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Effect of Light Emitting Diode (LED) Red Blue on the Production of Pakcoy (*Brassica rapa L.)*

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Abstract

The horticulture sub-sector is one of the fundamental sectors for body nutrition. Pakcoy (Brassica Rapa L.) has good nutritional content, high economic value, and is widely found in Indonesia. Sunlight plays an important role in the photosynthesis process of plants so that the right spectrum and intensity of light will have an impact on the characteristics and yields of plants. Therefore, artificial light is used to help agricultural activities. This study aims to determine the effect of light intensity on the production of Pakcoy plants. The research method was an experimental method that used Red (640-650 nm) and Blue LED lights (465-470 nm) with the light intensity of 1000 lux, 1500 lux, 2000 lux, 2500 lux, and 3000 lux, and applied for 12 hours. The analytical method used is a completely randomized design analysis. The results showed that the production of Pakcoy is significantly affected by red-blue LED light intensity, and the results showed that pakcoy biomass which uses a light intensity of 3000 lux to get the best results from other treatments, with the average value of the crown and root sizes of 0.6222 units(gram) and 0.0424 units(gram), respectively. The most effective and efficient light intensity for optimal production of Pakcoy was 3000 lux. Where 3000 lux produces the highest production. In conclusion, the greater the intensity of light given, the greater the production effect obtained by the Pakcoy.

Keywords: *LED, Light intensity, Production, Pakcoy*

INTRODUCTION

The increasing conversion of agricultural land at this time makes Indonesia's agricultural land area continues to decrease. This has resulted in lower land for food production so that other alternatives are needed to overcome these problems (Naznin and Lefsrud, 2017). The indoor cultivation system or plant factory is one technology that can overcome the problems of external environmental conditions and the use of space for agricultural cultivation (Gupta and Agarwal, 2017). Pakcoy or also known as mustard Huma has important health benefits including dietary fiber which can facilitate the digestive process and the fiber can also bind bile acids that cause cholesterol, the beta-carotene content in pakcoy can prevent cataracts (Kosyk et al., 2017). Vitamin K can help prevent stroke and heart disease, as well as vitamin E which is good for skin health (Mutryarny and Lidar, 2018).

Badan Pusat Statistika (2020) showed that every year the production of pakcoy plants fluctuates, the influencing factor is light. Light is an essential factor for plant growth and development. Light also plays an important role in plant physiological processes, especially photosynthesis, respiration, and transpiration (Pantilu et al., 2012). Blue light is a good light to maintain the vegetative process while red light is good for increasing the generative process of plants (Gautama et al., 2018). LED as a light source must have the right quality of light to start and maintain photosynthesis because chlorophyll can absorb and utilize the red (600-700 nm) to blue (400.500 nm) wavelengths, so the light source for plant growth must emit wavelengths this (As'adiya and Murwani, 2021). In the research of (Hakim et al., 2015) the growth of mustard plants in the plant factory with the use of red and blue can grow well. LED as the lighting in agriculture has many benefits, cultivation with LED lighting is an alternative that is worth considering in the future. The research of (Sigmarawan et al., 2019) discussed the effect of the combination of gamelan music and LED light on the growth and productivity of pakcoy plants, providing a lighting capacity of 48 Watts with a light intensity of 1800 lux 20 hours in a controlled growth chamber.

The results obtained from the combination of red-blue and red-white-blue LED light have a positive effect on the growth process and productivity of pakcoy mustard plants in the study using an intensity of 1800 lux not maximal. Therefore, this research used a light intensity of (1000 lux) P1, (1500 lux) P2, (2000 lux) P3, (2500 lux) P4, and (3000 lux) P5. The data obtained were then analyzed used analysis of variance to determine the effect of treatment on the observed variables. The purpose of this study was to determine

the effect and determine the amount of good red and blue light intensity on the growth of pakcoy. If the result is that the treatment given affects the observed variables, then statistical analysis is continued with Duncan's test using the SPSS Statistics 24 application.

MATERIALS*k*AND METHOD

Place and Time of Research

This research was conducted at the Greenhouse Laboratory of Agricultural Engineering Management System, Faculty of Agricultural Technology, Udayana University, from June 2021 until August 2021.

Materials

The tools used in this research are a growth chamber with a size of 60 x 45 x 115 cm equipped with LEDs with 1000 lux, 1500 lux, 2000 lux, 2500 lux, and 3000 lux, LED driver, and exhaust. The tools used for parameter measurement are a 30 cm ruler to measure plant height, Kern ALS 120-4N analytical balance to measure plant weight, Baohishan DHG-9030A oven to dry plants, chlorophyll meter SPAD (Soil Plant Analysis Development) Konica Minolta SPAD-502Plus, a chamber photo box and camera of iphone 7 camera, Lenovo Laptop equipped with Adobe Photoshop CS6 Software, Matlab 2019 software, TDS meter, and Lightmeter MS-1300 Voltcraft. The materials needed are Pakcoy (Brassica rapa L.) seeds from Benihpedia, fertile soil, manure, Multi Green liquid NPK, Curacron 500 EC syngenta liquid pesticide, polybag, and water.

