UNIVERSITI PUTRA MALAYSIA

EFFECT OF LIGHT-EMITTING DIODE (LED) LIGHTING ON GROWTH DEVELOPMENT AND PHYSIOLOGY OF LETTUCE (*Lactuca sativa*)

ASMA ADILA JAMALUDDIN

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FACULTY OF AGRICULTURE

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By

ASMA ADILA BINTI JAMALUDDIN

A project report submitted to the Faculty of Agriculture

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in fulfillment of the requirement of PRT 4999 (Final Year Project)

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CERTIFICATION

This study report entitled "EFFECT OF LED LIGHTING ON GROWTH DEVELOPMENT AND PHYSIOLOGY OF LETTUCE (*Lactuca sativa*)" is prepared by Asma Adila binti Jamaluddin and submitted to the Faculty of Agriculture in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Horticultural Science.

Student's name: Student's Signature:

ASMA ADILA BINTI JAMALUDDIN …….

Certified by:

……
(ASSOC. PROF. DR YAHYA BIN AWANG)
Project Supervisor,
Department of Crop Science,
Faculty of Agriculture,
Universiti Putra Malaysia

Date:

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LIST OF ABBREVIATIONS

ANOVA	-	Analysis of Variation
LED	-	Light-emitting diode
L	-	Litre
mL	-	mililitre
PPFD	-	Photosynthetic photon flux density
RCBD	-	Randomized Complete Block Design
RH	-	Relative humidity
RT	-	Room temperature
T1-T4	-	Treatment 1 – Treatment 4

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ABSTRACT

Lettuce (*Lactuca sativa*) that belongs to the family Asteraceae originated from the Middle East, is a leafy vegetable type often plugged with pests and diseases as well as unfavourable weather conditions when planted outdoors. The objective of this study was to observe the effect of different LED light on growth and development of *Lactuca sativa.* The plants were grown on a plant rack equipped with LED lights at Physiology Laboratory, Department of Crop Science, Faculty of Agriculture. Four different light regimes consisted of Red and Blue LED as Treatment 1 (T1), Red and Blue LED with Fluorescent as Treatment 2 (T2), Red and Blue with Orange LED as Treatment 3 (T3) and Red and White LED as Treatment 4 (T4) were applied on the lettuce plants. At the onset of the experiments, seeds were directly sowed in cocopeat in plug trays, and placed in a container under the different light regimes for three weeks. Randomized Complete Block Design (RCBD) was used. The most effective results were observed in Treatment 1 with Red and Blue LED light treatment. The study showed that supplemental Fluorescent light affected high in plant morphology but low in its physiology, while supplemental Orange LED inhibited lettuce growth. Treatment without Blue light, gave the lowest yield.

ABSTRAK

Salad (*Lactuca sativa*) yang tergolong dalam keluarga Asteraceae berasal dari Timur Tengah, adalah sejenis sayuran berdaun yang sering dihinggapi oleh perosak dan penyakit serta keadaan cuaca yang kurang baik apabila ditanam di luar rumah. Objektif kajian ini adalah untuk melihat kesan cahaya LED yang berbeza terhadap pertumbuhan dan pembentukan *Lactuca sativa.* Tumbuh-tumbuhan telah ditanam di atas di atas rak yang dilengkapi dengan lampu LED, di Makmal Fisiologi, Jabatan Sains Tanaman, Fakulti Pertanian. Empat rejim cahaya yang berbeza terdiri daripada LED Merah dan Biru sebagai Rawatan 1 (T1), LED Merah dan Biru serta Pendarfluor sebagai Rawatan 2 (T2), LED Merah dan Biru serta LED Jingga sebagai Rawatan 3 (T3) dan LED Merah dan Putih sebagai Rawatan 4 (T4) telah digunakan pada tanaman salad. Di awal eksperimen, benih telah disemai secara terus ke dalam habuk sabut kelapa yang diisi di dalam dulang palam, dan diletakkan di bawah rejim cahaya yang berbeza selama tiga minggu. Reka bentuk yang digunakan untuk analisis statistik adalah jenis RCBD. Keputusan yang paling berkesan dilihat pada Rawatan 1 dengan rawatan cahaya LED Merah dan Biru sahaja. Kajian ini juga menunjukkan bahawa tambahan cahaya pendarfluor hanya memberi kesan pertumbuhan yang tinggi kepada morfologi salad tetapi kurang dari segi fisiologi, manakala tambahan LED Jingga melambatkan pertumbuhan salad. Rawatan tanpa cahaya Biru pula memberikan hasil yang paling rendah.

CHAPTER 1

INTRODUCTION

1.0 Introduction

Light-emitting diode (LED) is an electrical device with two terminals conducting electricity in one direction. The diode, through the supply of electricity, radiates a bright light around a small bulb. The diode connected to electrical current excites electrons within the diode, releasing photons, which is the visible light that we see. LEDs easily produce a bright spectrum of colors using very low electricity (Wikipedia, 2014a). The color of the light is a direct result of the energy gap in the semiconductor of the diode. Many other electronic devices such as radios, televisions and computers have been using diodes commonly as an electrical component for conduction. LEDs have lots of advantages over incandescent lighting including lower energy usage, long-lasting, better physical strength, small in size and quicker switching (Wikipedia, 2014b).

The use of artificial lighting in daily life has been mainly for illumination in housing and entertainment. Exploiting this technology, scientist and researcher have been experimenting on how artificial lighting affect animals and plants. Studies were conducted due to uncertainty in weather conditions in Malaysia during droughts and heavy rains, decrease in arable land due to uncontrolled agricultural practices such as excessive use of chemical herbicides and pesticides, increase in urban population and increase of interest in urban farming. Thus, LEDs are used in conditions where

natural light sources are insufficient (Wikipedia, 2014c). Indoor farming has been successful and overwhelming in Japan producing 10,000 heads lettuce per day, a hundred times higher yield production than the traditional methods. Indoor farming uses 40% less power with 80% less food wastes and 90% less water usage than outdoor cultivation.

1.1 Problem statement

Various studies have been conducted indoor on the cultivation of plants especially vegetables under artificial lights. Earlier, the fluorescent light has been used for the cultivation of plants by tissue culture technique. Currently, LED technology in lighting are being studied due to their functionality where they can be closed to plants, more efficient in electrical usage, higher flexibility in design for their small size contraptions. In addition, LED lights can emit various colours. Thus, the advantages appear to be saving energy and light can be controlled since the plants absorb red and blue light for growth and development (Dougher and Bugbee, 1998; Yorio *et al.*, 1998). In the present study, the effects of Red and Blue LED, Red and Blue LED with Orange LED, Red and Blue LED with Fluorescent, and Red and White LED on the growth and physiology of lettuce will be evaluated.

1.2 Objective of study

The main objective of the study was to evaluate the effects of LED lights on growth and physiology of Lettuce *(Lactuca sativa).*

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