STUDY ON LED GROWTH LIGHT TO IMRPOVE THE QUALITY OF LETTUCE AND HELP IN PLANTS GROWTH

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Hons)

by

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DECLARATION

I declared that this report entitled “Study on LED growth light to improve the quality of lettuce and help in plants growth” is the results of my own research except for experts and summaries of each every one of them was me explain the source.

Signature : ……

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Hons.).

The members of the supervisory committee are as follow:

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(Prof. Dr. Chong Kuan Eng)

ABSTRAK

LED memainkan peranan penting dalam penanaman dalaman. Lampu LED memancarkan cahaya yang sama dengan cahaya matahari yang penting untuk tanaman. Walau bagaimanapun, terdapat pelbagai jenis LED yang berbeza dalam panjang gelombang, warna, dan jenama akan menjejaskan pertumbuhan tumbuhan. Masalah utama bagi projek ini adalah untuk menentukan nisbah antara merah ke biru dan susun atur LED yang merupakan gabungan terbaik untuk salad tumbuhan. Untuk projek ini, panjang gelombang merah 660nm LED digunakan dan 430nm adalah untuk LED biru. Oleh kerana nisbah yang berbeza dari LED merah ke biru akan membawa hasil yang berbeza, semakan kesusasteraan perlu dikaji untuk mengelakkan pengujian terhadap beberapa nisbah yang tidak membawa kesan kepada selada yang dilakukan oleh penyelidik lain. Nisbah 10: 1, R1 dan 5: 1, R2 merah kepada LED biru akan diuji untuk membuat perbandingan untuk menentukan nisbah yang akan membawa impak terbesar kepada salad. Kedua-dua jenis nisbah ini dilakukan oleh para penyelidik dan mencapai hasil terbaik ketika dibandingkan dengan nisbah lain. Selain nisbah merah ke LED biru, susun atur LED juga memainkan peranan penting dalam pertumbuhan tumbuhan. Terdapat dua jenis susun atur iaitu susunan RRRBRRRBRRRB LED, L1 dan susunan RBRBRBR LED, L2. Selepas menentukan dan reka bentuk nisbah dan susun atur LED, gabungan nisbah dan susun atur, R1L1, R1L2, R2L1 dan R2L2 akan menjadi percubaan untuk menentukan kombinasi yang akan membawa impak terbesar kepada salad. Salad ini akan diperhatikan dan diukur dalam berat dan warna kering untuk menentukan yang mana kombinasi terbaik LED untuk salad. Gabungan R2L1 telah mencapai hasil yang diinginkan untuk pertumbuhan selada. Oleh itu, matlamat projek ini telah dicapai.

ABSTRACT

LEDs play an important role in the indoor planting. LEDs light emits the light which is similar to the sunlight which is important for the crops. However, there is various type of LEDs different in wavelength, colors, and brand will affect the plant growth. The main problem for this project is to determine the ratio between red to blue and the layouts of the LED which is best combination for the plant lettuce. For this project, a wavelength of red LEDs 660nm is used and 430nm is for the blue LEDs. Since the different ratio of red to blue LEDs will bring in different results, a literature review needs to study to avoid testing on some ratio that did not bring any impact to lettuce that done by other researchers. The ratio of 10:1, R1 and 5:1, R2 red to blue LEDs will be tested to make a comparison to determine which ratio will bring the biggest impact to lettuce. Those two type of ratio is done by the researchers and it achieves the best result while comparing with other ratios. Besides the ratio of red to blue LEDs, the layout of the LED also play an important role in the plant growth. There will be two type of layout which is an RRRBRRRBRRRB arrangement of LED, L1 and RBRBRBRB arrangement of LED, L2. After determine and design the ratio and the layout of LEDs, the combination of ratio and layout, R1L1, R1L2, R2L1 and R2L2 will be experiment to determine which combination will bring the biggest impact to the lettuce. The lettuce will be observed and measured in the dry weight and color to determine which is the best combination of LED for lettuce. The combination of R2L1 has achieved the desired result for the growth of the lettuce. Hence, the objectives of this project has been achieved.

