



Plants, Light, and LEDs: Putting It All Together

Part 3 – Sunlight and Lamp Light: What’s the difference? Trying to compare apples to oranges



Topics

- How do sunlight and lamp light differ?
- Are all lamps the same?
- What is “white light”?

How do sunlight and lamp light differ?

Until about 200 years ago the only man-generated light source was fire, and it’s only in the last 100 years that electrically operated man-made light generators became practical for widespread use. Innovation has continued until today, giving us many types of lamp technologies. From the original glowing filament (incandescent bulbs) to glowing plasma (fluorescent tubes), to arc lamps, metal halide bulbs and LEDs, man-made light generators are available for many purposes, including growing plants.

To the human eye most man-made light generators seem to create light that’s very similar to sunlight. Yes, there are the odd-ball lamps like high or low pressure sodium that have a very skewed (and yellow) cast to their light, but for the most part man-made light generators produce some sort of white light that imitates the appearance of

sunlight. But the beautiful colors of a rainbow soon show that sunlight and light from man-made light generators is very different.

We noted in part 2 that sunlight contains all of the colors of light, in roughly equal proportion. This can be readily seen by shining sunlight through a prism to separate its light into a continuous rainbow of colors. What do we see if we shine the light from a man-made light generator through the same prism? For incandescent light sources like common household light bulbs we also see a continuous spectrum of light, but one that isn’t as even, and has very little blue light but a great deal of red light. The light from most other types of lamps will show narrow areas of bright color, broader areas of very dim colors, and many dark bands where some colors aren’t produced at all. Most LEDs, which have a very narrow spectral output, will typically show only a very narrow band of a single

color.

Are all lamps the same?

For the most part, the light from lamps used for “white light” room illumination will seem pretty much the same, visually speaking. The human eye is very forgiving of light sources. Yes, some lamps are brighter than others, or may be more efficient or have a higher operating temperature, still the quality of the light appears to be very similar. But when you start talking about how well different types of lamps are at growing plants, the differences between these lamps widen.

Incandescent lamps, while producing a continuous spectrum of light, generate very little blue light, making them a poor source of plant growing light. The other types of lamps, such as fluorescent tubes and HID lamps, can be modified to produce more colors of light plants like, making them a bit better for growing plants. But all of these types of lamps generate a lot of light in colors plants don’t use very efficiently. They also waste a lot of energy as heat, making them even less efficient.

LEDs, as discrete sources of nearly monochromatic light with high electrical efficiency, offer a unique opportunity to designers of plant growing lamps. Instead of starting with an existing lamp designed to light rooms for people, such as a fluorescent tube or HID lamp, an LED grow lamp designer can select LEDs that generate exactly the colors of light needed to target whichever plant pigments he

chooses. He can also add as many LEDs of each color he wishes so that each color of light is produced in the proper proportion. Finally, the individual LEDs can be arranged in whatever pattern desired to create the final lamp design. By leaving out colors of light that are useful for human vision but not useful for plant growth, even greater grow lighting efficiencies are achieved compared to other types of grow lights.

In the end, no man-made light generators used for growing plants are anything like sunlight. All of them are missing a lot of the colors of light that are found in sunlight. Is this a bad thing? Not necessarily, considering plants don’t use many colors of light very efficiently. In general, as long as a grow light can generate the colors of light plants require, and in the proper proportion, it doesn’t matter whether other colors of light are missing. Of all types of grow lights available, LED-based grow lights are potentially the most efficient.

What is “white light”?
Interestingly, in nature there really isn’t any such thing as “white light”. When all three of the light receptor pigments in the eye (red, green, and blue) receive light signals

simultaneously, there is no clear shade of color detected, and so the brain interprets the light as being some shade of “white” light. This means that despite the feelings of many people that a man-made light generator must produce some sort of “white” light in order to grow plants well, plants receive no special help from a light source simply because it appears “white” to the human eye. In fact, it only takes



two colors of light to make a light source that looks "white" to people, for example, yellow and blue, which would have limited use to many plant processes.

This has special implications for "white" LEDs. No one has yet built a single-chip LED that produces "white light". Today's "white" LEDs are nothing more than a blue LED mixed with a phosphor that uses some of the blue light output from the LEDs chip to create yellow light. Together, the yellow and blue light from a "white" LED looks very white to the human eye, but again offers very little of the colors of light

needed by most plant processes.

For now, all we know for sure is that there is no magical blend of light colors that are known to supply everything plants need to grow. Sunlight, obviously, provides all the light colors plants need, plus many more. In man-made light generators it is a waste of energy to create any colors of light not used efficiently by plants. This fact alone gives well designed LED grow lights the technological edge over the types of grow lights based on lamps originally designed to light up rooms for people.

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