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EVALUATION OF THE EFFECT OF LIGHT QUALITY TREATMENTS ON GROWTH AND FLOWERING OF SAINTPAULIA SEEDLINGS (*SAINTPAULIA IONANTHA WENDI*)

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ABSTRACT

Saintpaulia, highly popular flowering houseplants, need proper growing medium for optimal vegetative and reproductive growth. It has been proved that the application of supplementary fertilizers, appropriate growing medium, and artificial light could provide more favorable growth and flowering conditions for most plants. For this purpose, five separate experiments were carried out to study the factors affecting the growth and flowering of this plant. The fifth experiment was carried out separately to investigate the light quality treatments by using LED lamps at four levels (red light (650-665 nm), blue light (460-475 nm), combined light of red and blue with equal ratio and white light (380-760 nm)], 16 hours in daylight and 8 hours in darkness. All experiments were performed as factorial experiment in a completely randomized factorial design with 5 replications. Most of the measured traits were significantly affected by the treatments of these three experiments. The quantitative treatments of using of 8000 lux light and the use of a blue LED lamp, and then a white LED lamp, could improve the traits studied.

1. REVIEW OF LITRATURE

There are a few studies investigating the effects of light quality on plant growth and flowering. Sabzalian et al. (2015) found plants grown under artificial light were healthier than plants grown in the greenhouse, and plants grown under red-blue LED light were significantly smaller than other treatments. Moreover, blue light inhibits cell growth and blue light receptors may regulate and change the expression of genes that prevent stem elongation. To confirm this issue, a study was conducted

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by Lee and Park (2003) on the Iranian plant called as Cyclamen Persicum. The results showed that the highest number of flower buds and opened flowers was observed in plants grown under the treatment of a combinition of blue light and red light compared to other light sources. Moreover, applying blue and red light alone could reduce the flowering response in this plant. The length of the flower stem was also influenced by the quality of light, so that it was 14 cm in normal treatment, but it was 23.8 cm under the treatment of red light. Moreover, under the blue light and the combination of red and blue light, the length of the flowering stem was less than the control treatment. Moreover, different qualities of light also affected the flowering period. Under fluorescent light, this period was 20 days, under the red light, it was about 40 days, and under the blue and red lights, it was 39 days. According to these studies, it seems that flowering and growth of plant can be controlled by manipulating the quality of light and various wavelengths of artificial light. These types of systems can also be used at commercial scales.

In an investigation conducted by Ramasawheny (1977) on the effect of red light and blue light on the flowering of Chenopodium album, it was found that no flower was initiated in the light intensity of 0.9 µW of blue light. Although 50% of the flowers were initiated in the light intensity of 1.2 µW of blue light and 100% of the flowers were initiated in light intensity of 5.4 µW of blue light, no flower was initiated in the red light. Park et al. (2015) investigated the quality of light on flowering and morphogenesis of chrysanthemum plant. The results of the research show that the minimum time required for flower induction was 4 related to 4-hour nigh break with infrared light treatment with 12.2 days, and the latest flower induction was related to combinition of red and blue lights treatment and 4-hour nigh break with infrared light and red light treatment with 44 days. In the same study, the maximum number of flowers in the plant was related to 4-hour night break with light blue and infrared light treatment with 27.3 numbers. However, no flower was formed in long days and 4-hour night break with combination of red light and blue light treatment, 4-hours night break with red light and infrared light treatment, 4-hours night break with blue and white light treatment, and 4 hour-night break with red and white light treatment. The effects of red and blue lights on the morphology and flowering of the Petunia plant were examined by Gayutam et al (2015). The results showed that red light reduced the branch length of the plant, and the plants obtained from this treatment had a more compact and shorter form than other treatments. However, blue light improved the length of the branch in the plant so that the plant height was in a more appropriate size in this light. In addition, the flowering rate in blue light was significantly higher than that of other treatments. Nanya et al. (2012) investigated the effects of blue and red lights on the stem length and flowering of tomatoes. The results showed that the plants grown under red light had shorter branches than the two other treatments. The rate of flowering in blue light and combinition of red and blue lights increased compared to other treatments. Aslanpour (2018) reports the effect of light variables treatments on growth and flowering of Saintpaulia (*Saintpaulia Ionantha Wendi*).

In this experiment, we tried to investigate the important factors affecting the growth and flowering of Saintpaulia in order to reach a favorable growth form and proper flowering appearance of this plant by selecting the best environmental conditions.

2. METHODOLOGY

2.1 EXPERIMENT IMPLEMENTATION DURATION AND LOCATION

This experimental study was conducted in a 21-month period from November 2016 to July 2018. This experimental study was carried out in Noshahr city of Mazandaran Province, at North latitude 35° 37′ and East longitude 50° 42′ with height 2.9 meters above sea level.

2.2 EXPERIMENT DESIGN

In order to investigate the effect of growing medium type, nutrition, light variables, and acid glycerol and salicylic acid hormonal treatment this study was carried out in the form of 5 experiments as follows. This experiment investigates on the effect of light quality on growth and flowering of Saintpaulia seedlings

This factorial experiment is used in a completely randomized design with four light treatments including 1-white light (380-760 nm); 2- red light (650-665 nm); 3- blue light (460-475 nm); 4-combinition of blue and red lights with equal ratio. This experiment was performed on two Rapsody and Optimara cultivars, which five replicates were considered for each treatment. The pots were placed on the classes of shelves and to apply light quality treatments, LED lamps at the top of the pots were used. Lighting was performed 16 hours at daylight and 8 hours at darkness. The growing medium in this experiment was peat moss: Perlite (with equal ratio) and nutrition with solid fertilizer 20:20:20.

