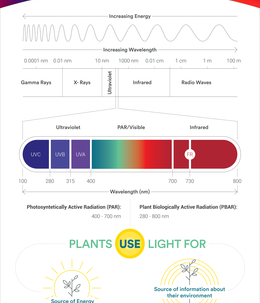
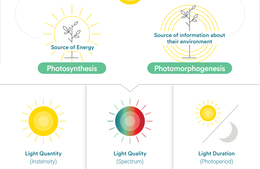
THE Impact OF THE LIGHT SPECTRUM ON PLANTS

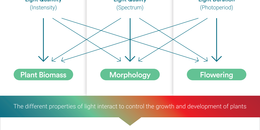


Photosynthetically Active Radiation (PAR): 400 - 700 nm

Plant Biologically Active Radiation (PBAR): 280 - 800 nm

PLANTS USE LIGHT FOR





The different properties of light interact to control the growth and development of plants

Important of Light Spectrum on Plants

Blue LIGHT

- Decreases stretching
- Facilitates branching and compact vegetative growth
- Increases production of antioxidants and vitamins
- Enhances coloration of dark or colored varieties

Green LIGHT

- Facilitates healthy development of leaves
- Increases light penetration into canopy
- Drives photosynthesis at lower canopy layers
- Facilitates traits such as inspection of plants

Red LIGHT

- Most efficient wavelength for photosynthesis.
- Stimulates biomass accumulation
- Stimulates stem and root development
- Facilitates germination, rooting and healthy plant development
- Drives flowering in proportion with blue light

Far Red LIGHT

- Promotes extension growth (stem, leaf) elongation and leaf expansion
- Decreases side branching
- Increases light penetration into canopy
- Facilitates uniform plant development in dense canopy
- Regulates flower development

Blue:

Compact plants. Smaller, thicker and darker green leaves.

- Wavelengths between 400 and 500 nm.
- Regulates the opening of stomata.
- Pronounced effects on plant growth and flowering.
- Blue light promotes: Compact vegetative growth, strong root development and coloration.

BLUE LIGHT AND Plant Growth

Blue photons drive the photosynthetic reaction.

Blue light can act as a growth inhibitor.

Blue regulates the opening of stomata, which are the tiny openings on leaves that control both water loss and the uptake of carbon dioxide.

Blue wavelengths generally suppress extension growth.

Using only blue light, however, can promote extension growth in certain crops.

BLUE LIGHT AND Leaf Color

Blue light's shorter wavelengths stimulate the production of compounds that can promote leaf coloration.

In crops such as lettuce and other leafy greens, blue can enhance the production of healthy antioxidants and vitamins.

BLUE LIGHT AND Flowering

With low intensity/ photoperiods lighting, blue light does not regulate flowering for most daylength-sensitive crops.

Blue light at a higher intensity is needed, with exceptions, for flowering of long-day crops and impede flowering of short-day crops.

To take in consideration during cultivation:

- Blue light can be used as a lighting strategy at the end of production to regulate traits such that coloration.
- High blue can lead to decreased stem elongation.
- High blue can increase the taste like sprouts in some crop.
- To ensure the general growth traits connected to a high blue spectrum the Blue-Red ratio needs to be high.
- Blue-Red ratio can be used for control of height, the more blue the more compact crop.

Green:

Better plant morphology. Healthier growth below the canopy.

- Wavelengths between 500 and 600 nm.
- Penetrates deeper into the canopy.
- Drives photosynthesis at lower canopy layers.
- Green light promotes: Natural growth and morphology, preventing abnormal development, such as poor coloration and texture.

GREEN LIGHT AND Plant Growth

Green light penetrate further into the plant canopy and can stimulate leaf photosynthesis to a greater extent than additional red or blue light can do.

Plants appear green because they reflect and transmit slightly more light than they do blue or red.

Compared to red and blue it is absorbed by other pigments and used in photosynthesis.

