Adjusting the colour ratios of LED lights can have tremendous effects on your plant's growth

PhytoLux news
The latest news, views and industry information from the LED plant growth lighting specialists

The internet is full of information about the best grow light spectrum. After reviewing much of this information, it is clear that more understanding on the wavelengths plants use for photosynthesis is needed. This understanding centres around the absorption spectrum versus the action spectrum. There seems to be some confusion between what each is and what each represents.

An absorption spectrum defines the spectrum of electromagnetic radiation, or light, plants absorb. This depends on the cellular and molecular build-up of the plant. An action spectrum defines the spectrum of electromagnetic radiation most effective for photosynthesis. In other words, it is the part of the light spectrum that does the work. The action spectrum is what is most important in plant growth and metabolism.

It is important to keep in mind that light absorption and light use are two different phenomena. The focus of this post is the Absorption Spectrum, and we will soon follow with a post focusing on the Action Spectrum.

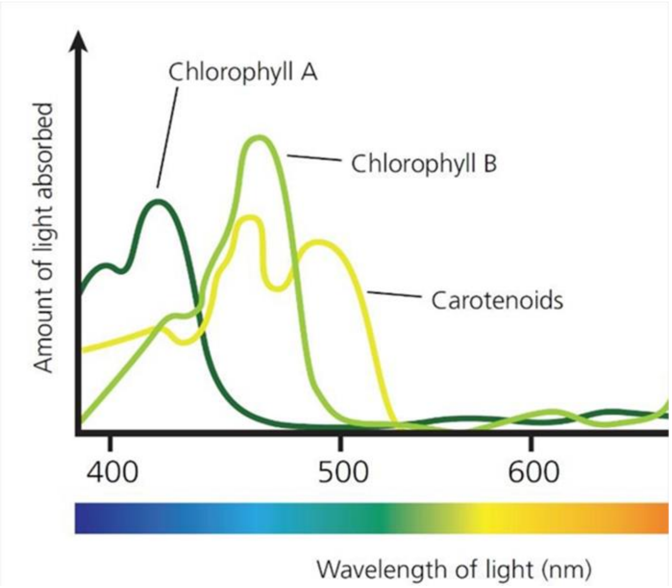
What is absorption spectrum?

Which regions of the visible light spectrum do plants absorb light? This is different for extracted chlorophyll molecules, whole chloroplasts (where the chlorophyll resides) and plant leaves. To complicate matters, the solvent in which chlorophyll is extracted also has an effect on the absorption spectrum.

The absorption spectra of chlorophyll 'a' and 'b' extracts is why LED grow lamps are typically made up of only blue and red LEDs. Many LED grow light companies claim this means plants do not use green light so it is not needed in their lights' spectrum.

The absorption spectra of isolated pigments have been the foundation for LED selection for most LED lamps. Furthermore, it has been ignored that carotenoids (accessory pigments) play a role in light absorption and energy transfer to the photosystems.

The absorption spectra of extracted chlorophyll and carotenoids. The primary light harvesting chlorophylls absorb light in the blue and red regions. Carotenoids absorb in the blue and green regions.



Tel: 0844 880 4763
Fax: 01372 371 001
Email: enquiries@phytolux.com

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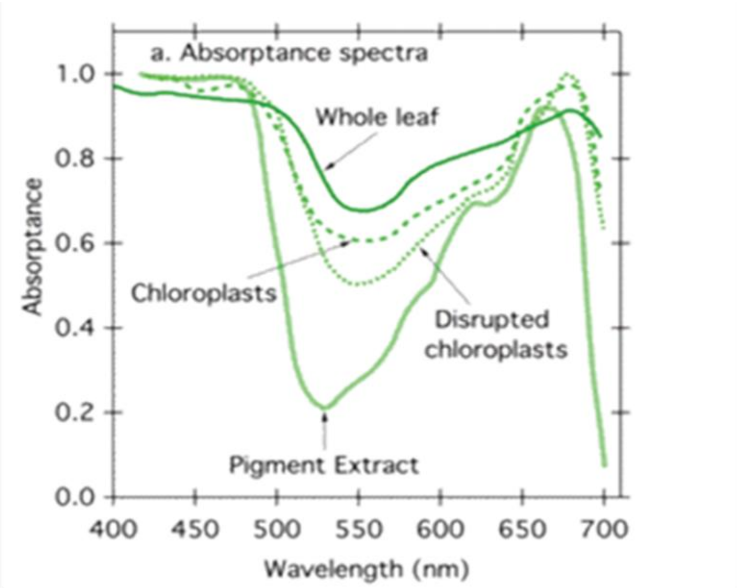
The absorption spectra of isolated pigments in vitro (i.e. studies performed with cells or biological molecules outside their normal biological context) do not represent what the whole plant absorbs. Each pigment has a specific absorption spectrum, and in living systems, pigments never exist alone. Pigments are always bound to proteins and this shifts their absorption spectrum. This phenomenon explains why wavebands are absorbed rather than a single wavelength.

In vivo (i.e. studies conducted on whole, living plants), the probability of a pigment absorbing light absorption depends on: 1) the specific protein that the pigment is bound to; 2) the orientation of the pigment-protein complex within the cell; 3) the forces exerted by the surrounding medium on the pigment-protein complex. The absorption spectra of isolated pigments have been the foundation for LED selection for most LED lamps. Furthermore, it has been ignored that carotenoids (accessory pigments) play a role in light absorption and energy transfer to the photosystems.

Absorption spectra for pigment extracts (isolated chlorophyll), disrupted and whole chloroplasts and a plant leaf where all of the pigments remain bound to their specific proteins. Figure reprinted with permission from Dr. Holly Gorton. (Absorptance spectra of isolated pigments, disrupted chloroplasts, intact chloroplasts, and whole leaves from spinach (Spinacia oleracea) Modified from (Moss & Loomis, 1952).

(http://photobiology.info/Gorton.html)



There is very little absorbance of green light (500-600 nm) in extracted chlorophyll molecules. However, as the integrity of the leaf increases we see more and more absorption in the green region.

Therefore, plant leaves do absorb green light. In this case, about 70%.

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