



Effect of Light Intensity on Rose Growth, Flowering and Quality

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Rose (*Rosa hybrida* L.) is one of the most important ornamental crops in the world and is widely cultivated for cut flowers, garden plants and landscaping. Among the environmental factors affecting rose production, light intensity is one of the most important because it directly influences photosynthesis, plant growth, flowering, stem development, flower colour and postharvest quality. Roses generally have relatively high light requirements, and inadequate light during cloudy weather, winter or greenhouse production can reduce photosynthetic activity and flower yield. Recent research has shown that supplemental LED lighting can improve growth, carbohydrate accumulation, photosynthetic performance and flower quality under low-light conditions. However, excessive light may also cause stress, particularly when high radiation is combined with high temperature and water shortage. The response also varies among rose cultivars. Modern LED technology provides an opportunity to manage not only light intensity but also light spectrum and photoperiod. Proper management of light can therefore improve flower production, quality and resource-use efficiency while reducing unnecessary energy consumption.

Keywords: Rose, *Rosa hybrida*, light intensity, photosynthesis, flowering, LED lighting, flower quality, greenhouse cultivation

Introduction

The rose is often called the “queen of flowers” because of its beauty, fragrance, diversity of colours and high economic value. Roses are cultivated throughout the world for cut flowers, bouquets, gardens, landscaping, essential oils and ornamental purposes. Commercial rose production requires careful management of temperature, humidity, nutrition, irrigation, carbon dioxide and light. Among these factors, light deserves special attention because it provides the energy required for photosynthesis and also acts as a signal controlling plant development. Light affects plants in two major ways. First, it serves as an energy source for photosynthesis, allowing leaves to convert carbon dioxide and water into carbohydrates. Second, light acts as a developmental signal through photoreceptors that regulate processes such as stem elongation, leaf development, branching and flowering. In roses, both the amount and characteristics of light can influence the number and quality of marketable flowers. Recent research confirms that insufficient natural light is a major limitation for greenhouse rose production, particularly during autumn and winter. Supplemental lighting has therefore become an increasingly important production technology. Studies using LEDs have demonstrated improvements in photosynthesis, carbohydrate accumulation, growth and flower yield under low-light conditions.

How Light Intensity Affects Rose Plants

1. Photosynthesis and carbohydrate production

The most direct effect of light intensity is on photosynthesis. At low light intensity, rose leaves receive insufficient energy to achieve a high photosynthetic rate. Consequently, less carbohydrate is produced and transported to growing shoots and developing flower buds.

When light intensity increases from a very low level, photosynthesis generally increases. The plant produces more sugars, which support leaf expansion, shoot growth, root development and flower formation. Research on greenhouse roses has shown that supplemental lighting can increase photosynthetic capacity and carbohydrate levels compared with plants grown under inadequate natural light. However, photosynthesis does not continue increasing indefinitely. Once the photosynthetic machinery reaches its capacity, additional light produces progressively smaller benefits. Very high radiation can also contribute to excessive leaf temperature, oxidative stress and photo inhibition, particularly when water availability is limited.

2. Effect on vegetative growth

Light intensity strongly affects the architecture of rose plants. Under insufficient light, plants may produce long, weak and thin shoots, larger but thinner leaves and reduced branching. Such plants often have poor structural strength and may not produce commercially desirable cut flowers. Adequate light encourages stronger shoots, better leaf development and greater accumulation of dry matter. In commercial cut roses, stem length and stem strength are particularly important characteristics because consumers and florists generally prefer long, straight and sturdy stems. Recent studies have also demonstrated that supplementary LED lighting can improve growth characteristics, although responses may differ considerably among cultivars. A 2024 study on cut roses found that supplemental white LED lighting during low-light conditions improved stem length and flower characteristics in some cultivars, while other cultivars showed little response

3. Flowering and flower yield

Light availability has a major influence on flowering. When light is inadequate, rose plants may produce fewer flowers, smaller buds and longer intervals between harvests. Some developing flower buds may also abort under unfavourable environmental conditions. Adequate light increases the supply of photosynthates to developing buds and supports the production of marketable flowers. Research on supplemental lighting has shown that providing additional light during periods of low natural radiation can increase rose growth and yield. This is particularly important in greenhouse production, where natural solar radiation may be insufficient during winter or prolonged cloudy periods.

Effect on Flower Colour and Pigments

Light intensity also influences the colour and visual quality of rose flowers. Pigments such as anthocyanins and carotenoids contribute to flower colour and are influenced by light conditions. Research on the rose cultivar ‘Dolce Vita’ demonstrated that increasing supplemental light intensity up to a certain level during low-light periods improved chlorophyll, carotenoid and anthocyanin contents. This suggests that appropriate light management can help produce flowers with stronger and more attractive pigmentation. However, the response depends on cultivar, temperature, nutrition and the quality of light supplied.

Light Spectrum Is Also Important

Light intensity should not be considered independently from light quality or spectrum. Plants perceive different wavelengths through specialized photoreceptors. Red and blue light are particularly important for photosynthesis and plant development, while far-red light can influence plant architecture and flowering responses. Modern LED systems make it possible to manipulate the ratio of red, blue, white and far-red light. A recent study found that red- and blue-enriched supplemental lighting improved growth, photosynthetic capacity, carbohydrate accumulation and yield of commercial rose cultivars under low-light conditions. More recently, research published in 2025 reported that a red-dominant supplemental spectrum improved physiological characteristics and postharvest performance of greenhouse-grown roses, with responses varying among cultivars. Therefore, the future of rose production is moving from simply asking “How much light does the plant receive?” to asking “How much light, which wavelengths, and for how long?”

