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Effect of Lights and Lighting Systems on Flowers and Ornamental Plants

Mithilaa. BA[1], M. Kavitha[2*], S. Padmapriya[2] and E. Parameswari[2]

[1]Dept. of Floriculture and Landscape Architecture, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu (641 003), India

[2]Controllerate of Examinations, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu (641 003), India

Corresponding Author

M. Kavitha

e-mail: murugavelkavitha@yahoo.com

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Abstract

Lights play a vital role in the development of plant parts and its process called photosynthesis. This light can be provided to the plants with the help of natural source i.e., the direct sun light or by artificial supplementation through various forms of lights sources by chronological development of light bulbs from INC bulbs, MHL, HPS Lamps, CFL, LED lights. This article throws light on the effects of the use of various forms of lights in individuals and in combinations of lights of varying wavelengths and varying duration on the flower crops, ornamental flowers and foliages which is mainly gaining importance in vertical walls and indoor gardening, also in the use of decorative light purposes.

Introduction

Photosynthesis is the process of making food and energy for further growth processes and development of plants which is primely triggered by light. Plants needs light for photosynthesis and hence for the promotion of natural growth habits. This light can be provided to the plants with the help of natural source i.e., the direct sun light or by artificial supplementation i.e., from incandescent bulbs, MHL, LED lights, HPS lamps, CFL (Ritu Jain, 2016). The most important photomorphogenic responses in higher plants appear to be under control of one or more of four classes of photoreceptors which are responsible for selective absorption and causes conformational change of pigments. They are:

- Phytochromes (red and far-red);
- Cryptochrome (blue and UV-A): seedling development and flowering;
- Phototropin (blue and UV-A): differential growth in a light gradient;
- UV-B receptors.

Three Main Factors of Light

There are 3 main factors of light which influences and determines the growth of plants. They are: (i) Intensity, (ii) Duration, and (iii) Quality.

Based on this, there are further more grouping of plants into low, medium, and high light requiring plants. The response in the growth of the plants based on the duration of exposure to the light is called as photoperiodism and based on this the plants are classified into short day, long day, day neutral plants. The particles in the plants which absorbs light are called Photoreceptors, which are grouped as phytochromes, phototropins, cryptochromes, UVR_8 which is the UV light photoreceptor, and these different photoreceptors captures light in different wavelength areas.

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E-mail: *bioticapublications@gmail.com*

Intensity

The intensity of light helps in the production of plant food by photosynthesis, stem length, leaf colour and also in flowering. It depends on the nearness of the light source. Intensity decreases rapidly as the distance of the light source increases. For eg,

- 1 foot distance from light source - 100% illumination
- 2 feet distance from light source - 25% illumination
- 3 feet distance from light source - 11.11% illumination
- 4 feet distance from light source - 6.25% illumination

Based on this light requirement, the plants are classified into low, medium, and high light requiring plants.

> Low light requiring plants – Between 50 to 250 foot candles

> Medium light requiring plants – Between 250 to 1000 foot candles

> High light requiring plants – More than 1000 foot candles

Duration

Photoperiodism is defined as the flowering response of a plant to relative lengths of light / dark period. This is the reason for the plants flowering in different seasons. Based on the photoperiodic responses, the plants are classified into 3 classes. They are,

Short Day Plants

It receives about ≤12 hours of light and hence its dark dominant plants. Examples are, Short day annuals like Cosmos, Chrysanthemum, Salvia, Aster, Amaranthus etc.

Long Day Plants

It receives about ≥12 hours of light and hence its light dominant plants. Examples are, Long day annuals like Antirrhinum, Carnation, Petunia, Sweet Williams, *Rudbeckia goldstrum* etc.

Day Neutral Plants

These plants are not sensitive to day length, i.e., these plants are not affected by the duration of light and dark. Examples are, Gomphrena, Balsam, African violet etc.

Window's Direction

Based on the window's direction to source of light i.e., sun, the amount or intensity of sun light received by the different directions are South (S) direction which have more intense warmest light. East and West direction (E, W) receives about 60% of southern (less warm) than southern, and Northern (N) which receives about 20% of southern direction.