2.3 PLANT MATERIALS

Seedlings resulting from tissue cultivation of three cultivars of Optimara, Rapsody and Tong wensis in the 6 to 7-leaf stage with 0.7 cm diameter, which were produced in the tissue cultivation laboratory of Noshahr, were used in this study.

2.4 THE CONTROL OF ENVIRONMENTAL FACTORS

From the laboratory environment recorded, the maximum temperature was set on 25°C in day and 18°C at night. The environment relative humidity was set for 45-55%.

2.5 MEASUREMENT OF MORPHOLOGICAL TRAITS

The number of leaves of each treatment was counted after the completion of each experiment period. The total number of flowers appearing on the plant was observed by repeated observations during the plant growth period and until the end of the experiment period. The total number of buds appearing on the plant during the experiment was counted. The number of flowering branches of each treatment was counted after each experiment period.

The number of days to flowering per plant was carried out with repeated notetakings during the plant growth period and until the end of the experiment period. The longevity of flowers in each plant was recorded by frequent notetaking during the flowering period since the observing the full-opened flower until flower full beauty maintaining. The diameter of flowers was measured by using calipers and the mean diameter was used in statistical analysis. The leaf area was measured using the Digimizer software. The root of plants was exposed to oven at 70 ° C for 48 hours and their dry weight was measured. The number of flowers in each inflorescence in each plant was counted separately. The time distance between observing the first bud and the appearance of the last flower

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on the plant was measured. The time distance between flowering periods since the end of each flowering period until the beginning of the next period was measured. The height of each plant was measured with a ruler from the surface of the pot soil. The length of each inflorescence in each plant was measured using a ruler.

2.6 STATISTICAL ANALYSIS

The Minitab®16 software was used to perform statistical analysis on the obtained experimental data and the comparison of the means was performed based on Tukey's test at 5% probability level. The charts were also plotted with Excel® software.

3. RESULTS AND DISCUSSION

The results of analysis of variance and comparison of mean values of the data showed that light quality treatments had a significant effect on all traits. The effect of cultivar on all measured traits of Saintpaulia was significant except for the number of flowering branches, number of buds, flower longevity, flowering period, and distance between flowering periods. Based on Tbale 1, the results of analysis of variance and comparison of mean values of data showed that the interaction effects of light quality and cultivar treatments on all traits except the number of flowering branches and the number of flowers in inflorescence were significant.

Table 1: Analysis of variance (mean square) and the effect of light quality and cultivar on morphological traits of Saintpaulia

Source of variations	df	Number of leaves	Number of flowers	Number of buds	Number of flowering branch	Number of days to flowering	Flower longevity	Flower diameter	Leaf area	Root dry weight	Number of flowers in inflorescen	Flowering period	Distance between flowering	Plant height	Inflorescen ce length
Light quality	3	6.164**	0.191**	2.373**	1.8**	4.1918**	4.12**	9.0**	3.26**	8.18**	0.7**	6.649**	0.602**	5.21**	6.20**
cultivar	1	2.970**	2.133**	6.0 ns	2.4 ns	0.5040**	2.0 ns	5.1**	3.236**	5.74**	0.9**	ns4.0	6.0 ns	2/4**	0.16**
Interaction effect light quality and cultivar	3	2.200**	4.18**	6.4**	ns9.0	4.119**	4.1**	2.0 ns	0.2**	7.10**	2.0 ns	6.5**	4.123**	2.0*	1.1**
error	32	3.1	4.1	0.1	9	1	2	3.1	1	0	2.1	4.1	4.1	0	0

Note: ns, *, and ** , respectively, are non-significant, significant at a probability level of 5% and 1% based on the Tukey's test

Table 2: Results of comparison of mean effect of light quality on morphological traits of Saintpaulia

Light quality treatments	Number of leaves	Number of flowers	Number of buds	Number of flowering branch	Number of days to flowering	Flower longevity (day)	Flower diameter (cm)	Leaf area (cm2)	Root dry weight (g)	Number of flowers in inflorescence	Flowering period (day)	Distance between flowering periods	Plant height (cm)	Inflorescence length (cm)
White light	8.23b	8.12b	2.15b	5.3b	7.49d	5.5b	8.1b	4.11b	1.4b	3.3b	9.23c	2.31c	8.5b	5.5b
Red & blue lights	4.28a	1.8c	3.11c	1.4ab	6.71b	18.4c	7.1c	0.10c	0.3c	8.2b	0.28b	1.42b	4.4c	4.4c
Blue light	7.27a	6.17a	5.23a	1.5a	3.62c	3.6a	a2.2	a0.13	a3.5	a7.4	8.15d	1.32c	8.6a	9.6a
Red light	6.19c	8.8a	9.9d	0.b	3.82a	0.4c	4.1d	4.9d	1.2d	1.3b	1.35a	1.47a	5.3d	5.3d

The means that have one shared letter in each column have no significant difference at the 1% probability level according to Tukey's test