Supplemental LED Lighting in Rose Production

LED technology has become increasingly attractive for greenhouse floriculture because LEDs can provide specific wavelengths with relatively high efficiency and can be controlled according to crop requirements. Supplemental lighting is particularly useful when natural sunlight is inadequate. Instead of replacing sunlight completely, growers can use LEDs to supplement natural radiation during periods when light levels fall below the desired range. Research has shown that supplemental lighting can improve photosynthesis, growth and yield in roses. Nature In addition, a 2025 study reported that roses grown under LED supplemental lighting showed improved production and postharvest longevity when lighting was combined with appropriate nutritional management. The use of LEDs should nevertheless be economically optimized because electricity consumption represents an important component of greenhouse production costs.

Can Too Much Light Be Harmful?

Although roses require relatively high light levels, more light is not always better. Excessive radiation can increase leaf and flower temperature, accelerate water loss and create oxidative stress. The problem becomes particularly serious when high light intensity occurs together with high temperature and inadequate irrigation. Under such conditions, leaves may experience heat stress, reduced photosynthetic efficiency and premature ageing. Therefore, light should be managed together with temperature, humidity, irrigation, nutrition and carbon dioxide. Shading may be beneficial during periods of extremely high solar radiation and temperature, while supplemental lighting is useful during periods of inadequate radiation. Interestingly, a recent 2026 study found that rose plants grown under substantial shading showed reduced vegetative growth and several nutrient concentrations compared with full-sun conditions, emphasizing the importance of maintaining adequate light availability

Practical Light Management for Rose Growers

For commercial growers, the following principles are useful:

1. Avoid prolonged low-light conditions, especially during bud development.
2. Use supplemental LED lighting during periods of inadequate natural radiation.
3. Consider light intensity, spectrum and photoperiod together rather than intensity alone.
4. Select lighting strategies according to the rose cultivar because cultivars can respond differently.
5. Avoid excessive radiation when temperature and water stress are high.
6. Monitor plant growth, leaf colour, stem length, flower size and yield to evaluate lighting performance.
7. Use sensors and automated greenhouse systems where economically feasible.
8. Optimize lighting duration to obtain maximum crop benefit without unnecessary electricity consumption.

Modern controlled-environment horticulture is increasingly moving toward dynamic lighting systems in which light intensity and spectrum can be adjusted according to crop demand and environmental conditions. A 2025 review highlighted the potential of intelligent and dynamic lighting systems to improve crop productivity while increasing energy efficiency.

Conclusion

Light intensity is a key determinant of rose growth, flowering, yield and quality. Insufficient light reduces photosynthesis and carbohydrate production, resulting in weak growth, poor flowering and reduced flower quality. Appropriate supplemental lighting can overcome seasonal and greenhouse-related light limitations and improve photosynthetic performance, stem development, flower production and pigmentation. At the same time, excessive light can become harmful when combined with high temperature or inadequate water availability. Therefore, successful rose production requires a balanced approach rather than simply increasing light intensity. The combination of natural sunlight, supplemental LED lighting, appropriate spectrum, proper photoperiod and intelligent environmental control offers

considerable potential for producing high-quality roses throughout the year. The latest research indicates that the future of rose cultivation will increasingly involve precision lighting, where light is supplied according to cultivar, growth stage and environmental conditions. Such an approach can improve productivity and flower quality while minimizing energy use, making rose cultivation more sustainable and economically efficient.

References

1. El-Naggar, A.H.M., El-Tanbouly, R., Imhmd, G.F.M. et al. (2026). *Optimizing the growth and flowering of Rosa hybrida L. (Roses) through synergistic light and biostimulant management*. BMC Plant Biology, 26, 917. Springer Link
2. Davarzani, M. et al. (2025). *Enhancing the vase life of cut roses through spectral optimisation during greenhouse cultivation*. Annals of Applied Biology. Wiley Online Library
3. Davarzani, M., Aliniaiefard, S., Zare Mehrjerdi, M.R. et al. (2023). *Optimizing supplemental light spectrum improves growth and yield of cut roses*. Scientific Reports, 13, 21381. Nature
4. *The role of supplemental lighting during late fall and winter on photosynthetic and non-photosynthetic pigments biosynthesis of cut rose flower (Rosa hybrida cv. 'Dolce Vita')*. (2024). Journal of Horticultural Science & Biotechnology, 99, 431–442. Taylor & Francis Online
5. Kim, S.J., Kim, W.H., Jung, H.H., Yun, S.W. & Oh, S.I. (2024). *Cut flower yields and qualities of Rosa hybrid L. affected by supplementary LED lighting at night under high temperature and low light intensity conditions*. Journal of the Korean Society for Environmental Biology/Protected Horticulture research, 33, 200–209. KSBEC
6. Rezaei, S., Sabzalian, M.R., Nikbakht, A. & Zareei, H. (2024). *Red LED light improved the vase life of cut rose flowers during cold storage*. Postharvest Biology and Technology, 210, 112752. ScienceDirect
7. *Roses exhibited higher production and postharvest longevity in response to nano-nutrients of Fe, Ca and Zn under LED supplemental lighting*. (2025). BMC Plant Biology. Springer Link
8. *Photobiology, photosynthesis, and plant responses under artificial lighting in controlled environment agriculture*. (2025). Scientia Horticulturae, 349, 114248