Also, light coloured surfaces inside a home or office increases the intensity, whereas the dark coloured surfaces decreases intensity.

Symptoms

If a plant receives more amount of light than required amount, the symptoms noticed are,

- leaves become pale and shrivels
- Drooping of leaves,
- Flowers shrivels and dies

If the amount of light received by the plant is lesser than the actual amount needed, then the symptoms that may be seen are,

- yellowing and paleness
- No blooms
- Slow growth
- New leaves remains smaller

Red Drop

Red Drop is a phenomenon where a sharp decreases in quantum yield at wavelength greater than 680 nm. Since this decrease in quantum yield took place in the red part of the spectrum, the phenomenon is called as red drop.

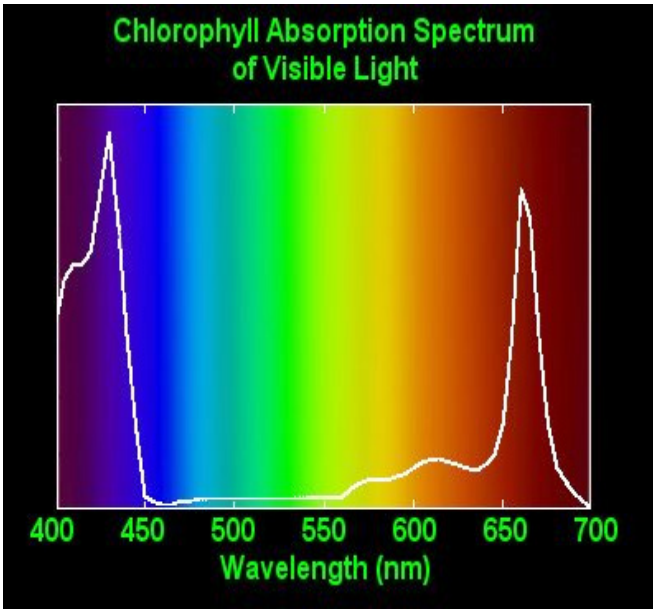

Figure 1: Chlorophyll absorption spectrum of light

Artificial Lighting

Artificial lighting is needed in the cases where getting access to sunlight is a main problem or risk, in case of growing plants in indoors and under shade. It is used in vertical gardening, indoor gardening, home plants, and greenhouse production of plants. The main reasons for providing light source are primely for photosynthesis and for the growth and promotion of flowering.

Chronological Evolution of Different Types of Lights:

- Solar bulbs
- Incandescent bulbs
- Fluorescent bulbs
- Compact fluorescent bulbs
- Fluorescent lamps
- Sodium vapour lamps
- Halogen lights
- High Intensity Discharge
- Metal halide bulbs
- LED lights

Solar Lights

In these lights, use of tiny photo voltaic cells (PV cells) or solar powered cells is done to charge the battery. Most manufactures prefer to install PV cell into the lighting fixture itself. It can't work if they are placed in shade. PV panel will be able to receive maximum sunlight. Drawback is that wires have to be buried.

Incandescent Bulbs

They are the general household bulbs. It gives an efficiency of about 5%. Spectrum produced isn't ideal for growth of plants. It produces large amount of heat which increases cooling costs. Hence, growers do not recommend this. For delaying the flowering period of *Kalanchoe blossfeldiana* 'Kaluna' and 'Taos', and *Dendranthema grandiflorum* 'Lemon Eye', the flowering was found to be slightly delayed after 9 weeks of flowering was noticed incandescent and an infrared heating lamp (Chung HoKo *et al.,* 2012)

Fluorescent Bulbs

It has a long straight tube coated with phosphor containing low pressure mercury that produces white light. It is a decent grow light for indoor house plants. Generally used for plants starting with seeds. Best along with supplementary natural light where lights are needed the most. Fairly weak in light intensity. Placed within few inches of the plant to have more effect.