DEDICATION

To my beloved parents

ACKNOWLEDGEMENT

Final year project report is a hard work to complete and without the help of numerous people is a difficult and require a long time to complete it. First, I would like to thank my final year project supervisor, Prof. Dr. Chong Kuan Eng, for his supervision and constant support.

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LED	-	Light Emitting Diodes
HPS	-	High Pressure Sodium
CO_2	-	Carbon Dioxide
Nm	-	Nanometer
Cm	-	centimetre
g	-	gram

CHAPTER 1
INTRODUCTION

Chapter 1 is the summary of the whole project. It consists of a background of the project, problem statement, objectives, scope, and importance of the study and structure of the report.

1.1 Background of Project

Company X is a company that cooperate with semiconductor industries that supplying high precision engineering parts, product, and services. Besides, company X also supply electronic application equipment such as a high precision of tooling and parts, pins and punches, connectors, and machines parts. For recent years, company X trying to use those electronic components such as LED growth light for the purpose of growing fruits and vegetables.

Horticulture in a factory actually similar with at the garden. The requirements of plants to growth such as sunlight, water, humidity, nutrients and etc. the difference between growth at outside and inside the factory is to replace the sunlight with LED lights. LED lights play the same role as the sunlight. The advantages of having horticulture inside the factory are it can reduce in lead time. Agriculture requires 60 days to harvest while horticulture requires only 30 days to harvest. It would be fast and do not worry about the absence of sunlight during a rainy day or at night.

However, there are some considerations must be taken during designing the layout of LED and the parameter between the LED and the plants. Effect of the different combination of red and blue LED will affect the result of the growth. To obtain a good result, the combination of the colors of LED light must be correct to ensure the plants get enough of nutrient from sunlight same as outdoor. With the proper design of the layout and the ratio of the red and blue lights, the result of the plants can be grown well in quality and quantity.

1.2 Problem Statement

Different colors of LED light will provide different nutrients for plants. Hence, each color plays an important role in the plants to ensure the plants obtain enough nutrients that emit out by the LED lights. Since there are plenty of color for the LED lights such as yellow, green, blue, red, white and etc. we need to figure out which colors of LED lights will emit out the light that fulfills the plant's requirement for growth. For this project, red and blue LED lights will be focused since it brings a lot of impact to the plants. However, the ratio between red and blue LED lights to need to figure out to ensure the plants acquire the balanced nutrients that emit out from the red and blue LED lights.

The other factors that can affect the growth of the plants are the layout of the LED lights. Different type of layout will show different results. LED lights can be designed in the tube lights, in a square box or in a cylindrical container. It is important to determine which layout is suitable for the plants which can receive the maxima lights that transmit out by the LED lights with a suitable layout. Besides the layout of the LED lights, the distance between the plants and LED also will affect the growth of the plants. A long range of distance between the plants and LED will cause the plants require not enough of light while the short range of distance will cause sunburn or do not acquire the balance of light emit out from red or blue lights. There are also some other parameters that affect the growth of the plants such as humidity, temperature, CO_2, and nutrients.

1.3 Objectives

The aim of this project is to promote or improve the quality of the plant's growth. The objectives of this project are:

- To determine the ratio between red and blue LED.
- To determine the number of LEDs
- To design the layout of the LED.

1.4 Scope of Study

This study mainly focused on the ratio of red to the blue LED and the layouts of the tube light. There is 4 combinations of LED with 2 different ratio and 2 different layouts. The plant for this study to focus is lettuce where ratio and layouts of red to blue LED growth light need to figure out for the best combination of a good quality of lettuce can be grown. However, only red and blue LEDs is studied although there is plenty color of LED. This is due to red and blue LED plays important role in plant growth compared with other lights.

