UNIVERSITI PUTRA MALAYSIA

EFFECTS OF FORMULATED AND COMMERCIAL LIQUID FERTILIZER ON GROWTH, YIELD AND NUTRIENTS CONTENT OF TOMATO (Lycopersicon esculentum Mill.)

NUR ADILA BINTI ROSIDI

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By

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree Master of Science

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Chairman : Susilawati Kasim, PhD
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Increasing agricultural activities produced various types of organic wastes. Inappropriate management of these wastes create environmental problem such as land and water pollutions. Wet anaerobic digestion process was use in this study, to produce liquid organo-mineral fertilizer by mixing grey water (washing machines disposal water) with vegetable wastes. Oven-dried vegetable wastes were mixed with non-treated washing machine disposal water at two different ratios. The mixtures were then arranged in orbital shaker before shook for 0, 8, 16 and 24 hours. Liquid sample was collected at 0, 3, 6, 9, 12, and 15 days of incubation before they can be analyze using standard procedures. Generally, formulated fertilizers contain high K content with alkaline pH (>7). Rapid degradation of organic acids might increase the pH of formulated liquid organo-mineral fertilizers whilst the surface size of the vegetable wastes increased nutrients dissolution. Generally, higher vegetables wastes are needed to increase the nutrients content of formulated liquid organo-mineral fertilizers. Five different combinations of formulated liquid fertilizers with commercial liquid fertilizer (AB fertilizer), were then further evaluated to determine their effects, on tomato growth, yield and nutrient contents of tomato. This study was conducted under controlled condition in a

shelter house at Universiti Putra Malaysia, Bintulu Campus Sarawak. The plants were monitored for their growth performance up to seven trusses before they can be harvested and analyze for their nutrient content. Treatments using combination of formulated liquid fertilizers (T2, T3, T4 and T5) significantly increased the concentration of N, P, K, Mg and Na in tomato plant. However, the growth and yield of tomato for T1 was significantly higher compared with other treatments. Yet better fruit nutritional value quality such as protein, fat and fibre are higher when the plants received formulated liquid fertilizers. Moreover, tomato plant that treated with formulated liquid fertilizer has no or less microbial population in the fruits. The effectiveness of formulated fertilizers was reduced due to high concentration of Na and pH. Modification of present formulated fertilizers is needed in order to utilize them as an alternative source for chemical fertilizer.

Abstrak thesis yang dikemukan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan ijazah Master Sains

EFFECTS OF FORMULATED AND COMMERCIAL LIQUID FERTILIZER ON GROWTH, YIELD AND NUTRIENTS CONTENT OF TOMATO (*Lycopersicon esculentum* Mill.)

Oleh

NUR ADILA BINTI ROSIDI

Februari 2018

Pengerusi : Susilawati Kasim, PhD
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Peningkatan pengeluaran sisa pertanian menghasilkan pelbagai sisa buangan organik. Pengurusan sisa buangan yang tidak bersesuaian boleh mengakibatkan berlakunya masalah alam sekitar seperti pencemaran tanah dan air. Proses pencernaan secara anaerobic basah telah dijalankan untuk menghasilkan baja cecair dari air buangan mesin basuh dan sisa sayur-sayuran. Sisa sayur-sayuran yang telah kering dicampurkan dengan air buangan mesin basuh yang tidak dirawat mengikut dua nisbah berbeza. Seterusnya, botol tersebut disusun di dalam mesin pengoncang dan digoncang mengikut masa yang telah ditetapkan iaitu selama 0, 8, 16 dan 24 jam. Sampel cecair dikumpul pada akhir proses inkubasi iaitu pada 0, 3, 6, 9, 12, dan 15 hari, sebelum kaedah piawai diguna untuk menganalisis sample cecair. Secara amnya, baja yang dihasilkan mempunyai kandungan K yang tinggi dengan ph (>7). Penguraian asid organic yang cepat meningkatkan pH formulasi baja cecair organo-mineral manakala luas permukaan sisa sayur-sayuran meningkatkan kandungan kadar pembebasan nutrient. Secaraam nya untuk meningkatkan kandungan nutrient dalam formulasi baja cecair organo-mineral, sisa sayur-sayuran yang banyak diperlukan. Lima jenis kombinasi baja cecair yang berbeza peratusan dicampur antara baja cecair yang di

