Inda-Gro Sub-Peer Review of Bugbee/Nelson "Economic Analysis of Greenhouse Lighting: Light Emitting Diodes vs. High Intensity Discharge Fixtures" June 2014

First, let's be clear that this about supplemental lighting for greenhouses. The main thing to infer is that the plants will get a dose of full spectrum from the natural sunlight. Therefore, the function of the supplemental lighting is to add additional energy to meet desired crop DLI. *Not addressed, is that supplemental lighting of specific wavelengths could be used to obtain specific responses in the plants.* Additionally it is also a comparison of HPS and LED, the induction and fluorescent lamps were likely included as a point of reference only.

They spend some time analyzing and discussion variations of the light incident angle and how that factors tray and isle widths. They completely neglect to address that the height of the light can be adjusted to compensate for keeping the majority of the light on the plants. I think you can almost disregard this discussion with the exception of the case of 1000 Watt HPS which generate high enough heat that distance from the crop is an issue.

In respect to the supplemental light generated, the focus of the article is on propagated growth and not necessarily quality of the growth.

They state that in the design of LED fixtures and the choice of LED wavelengths used is driven by the efficiency of the individual LEDs used. My experiences are that the blue and red LEDs are chosen for use because these wavelengths correspond to the peak chlorophyll absorption points. All the manufacturers sure make an effort to point this out.

In respect to the testing performed at TUV SUD America vs. their lab testing the main difference in values is likely a result of their extrapolation routine for the flat plane integration. It did appear that they used the TUV result for all of their analysis.

Their choice of the two referenced fluorescent fixtures, I believe resulted in an unintentional negative bias toward fluorescent. The IGrow 400 watt flowering induction uses a phosphor blend that has an extremely high ratio of a red phosphor. The problem with this particular combination is that it inherently has a very low efficiency. Several Chinese induction manufacturers have offered this blend and surprisingly grow light companies have adapted it because the spectral distribution appears to be very good for flowering. They have all seemed to miss the inefficiency and the overall significance of that. The Inda-Gro Pro 420 PAR has a 1.24 uMol/J. The T8 lamp they chose appears to be an 8 foot version based on the 60 Watt rating. Most fluorescent grow lights are T5s, not T8s, and 4 foot. Had they chose a 4 foot lamp they could have had the TUV integrating sphere measurements, but 8 footer could not fit in their sphere. All of this aside, I'm still surprised that the output is only 0.84 uMol/J.

They state that photosynthetic efficiency is best measured as uMoles per Joule; I would contend that a weighted measure using the photosynthetic efficiency curve would be better as it would account for the differences in wavelength absorption efficiencies. Also a bit peculiar is their use of the units of uMole/J rather than the more commonly used uMole/s per Watt. Numerically they are the same, but the latter is pretty much the industry standard.

Their final conclusions are a bit vague in that you should concluded the best choice as the new generation HPS lamps, but still strongly plead the case for LED.

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