1.5 Importance of study

The importance of this study is to determine which layout will suitable for a faster growth of plants with quality. Furthermore, to determine which combination of color in a layout could bring the biggest impact on the growth of the plants. By doing some research and analysis, then design and rework on the layout and the combination of color to improve the result of this project. These steps will slowly improve the quality and quantity of the plants which is lettuce. After all the requirement is fulfilled, we will choose the solution which brings the biggest impact on the growth of the lettuce to shorten the harvest time.

1.6 Organization of Report

This report contains five chapter which is an introduction, literature review, methodology, result and discussion and conclusion and recommendation.

Chapter one is the introduction of the project. In this chapter, few topic is covered such as the background of the project, problem statement, objectives, scopes of study, the importance of study and organization of the report.

Chapter two is about the literature review. A literature review concludes or summarizes all the journals, article and study done by experts. It is an important chapter which leads us in a correct way to complete our project.

Chapter three is about the methodology. The methodology provides all the steps and as a guideline for us to complete the project following each step listed in chapter three.

Chapter four is the result and discussion. In the chapter, all the experiment or analysis is done will be shown and discussed.

Chapter five is the conclusion and recommendation. This is the final chapter of this project where it summarizes the whole chapter with the main points. At the end of this chapter, a recommendation is written for future work.

CHAPTER 2

LITERATURE REVIEW

This chapter contains the literature review of the topics which are related to the scope of the study. It covered information about agriculture, horticulture, factors affecting the plant growth, hydroponic system, and effect of parameter of LED to plant. Source of information were obtained from journals, books, case studies, reports and also sources from internet.

2.1 Agriculture

Agriculture is the production of farming and rearing of animals to supply foods, human needs, and other products. The industry of agricultural are mostly engaged in growing plants, cultivate animals, logging, and etc. The evolution of agriculture has to span many years and it does affect by human societies, climate changes, and involving human technology. Although the industry evolution is improving years by years, all types of farming still depend on the same strategy to maintain the environment for the purpose of cultivating domestic species. There is some difference between plants and living species, plants must depend on the land where it must sustain with a type of irrigation system. Due to the support of chemicals, technology, and improvements in the skills of breeding, farms yields have greatly increased. However, some of these measures can bring negative effect and is harmful to the environment and will bring some health problems to humans. The green revolution is the most advanced technologies in the industry of agriculture. The benefits of this innovation are to help people around the world from suffering starve through initiatives involving irrigation systems, production of high yielding crops, and better management strategies.

Although there are some advances made in the agriculture, the industry still remains as a hazardous industry. Fatalities and injuries can occur during operating a machine also diseases and birth defects created by exposure to direct contact to pesticides and fertilizers among the agricultural workers (Researchers from ASIA school of business (2016)).

2.1.1 Background of Agriculture

According to Researchers from ASIA school of business (2016), preliminary farming was developed approximately 10,000 years ago and the first planted seeds are about 9000 B.C. the food production, animal husbandry, fishing, and planting skills become more sophisticated as the skills of the farmer has improved. Besides the skills of the farmer, the invention of machines and tools for the agriculture field bring a huge impact. Sickle for harvesting, irrigation system and plow pulled by oxen are the tools and ways to improve farmer skills. During the Middle Ages, oxen are replaced by the horses which increase the speed of the plow. Jethro Tull is the first built machine for seed planter is invented in the early 1700s. The agricultural revolution starts from 1700 to mid-1800s, during this revolution it mainly focuses on crop production. This revolution allowed farmland to be used over and over again, and animal breeding has improved much more. Thus, farmers are able to yields crops that exceed more than the requirement from the communities. This become one of the reasons where it helps in improving the development of the market, which becomes central to the rapid growth of cities. During the 20th century, few developments have been introduced to increased and reshape the agricultural industry. Gasoline tractor has opened a new pathway for new machine technology, while some areas having the scientific advancements in the propagation of plant and maintain the quality of soil has allowed farmers to fully use that area and soil for farming.

