



Importance of Light and Its Impact on Indoor Growing Plants

(Godasu Pradeep Kumar, R Sandeep Kumar, *B Varshitha Reddy and T Sirisha)

Malla Reddy University, Hyderabad, Telangana State, India

*Corresponding Author's email: varshithareddybembadi@gmail.com

Natural light is crucial for photosynthesis, the process through which plants convert carbon dioxide and water into carbohydrates for energy. This energy is essential for growth, blooming, and seed production. Without sufficient light, plants cannot produce carbohydrates, depleting their energy reserves and ultimately causing death. The intensity of natural light affects various aspects of plant development, such as food production, stem length, leaf colour, and flowering. In low light, plants become spindly with pale leaves, while in bright light, they are shorter with larger, darker green leaves.

Artificial lighting

Artificial light has become a vital tool in agriculture, especially for growing vegetables and crops indoors. It supports year-round production, extending the growing season and enabling methods like hydroponics and vertical farming. Initially, incandescent bulbs were used, but advancements in lighting technology, particularly LEDs, have made indoor farming more efficient. LEDs offer energy efficiency and can be customized for different growth stages, optimizing light intensity, duration, and spectrum to improve plant growth and yields. This technology allows plants to thrive indoors year-round, supporting a wide range of crops, from herbs to exotic plants, regardless of natural sunlight.

Essential Aspects of Indoor Lighting for Plant Growth

Light Spectrum: Different wavelengths of light are required by plants at various stages of growth. Mentioned detailed in **table 1**

Light Intensity: Measured in lux or PPFD (photosynthetic photon flux density), higher light intensity is needed for plants during their flowering stage or for those that demand more light.

Light Duration: Plants have specific requirements for light and dark cycles.

- Seedlings and Vegetative Plants: Generally, require 14-18 hours of light each day.
- Flowering Plants: Usually need 12 hours of light and 12 hours of darkness.

Colour temperature: For houseplants and seedlings, a full-spectrum light bulb promotes healthy plant growth. Fruiting and flowering plants, such as cherry tomatoes and citrus, may need a specialized bulb with a warmer colour temperature (2,500-3,000 K). For growing leafy greens, a cooler bulb (around 6,000 K) is more suitable

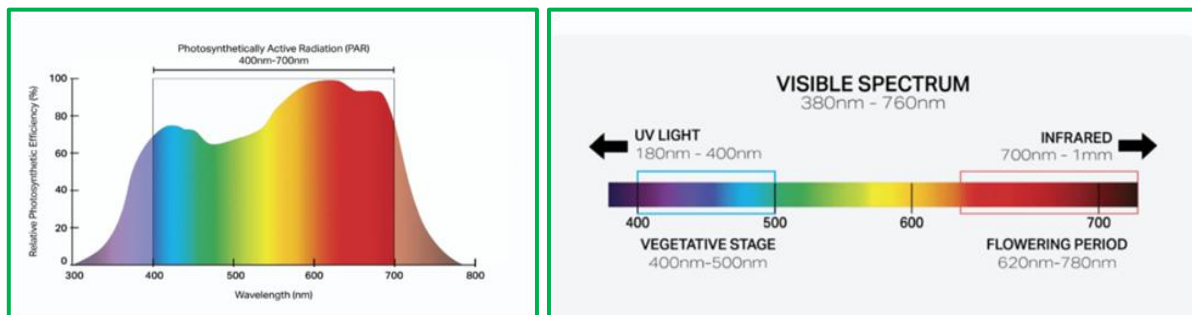
Photoperiod: Leafy greens like lettuce and spinach have moderate light requirements, needing about 10-12 hours of light daily. In contrast, sun-loving herbs and fruiting plants require more energy— for basil, tomatoes, and compact pepper varieties, strive to mimic outdoor sunlight by using a high-output LED light for 14-18 hours a day.

Light Intensity: Although increasing light intensity can help compensate for low light levels, other factors must also be considered. Plants need a period of darkness for proper development, and continuous light exposure is not ideal. Exposing plants to more than 16 hours of light per day can interfere with their growth cycles and may cause harm. Maintaining a balance between optimal light intensity and the appropriate light/dark cycles is crucial for healthy plant growth.

Light uniformity: Light uniformity refers to how evenly light is distributed across a growing area. Uneven light distribution can lead to inconsistent plant growth, with some drying out or developing at different rates. Factors affecting light uniformity include the light source, reflector design, fixture type, spacing, and distance from plants. Proper light uniformity is essential for balanced crop growth, flowering, and water distribution.

The Spectrum of Light and the Role of UV Light in Plant Growth

Plants depend on light for photosynthesis. This is how they turn light energy into chemical energy to grow. The light spectrum includes various wavelengths, each playing a different role in plant development.



By using full spectrum LEDs to select the exact quantities of red and blue light, chlorophyll pigments can absorb more of the light that they need. This means that when used strategically, bigger leaves and better flowering periods can occur without unnecessary stress.

TABLE 1: List of light colours with their spectrum range and usage.

S.No	Light Colour	Spectrum Range	Usage
1	Red Light	600-700 nm	Red light boosts photosynthesis, especially during flowering, promoting stem, leaf, and flower growth, with a focus on leaf elongation.
2	Far-red Light	700-850 nm	Promotes flowering and can increase fruit yield in some plants. It plays an essential role in regulating seed germination, blooming cycles, root development, and shade avoidance.
3	Blue Light	400-500 nm	Enhances plant quality, especially in leafy crops. It promotes stomatal opening, aiding water retention and CO ₂ absorption, and is vital for seedlings, supporting healthy root and stem growth while preventing excessive stem stretching.
4	Broad Spectrum (White) Light	400-700 nm (PAR spectrum)	Accelerates flowering, increases nutrition, and speeds up growth rates. Effective for general plant development.

Visible light, which includes red and blue wavelengths, is essential for photosynthesis. However, ultraviolet (UV) light, which is beyond the visible spectrum, also impacts plant growth in several significant ways.

UV light is divided into three categories

- **UV-A (315-400 nm):** This is the least harmful form of UV light and can promote photosynthesis and enhance certain pigments in plants.
- **UV-B (280-315 nm):** This type of UV light can stimulate the production of protective compounds and secondary metabolites in plants, improving their flavour and nutritional value.
- **UV-C (100-280 nm):** The most harmful form of UV light, often used for sterilization purposes, and can damage plant tissues if exposure is too high.

Table 2: Types of Artificial Lighting for Indoor Plants

Lighting Type	Description	Benefits
Fluorescent Lights	Available in cool white, warm white, and full spectrum for plant-specific needs.	Affordable, energy-efficient, and suitable for most plants
LED (Light Emitting Diode)	Adjustable wavelengths for different growth stages; produces less heat.	Precise light control, reduces heat stress, energy-efficient.
High-Intensity Discharge (HID)	Includes metal halide (MH) and high-pressure sodium (HPS) lamps, ideal for large plants or high yields.	Intense light output, suitable for a variety of plants, but less energy-efficient than LEDs.

Conclusion

In conclusion, artificial lighting is crucial for indoor gardening, enabling the growth of diverse plants in any environment. By understanding light spectrum, intensity, and energy efficiency, growers can create the best conditions for year-round success. Whether you're an experienced gardener or a beginner, investing in high-quality lighting can elevate your indoor gardening experience and open up new possibilities.