LED GROW LIGHT TECHNOLOGY AND KNOWLEDGE SHARING

Knowledge

From the start of research into LED grow lighting, Plessey has adopted an open policy of knowledge transfer to enable end users to achieve the best performance and crop yield.

Plessey shares a strong working partnership with Rothamsted Research that began in 2011. Julian Franklin, Head of Controlled Environments at Rothamsted Research, helped Steve Edwards, founder of PhytoLux pioneer the unique Attis range of units. Now as the leading LED supplier, working with multiple universities and research institutions in the UK, Plessey continues to draw on a wide range of expert plant scientists to improve the knowledge and information available to their end users.

The information below provides a short summary of some of this knowledge.

Photosynthesis

Photosynthesis is a process whereby plants and other organisms convert light energy captured from the sun into chemical energy that can be used to fuel the organism's activities. Plants are empowered with an array of photoreceptors controlling diverse responses to light parameters, such as spectrum, intensity, direction, duration etc.

These photoreceptors include:

- Red and far-red absorbing phytochromes
- Blue and UV-A light absorbing crypto chromes and phototropins
- Other implied photoreceptors absorbing in UV-A and green regions

Spectral changes of illumination evoke different morphogenetic and photosynthetic responses, which can vary among different plant species.

In agrotechnology, photoresponse is important since the feasibility of tailoring illumination spectra enables control of plant growth development and nutritional quality. Optimisation of lighting is of particular importance for plant cultivation in glasshouses and a suitable lighting spectrum ensures normal plant growth. Using a custom-designed lighting spectrum enables:

- Regulation of flowering time
- Balancing of growth and development processes
- Accumulation of biomass
- Suppression of stem elongation
- Impact of plant primary and secondary metabolisms directly associated with the food quality of vegetables

LED plant growth configuration

RED SPECTRUM affects the flowering and fruiting stages with increased number of buds and overall larger yield. Red wavelengths have the highest quantum yield, whereas blue light is 25 to 35% less efficient in driving photosynthesis (Bugbee, 1994). Blue light is absorbed not only by chlorophyll, but also by carotenoids. Carotenes do not transfer the absorbed energy efficiently to chlorophyll and thus some part of absorbed blue light is not used in photosynthesis. On the other hand, all red light is absorbed by chlorophylls and used effectively.

BLUE SPECTRUM affects vegetative growth during early stages to produce thick, stocky plants. Blue light is important for the growth of many plants, including lettuce, spinach, wheat and radish. It affects the chlorophyll formation; photosynthesis processes, stomata opening and through the cryptochrome and photochromic system, raises the photomorphogenetic response. Blue light (460 nm) promotes dry matter production and inhibits cell elongation in stems and leaves. The optimal flux of blue light for leafy plants is about 10-15% of the total PAR. The higher flux of blue light is essential for normal carbohydrate metabolism and transportation from leaves to storage organs assuring tuber formation. It also has a slight effect on primary and secondary metabolite synthesis, indicating light-dependent metabolism.

YELLOW AND GREEN SPECTRUM. Yellow and green light is more efficiently transmitted through the plant body and acts as a signal to tissues not directly exposed to the light environment. Therefore supplemental yellow and green light enhances biomass

accumulation in the above-ground part of the plants and also affects chlorophyll and carotenoid synthesis, thus
improving the colour of leaves.

Phytochromes principally thought of as red/far-red reversible pigments, are extremely sensitive to the entire illumination spectrum and even small variations in the spectrum initiate responses in the photochromic system.

Example case study

Commencing in early September 2014, Moulton College has been testing the difference in Arctic King lettuce plants grown under the PhytoLux Attis-5 LED grow light in an enclosed Grow Tent versus plants grown outdoors under natural light in a cold frame. By December the trial had produced some very interesting and exciting results, with lettuces grown under the Attis-5 having;

- More compact plant morphology
- Higher chlorophyll content
- Thicker and sturdier leaves - equating commercially to a longer shelf life and easier processing
- Faster growth rate
- Higher dry weight while maintaining root:shoot ratio
- A growth advantage when germinated under LED before moving to natural light

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