BY ERIK RUNKLE

Is Green Light Useful to Plants?

Fact or fiction: Green light is not useful for photosynthesis. While I don't hear or read this statement as often as I used to, it is a myth that continues to be perpetuated by people who "know enough to be dangerous" about plant lighting, but don't have sufficient plant biology or horticulture expertise, nor a good understanding of photosynthesis. It is a good example of what you read online may not be based on science, or if it is, the science is misinterpreted or misunderstood.

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LET'S BE CLEAR: GREEN LIGHT IS USEFUL TO PLANTS.

By definition, the waveband for photosynthetically active radiation (PAR) is 400 to 700 nm. In the middle of this waveband is green light, which has a wavelength between 500 and 600 nm. If one-third of PAR was not useful in photosynthesis, why would green light be included in the definition? The main reason why green light is purportedly not useful to plants is because it is poorly absorbed by chlorophyll. However, absorption of chlorophyll is usually measured using extracted and purified chlorophyll, in a test tube (in vitro), and not using an intact leaf (in vivo).

There are a few problems making conclusions based on in vitro measurements. First, there are pigments other than chlorophyll that absorb light and make it useful for photosynthesis. These "accessory pigments" have different absorption spectra, and some of them absorb green light. Second, the absorption of chlorophylls (and other pigments) can depend on the solvent used for extraction. Therefore, in this case, interpretations made from measurements in a test tube do not apply well to whole plants.

Another explanation commonly used to support the green light myth is that plants reflect green light, which is why they appear green. While that's true, it is usually exaggerated. When light strikes a leaf surface, it can be absorbed (and potentially used for photosynthesis), reflected off the leaf, or transmitted through the leaf. Most plants appear green because their leaves reflect more green light than red or blue light. However, most (e.g., 85%) green light is absorbed, and only small percentages of green light are reflected or transmitted. The green light that is not absorbed is not lost; it can be reflected to other nearby leaves or transmitted to leaves below.

THE "MCCREE CURVE"

The "McCree curve" is also sometimes used to justify the concept that green light is less effective than blue or red light at stimulating photosynthesis. Briefly, this curve describes the relative quantum efficiency of photons useful in photosynthesis. While this curve is very useful, it can be misinterpreted.

First, data are based on instantaneous measurements using relatively low intensities of light. Plants are very good at adapting to their light environment, and characteristics such as leaf size and thickness change to maximize the capture of photons. In addition, a closer look at the curve shows that the region with the lowest quantum efficiency is from 470 to 490 nm, which is part of the blue light waveband.

"Most plants appear green because their leaves reflect more green light than red or blue light."

In some situations, green light can be even more useful than blue or red light. Green light typically penetrates deeper into a leaf than blue or red light. Under a high intensity of blue and red light (a common spectrum for LED fixtures), chlorophylls and accessory pigments on the upper leaf surface become saturated, leaving chlorophylls lower in the leaf (or other accessory pigments) not saturated. With the addition of green light, photons can penetrate deeper in the leaf and be used for photosynthesis. Therefore, green light is especially useful under high-light intensities.

Arguably the only credible justification to grow plants without green light relates to the efficacy of an LED lighting fixture. Efficacy refers to the conversion of electricity into photosynthetic photons. Red LEDs have the highest efficacy values and blue (or white) LEDs are not far behind. In contrast, green LEDs have low efficacy values and thus, green LEDs are almost never used for commercial plant lighting applications. Currently, the most effective way to deliver green light to plants using LEDs is with white LEDs. gpn