The Next Frontier of Lighting Efficiency

Light is the energy necessary for plants to grow. For the indoor gardener then, supplying light represents a major cost associated with cultivation. Traditional lighting methods such as fluorescent, metal halide (MH), or high pressure sodium (HPS) lamps waste significant amounts of wattage supplied to them in the form of heat to produce an adequate quantity of photons at the proper energies (wavelengths). This 'oversaturated' method of photon-supply is also found outdoors underneath the Sun.

Light from the Sun consists of a wide spectrum of photons at varied energy levels which can correspond to the different colors we see. There are two major problems with this method for indoor gardening. One is the *qualitative* problem that many of the photons emitted will be at energies (such as green or far-infrared wavelengths) which are either reflected by the plants, only absorbed as heat, or pass through without any interaction; essentially useless in all cases. The other problem, which is *quantitative* in nature, can be understood by considering the fact that the photosynthetic machinery within plants has a maximum rate at which it can perform [1] [2]. Supplying photons in excess of this maximum, such as in the oversaturated method, results in wasted energy at best or photobleaching [3] [4] and damage [5] [6] [7] at worst.

The first (qualitative) problem can be mitigated with light-emitting diode (LED) technology which emit a stream of photons at a single wavelength with high luminous efficiency and almost no residual waste at other wavelengths. By choosing a composition of different LED's the grower can select frequencies which the target plant uses and ignore those frequencies it does not.

The second (quantitative) problem is uniquely addressed by **GroCelerator**, which allows growers to easily modify the supply of photons from a steady stream to a pulsed form using patent-pending J-Factor technology (See Figure 2). This process artificially simulates the natural process which occurs when outdoor canopies are buffeted by wind - portions of the plants below (and within) the canopy are subjected to regular periods of light and shade when sunlight is temporarily blocked by neighboring leaves. Similarly, GroCelerator applies regular periods of light and shade in the form of pulses (either on or off). It also allows time for the process of photosynthesis to occur in the cell without receiving potentially damaging excess irradiation (a.k.a. light) that plants have had to evolve defense mechanisms against.

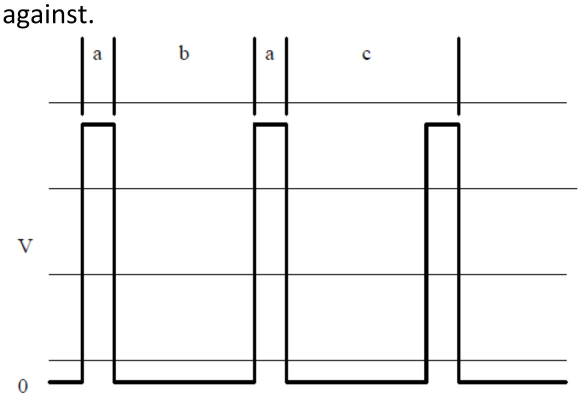

Figure 2: Illustration of GroCelerator Concept. The peaks (a) represent when voltage is flowing and valleys (b) represent when the circuit is open, using no electrical energy. The (c) space represents an entire on/off cycle.

GroCelerator can be used as a stand-alone system, or in conjunction with other lighting with no ill effect. Though it is possible to damage plants with an excess of light they have, as mentioned before, evolved an array of protective mechanisms to withstand the relatively strong, constant bombardment of the Sun. Though we may conjecture resulting increased efficiencies at a molecular level, it is without any doubt that the energy savings for photon production alone will distinguish GroCelerator well above the competition. Scalability is easily adaptable to large or small grows and it will complement most if not all methods of gardening including hydroponics, and Sea of Green (SoG) or Screen of Green (ScroG). In fact, the reduced power requirement may be especially useful for household growing, or in other cases where a noticeable increase in power-draw may be undesirable.

Experimental studies have shown increased or similar growth patterns when pulsed light was applied to certain species of algae [8] [9] and cos lettuce (romaine) [10] with increased energy efficiencies. Similar studies done with tomatoes [11] found greater photosynthetic efficiency with pulsed light than with continuous. There is sparse, if any, research done on the effects of this system on the most popular indoor cultivar, Cannabis. The explosion of social Cannabis acceptance and its coinciding rise of market-demand presents opportunities for discovering better ways of capitalizing on this phenomenon. What is needed are experiments on these plants using this new LED technology to determine optimal production parameters in different strains. We are looking for growing partners to apply GroCelerator to their lines and see the energy savings for themselves.

Perhaps the only 'downside' to this method of light production is that since essentially no energy is wasted as heat, these systems run much colder than HID lamps or even fluorescents. In colder climates growers may think that waste heat from traditional lighting is beneficial in maintaining a higher temperature. This dubious claim is turned on its head, however, when we consider the practicality and economic feasibility of using HPS or MH lamps as heaters in other areas – surely there is a reason we heat our homes with dedicated heating units instead of lamps? Even in cases where a grower would benefit from higher temperatures it is usually better from an economic standpoint to use a more direct form of heating and reap energy savings in lighting and heating at the same time. The American Southwest and other warm climates with advanced agricultural development are uniquely positioned to benefit from this form of directed-LED technology because the hot environment provides adequate warmth to plants.

References

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