2.1.2 Structure of Agriculture

Basically, agriculture is made up of farmers who develop the land, take part in animal husbandry, and grow plants and vegetables. Next is the industry that purchases the product

of the farmers, processes the product according to market requirement, and transfers all the farm products and farm supplies to other organization. The organization who received all the product and supplies will be sold to the customer and the farmer. The completed cycle of all the activities is known as agribusiness. Farm play a huge role in the cycle of agricultural work as it is the base for it. Farm operator or a farm manager is in charge for the farm who had attended college and earned the agricultural degree. There are two workers that farms usually employed, the permanent workers and the part-time workers. The permanent workers are responsible to operate the farm all the day throughout the whole year while the part-time workers are mainly focusing during harvest and planting seasons. There is two type of farms, the single-crop farms, and diversified farm. The crop is mainly focused for sale in single-crop farms, which means only one single type of item is produced. Examples of single livestock operations are mostly the animal farms such as sheep, goat, turkey, goat, chicken and fish farms. Diversified farms can produce a different type of crops, animals or both for the purpose of sale. Diversified farms are less well known due to the austerity of specialized production. However, the profit margin of the diversified farm is normally higher than single-crop production. Since the plant only can sustain in the land that fulfills plant's requirement, hence diversification is difficult since not all the plants and vegetable could fit inside most of the soil. Moreover, the chance of failure for the diversified farm is higher than single-crop farm due to diseases, natural disasters or drought need to consider more than single-crop farm for all the different plants. Farmers and industries need each other in the agribusiness, industries supply seed, fertilizer, and machine for the farmer while farmer use all the facilities provided by the industries plant crops. After the crops have been harvested, industries will continue the entire job such as storage, shipping, processing, packaging, and canning. To ensure the sales of their produce, contract farming has introduced where the position of crops are determined by farmers before producing them. Contact farming has brought benefits to both buyer and the farmer which stated by the researchers from ASIA school of business (2016).

2.1.3 Industry Outlook of Agriculture

According to researchers from ASIA school of business (2016), employment in the agricultural field is decreasing through 2024. 2% decreases for farmers, ranchers and

agricultural managers while general agricultural workers will face 6% decrease in employment. Due to the fear of public worrying that the fertilizer that applies to the crops in the traditional agricultural that will bring harms to their health, most of the farmer starting to switch into all-organic farming. Fish farming and aquaculture will become more vital for coming years due to a huge requirement from the consumer such as shrimp, salmon, and catfish. Food safety also the most discussed issue that brings a huge impact for experts that work in the agricultural field. Recently in Europe, there are some outbreaks of mad cow disease and foot-and-mouth disease in livestock which have highly highlighted the efforts to detect and prevent the problems occur in the United States. Furthermore, West Nile virus, anthrax, E. coli bacteria in livestock and meat products, residual pesticides in plant products also be the main concerns. Some farming technologies and apparatus need to be invented by the experienced farms and operators to ensure the product of farm will have no any issues that concern about the consumer with the assists of computer-aided operations. After having some research to solve all those problems, experts in agriculture have figured out that the plants and soil are better to treated separately. Precision farming using computers, satellites, and sensors will lead each soil and plants to reach their own specific requirements. With the aid of a computer, farmers are able to determine the correct volume and quantity of how much fertilizer, herbicide should be applied on the plant and soil. Farmer also can prevent pesticide and pollution from the surrounding environment if moving the farm from outdoor into indoor which is fully monitored by computer.

2.2 Factors Affecting the Plant Growth

According to researchers from Stanford and the Carnegie Institution's Department of Global Ecology (2017), plants are the only creatures that can be reproductive by itself and play a major role in the environment. There are several roles that plants and greenery depend on to successfully sprout by itself but there are some environmental factors that affecting the growth of plants by decreasing their ability to grow which is light, soil composition, PH, nutrients and climate change.