUNAAN ASID AMINO IKAN DAN BORON TERHADAP PERTUMBUHAN DANHASIL TERHADAP *SOLANUM LYCOPERSICUM* (TOMATO) MENGGUNAKAN MEDIA TANAH DAN TANPA TANAH

ABSTRAK

Penggunaan baja kimia untuk meningkatkan hasil tanaman bagi menambahkan ketersediaan nutrient telah dibangkitkan dalam sektor pertanian namun penggunaan baja kimia yang berlebihan ini menyebabkan masalah alam sekitar yang serius. Maka, objektif kajian ini dilakukan untuk menentukan kesan penggunaan baja organic cecair dan boron terhadap pertumbuhan dan hasil *Solanum lycopersicum* (tomato) menggunakan media tanah dan media tanpa tanah. Terdapat 2 eksperimen yang dijalankan. Dalam Eksperimen Saringan, eksperimen ini melibatkan 16 rawatan dengan 5 replikasi termasuk kawalan, baja organik cecair (asid amino ikan [FAA] dan ekstrak udang [SE]) dan penggunaan Boron. Untuk eksperimen kedua, terdapat 6 rawatan dengan 4 replikasi dijalankan menggunakan data yang diperolehi dari eksperimen saringan. Rekabentuk kajian yang digunakan adalah randomized complete block design (RCBD) dan dianalisis menggunaakan ANOVA, perisian SPSS dan perbezaan min antara rawatan analisis menggunakan Tukey HSD dengan tahap signifikan ($P \leq 0.05$). Parameter yang diukur dalam kajian ini ialah tinggi pokok, bilangan daun,berat kering pucuk dan akar, pH media, kandungan bahan organik, berat dan bilangan buah. Keputusan kajian terhadap kesan penggunaan FAA terhadap pertumbuhan dan hasil tomato dalam media tanpa tanah telah berjaya dicapai. Rawatan dengan 30 mL/L FAA (T3) telah menunjukkan kesan signifikan dalam bilangan daun dan memyamai keputusan menggunakan baja AB. Sementara itu, kajian tentang kesan penggunaan boron terhadap pertumbuhan dan hasil tomato dalam media tanpa tanah juga berjaya. Rawatan 30 mL/L FAA + 1.87 mg/L boron (T4) memberikan hasil yang sama dengan rawatan menggunakan baja (T6) untuk bilangan daun. Kajian ini membuktikan penggunan baja FAA dan boron mampu memberi kesan positif terhadap pertumbuhan pokok bagi parameter tertentu dan boleh digunakan sebagai baja alternatif kepada baja kimia.

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LIST OF ABBREVIATIONS

B	Boron
Ca	Calcium
cm	Centimeter
DOA	Department of Agriculture
FAA	Fish amino acid
FAO	Food and Agriculture Organisation
g	Gram
g/ha	Gram per hectare
ha	Hectare
k	Potassium
kg/ha	Kilogram per hectare
MARDI	Malaysian Agriculture Research and Development Institute
mg	Miligram
Mg	Magnesium
mL/L	Mililiter per liter
mg/L	Miligram per liter
mm	Milimeter
µs	Micro simen
N	Nitrogen
Na	Natrium

NH4	Ammonium
P	Phosphorus
RNA	Ribonucleic acid
SE	Shrimp extract
t/ha	Ton per hectare
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Tomato (*Solanum lycopersicum)* belong to family Solanaceae and the most common fruiting vegetable among home gardeners, which is significant to being a crop that is very important in both science and the economy (Heuvelinm, 2018). Tomato considered one of the ten most significant fruits and vegetables of all time which produced about 124.5 million tons every year throughout the world. Currently, 159 nations

commercially farm tomatoes. In 2009, the top tomato-producing countries were Italy, China, Egypt, the United States, Turkey, India and Iran (Ibrahim *et al.,* 2015).

In Malaysia, Cameron Highland become the successful location for large scale of tomato cultivation and it mainly due to the milder temperature (Wang *et al.,*2009). According to the Malaysia Trade Statistical Volume 1/2020 report, Malaysia's Import Dependency Rate (IDR) for tomato crops is 2.9%, seventh rank after chilli (73.1%), round cabbage (62.2%), lettuce (23.4%), cucumber (19.9%), eggplant (12.4%), and mustard (7.8%). This showed that Malaysia's tomato production is still inadequate (Jabatan Perangkaan Malaysia, 2020).

