ACHIEVING A 1.2:1 RED:FAR-RED RATIO AT 500 µMOL/M^2/S IN A 120 FT^2 GROWTH CHAMBER

CONVIRON
Building Partnerships | Creating Solutions

TEST PURPOSE

The purpose of this test is to verify that a 1.2:1 red:far red ratio, similar to that of natural sunlight, is achievable using LEDs in a 120 ft^2 growth chamber with an intensity of 500 $\mu mol/m^2/s$, 1m below the LED fixtures.

TEST EQUIPMENT

- Conviron BDW120
- Valoya AP67 Broad Spectrum Dimmable LEDs (42 fixtures)
- Valoya 730nm Far-Red Dimmable LEDs (12 fixtures)
- Apogee PS-200 Spectroradiometer (with included spectral data viewing software).

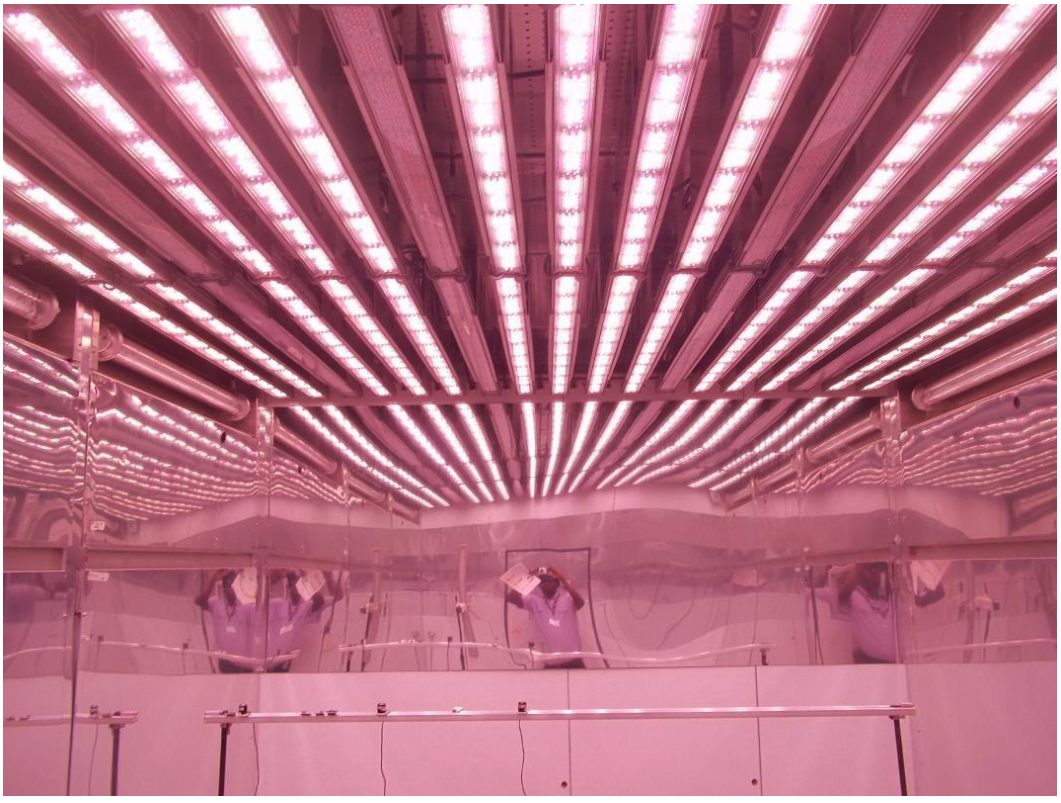

Figure 1 - Interior of BDW120 with Valoya LEDs

PROCEDURE

The spectroradiometer light sensor was positioned 39.4'' (1000mm) below the LED lamp canopy. The spectroradiometer was connected to a laptop which displayed the spectral distribution from 280nm to 850nm.

Spectral data was collected at the following set points:

- 15°C, 500µmol/m^2/s
- 27.5°C, 500µmol/m^2/s
- 40°C, 500µmol/m^2/s

At each data collection point, the AP67 primary lighting was set to the desired light intensity of 500µmol/m^2/s, and the 730nm secondary lighting, which does not contribute to PAR, was adjusted until the desired red: far red ratio was achieved. This was determined using the data collected by the spectroradiometer. The R:FR ratio was calculated by dividing the total light output (µmol/m^2/s) from 655nm to 665nm (Red) by the total light output from 725nm to 735nm (Far-red). PAR, YPF, & PPE values were also documented at each data collection point. Full spectral data at each data collection point is available for further analysis.

