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# Effects of Blue Light at High Photosynthetic Photon Flux

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# Effects of Blue Light at High Photosynthetic Photon Flux

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## MATERIALS & METHODS

*Plant Material and Experimental Trials.*

Four species have been studied so far:

1. Cucumber (*Cucumis satuvis*, cv. 'Pepino') one study
2. Lettuce (*Lactuca sativa*, cv. 'Waldmann's Green') two replicate studies
3. Radish (*Raphanus sativus*, cv. 'Cherry Belle') three replicate studies
4. Soybean (*Glycine max*, cv. 'Hoyt') one study

Each species was separately grown under one of two arrays of light-emitting diodes (LEDs) (white and purple color, manufactured by the Lighting Sciences Group) at a photosynthetic photon flux (PPF) of 800 µmol $m^{-2}$ $s^{-1}$.

*Cultural conditions.* Pre-germinated seeds of each species were transplanted to 24, one-liter pots. Pots were filled with horticultural grade soilless media (1 peat: 1 vermiculite by volume) and watered to excess with a complete nutrient solution (100 ppm N; 0.01N-0.001P-0.008K; Scotts® Peat-Lite, 21-5-20). The pots were randomly assigned to one of two LED treatments.

The walls were lined with a diffuse white reflective surface. Cooling fans thoroughly mixed the air and maintained uniform temperatures between treatments. Day/night temperature was 25/22 °C. Emergence occurred 3, 2, 5, and 3 days after planting for lettuce, radish, soybean, and cucumber, respectively. After the cotyledons were fully expanded, plants were thinned to one per pot. Plants were grown until the leaves began to overlap which occurred 15, 12, 18, and 13 days after emergence (DAE) for lettuce, radish, soybean, and cucumber, respectively. At this point plants were thinned to six plants, which were harvested at 22, 19, 24, and 24 DAE.

*Light treatments.* The two LED arrays included:

1) a combination of cool white with monochromatic red LEDs
2) a combination of monochromatic red and blue LEDs

Both LEDs were manufactured by Lighting Sciences Group, Satellite Beach, FL. The PPF, yield photon flux (YPF), phytochrome photoequilibrium (PPE), relative (percent of total PPF) amounts of blue (400 to 500 nm), green (500 to 600 nm) and red (600 to 700 nm) light, and the *absolute* (µmol photons $m^{-2}$ $s^{-1}$) amount of BL for all LED treatments were made using a

spectroradiometer (model PS-200; Apogee Instruments, Logan UT; Table 1). At the beginning of the experiment, PPF was measured using a quantum sensor (LI-188B; LI-COR, Lincoln, NE) calibrated for each treatment against the spectroradiometer. PPF was maintained constant throughout the trial at 800 µmol $m^{-2}$ $s^{-1}$. Spatial Variability of PPF within each treatment was less than 4% and pots in each treatment were randomized every four or five days. The photoperiod was 16-h day/8-h night.

*Plant Measurements*. Prior to harvest chlorophyll content index (CCI) of the top most fully expanded leaf was measured with an optical chlorophyll meter (CCM-200; Opti-Sciences Inc., Hudson, NH).

Stem and leaf fresh weight (FW) were measured immediately following harvest. The number of leaves per plant was counted and total leaf area (LA) was measured using a leaf area meter (model LI-3000; LI-COR, Lincoln, NE). Hypocotyl length in lettuce, storage root length in radish, and total stem length in soybean and cucumber were all measured, as well as the longest petiole length in radish, soybean, and cucumber. For lettuce, soybean and cucumber the number of branches greater than 1 cm were counted. For lettuce the stem girth was measured and for radish the storage root girth was measured. Stems and leaves were dried for 48 hours at 80°C and weighed. Roots were not measured. These measurements were used to determine specific leaf area (SLA), the ratio of leaf dry weight (DW) to total DW, the ratio of DW to FW, and total DW per total LA (an estimate of photosynthetic efficiency).

