Enhanced Production Capacity of Chrysanthemum Seeds and Flowers using Ultraviolet Light Exposure Method

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***Abstract*— Chrysanthemum flowers are a short-day plant which its growth and initiation is affected by long light exposures. This study aims to investigate the influence of extra light colors to the flowering of seven varieties of chrysanthemums and acquire a light color most suitable for the growth and flowering of chrysanthemum. The reseach compares the effects of ultraviolet light on LED lights with LHE lights which normally used for chrysanthemum plants, consists of two factors which are arranged in a split plot design, extra light color is the main plot and varieties as a subplot. Additional light used include ultra violet light emanating from the LED light and the white color comes from LHE, while the varieties used are the red Aster, white Aster, M, 2000, Felling green, white Semifil, Fiji, and Puspita nusantara. The results showed that chrysanthemum get additional ultraviolet light coming from LED have better growth than using white coloured LHE light and the height growth of plant is 15 days faster when using LHE light and for the bud growth of chrysanthemum flowers using ultraviolet lamps is 10 days faster when compared with the normal LHE light. The color of the chrysanthemum flower produced using LED is brighter and thicker when compared with chrysanthemum flower that uses LHE light.**

Keywords— Chrysanthemum flowers; LED UV; growth

I. PREFACE

Chrysanthemum is a short-day plant which its flower initiation and development is controlled by the length of day. Chrysanthemum plants require light for more than 13-16 hours a day to keep growing in a vegetative manner. In tropical regions like Indonesia these needs cannot be met by sunshine duration which average at 12 hours a day so it needs to be supplemented by artificial electrical light which is usually done after sunset. Highest photosynthesis occurs in midday from 11 am - 2 pm and that could drop significantly if covered by clouds. At 6 pm- 6 am it does not even take place because there is no sunlight [1]. Chrysanthemums can be grown well in the highlands (> 800 MASL) with a soil pH of 5.5 - 6. Plantation in a mountainous area with soil pH of 5 - 5.5 needs liming. Chrysanthemum requires soil with moderate fertility, because the fertile soil will result into lush plants. When grown in pots, the appropriate pH of the medium is 6.2-6.7. Genetically chrysanthemum is a short-day plant and to obtain uniform growth and high flower production, its vegetative growth needs to be treated a long day treatment with the addition of incandescent or fluorescent light [2].

For tropical areas like Indonesia, the daily average temperature in the lowlands is too high for the growth of chrysanthemum, temperatures during the day are ideal for the growth of chrysanthemum plants ranging from 20o-26o Celsius with the minimum of 17o Celsius and maximum of 30o Celsius. The air temperature at night is an important factor in accelerating the growth of flower buds. The ideal temperature ranges from 16oc - 18o C when the temperature drops to below 16o Celsius then its growth becomes higher in a vegetative manner and slow flowering. At those temperatures, the colour intensity of the flower increases (bright) otherwise if the night temperature is too high could result the fading of flower colour so that it is dull in appearance although the flowers are still fresh [3]. Chrysanthemum cultivation in greenhouses is much better than in open fields because in his native country chrysanthemums are cultivated in greenhouses. This is because to get a flower to grow a uniform, cohesive and high quality, a needed special treatment should be applied, such as the manipulation of day length with incandescent / fluorescent lamps, application of hormones, irradiation and other applications. This treatment is more manageable and applicable in a glass house or plastic rather than in open fields. Disruptions will occur in open fields such as pests and diseases, besides flower which is exposed to rain will be susceptible to rot [4].

The duration difference of adding light does not affect the growth of the plant height, girth of stem, wet weight and dry weight, but the addition of light can maintain the vegetative phase of chrysanthemum [5].

Extra light are provided with a continuous manner that the light is on for 4-6 hours continuously. The addition of light on the plants to give the effect of a long day starts from the time of planting until 4-6 weeks after planting. The addition of light is given by using a 60-watt incandescent bulb with a height of 2.0 meters from the ground. Each incandescent

lamps is used to illuminate an area of + 3 meter2. The distance between lamps are about 1.5 meters. Time of illumination starts at 18.°° to 22. °° pm. Chrysanthemum grown in plastic house with high intensity light will produce long stems;larger leaves compared to grown outside a greenhouse. In addition, prevention and control of pests and diseases are necessary [6].

