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ASSESSMENT OF FUNGAL AND BACTERIAL POPULATIONS ON SELECTED VEGETABLE CROPS USING THE VERTICAL HYDROPONICS SYSTEM

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BY

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A project report submitted to Faculty of Agriculture, Universiti Putra Malaysia, in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree in Bachelor of Agricultural Science

DEPARTMENT OF PLANT PROTECTION
FACULTY OF AGRICULTURE
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CERTIFICATION

This project report entitled *"Assessment of Fungal and Bacterial Populations on Selected Vegetable Crops using the Vertical Hydroponics System"* is prepared by Mohd Alif Omar Bin Mustaffa and submitted to the Faculty of Agriculture in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree in Bachelor of Agricultural Science.

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LIST OF ABBREVIATIONS

UNDP	United Nations Development Programme
UN-HABITAT	United Nations Human Settlements Programme
FDTCP	Federal Department of Town and Country Planning Peninsular Malaysia
FAO	Food and Agriculture Organization
LED	Light-Emitting Diode
DEPI	Department of Environment and Primary Industry
PDA	Potato Dextrose Agar
NA	Nutrient Agar
PVC	Polyvinyl Chloride
^{o}C	Degree Celsius
Ml	Milliliter
cm	Centimeter
µm	Micrometer
CFU	Colony Forming Unit
cfu/mL	Colony forming unit per milliliter
Log_{10} cfu/mL	Colony forming unit per millilitre convert to log value
EC	Electrical Conductivity
LCB	Lactofenol cotton blue
SAS	Statistical Analysis System
ANOVA	Analysis of Variance
HSD	High Significant Different

ABSTRACT

The vertical hydroponics system is a method for plant cultivation that using the height of a hydroponics system. The role of microbes in plants growth is a very important. All plant surfaces have microbes on them, fungi and bacteria are among the microbes that successively colonize plants as they mature. Therefore, the objective of this study was to determine populations of fungi and bacteria on selected vegetable crops using vertical hydroponics system. The study was conducted to assess the high concentration on both populations of fungi and bacteria on Lemon Basil (*Ocimum americanum*), Chinese Kale (*Brassica oleracea* var. *alboglabra*), Hong Kong Choy Sum (*Brassica chinensis* var. *parachinensis*) and Lion Head Lettuce (*Lactuca sativa*). The experiment was conducted at the glasshouse in the urban agriculture unit at Faculty of Agriculture, Universiti Putra Malaysia. CFU/mL was be used in enumeration of fungi and bacteria populations using surface plating method and direct plating method from root and water sampling on selected vegetable crops within four week was assessed. Based on the results, the selected vegetable crops showed that there was significant different on fungi and bacteria populations. In fungi population, *B. oleracea* var. *alboglabra* and *L. sativa* has high concentration in root sampling and *O. americanum* also has high concentration in water sampling. For bacteria population, *L. sativa* has high concentration in the both of root and water sampling. The new finding in this study, the both populations of fungi and bacteria is more to give the beneficial microbes on selected vegetable crops and will be useful to plant growth in vertical hydroponics system. In conclusion, *Aspergillus fumigatus*, *Aspergillus niger*, *Cladosporium herbarum*, *Curvularia lunata*, *Bacillus subtilis*, *Proteus vulgaris*, *Staphylococcus aureus* and *Streptococcus pyogenes* were found from root and water sampling using morphological identification method.

ABSTRAK

Sistem hidroponik menegak adalah kaedah untuk penanaman tanaman yang menggunakan ketinggian sistem hidroponik. Peranan mikrob dalam pertumbuhan tanaman adalah sangat penting. Semua permukaan tanaman mempunyai mikrob, kulat dan bakteria adalah antara mikrob yang berturut-turut menjajah tanaman sehingga tanaman matang. Oleh itu, objektif kajian ini adalah untuk menentukan populasi kulat dan bakteria pada tanaman sayur-sayuran terpilih menggunakan sistem hidroponik menegak. Kajian ini telah dijalankan untuk menilai tumpuan populasi yang tinggi di kedua-dua populasi kulat dan bakteria pada tanaman basil (Ocimum americanum), kailan (Brassica oleracea var. alboglabra), sawi (Brassica chinensis var. parachinensis) dan salad (Lactuca sativa). Eksperimen ini telah dijalankan di rumah kaca dalam unit pertanian bandar di Fakulti Pertanian, Universiti Putra Malaysia. CFU/mL telah digunakan dalam penghitungan kulat dan bakteria dengan menggunakan kaedah penyaduran permukaan dan kaedah penyaduran terus dari persampelan akar dan air ke atas tanaman sayur-sayuran yang terpilih dalam tempoh empat minggu telah dinilai. Berdasarkan keputusan, tanaman sayur-sayuran terpilih menunjukkan bahawa terdapat perbezaan yang signifikan pada populasi kulat dan bakteria. Dalam populasi kulat, B. oleracea var. alboglabra dan L. sativa mempunyai tumpuan populasi yang tinggi dalam persampelan akar dan O. americanum pula mempunyai tumpuan populasi yang tinggi dalam persampelan air. Bagi populasi bakteria, L. sativa mempunyai tumpuan populasi yang tinggi dalam kedua-dua persampelan akar dan air. Penemuan baru dalam kajian ini, kedua-dua populasi bagi kulat dan bakteria lebih kepada memberi mikrob bermanfaat pada tanaman sayur-sayuran terpilih dan akan menjadi berguna kepada pertumbuhan tanaman dalam sistem hidroponik menegak. Kesimpulannya, Aspergillus fumigatus, Aspergillus niger,