GREEN LIGHT Inside the canopy

The greater reflection and transmission of green light can benefit crops with a dense canopy.

Green light can better penetrate the canopy and reach lower leaves and help reduce leaf yellowing and loss.

GREEN LIGHT AND Efficiency

Green light has shown to increase yield in some crops, particularly in lettuce, flowers, and a long life-cycle and a multilayer canopy structure, for example tomatoes.

Green LEDs have historically been less efficient at converting electricity into photons than blue and red LEDs. Therefore the much more efficient white LEDs has been used to add the green light into the spectrum of grow lights.

To take in consideration during cultivation:

- Blue and green need to be in balance to achieve growth goals.
- Green light can be used for promoting extension growth similar to far-red.
- Green light is the spectrum makes the light white, which makes inspection for nutritional problems, pest issues and physiological disorders easier.

Red:

Robust biomass accumulation. Strong stem and shoot development.

- Wavelengths between 600 and 700 nm.
- Most efficient wavelength for photosynthesis.
- Important for flowering.
- Red light promotes biomass accumulation.

RED LIGHT AND Photosynthesis

Red light wavelengths are absorbed well by chlorophyll and promote photosynthesis.

Red light is used to stimulate plant growth.

RED LIGHT AND Extension Growth

When only red light is used during plant cultivation (indoor production), plants can become elongated and develop thin leaves.

Indoor growing: By adding blue light to the red the extension growth is inhibited.

In the presence of natural light, like in greenhouses, the addition of red in supplemental light can increase if FR ratio.

RED LIGHT AND Flowering

Red light delivered during the night can prevent flowering in short-day crops.

Red and far-red light combined are the most effective at promoting flowering of a wide range of crops.

Red is usually the dominant color used for photosynthetic and photoperiodic lighting.

To take in consideration during cultivation:

- Chlorophyll strongly absorbs red light, so it is effective drive photosynthesis, less than does a high proportion of far spectrum due this.
- The ratio between blue and red light is important, the more red usually the more stretch plant.
- For plant production, to add 7-20% of blue to red light is necessary to secure normal plant development and stimulate healthy plant growth.

Far-Red:

Taller plants, with larger leaves and elongated stems.

- Wavelengths between 700 and 800 nm.
- Not included in PAR region, but influence the growth of the plant.
- Plays a role in flowering.
- Far-red promotes: Extension growth and has a positive effect on biomass.

FAR - RED LIGHT AND Extension Growth

By promoting extension growth far-red influences the size of leaves, the length of stems, and ultimately the height of plants.

The R:FR ratio influences the plant height, the extent of the extension growth, therefore it is important to have a balance.

FAR - RED LIGHT AND Flowering

When natural daylight hours are short, low-intensity/ photoperiodic lighting is often delivered to promote flowering of long-day plants.

Flowering is accelerated most when the lighting includes both red and far-red wavelengths.

Since far-red light plays a role in flowering of some plants, some LEDs developed specifically for flowering applications which both red and far-red.

FAR-RED INDIRECTLY Increases Growth

By using far-red in a sole-source lighting environment you can increase the growth of your crop.

Adding far-red to the light spectrum can increase that rate, enabling plants to capture more light which can indirectly increase growth over time.

To take in consideration during cultivation:

- The effect depends on the FR ratio. The more red in the spectrum the more far-red is needed to achieve the ratio.
- Far-red can be used to increase size and biomass in plants, especially helpful in sole-source indoor growth environments.
- Far-red can be used as a end-of-day treatment to reduce energy use.

heliospectra

Light works in synergy. Always keep in mind that the ratio between the light wavelengths (blue, green, red, FR) is of importance.

Contact us to customize a lighting strategy to fit your growing needs.
www.heliospectra.com

Infographic Sources: 1. Dr. Erik Runkle, Professor/Floriculture Extension Specialist, Michigan State University | 2. | 3. Plant Biologists at Heliospectra AB