Table 3: Results of comparing the mean effect of cultivar on morphological traits of Saintpaulia

under the light quality treatments

	traits									
cultivar	Number of leaves	Number of flowers	Number of flowering branch	Number of days to flowering	Flower diameter (cm)	Leaf area(cm^2)	Root dry weight (g)	Number of flowers in Inflorescence	Plant height (cm)	Inflorescence flower length (cm)
Rhapsody	9.19b	6.13a	2.4a	2.55b	0.2a	4.13a	2.2b	0.3b	8.4b	4.4b
Optimara	8.29a	0.10b	6.3b	7.77a	6.1b	5.8b	0.5a	9.3a	4.5a	7.5a

Note: the means that have at least one common letter in each column have no significant difference according to the Tukey's test at 1% probability level

3.1 NUMBER OF LEAVES

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. Simple effect of cultivar and quality of light treatment and the interaction effect of cultivar and treatment were significant at 1% probability level (Table 1). The results of the comparison of the mean values of data also showed that the highest number of leaves was seen in white light and Optimara cultivar with a mean of 34.6 leaves, followed by combinition of blue light and red light in the same cultivar, which had a significant difference with other treatments. The lowest number of leaves was observed in white light and Rhapsody cultivar with a mean of 13.0 leaves, which had a significant difference with other treatments (Figure 1).

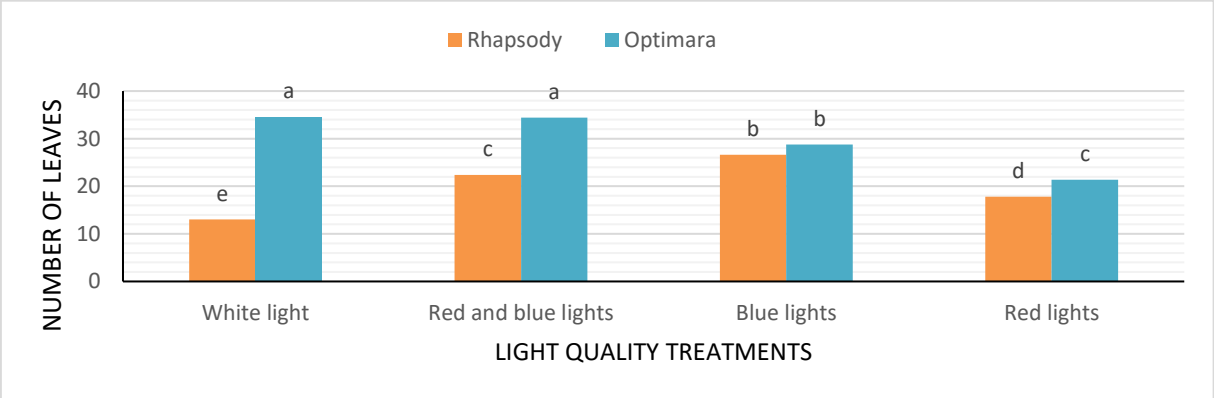

Figure 1: Interaction effect of light quality and cultivar on the number of leaves in Saintpaulia

4. NUMBER OF FLOWERS

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. Simple effect of cultivar and quality of light treatment and the interaction effect of cultivar and treatment were significant at 1% probability level (Table 1). The results of the comparison of mean values of data also showed that the highest number of flowers was observed in blue light treatment and in Rhapsody cultivar with a mean of 14.2 flowers, which had a significant difference with other treatments. The lowest number of flowers was seen in red light treatment and Optimara cultivar, followed by combination of red and blue light treatment in the same cultivar, which had significant difference with other treatments (Figure 2).

Light blue and then white light increases the number of flowers created in the plant than other colored lights in Saintpaulia. These results are consistent with the results of the research conducted by Gayutam et al. (2015) on petunia.

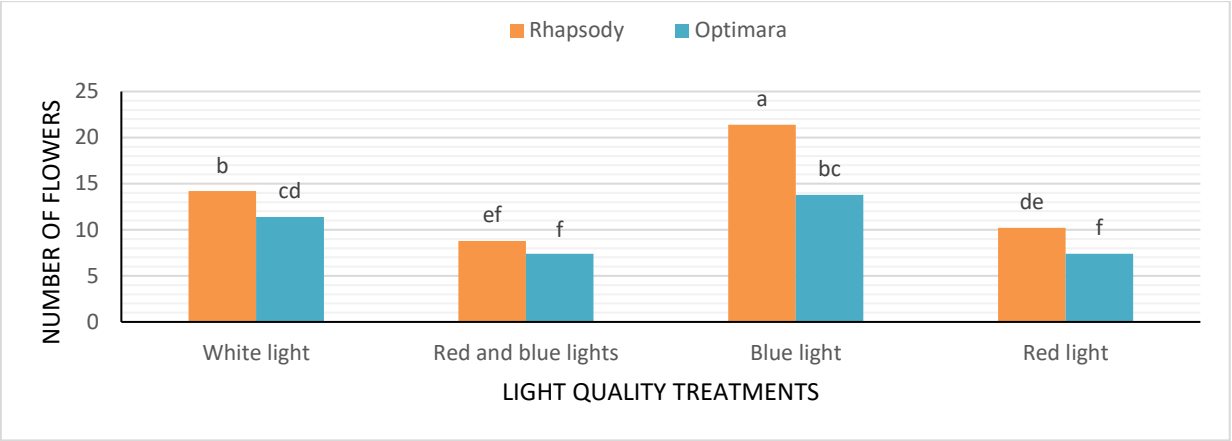

Figure 2: Interaction effect of light quality and cultivar on the number of flowers in Saintpaulia