Light plays an important role in the process of photosynthesis through phytochrome. Phytochrome is the most effective light recepient in controlling the morphogenesis process of plant compared to the others. Phytochrome can detect light waves of 300-800 nm with a maximum sensitivity to red light (R, 600-700 nm with peak absorption at 660 nm) and far red (FR, 700-800 nm with peak absorption at 730 nm). Phytochrome respond very well to changes in the wavelength of red (R) and far red (FR) of the light spectrum. Phytochrome exists on two forms of light that can change, those are active FR and inactive R. Far red light (FR) is not efficient for photosynthesis, thus requiring the addition of light with a wavelength that is lower to be more efficient [7].

Induction of flowering through photoperiodensity modifications has been successfully performed to set the period of flowering (flower harvest) in some plants, such as chrysanthemums (Langton 1987), Kalanchoe (Harder 1958), and poisenttia (Chockshull et al. 1995). In lilies, it is not certain that the response of flowering lily has adapted well in tropical areas such as local Sukabumi lilies, although some native species of lily reported to show flowering response to photoperiodensity especially long day (Wilkins and Dole 1997). In addition to photoperiodensity modifications, some growth regulators (PGR) as GA3 to increase the uniformity of flowering in some plants.GA3 Applications been reported to stimulate flowering in dieffenbachia plants (Henny 1980), spathyphyllum (Henny 1981), Aglaonema (Henny 1983), calalily (Tjia 1987), homalomena (Henny 1988), anthurium (Henny and Halmilton 1992), and philodendrop (Chen et al., 2003) with a concentration that varies between 150-300 ppm. In connection with this, an experiment was conducted to know the techniques to accelerate flowering lily with various sizes tuber with the provision of a long day and GA3. [8]

II. RESEARCH METHOD

The data collection was conducted in early June 4 - 8 September 2015, in the chrysanthemums plantation area in the panggeran hamlet Hargobinangun village Pakem sub-district Sleman District, Yogyakarta, with the method of using the random plan design complete using 5 treatments (5 LED lights as a comparison of plant growth and 5 lights LHE as a comparison) and 7 varieties of chrysanthemum (white Aster, red Aster, M2000, white Semifil, Filling green, Fiji, Puspita nusantara. The addition of light given using Ultra Violet light with a luminance of 100 lux at a height of 120 cm of shoots top plant chrysanthemums. Ultraviolet LED lights are used to illuminate each area + 3 meter2. The distance between lamps are about 1.5 meters. The adding time begins at 18.00 to 22.00 pm. Data acquire with method, each light point on kumbung given LED light is studied by means of measuring and for the parameters taken as data are as follows:

a) Plant height (cm)

b) The diameter of the stem (mm)

c) Number of leaves

d) The width of leaf

Fig. 1. chrysanthemum flower seeds and its varieties

Fig. 2. Use of white LHE and UV LED

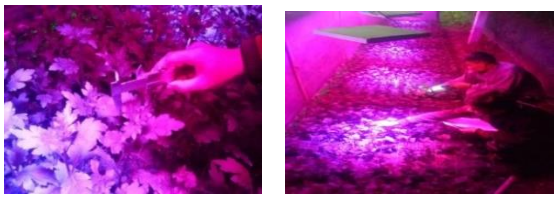

Fig. 3. Measurement of chrysanthemum on the UV LED

Fig. 4. Measurement of diameter and width leaf chrysanthemum flower bulbs LHE

III. Result of The Research

Analysis results of chrysanthemum plants growth showed that the addition 6 hours per day light exposure during the growth period (30 days) using Ultraviolet LED light as well as using plain LHE white lights, the differences in plant growth is very significant, for the first growth where chrysanthemum flower seed planted will be exposed to light for 30 days to achieve a standard height of Chrysanthemum flower whereas using Ultraviolet LED light, the first growth period only 20 days has reached the desired standard height of 20 cm. after that the lights will be turned off to make room for chrysanthemum flowers to grow normally without assistance from any additional light, on the 70th day it's seen that chrysanthemum by using UV LEDs has height of 112 cm on average experiencing faster height growth when compared with chrysanthemum which uses white LHE light with 82.6 cm in height (Figure 3). For the growth of stem diameter and leaf width of chrysanthemum, seen that the growth of chrysanthemum stem width is significant where for the stem diameter of chrysanthemum that uses UV LED, the diameter is 0.6 mm while the stem diameter of chrysanthemum flower that use LHE is 0.5 mm (Figure 4) for quantity growthand width of leaf, the amount of growth between the chrysanthemum which uses UV LED light and white LHE has no visible difference in terms of quantity and size due to the growth of leaves every day has to be in the afternoon to accelerate the growth of chrysanthemum flower buds. As shown in the following figure.