Compact Fluorescent Bulbs

Modified form of fluorescent bulbs. For small spaces, small sized indoor gardens. Efficient alternative to incandescent bulbs. Has less power than incandescent and long life. Installment is easy – simply screwed into a socket. Reflector– saves light from unwanted directions.

Fluorescent Lamps

Great alternative for indoor plant growth. Best for large plants. 3-5 times more efficient than incandescent. Consumes less electricity but emits more light. Placed above and to the side of the plants.

Halogen Lights

High pressure incandescent lamps containing halogen gases such as iodine or bromine allowing filament to be operated at higher temperatures.

HID Grow Lights

For large indoor plantings. Very powerful, very high light output, very effective. 4-8 times efficient than incandescent. It has disadvantages like it is costly and produces more heat, electricity consumed more inefficiently. Though costlier, it penetrates farther into foliage than into bulbs. It has 2 types namely, High pressure sodium, Metal Halide lamps.

LED Grow Lights

It is expensive than fluorescent bulbs. It exploits half the electricity and has 5 times longer life. It has greater light intensity. It is available in full spectrum of wavelength. These lights without filament that are illuminated by the movements of electrons. The advantages of the lights are it generates very little heat and can be preferred for larger plants**.** Being used as the focal or specimen tree on landscaping purposes, *Cunninghamia lanceolata* commonly called as Chinese Fir tree, the 12th generation seedlings were evaluated under TC with composite LED lights with white LED as control and 5 composite LED treatments with combinations of red, green, blue, purple were studied for the relationship between root growth parameters and anti-oxidant capacity. Of all, Red- blue-purple-green was found best for the rooting rate and root growth which were maximum.

Other Uses of Lights in Landscape

- Safety
- Silhouetting
- Security
- Ambiance
- Utility

Wavelength Spectrum

1. 400 – 460 nm - responsible for leaf growth (vegetative)
2. 660 – 730 nm - responsible for flowering (reproductive)

Lights and Spectrums

- Fluorescent lights - High blue, low red
- Incandescent bulbs - High infrared and red
- Mercury vapor - Violet to blue
- Metal halide - Green to orange
- High pressure sodium - High in red to infrared

Lights for vegetative growth are 430 to 450 nm (blur light) and required wavelength of light for reproductive growth i.e., flowering is 640 to 680 nm (red or warm). As the mimic of the

natural light, artificial light also leads to the shift in primary and secondary metabolism, leading changes in the photosynthesis, chloroplast differentiation and dedifferentiation, secondary metabolites production (Eva Darko *et al.,* 2018).

Table 1: Different types of bulbs with luminous efficiency

Bulbs types	Power	Luminous efficacy	Life expectancy
Incandescent bulb	40W	12 lumen/watt	750hr
Compact Fluorescent	48W	66 lumen/watt	20,000hr
Compact Fluorescent High Output	126W	74 lumen/watt	12,000hr
Metal Halide	425W	94 lumen/watt	15,000hr
High Pressure sodium	425W	117 lumen/watt	24,000hr
Light Emitting Diode	90W	70 lumen/watt	>50,000hr

Conclusion

This article throws light on the effects of the use of various forms of lights in individuals and in combinations of lights of varying wavelengths and varying duration on the flower crops, ornamental flowers and foliages, which is mainly gaining importance in vertical walls and indoor gardening, also in the use of decorative light purposes.

References

Ritu, J., Janakiram, T., 2016. Vertical Gardening: A New Concept of Modern Era. Commercial Horticulture, 527-536.

Eva, D., Parisa, H., Benoit, S., Mohammed, R., Sabzalian, 2018. Photosynthesis under artificial light: the shift in primary and secondary metabolism. *Philosophical Transactions of the Royal Society.*

Chung, H., Sang, B.L., Byoung, R.J., 2012. Photoperiodic Responses of Kalanchoe and Chrysanthemum to Radiation by an Infrared Lamp. *Hort. Environ. Biotechnol.,* 53(6), 484-489. 2012. DOI 10.1007/s13580-012-1001-7.