At each temperature change, the chamber was left to stabilize for a minimum of 1 hour before data collection continued.

Furthermore, three additional spectrums were recorded:

- Valoya AP67 fixed at 3:1 Red:Far Red only (730nm LED off).
- Valoya 730nm only (with AP67 LED off).
- Valoya AP67 with Valoya 730nm at maximum power, to demonstrate lowest achievable red:far red ratio at 500µmol/m^2/s PAR

RESULTS

All data shown was collected at a chamber temperature set-point of 27.5°C.

Figure 1, below, shows the spectrum of an AP67 at 500µmol/m^2/s with a fixed red:far red ratio of 3:1. Without the addition of 730nm LED bars, it is not possible to adjust this ratio. A YPF of 450 and a PPE of 0.79 was observed.

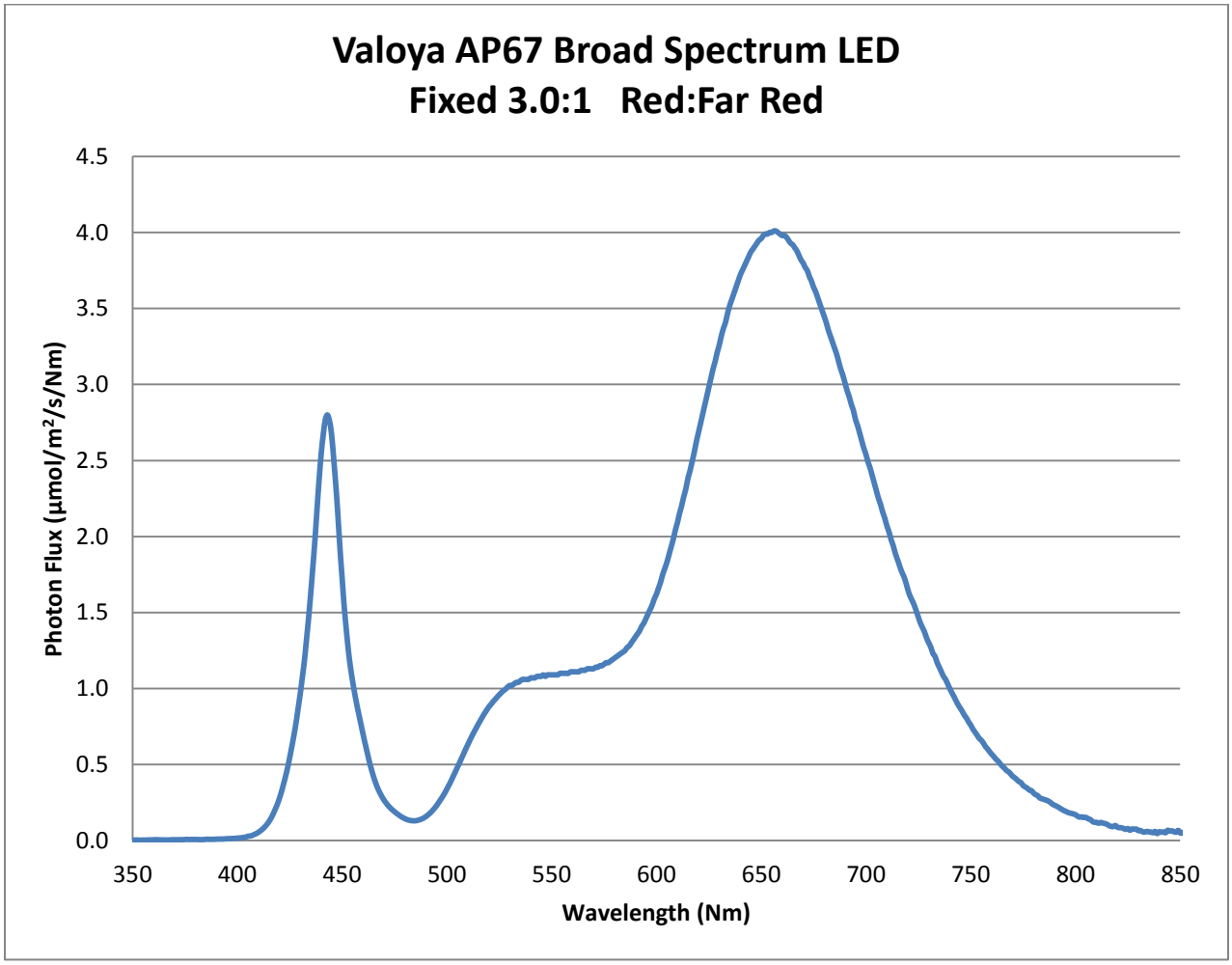

Figure 2 - Spectral Distribution of Valoya AP67 LED

Figure 2, below, shows the 730nm LED spectrum superimposed over the AP67 spectrum. This spectrum will be added to the AP67 spectrum to decrease the red: far red ratio.