Chrysanthemum plant growth period experienced significant growth which at day 67, the chrysanthemum plant which uses UV LED lampshave started emerging flower buds, while the chrysanthemum plant that uses white LHE flower buds appear on day 76. The harvest period of chrysanthemum is also faster when chrysanthemum which uses UV LED light compared with the chrysanthemum which uses white LHE, where the harvest of chrysanthemum flower which uses UV LED light is on day 97, whereas the chrysanthemum plant that uses plain white LHE yet entered the harvest time.

In figure 8,9,10 can be seen that the comparison of colour and brightness of chrysanthemum flower using Ultraviolet LED lights is brighter when compared to the chrysanthemum flower that uses the white Energy Saving lamps (HE).

From observations we found that the extra UV LED light is very influential in the growth of chrysanthemum, UV LED light with a wavelength which is adapted to the process of photosynthesis of plants.

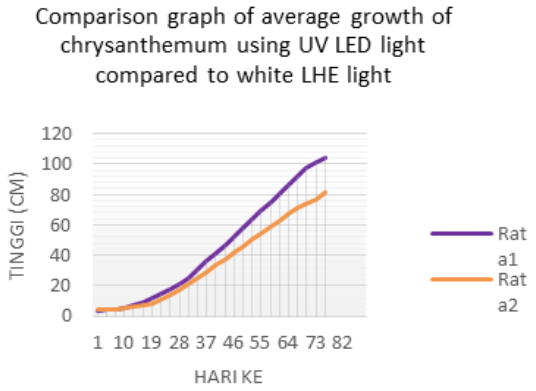

Fig. 5. Graph comparison of the average growth of chrysanthemum plants

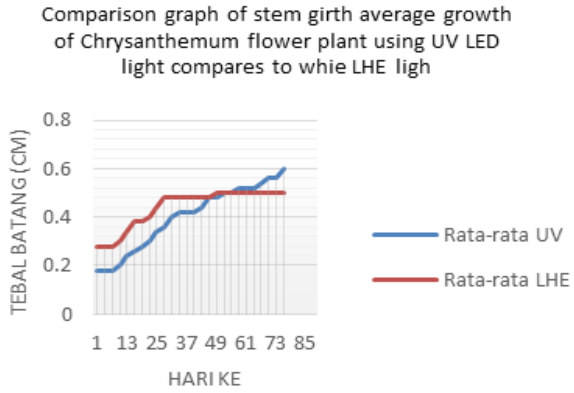

Fig. 6. Comparison graph of average stem girth of Chrysanthemum plant using UV LED and White LHE light

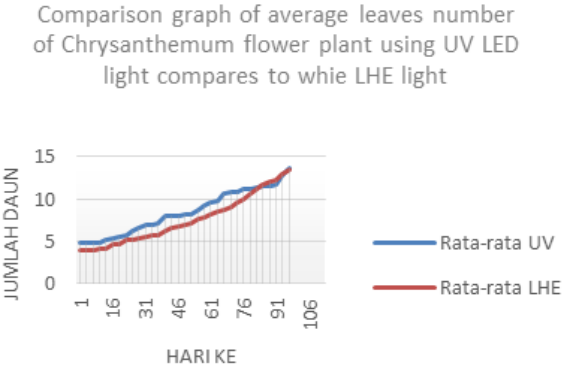

Fig. 7. Comparison graph of average leaves width amount of Chrysantemum plant using UV LED and white LHE light

Fig. 8. Brightness of chrysanthemum flower color for UV LED light

Fig. 9. Brightness of chrysanthemum flower for UV LED

Fig. 10. Brightness of Chrysanthemum flower for white LHE light

IV. CONCLUSION

From the results of research and measurements that have been done, it can be concluded as follows:

- UV LED light greatly affect the height growth of chrysanthemum, which in 20 days has reached a standart height of chrysanthemum (20 cm)
- The use of UV LED lamps and white LED light did not affect growth of the number of leaves and leaf width.
- The diameter of the chrysanthemum stem has no significant effect on the use of UV LED light and white LHE light
- The growth period of chrysanthemum flower buds for UV LED lightis 10 days faster when compared with white LHE
- The period of harvest of chrysanthemums for UV LED lights usage is 10 days faster when using white LHE light.
- The brightness of chrysanthemums for the use of UV LED light is better and brighter when compared using white LHE light.

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