4.1 NUMBER OF BUDS

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. The interaction effect of cultivar and treatment was significant at 1% probability level. However, the simple effect of cultivar was not significant at the probability level of 1% and 5% (Table 1). The results of comparison of the values of data also showed that the highest number of buds was observed in blue light treatment and Rhapsody cultivars with a mean of 23.8 buds, followed by blue light treatment and Optimara cultivar, which had a significant difference with other treatments. The lowest number of buds was observed in red light treatment and Rhapsody cultivar with mean number of ? buds, which had a significant difference with other treatments (Figure 3). In blue light, the reproductive growth of plants increases, so that the parameters related to growth and flowering in this treatment is more than the others. These results are consistent with the results of the research conducted by Gayutam et al. (2015) on the petunia.

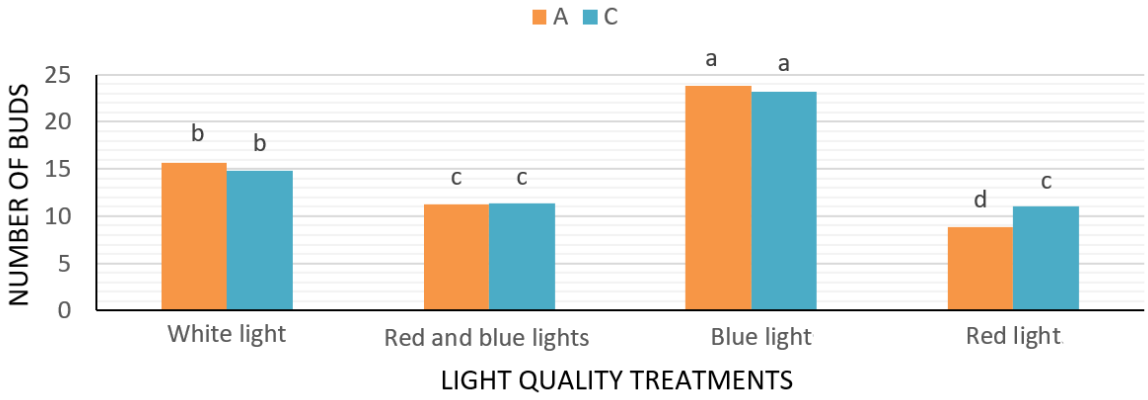

Figure 3: Interaction effect of light quality and cultivar on the number of buds in Saintpaulia.

4.2 NUMBER OF FLOWERING BRANCHES

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level, but the simple effect of cultivar and interaction effect of cultivar and treatment were not significant at the probability level of 1% and 5% (Table 1). The results of the comparison of the mean values of data in investigating the effect of light quality treatments showed that the highest number of flowering branches was observed in blue light treatment with a mean of 5.1 branches, which had a significant difference with other treatments except for red and blue light treatment. The lowest number of flowering branches was observed in red light treatment with a mean

of 3.0 branches, followed by white light treatment, which had no significant difference with red and blue light treatment but significant difference with other treatments (Table 2).

4.3 NUMBER OF DAYS TO FLOWERING

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. Simple effect of cultivar and quality of light treatment and the interaction effect of cultivar and treatment were significant at 1% probability level (Table 1). The results of comparison of the mean values of data also showed that the highest number of days to flowering was observed in red light treatment and in Optimara cultivar with a mean of 89.0 days, which had a significant difference with other treatments. The lowest number of days to flowering was observed in white light treatment and in Rhapsody cultivar with a mean of 34.6 days, which had a significant difference with other treatments (Figure 4).

The effect of different lights on the physiology of plant growth and flowering has not yet been determined and it is also true for Saintpaulia. However, it seems that red light to increase the growth period and delay their aging by causing changes in the rate of plants' growth. The combined light of red and blue also has led to fewer negative traits in plant due to having lower amounts of red light and the presence of light blue. With regard to the number of days to flowering in plants, the effect of light has not been thoroughly investigated. The same results were found in the research conducted by Gayutam et al (2015) on petunia.