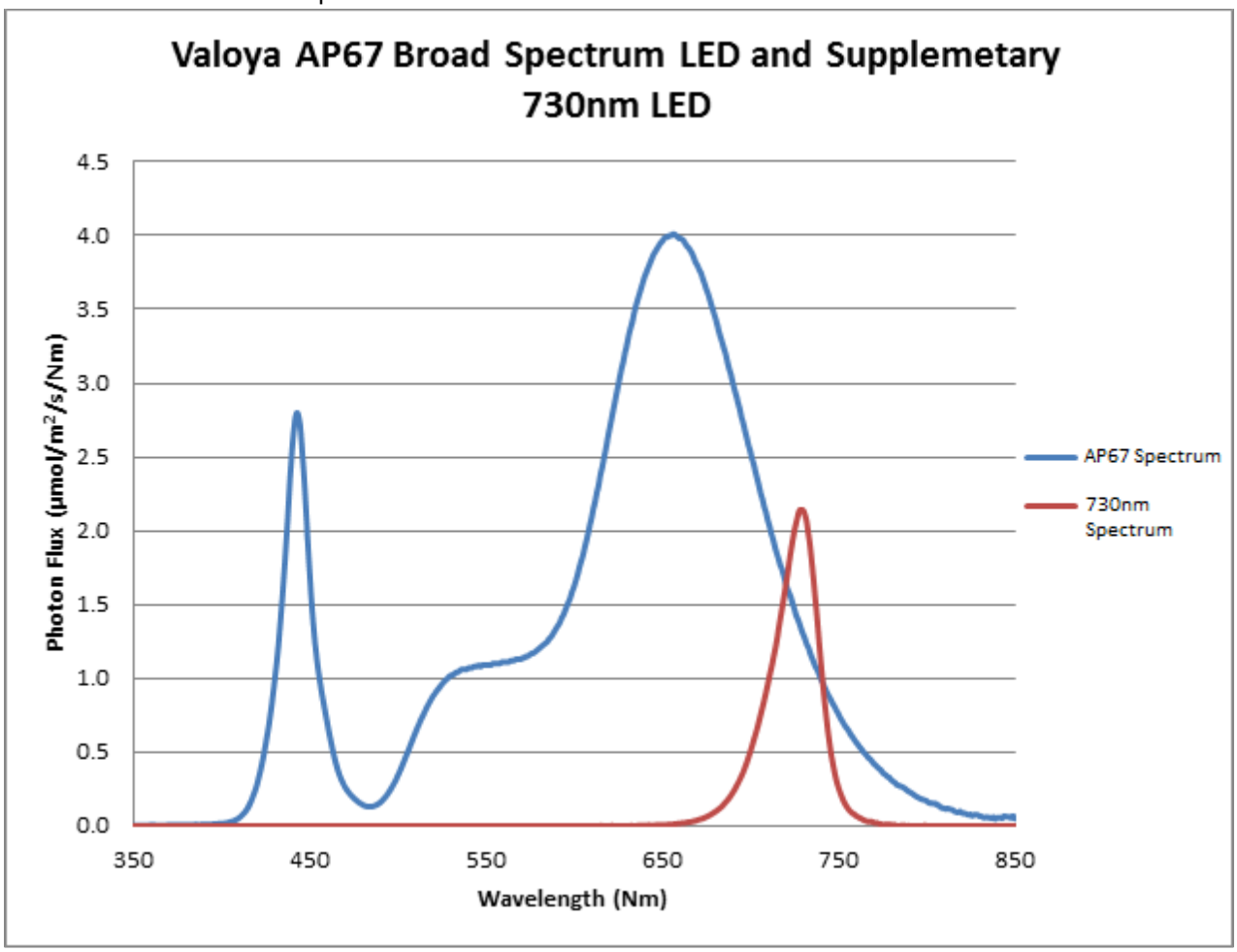

Figure 3 – Superimposed Spectral Distribution of Valoya AP67 and 730nm LEDs

Figure 3, below, shows the combined AP67 and 730nm spectrum. The output of the 730nm bar was adjusted to achieve a 1.2:1 red:far red ratio. A YPF of 471, and PPE of 0.76 was observed.

