Posted by Vanessa Nielsen, PhD on February 28, 2018

Choosing the best lighting for growing cannabis can be intimidating, especially when there are so many factors to consider, like spectrum, lumens, PPFD, CRI, CCT, and more! Don't know what those terms mean? We've already covered the basics of horticultural lighting, so read that first if you haven't already. We are going to dive deeper into one of those factors, and that's spectrum. The spectrum of light used by a plant is called photosynthetically active radiation (PAR). PAR was first defined in the 60s as the wavelengths from 400 to 700 nm. Today we now understand PAR to encompass wavelengths outside of this range, to include UV and far-red light. This article is part of a series covering all the wavelengths of light, including UV, violet, blue, green, yellow, orange, red, and far-red light! This focus of this article will be on red light. Red light is radiation with wavelengths between 620 and 750 nm. These wavelengths are within the visible spectrum and red light has a pronounced effect on both photosynthesis and flowering.

Red Light and Vegetative Growth

Red light fits with the absorption peak of chlorophylls, which do photosynthesis to produce sugars and carbons[1]. Sugars and carbons are essential for plant growth, as they are the building blocks for plant cells. For this reason, red light increases photosynthesis rate and plant size[2]. In particular, red light at 690 nm is thought to be more effective than red light at 660 nm for increasing plant size in some species[3]. Although a plant can be grown using just red light, most plants have faster growth with a broader spectrum of light. Furthermore, plants grown under only red light may not have the desired characteristics. For example, plants grown with only red light can have skinny, stretched stems ("etiolation") with fewer leaves[4]. This is particularly true if the plants are young[5]. Red light can be used in conjunction with blue light. Both red and blue light are more efficiently absorbed by photosynthetic pigments compared to other regions of the spectrum. The red-blue combination allows for a faster rate of photosynthesis than either red or blue light alone[1]. Compared to red light alone, the red-blue light combination also increases plant size, leaf number, leaf size, and chlorophyll content[6,7]. Read more about blue light.

How much red and blue light should you give your cannabis plants? Anecdotally, many growers consider red light to be more effective than blue light at increasing cannabis photosynthesis and growth, and so they are inclined to provide plants with more red light than blue. We can look at other plant species to see what ratio of red: blue light is ideal. Depending on the species, the ideal ratio of red: blue light varies. Higher levels of red light compared to blue light increase plant biomass in tomato, strawberry, and marigold[6-8]. On the other hand, higher levels of blue light compared to red are documented to increase biomass in tomato (yes, there is conflicting evidence for tomato), cucumber, pea, and peppers[9-11]. What about adding other colors of light? The addition of moderate amounts of other colors of light, such as purple, green, yellow, and orange light have further benefits for plant growth. For example, the addition of green light to red-blue light increases plant size and height, as well as leaf size[12].

It's clear that red light is key for vegetative growth. The addition of blue light and other colors of light further increase photosynthesis rate and plant size. At this time, the ideal ratio of each of these colors of light is unknown. Likely, the ideal spectrum for vegetative growth will be species- and strain-dependent. For this

reason, it's important to choose a "full-spectrum" horticultural light that has high amounts of red and blue light and moderate amounts of other colors of light.

Red Light and Flowering

When it comes to growing cannabis, many cultivators are most interested in the quality of light used for the flowering stage. Red light impacts flowering in two ways. First, because red light is important for photosynthesis, it is by extension, also important for flowering. Second, red light mediates flowering time in some species.

The flowering process is resource-intensive, and there is a strong positive correlation between plant size (i.e., vegetative growth) and bud size. Therefore, a plant with high photosynthetic rates will accumulate more resources that later allow it to produce large, dense flowers. In order to have a high yield, it is important that a cannabis plant is provided with high amounts of PAR during the vegetative stage. Light can also affect the timing of flowering, the number of flowers, and the size of flowers. Red light accelerates flowering in cranberry, wheat, and strawberry but delays flowering in mustard plants[13–16]. At the time of publishing this article, there are no studies exploring the relationship between red light and cannabis flowering time. There is little evidence for red light affecting flower number or size in any species. If we look to other species, there is mixed evidence on the effect of red light on flowering. Until additional studies are performed, it is not recommended to use only red light for flowering, but rather a "full-spectrum" horticultural light that includes high amounts of blue light, as well as other colors of light.

Red light is important for both the vegetative and flowering stages of plant growth. Red light should be used in conjunction with blue light to increase photosynthesis and plant size. The addition of other colors of light, such as green, further increases plant growth. For this reason, "full-spectrum" lighting usually produces better results that mono-colored or dual-colored lighting. Red light can regulate flowering time in many species. For some species, flowering time is accelerated, for other species, it is delayed. At this time, the effect of red light on the flowering time in cannabis is unclear.