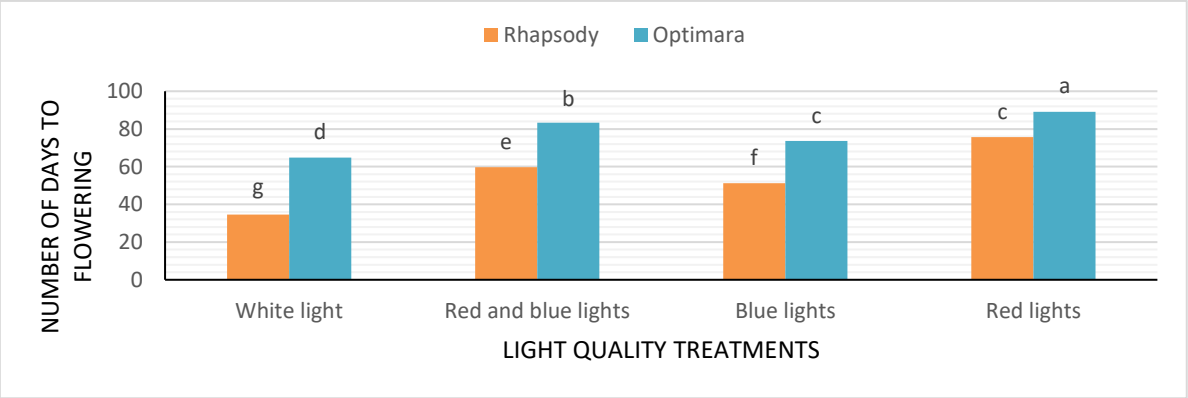

Figure 4: Interaction effect of quality of light and cultivar on the number of days to flowering in Saintpaulia

4.4 LONGEVITY OF FLOWERS

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. The effect of light quality treatment and the interaction effect of cultivar and light quality treatment were significant at 1% probability level. However, the simple effect of cultivar was not significant at the probability level of 1% and 5% (Table 1).

The results of the comparison of the mean values of data also showed that the highest longevity of flowers was observed in blue light treatments and in Rhapsody cultivar with a mean of 6.4 days, followed by the same treatment in Optimara cultivar, which they did not show significant difference with white light treatments in both cultivars, but showed significant difference with other treatments. The lowest longevity of flowers was observed in red light treatments and Optimara cultivars with a mean of 3.4 days, which showed no significant difference with red and blue light treatments in both

cultivars. However, it had a significant difference with other treatments (Figure 5).

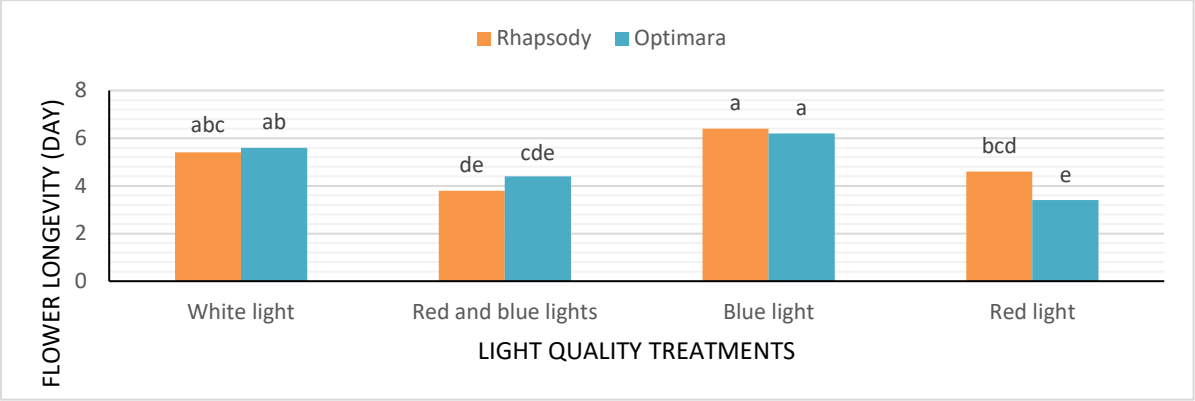

Figure 5: Interaction effect of quality of light and cultivar on longevity of flowers in Saintpaulia

4.5 DIAMETER OF FLOWER

The results of analysis of variance showed that the simple effect of light quality treatments and simple effect of cultivar was significant at 1% probability level. Interaction effect of cultivar and treatment was not significant (Table 1). The results of the comparison of the mean values of the data in investigating the effect of light quality treatments showed that the highest flower diameter was observed in blue light treatment with a mean of 2.2 cm, which had a significant difference with other treatments. The lowest flower diameter was observed in red light treatment with a mean of 1.4 cm, which had a significant difference with other treatments (Table 2).

The comparison of the mean values of data in investigating the effect of light quality treatments showed that the highest flower diameter was in the Rhapsody cultivar with a mean of 2.0 cm, which had a significant difference with other cultivars. The lowest flower diameter was seen in Optimara cultivar with a mean of 1.6 cm, which had a significant difference with other cultivars (Table 3).

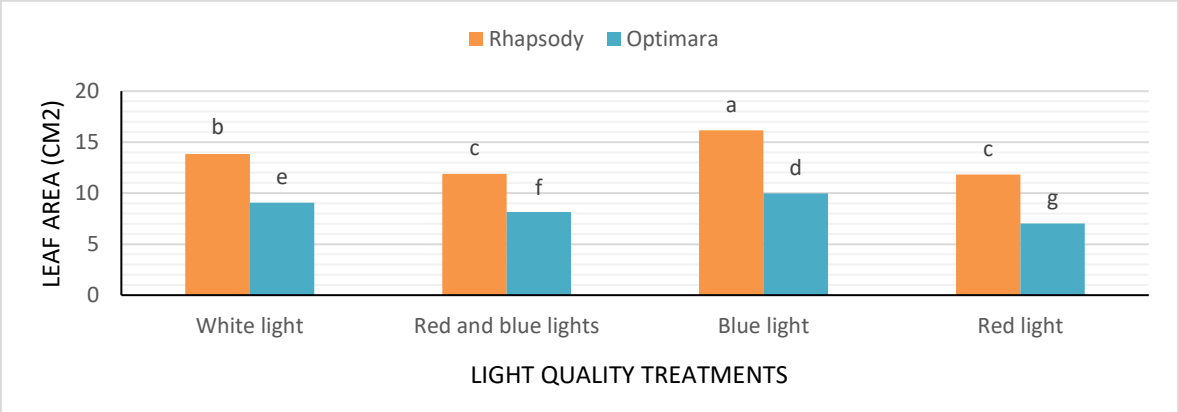

Figure 6: Interaction effect of light quality and cultivar on the leaf area of Saintpaulia