Experimental Design

The research was carried out in several stages, starting with site preparation of tools and materials, planting and maintaining plants, observing and measuring variables, analyzing and processing data. This study used a completely randomized design (CRD) with 1 factor from 5 treatments, namely P1 (1000 lux), P2 (1500 lux), P3 (2000 lux), P4 (2500 lux), and P5 (3000 lux). The data obtained were then analyzed if the treatment had a significant effect, then statistical analysis was continued to Duncan's test using SPSS.

Research Implementations

The research starts from the preparation of planting media, sowing seeds, planting seeds, maintaining plants, giving treatment and observing, and measuring variables. The planting medium has a composition of fertile soil and manure with a ratio of 2:1. Seeds were sown for 14 days. After 14 days the seedlings were transferred to poly bags that had been prepared with planting media. The treatment was given on the sixth day in a growth chamber equipped with LED for 12 hours starting at 06.00 WITA until 18.00 WITA. Plant maintenance was carried out at the beginning of transplanting until before harvest in the form of plant radiation, nutrition, weeding, and pesticides. Watering does twice a day at a rate of 50 ml/plant for once watering. Nutrition was carried out on day 7 DAP (days after planting) 500 ppm, 14 DAP 700, 21 DAP 900 ppm, 28 DAP 1,200 ppm, 35 DAP 1,300 ppm and 42 DAP 1,300 ppm. Weeded was carried out on days 14 DAP and 28 DAP.

Research Variable

The variables observed were Fresh Weight and Biomass. Variable observations were made after harvest. Then the data obtained were analyzed by one-way ANOVA followed by Duncan's test using the SPSS Statistics 20 Application.

RESULTS

The Effect of Red Blue LED Light Intensity on Production of Pakcoy

The results of observations and calculations of the effect of red and blue LED light intensity on the fresh weight of the pakcoy can be seen in **Figure 1**.

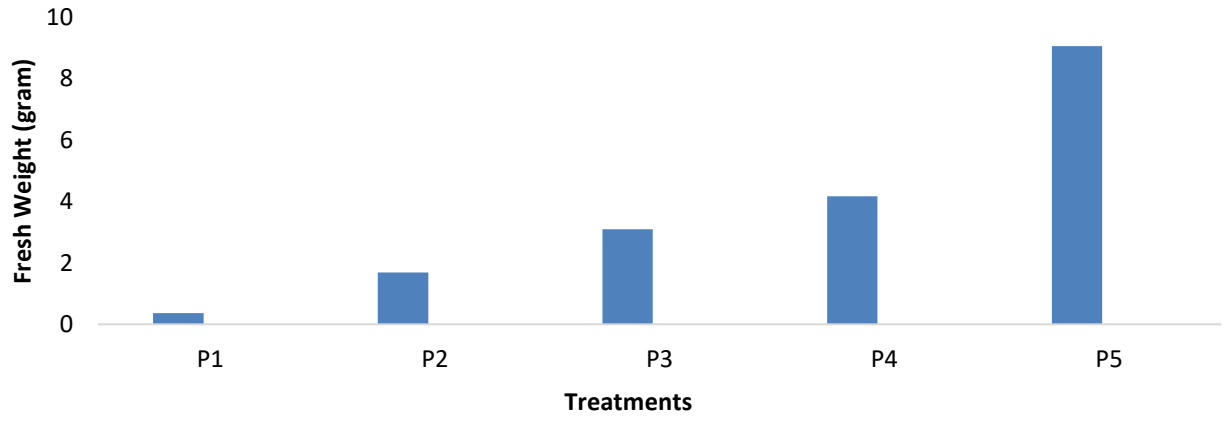

Figure 1. Grafik of fresh weight of pakcoy

Figure 1 shows the 3000 lux treatment (P5) produces the largest average fresh weight, while in the 1000 lux treatment (P1) it gets the smallest average fresh weight value. This explains that the higher the light intensity, the higher the weight because the photosynthesis process takes place intensively. The results of photosynthesis will be translocated throughout the plant tissue through the phloem, which then the energy from photosynthesis will be used by plants to activate the growth of shoots, leaves, and stems so that plants can grow optimally. In this study, statistical tests were carried out in the form of a one-way ANOVA test followed by Duncan's test to determine the difference in fresh weight in each treatment. The better and greater the plant growth, the greater the weight of the plant. The test results can be seen in **Table 1**.