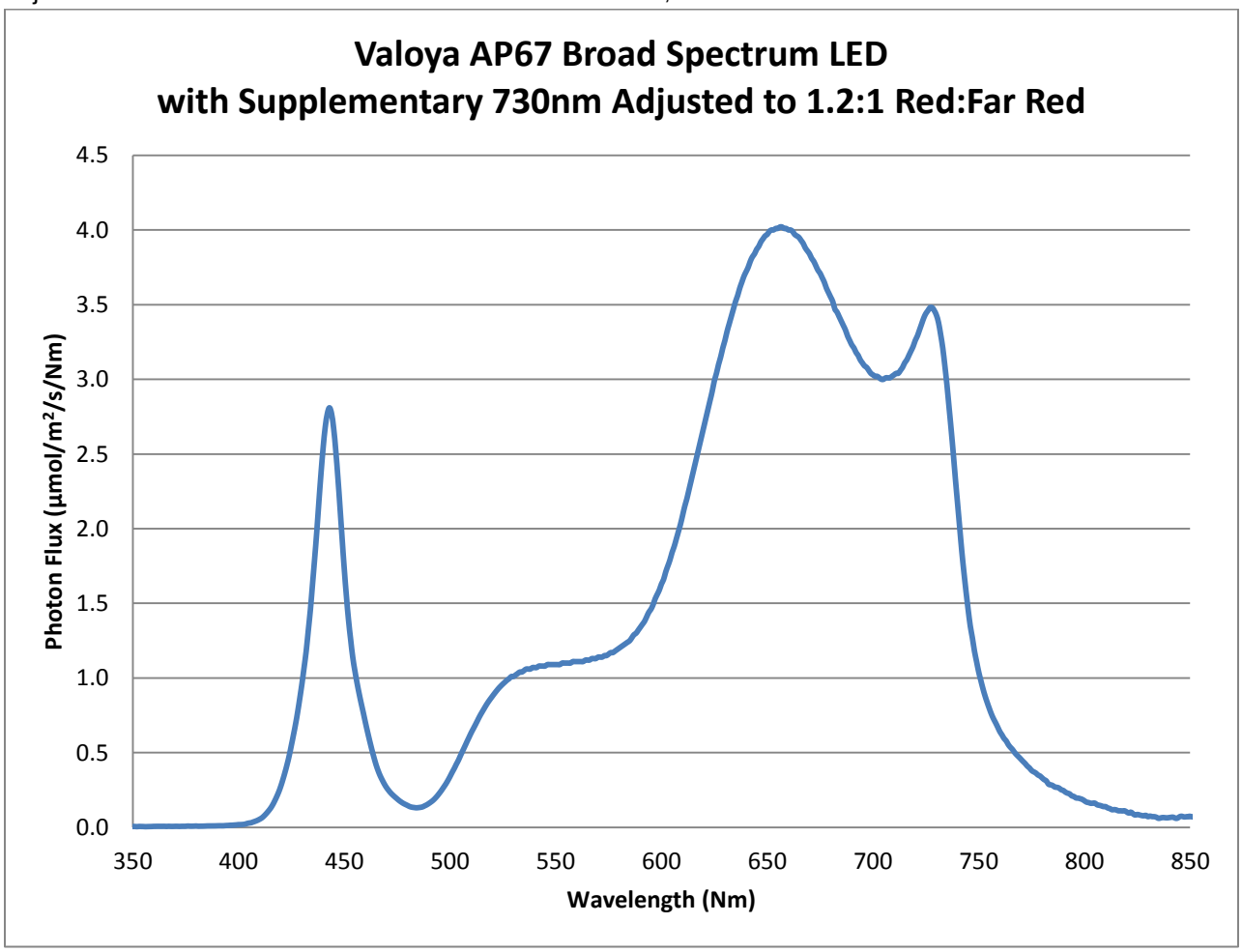

Figure 4 - Combined Spectral Distribution of Valoya AP67 and 730nm LEDs

Figure 4, below, shows the spectrum with the 730nm bar set to maximum light output. A red: far red ratio as low as 0.9:1 can be achieved with 44.2 µmol/m^2/s in the red band (655-665nm), and 49.1 µmol/m^2/s in the far red band (725-735nm). A YPF of 482 and PPE of 0.73 was observed.