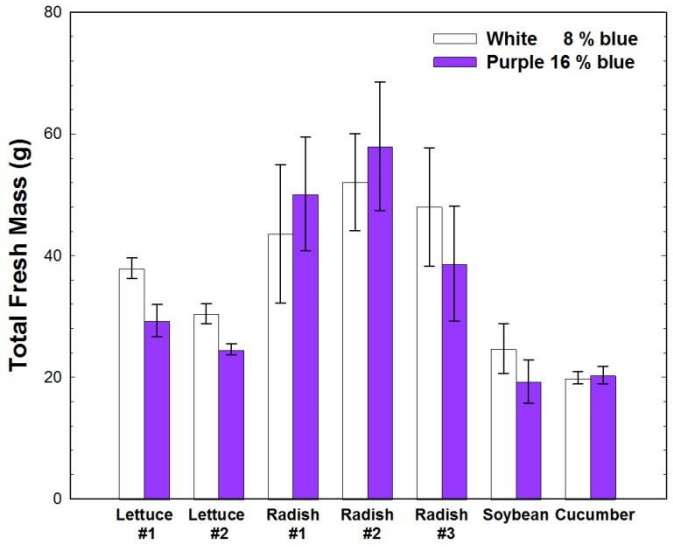
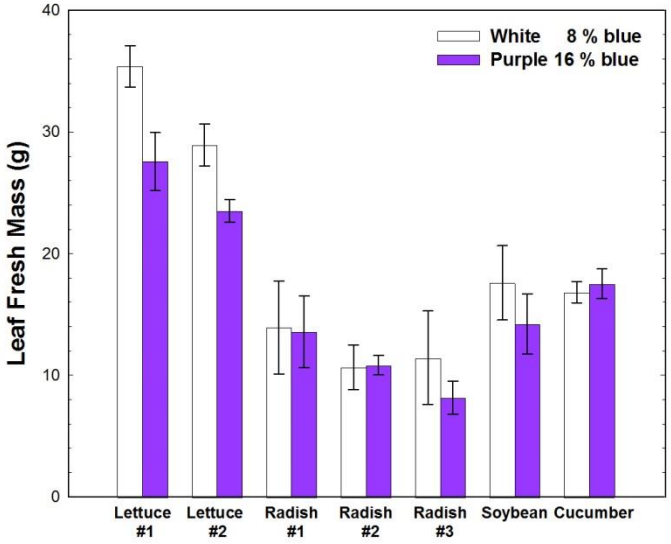



**Figure 1**

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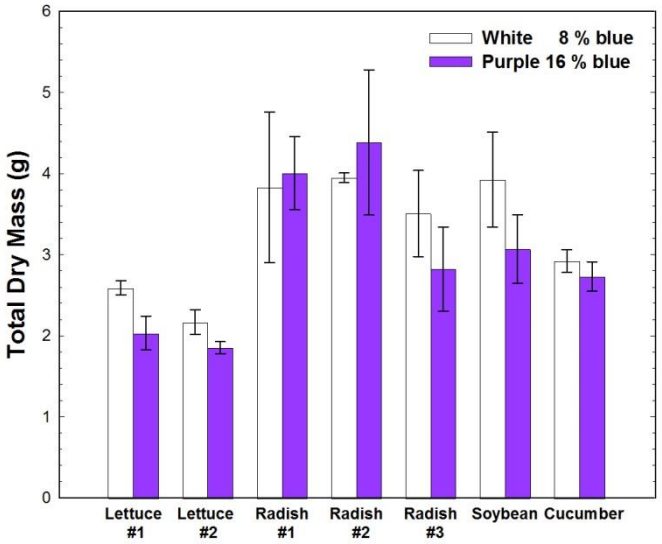


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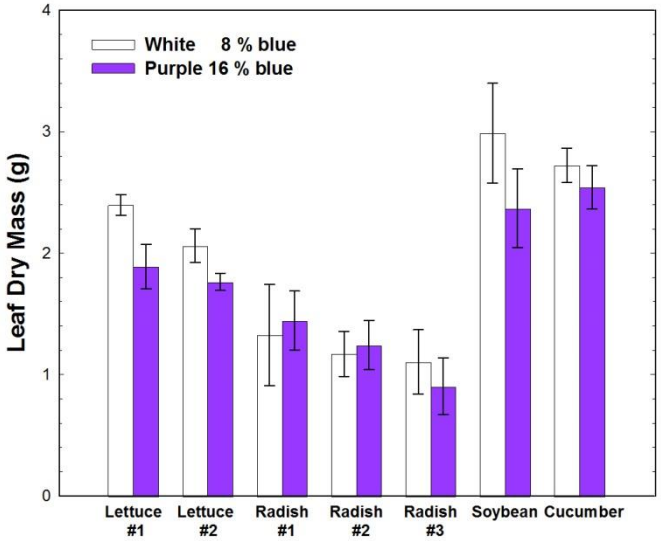