4.6 LEAF AREA

The analysis results of variance showed that the simple effect of light quality treatments was significant at 1% probability level. Simple effect of cultivar and quality of light treatment and the interaction effect of cultivar and treatment were significant at 1% probability level (Table 1). The comparison of mean values of data also showed that the highest leaf area was observed in blue light treatment and Rhapsody cultivar with a mean of 16.1 cm2, which had a significant difference with other treatments. The lowest leaf area was observed in red light treatment and Optimara cultivar with a mean of 7.0 cm2, which had a significant difference with other treatments (Figure 6).

4.7 ROOT DRY WEIGHT

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. Simple effect of cultivar and quality of light treatment and the interaction between effect of cultivar and treatment were significant at 1% probability level (Table 1). The results of comparison of the mean values of data showed that the highest root dry weight was observed in blue light treatment and Optimara cultivar with a mean of 7.8 g, which had a significant difference with other treatments. The lowest root dry weight was observed in red light treatment and Rhapsody cultivar with a mean of 1.8 g, which showed significant difference with combinition of red and blue lights (Figure 7). The effect of blue light on vegetative growth improves the growth and development of the roots, so that the plant can receive nutrients to increase its photosynthesis level. This can justify the increasing growth of roots in blue light. These results are in line with those of research conducted by Jong Wuk et al. (2006) on cyclamen.

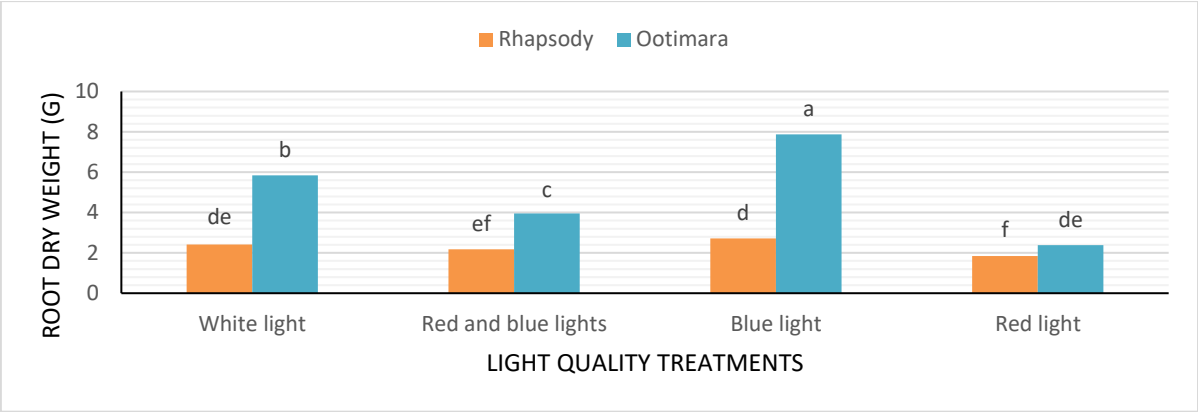

Figure 7: Interaction effect of light quality and cultivar on the root dry weight of Saintpaulia

4.8 NUMBER OF FLOWERS IN INFLORESCENCES

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. The simple effect of cultivar and light quality treatment were significant at 1% probability level. However, the interaction effect of cultivar and treatment was not significant at the probability level of 1% and 5% (Table 1). The results of the comparison of the mean values of the data in investigating the effect of light quality treatments showed that the highest number of flowers in inflorescences was observed in blue light treatment with a mean of 4.7 flowers, which was significantly different with other treatments. The lowest number of flowers in inflorescence was observed in combinition of red and blue light treatment with a mean of 2.8 flowers, which did not show a significant difference with white light and red light, but it showed a significant difference with other treatments (Table 2). The results of comparison of mean vales of data in simple effect of cultivar showed that the highest number of flowers in inflorescence was found in Optimara cultivar with a mean of 3.9 flowers, which showed a significant difference with other cultivars. The lowest number of flowers in inflorescence was observed in Rhapsody cultivar with a mean of 3.0, which showed a significant difference with other cultivar (Table 3).

4.9 FLOWERING PERIOD

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. The interaction effect of cultivar and treatment was significant at

1% probability level. However, the simple effect of cultivar was not significant at 1% and 5% probability level (Table 1). The results of comparison of the mean values of data also showed that the highest flowering period was observed in red light treatment and Optimara cultivar with a mean of 35.8 days, followed by the same light treatment and in the Rhapsody cultivar, which had a significant difference with other treatments. The lowest flowering period was observed in blue light treatment and Optimara cultivar with 15.4 days, followed by the same light treatment and Rhapsody cultivar, which had a significant difference with other treatments (Figure 8).