formulasi dengan baja cecair komersial (AB fertilizer) untuk menentukan kesan kepada pertumbuhan, hasil dan kandungan nutrient pada pokok tomato. Kajian ini telah dijalankan di bawah persekitaran terkawal di dalam rumah perlindungan di Universiti Putra Malaysia, Kampus Bintulu Sarawak. Pertumbuhan pokok tomato dipantau hingga pembentukan gugus bunga ketujuh sebelum dituai dan dianalisis kandungan nutrien. Hasil kajian menunjukkan bahawa baja cecair yang dicampur dengan formulasi baja yang dihasilkan (T2, T3, T4, dan T5) meningkatkan kandungan N, P, K, Mg dan Na pada pokok tomato berbanding T1 (standard formulasi AB). Walaubagaimanapun, dari segi pertumbuhan dan hasil tomato, T1 lebih baik berbanding dengan rawatan lain. Namun, nilai khasiat buah seperti protin, lemak dan serat adalah tinggi apabila pokok menerima baja cecair yang diformulasi. Malahan pokok tomato yang menerima baja cecair yang diformulasi tidak mempunyai atau hanya sedikit sahaja populasi microbial wujud di dalam buah. Kurangnya keberkesanan baja yang diformulasi berkemungkinan disebabkan oleh kepekatan kandungan Na, dan pH. Penambah baikan terhadap baja yang telah diformulasi adalah diperlukan untuk memanfaatkanya sebagai sumber alternative untuk baja kimia.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows;

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LIST OF ABBREVIATIONS

WM	washing machine
Rpm	revolutions per minute
SE	standard error
CF	commercial fertilizer
FLF	formulated liquid fertilizer
DAT	day after transplanting
MPN	most probable number method

CHAPTER 1

INTRODUCTION

The world population is growing at 80 million people per year (1.14%). This figure is estimated to reach 9.1 billion in 2050. The increasing human population has increased food demand up to 70% (Fischer *et al* ., 2011). The current agricultural practices that used huge amount of chemical fertilizers to support the human food demand are indirectly affecting the ecosystem. According to Oldeman (2000), agricultural practices have caused land degradation. This has reduced the ability of the soil to supply water, nutrients, and root space. In addition, the excessive uses of fertilizers have resulted in acidification, nutrient imbalance, and pollution of the soil and water resources (Oldeman, 2000). Excessive application of mineral fertilizers is not recommended because they can cause environmental problems such as ammonia (NH_3) volatilization and eutrophication in water (Childers *at el*., 2011; Cordell *at el*., 2009).

The demand for N, P_2O_5, and K_2O has been estimated to range between 180.0 million (2012) to 183.2 million Mt (2013)(FAO, 2015). From 2014, the demand was forecasted to increase up to 186.9 million Mt with a further increase to 200.5 million Mt by 2018 with a successive growth of 1.8 % per year(FAO, 2015). In order to reduce the dependence on mineral fertilizers, there is a need to replace these fertilizers with organic fertilizers.

Addition of organic matter improves environmental efficiency which is more natural and healthier for the practicing of sustainable agriculture. However, a large quantity of organic fertilizers is required to fulfill crop's requirement. Therefore, organo-mineral fertilizers need to be considered to improve soil fertility. Organo-mineral fertilizers are a combination of organic and inorganic wastes (Oladipo *et al*., 2009). Organo-mineral fertilizers improved soil nutrients and organic matter content. It also improved soil available water due to the increase of pore size distribution in soils(Oshunsanya and Akinrinola, 2013). Furthermore, organo-mineral fertilizer able to improve crop productivity at lower production cost (Akanbi *et al*., 2006).

In 2012, the freshwater demand increased up to 64 million cubic metres per year and agricultural sector used about 70% of the world's water resources (Cordell et al., 2009). The manufacturing industry and domestic sector used

about 20 and 10 % of the water resources, respectively. The increasing demands for freshwater is characterized by the production of substantial volumes of wastewater. In recent time, wastewater management becomes a challenge. Reuse of wastewater especially grey water in the irrigation system reduced the amount of fresh water which are requirement in the agricultural sector (Hussain *et al*., 2002; Ladwani *et al*., 2012). Domestic wastewater or grey water is defined as the discharge of water from domestic residences, commercial or individual premises into the public sewer (Kling, 2007). It includes combination of wastewater from toilets, bathroom, kitchen sink, dishwashers, and washing machine. These wastes water could be beneficial to plants as they have nutrients such as N, P, K, and other micro elements and also organic matter (Khai et al., 2008). They also serve, as a convenient way to dispose wastewater with low cost treatment (Friedler, 2004).

According to Madhumithah *et al*. (2011), about 50 million tons of vegetable wastes are generated yearly. Handling large quantities of agricultural wastes that are high in moisture contain is challenging *(*Asquer *et al*., 2013). Vegetable wastes are high in organic matter (70-80%) and moisture (80-90%). Vegetable wastes also harbor microbes (Kalpana *et al*., 2011) and because of this, the wastes can be fermented into liquid organic fertilizers to optimize plant growth and development (Padmini and Brotodjojo, 2012).

The benefits of nutrients either from vegetables or wastewater from washing machines have stimulated the interest in converting these wastes into commercially valuable products. Therefore, a study was carried out to:

1) To formulate liquid fertilizer from selected waste

2) Determine the effect of formulated liquid fertilizer from selected waste and commercial liquid fertilizer on the growth, yield and nutrients content of tomato *(Lycopersicon esculentum* Mill.)

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