Cladosporium herbarum, Curvularia Lunata, subtilis Bacillus, Proteus vulgaris, Staphylococcus aureus dan Streptococcus pyogenes ditemui dari persampelan akar dan air dengan menggunakan kaedah pengenalan morfologi.

CHAPTER 1

INTRODUCTION

1.1 Overview

According to UNDP (1996) reports that urban agriculture defined as an agriculture practice in activity of producing, processing and marketing of food and agricultural products in urban and suburban areas by using intensive production methods, natural resource and urban waste to yield a diversity of crops, fisheries and livestock. Besides, according to UN-HABITAT (1996) that the concept of urban agriculture has long existed if look at the development model of Machu Picchu in Peru around 1450 years ago, are designed to create a productive urban farm with farm houses in and around the city. Even, according to FDTCP (2012) also the urban agriculture as an important medium for continuously supply of local food, reduce urban poverty and improve the management of the urban environment (JPBD, 2012).

Today, the planting systems commonly used in urban agriculture are fertigation, hydroponics, aeroponics and roof-top farming. Through this system, planting vegetables on a small scale by individuals and communities can do to narrow the urban areas. In my project studies, I was selected vertical hydroponics system. According to Paraskevopoulou and co-workers (1995) assert that a vertical system is method for plant cultivation that using the height of a hydroponics system in addition to the ground space and this can increase the number of plants onwards enhance the yield. For example, vertical systems are mostly used in Japan, Australia, USA and European countries such as Italy (Shahla *et al*., 2012).

The introduction of microorganisms population, according to Clements (1916) defined that the population which as a level of organization with have tight interactions between organisms that comprise a causal system and gives rise to emergence properties (Rangaswami, 1966). In addition, populations also are defined as multi-species assemblages. In which a contiguous environmental there are organisms that live together and interact with each other (Konopka, 2009). According to Pomeroy et al. (2007) and Findlay (2010) that they are mainly composed of fungi, bacteria, viruses, algae, protozoa and archaea (Liu *et al*., 2013).

Furthermore, according to Paulitz (1997) and Utkhede *et al*. (2000) write that in the hydroponics system, fungi and bacteria are also very common carried in water supplies. Usually nutrients application and media provide an ideal breeding ground for many fungi and bacteria since they contain mineral elements, usually some moisture and are often warmed to just the right temperature for optimum microbial growth. The newly planted hydroponics system is very much like a soil garden and the mixtures of different microbes will compete with each other, just as they do in soil, and populations of different species will begin to dominate. But, many of the species are in fact beneficial microbes such as fungi and bacteria on the plant growth. Besides, many of the naturally occurring beneficial fungi and bacteria which colonise nutrient solutions are species of *Pseudomonas*, *Bacillus*, *Trichoderma*, and *Gliocladium virens* although a huge range of microbes may be in existence in different hydroponic systems. Because these types of species are known to have a natural suppressant action to many of the root diseases we encounter in hydroponics such as *Pythium*, *Fusarium* wilts and others (Morgan, 2008).

Presently, there is limited scientific researches have been done on populations of fungi and bacteria in the vertical hydroponics system. Therefore, this will be the first project report on assessment of fungal and bacterial populations on selected vegetable crops using vertical hydroponics system in Malaysia. The specific objective of this research was to determine populations of fungi and bacteria on selected vegetable crops using vertical hydroponics system. This study is to assess the high concentration on both populations of fungi and bacteria on Lemon Basil (*Ocimum americanum*), Chinese Kale (*Brassica oleracea* var. *alboglabra*), Hong Kong Choy Sum (*Brassica chinensis* var. *parachinensis*) and Lion Head Lettuce (*Lactuca sativa*).

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