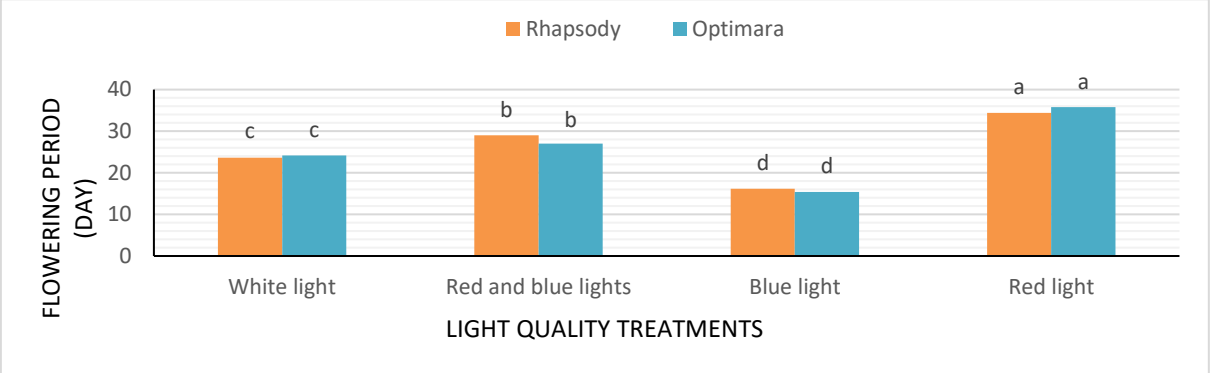

Figure 8: Interaction effect of light quality and cultivar on flowering period in Saintpaulia

4.10 DAYS BETWEEN FLOWERING PERIODS

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. Simple effect of light quality treatment and the interaction effect of cultivar and light treatment were significant at 1% probability level. However, the simple effect of cultivar was not significant at the 1% and 5% probability level (Table 1).

The results of comparison of the mean values of data also showed that the highest distance between flowering periods was observed in red light treatment and Rhapsody cultivar was 47.6 days, which did not have a significant difference with Rhapsody cultivar, but significant difference with other treatments. The lowest difference between flowering periods was seen in white light and Rhapsody cultivar with a mean of 26.6 days, followed by blue light treatment and Optimara cultivar, which had a significant difference with other treatments (Figure 9).

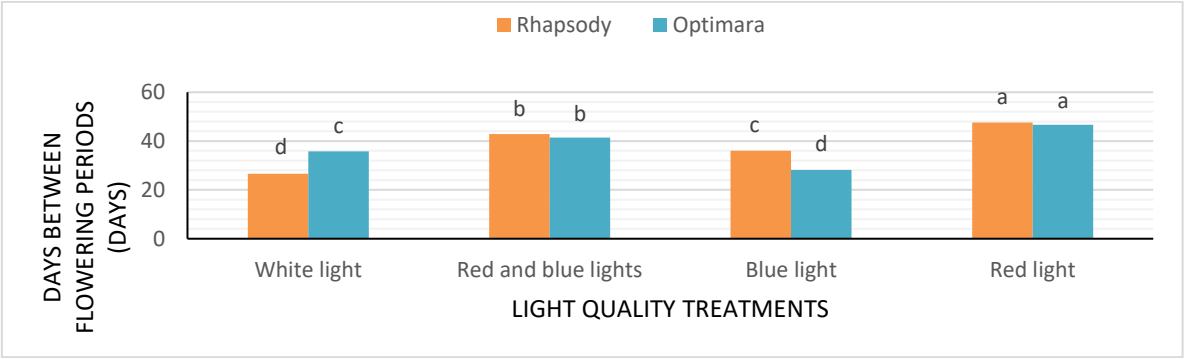

Figure 9: Interaction effect of light quality and cultivar on the number of days between flowering periods in Saintpaulia

5. PLANT HEIGHT

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. The simple effect of cultivar and quality of light treatment was

significant at 1% probability level and the interaction effect of cultivar and treatment was significant at 5% probability level (Table 1).

The results of the comparison of the mean values of data also showed that the highest plant height was observed in the blue light treatment and Optimara cultivar with a mean of 7.3 cm, which had a significant difference with other treatments. The lowest plant height was observed in red light treatment and Rhapsody cultivar with a mean of 3.3 cm, which showed no significant difference with red light treatment in Optimara cultivar, but it had a significant difference with other treatments (Figure 10).

Red light significantly reduces plant height by interfering with the plant growth mechanism. This light causes horizontal growth in the plant compared to other applied lights. These results are consistent with the results of the research conducted by Gayotam et al. (2015) on petunia.