Table 1. Average fresh weight harvested by pakcoy in each treatment

Treatment	Fresh Weight
P1	0.3625 a
P2	1.6850 ab
P3	3.0950 bc
P4	4.1700 c
P5	9.0525 d

Note: Different letters behind the numbers in the same column show significantly different values based on Duncan's Test with a level of 5%

The results of Duncan's test showed that the average fresh weight in the P5 treatment was significantly different from the other treatments. In the P5 treatment, the average crown weight of the largest was 9.0525 grams. This shows that light intensity has a positive effect on the fresh weight of pakcoy crop yields. Very low intensity will reduce the rate of photosynthesis which is quite large, decreasing the rate of photosynthesis will interfere with metabolic activities and other physiological processes in plants which will ultimately reduce the rate of plant growth (Muhyidin et al., 2019). A very low intensity will reduce the rate of photosynthesis quite large, a decrease in the rate of photosynthesis will interfere with metabolic activities and other physiological processes in plants which will ultimately reduce the rate of plant growth (Ferita et al., 2009).

The Effect of Red Blue LED Light Intensity on Biomass of Pakcoy

Pakcoy after harvest is dried to determine the value of biomass. Pakcoy biomass value can be seen in **Figure 2**. Grafik of pakcoy biomass shows that the 3000 lux (P5) treatment has heavier crowns and roots than the other treatments, while 1000 lux (P1) gets the smallest value. The statistical test results of the one way ANOVA test show the differences in each.

Table 2. Average pakcoy biomass in each treatment

Treatment	Biomass	
	Crown	Root
P1	0.0123 a	0.0017 a
P2	0.0916 ab	0.0092 ab
P3	0.1596 ab	0.0147 bc
P4	0.2047 b	0.0203 c
P5	0.6222 c	0.0424 d

Note: Different letters behind the numbers in the same column show significantly different values based on Duncan's Test with a level of 5%

The results of Duncan's test on the P5 treatment showed a significant difference with the average value of the crown and root sizes of 0.6222 units (gram) and 0.0424 units(gram), respectively. Then the smallest value was obtained by treatment P1 with the size of the crown and root of 0.0123 units and 0.0017 units. This shows that the P5 treatment is a light intensity treatment that has a positive effect on pakcoy biomass. The dry weight of the plant is influenced by its high photosynthetic capacity. High photosynthetic capacity can increase the amount of photosynthate significantly (Restiani et al., 2015). The high amount of photosynthate can affect the plant so that it becomes more fibrous, sturdy, and increases the dry weight of the plant (Chen et al., 2020). The size of the intensity of light entering the plant surface will affect the length of the internodes formed, high light intensity causes the formation of internodes to be shorter than the provision of low intensity (Wiguna et al., 2017). stated that the size of the light intensity

that enters the plant surface will affect the length of the short internode formed, high light intensity causes the formation internode to be shorter than the provision of low intensity (Lindawati et al., 2015).

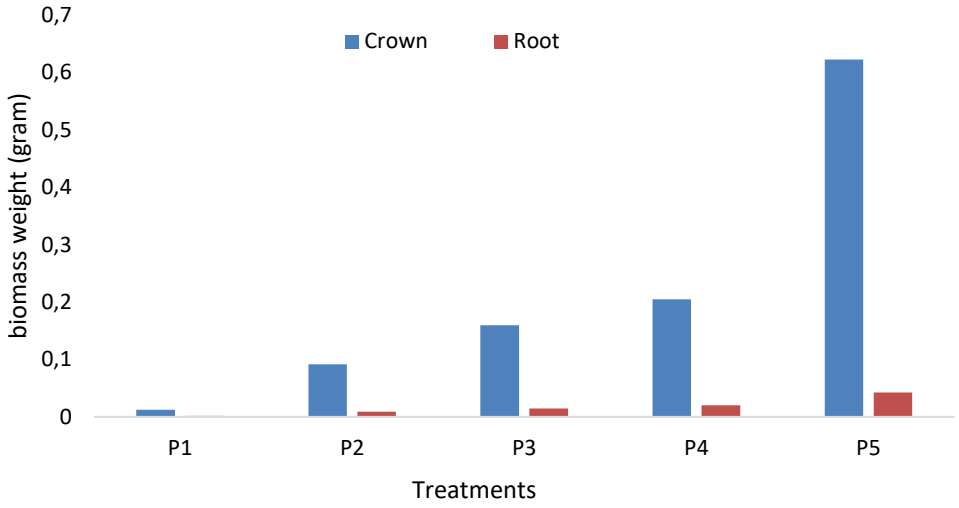

Figure 2. Biomass Grafik of Pakcoy

CONCLUSIONS

The intensity of red and blue LED light has a positive effect on the yield of pakcoy. The light intensity of 3000 lux produces a total yield of 9.0525 grams and biomass of 0.6222 grams.

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