Tomato cultivation can be done by soilless and soil media. Soilless method suitable for fruiting crops such as tomato, chilies and rock melon where the plant medium either consists of cocopeat, cocopeat mixed sand with roasted rice husk, perlite, peatmoss or vermiculite. While for conventional cultivation this method is suitable for all types of crops using only soil planting medium (Shahid *et al.,* 2019).

Additionally, it has been shown that organic additions in soil have a positive impact on a variety of soil properties and functions when compared to chemical inputs. In comparison to chemical fertilizers, organic fertilizers add more organic carbon and nitrogen to the soil, increasing microbial populations. Based on population level physiological profiles, it was discovered that manure-treated soil had greater functional diversity of soil microbes than mineral-fertilized soil (Pratibha and Shachi, 2016).

The majority of the issues that farmers were facing in order to boost the output of their plantations were resolved when chemical fertilizers were first introduced into the agricultural area. But with time, it became clearer the harmness due to chemical fertilizers caused to both humans and the environment. The best substitute for chemical fertilizers will be organic fertilizers (Kochakinezhad *et al.,* 2012). The consumers believe organic products are healthier than conventional ones and because they are concerned about the environment, there is a growing demand for goods that have been farmed organically.

In order to determine the different concentration of liquid organic fertilizers (fish amino acid and shrimp extract) and boron on plant growth and yield of tomato a research were run to determine the effects of different liquid organic fertilizers application on growth and production of tomato in soil and soilless media and to determine the effects of boron application on growth and production of tomato in soil and soilless media. The researcher will be able to suggest liquid organic fertilizer as an alternative to chemical fertilizers, if at all practicable.

1.2 Statement of Problems

For society, farming is an important and necessary phase in the production of food. By the year 2050, there will be 9.1 billion people on the planet (United Nations (UN), 2015). To feed the global population, agriculture should boost food production by 70%. The United Nations' Food and Agriculture Organization (FAO) estimates that this increase should consist of 3 billion tonnes of grain and 0.47 billion tonnes of beef in 2015. Chemical fertilizers should be used in farming in order to speed up growth (Chakrabarty *et al.,* 2014). As a result, by the year 2000, agricultural chemicals will be used on an annual basis in excess of 5 million tonnes Due to the widespread annual use of pesticides, the ecology will become contaminated (Fernando, 2017).

Both large and small farm systems typically use chemical fertilizers, insecticides, and herbicides, which have been used in agricultural production for a long time (Savci, 2012), where the health of both customers and farmers who use pesticides for agricultural purposes is impacted (Da Costa *et al.,* 2014). Massive usage of synthetic fertilizers to increase crop production has had a negative impact on the water, land, and air. People are now increasingly skeptical of the standard of an (Vassilev *et al.,* 2015). In order to ensure global food security, inorganic fertilizer was heavily used in agriculture worldwide, which resulted in numerous, irreversible health issues.

Utilizing chemical fertilizer constantly for a long time has caused a variety of unanticipated consequences. For addition, the relationship between production and cost is not linear and leads to enormous mineral resource waste. In addition, plants do not

utilize the millions of tonnes of synthetic fertilizers applied to soil each year. The creation of greenhouse gases, eutrophication in aquatic systems, and salinization of soil are all caused by up to 50% of N and 90% of P escaping from crop fields and ending up in the air or water, according to reports (Simpson *et al*., 2011).

Furthermore, improper use of chemical fertilizers leads to issues with food security and quality decline, such as nitrate build up in vegetable goods. Numerous studies have shown that organic farming, which strictly forbids the use of synthetic fertilizers, offers a solution that might be able to lessen the negative effects of using chemical fertilization, and the products from the organic farming systems are usually endowed with improved nutritional properties (Luthria *et al*., 2020). Chemical and organic fertilizers were utilized in tomato farming to boost crop yield. Overuse of chemical fertilizers results in higher operating costs for soilless media and conventional cultivation and problems to the environment (Shahid *et al.,* 2019).

Massive amounts of solid waste after processing of shrimp and fish is a major source of animal protein, chitin, carotenoids, acid amino and other bioactive substances that are not properly exploited (Priyanka *et al*., 2009; Jeyasanta *et al*., 2013). This waste can be converted into a liquid eco-enzyme that serves a variety of functions on a local or large scale (home or industrial). Eco-enzyme is an organic molecule that forms a complex solution when kitchen trash is fermented to produce liquid organic fertilizer (Muliarta & Darmawan, 2021). It's crucial to recycle household waste into organic fertilizer to lessen the impact of garbage-related pollution. The effects of waste pollution include air pollution from odorous air, water pollution from waste water (leachate), and ground pollution from the presence of

garbage, which may spread disease outbreaks (Sudradjat, 2006).