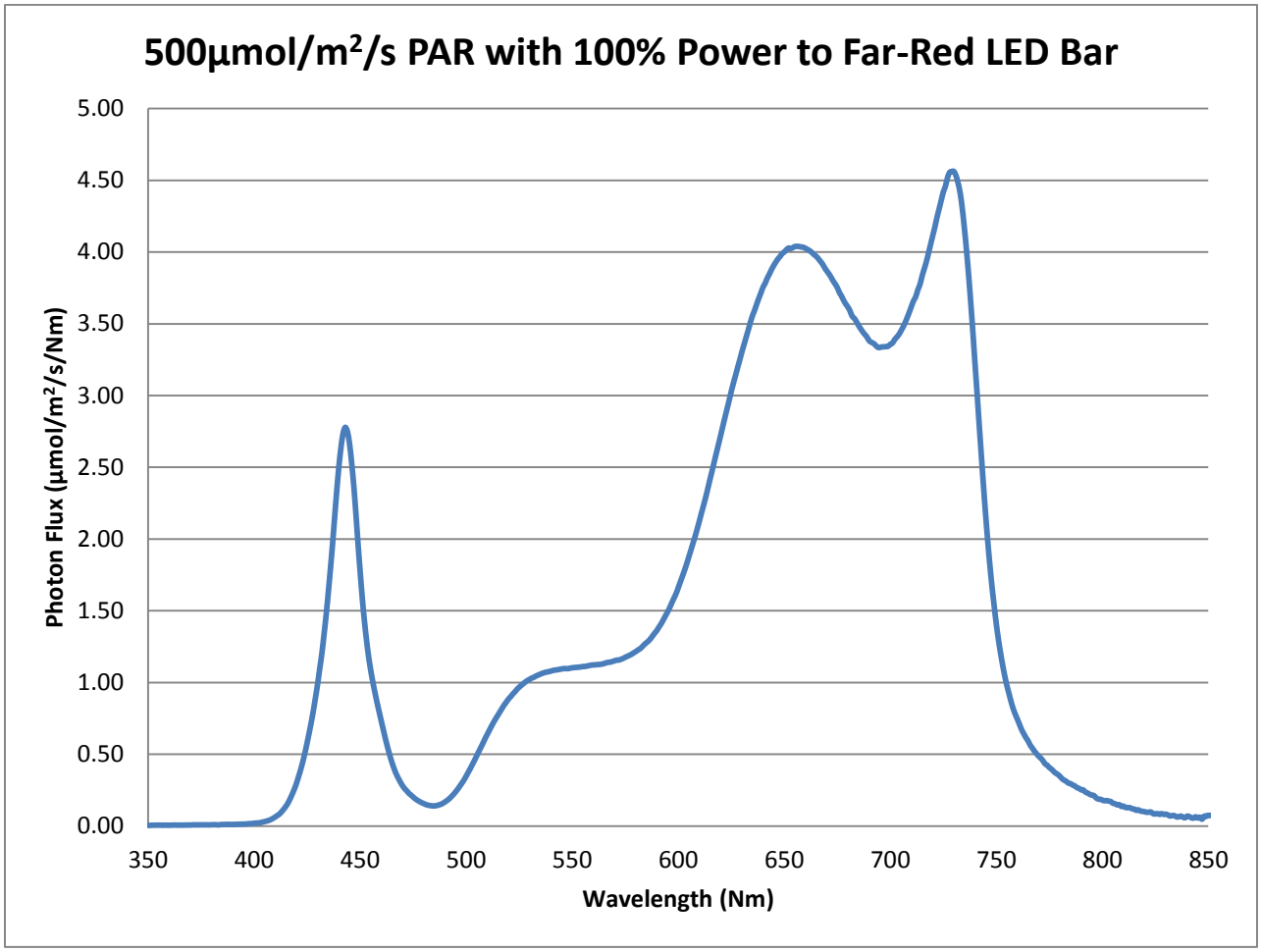

Figure 5 - Minimum Red:Far Red ratio achieved

CONCLUSION

We have determined that with the use of LEDs, it is possible to manipulate the red:far red ratio, and achieve a similar ratio to that of natural sunlight. From this particular experiment, it was possible to control the red:far red from 0.9:1 to 3.0:1. Results were further confirmed when testing was performed at 15°C and 40°C. From the results obtained we believe that the ratio could be further extended by adjusting the quantity of each LED type.