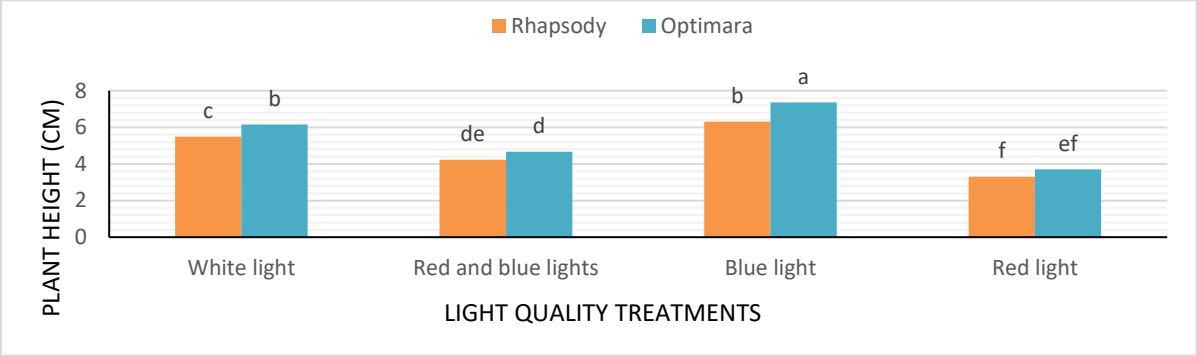

Figure 10: Interaction effect of light quality and cultivar on the plant height of Saintpaulia

6. INFLORESCENCE LENGTH

The results of analysis of variance showed that the simple effect of light quality treatments was significant at 1% probability level. The simple effect of cultivar and the interaction effect of cultivar and treatment were significant at the 1% probability level (Table 4-13). The results of comparison of the mean values of data also showed that the highest inflorescence length was observed in blue light treatment and Optimara cultivar with a mean of 8.0 cm, which had a significant difference with other treatments. The lowest inflorescence length was observed in red light treatment and Rhapsody cultivar with mean of 3.2 cm, which had a significant difference with other treatments (Figure 11).

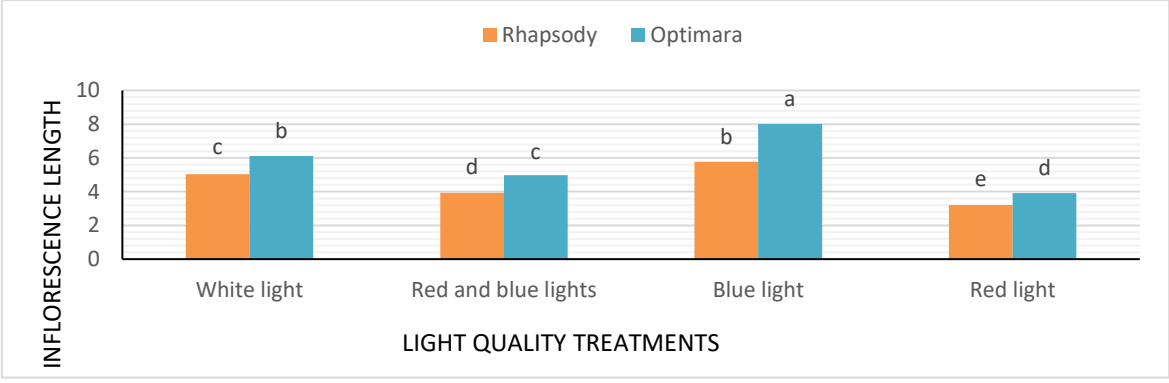

Figure 11: Interaction effect of light quality and cultivar on the inflorescence length of Saintpaulia

According to the results of this experiment, it was observed that the traits such as number of flowers, inflorescence length, plant height, flowering period, and number of buds, flower diameter,

and its longevity had the best values in blue light. However, in terms of number of leaves and also the distance between flowering periods, white light was better. In red light, plants had lower height, less number of flowers, and longer flowering periods. However, in terms of number of days to flowering, the plants flowered earlier in the white light. The number of leaves in this light also higher. In general, research has shown that spectral distribution in the use of LED light sources for any plant can be specific for that cultivar and the optimal conditions should be found for each cultivar individually. In this research, with regard to Saintpaulia, it can be suggested that light blue and then white light can be effective in improving the morphological growth of the plant.

Based on the studies, it seems that flowering and growth can be manipulated by controlling the quality of light. Blue light and red light affect plant photo morphogenesis through an effect on cryptochromes and phytochromes, respectively. There are few reports of flowering physiology under the influence of light quality (Jeong Wuk, 2003), since the effect of the light spectrum on different plants varies, and an accurate study needs to be conducted in each plant at cell surface with regard to the effect of light on plant physiology. Hence, in this study, it is not possible to state the accurate details of the effect of any light wavelength on the physiology of the growth and flowering of the Saintpaulia.

7. CONCLUSION

In general, Saintpaulia requires a light growing medium with a proper ventilation porosity and good drainage due to its fine root system. For this reason, peat moss: perlite growing medium with the lowest density and the highest ventilation porosity is very good growing medium for vegetative and reproductive growth of this plant, so that all traits measured in this medium have the best values compared to other media. In light quality experiment, the use of blue light improves the growth and flowering traits of this plant, but the white LED light has also been able to cause the same effects of blue light to some extent in most of the measured traits. However, red light caused the plant shortening and also reduced flowering significantly in plants. The use of combinition of red and blue light also had similar effects of red light in the plant to some extent, but these effects were less due to the presence of blue light in the treatment. For this reason, it can be stated that for the application of artificial light in this plant, it is recommended to use both light and white to have the most suitable growth and flowering. With regard to combined use of red and blue light, it is better to use other ratios of this light in order to reduce the amount of red light received by the plant. In general, Saintpaulia shows favorable effects when artificial light is used.

8. REFERENCES

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