1.3 Objectives

The purpose of this study is to determine the effects of boron application and liquid organic fertilizer application on tomato plant growth and yield in soil and soilless media. Therefore, the objectives of this study are:

1. To determine the effects of different liquid organic fertilizers application on growth and yield of tomato in soil and soilless media.
2. To determine the effects of boron application on growth and yield of tomato in soil and soilless media.

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1.4 Research Questions

Based on the research objectives, the research questions of the study are:

1. What are the effects of different liquid organic fertilizers application on growth and yield of tomato in soil and soilless media?
2. What are the effects of boron application on growth and yield of tomato in soil and soilless media?

1.5 Hypothesis

Ho1: There are no significant effects of different liquid organic fertilizers application on growth and yield of tomato in soil and soilless media.

Ha1: There are significant effects of different liquid organic fertilizers application on growth and yield of tomato in soil and soilless media.

Ho2: There are no significant effects of boron application on growth and yield of tomato in soil and soilless media.

Ha2: There are significant effects of boron application on growth and yield of tomato in soil and soilless media.

1.6 Significance of Study

It is hoped that this study will provide guidance to farmers to be more creative in diversifying the agricultural methods carried out. This method is also able to provide early surgery to households to recycle agricultural waste, kitchen waste such as fish waste and crop waste as organic fertilizer while reducing dependence on chemical fertilizers alone and can reduce production costs. This study can illustrate the effectiveness of use liquid organic fertilize on soil fertility and tomato production compared to the use of chemical fertilizers.

The findings of this study are also expected to give information to farmers on the benefit of organic fertilizers and boron compared to use inorganic fertilizers. Continued use of chemical fertilizers will cause various health and environmental problems. It because the good agricultural practices will avoid negative implications on the environment and human health such ad utilization of biosolids and animal manures, use of agricultural chemicals, management of post-harvest residue on the right amount to the crops.

It is hoped that the results of this study will be able to help the authorities to provide exposure and guidance to all farmers on the advantages of organic farming compared to the use of chemical fertilizers. This is in line with the current situation where the level of pollution is increasingly alarming. Therefore, the authorities can campaign on a large scale to encourage the industry to venture into the field of organic agriculture to increase organic farming products in the market. this is because the lack of organic products causes the price of such products to soar in the market compared to agricultural products using chemicals fertilizers.

1.7 Scope and Limitations of study

This study aims to determine the impact of boron treatment and other liquid organic fertilizers on tomato growth and production in soil and soilless media. In addition, this study examined the effects of boron treatment and liquid organic fertilizer on tomato growth and production in soil and soilless media. Previous publications and studies

were consulted to assess the effects of boron and liquid organic fertilisers on tomatoes. The study's main research topics were tomato plant growth and yield.

This research was conducted in two phases. For preliminary test, 16 treatments were involved and were run for 8 weeks in soil and soilless media. The treatment 10mL/L, 20mL/L and 30mL/L concentration of each fish amino acid (FAA) and shrimp extract (SE) were used in the experiments. These liquid fertilizers were dilute in the water and then were watered to the plant directly to the media. Meanwhile, for boron treatment, 1.87mg/L Hibor fertilizer (sodium borate) were diluted in the water before used as foliar spray treatment to the plant. This test was run to determine the best treatments before proceed to the second experiment. The best treatment of liquid organic fertilizer and boron treatment in preliminary test were selected to the second experiment. In the second experiment, which lasted 12 weeks and included six treatments, the optimal treatment for tomato plant growth and yield was determined.

The primary problem with the study is the increasing randomness of the weather during the research time, which will result in damage from extremely hot temperatures and heavy rain. The usefulness of the advice given here is meant notwithstanding the fact that there is some uncertainty related to climate change. Although the variables are described in an ad hoc way, history demonstrates that social and economic factors, political difficulties, and legal restrictions frequently have an impact on agricultural practises in vineyards and other agricultural sectors. As a result, a strategic long-term perspective should be anticipated, and the constraints mentioned below should be taken into account.