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Light Spectrum for Different Applications

There are several terms used to describe the color, or spectral distribution of light, including light quality, spectral quality, light spectrum and photon spectrum. These terms describe the relative quantities of different wavebands of light, such as blue light, red light and far-red light. With light-emitting diodes (LEDs), the peak wavelengths are also important, since "blue light" and "red light" are rather generic and have a broad waveband range. This article discusses the effects of the light spectrum on plants, and conceptually how it can be used for different greenhouse and indoor crop production applications.

Compact growth during propagation. Whether growing in vertical farms or in greenhouses, growers strive to produce plugs and liners that have compact growth. The light spectrum and intensity regulate extension growth and can act as a growth regulator. Extension growth is typically suppressed when the light intensity is moderately high, and by blue light. When sunlight is a limiting factor in greenhouses (during the winter), supplemental lighting can accelerate rooting as well as produce more compact young plants. This is especially true when fixtures emit at least a moderate percentage of blue light (such as 10 to 15%) and little or no far-red light.

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Increase leaf size and stem length. Although compact growth is a common goal for ornamental production, there are some situations where larger leaves and taller stems are desired. A low-light environment can trigger both of these elongation responses, but usually crop quality is negatively impacted, and flowering can be delayed. A more effective way to increase leaf size is to decrease the intensity of blue light that reaches plants by delivering light that includes far-red, or both.

Some companies offer supplemental lighting products that emit a modest proportion of far-red light. While not very common, this type of fixture can generally produce plants that are less compact than lighting with little or no far-red light. If you grow crops that have undesirably small leaves and/or are too compact, such as some begonia varieties, this may be a worthwhile investment.

Alternatively, extension growth can be increased by delivering daylength extension (end-of-day) lighting that includes far-red light. Incandescent lamps and LED fixtures that emit far-red light (sometimes called "flowering lamps") are both effective when used beginning around sunset for at least two hours. This promotion of extension growth often increases as the duration of lighting increases.

Increase leaf coloration. There are many different pigments in plants, and their concentrations vary widely from one species or cultivar to another. Pigment biosynthesis and degradation are regulated by cultural and environmental conditions, including by the light environment. Factors or conditions that promote extension growth, such as far-red light or low-light intensity, typically decrease the concentration of pigments per unit of leaf area. As a result, plants appear lighter green and lack purple pigments. Growing practices that inhibit extension growth, such as a high light environment and delivery of blue and/or ultraviolet (UV) light, usually increase pigmentation concentration and thus leaf coloration.

Because blue and especially UV photons have high energy, pigments accumulate to protect plants from the high energy. This is why plants grown under high light and/or with at least a moderate percentage of blue and/or UV have darker green or purple leaves. Therefore, if your objective is to increase pigmentation, supplemental lighting, especially when rich in blue light, will produce plants with more vivid leaf and flower colors.

Accelerate flowering of long-day plants. When the natural days are short and solar light levels are low, delivery of both red and far-red light as day-extension or night-interruption lighting will promote flowering of many long-day plants. Similarly, when plants are grown indoors, inclusion of far-red light induces early flowering of at least some long-day plants. Use of lighting fixtures that emit far-red light generally has no positive or negative impact on flowering time of short-day or day-neutral plants.

In summary, growers can use lighting to regulate plant growth and pigmentation. Blue light typically inhibits elongation of leaves and stems, but also increases pigmentation that makes leaves a darker green or purple. Far-red light does the opposite: it promotes extension growth but typically decreases leaf pigmentation. The effects of these wavebands are relatively large when the daily light integral is low, and decrease as plants are grown under progressively higher light levels. gpn

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