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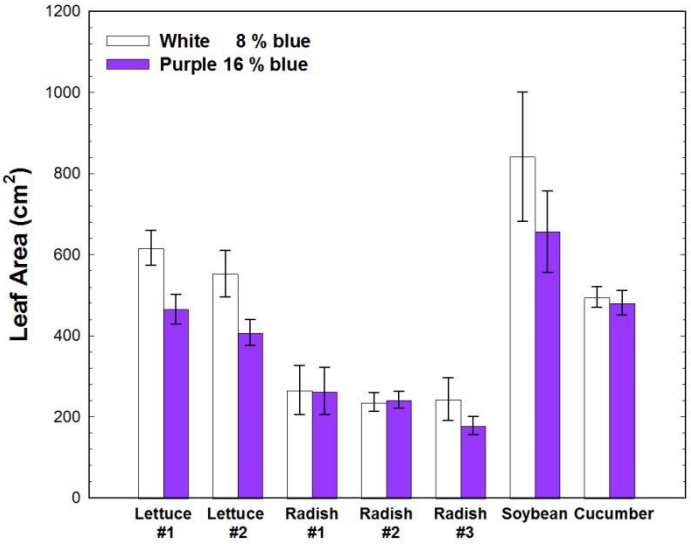


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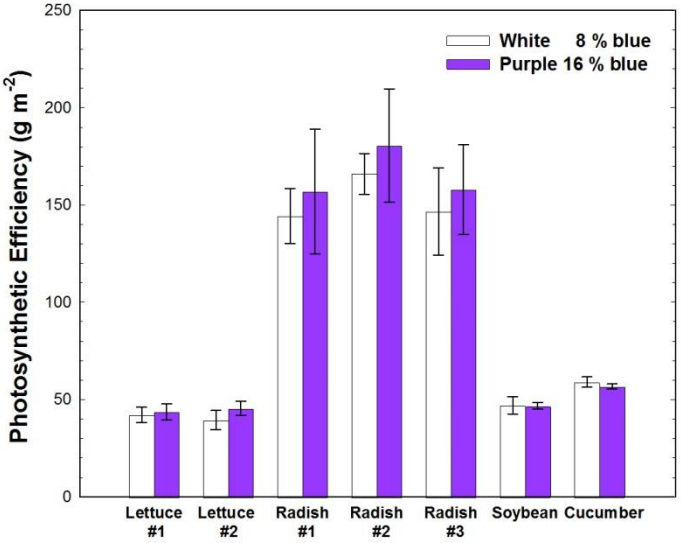


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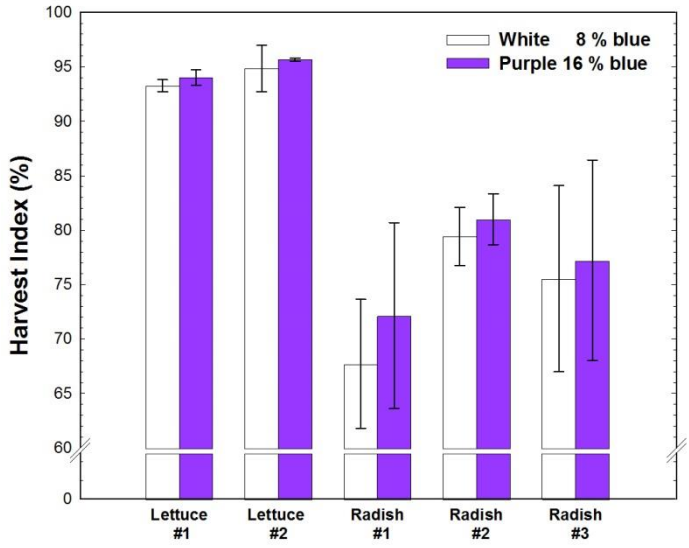


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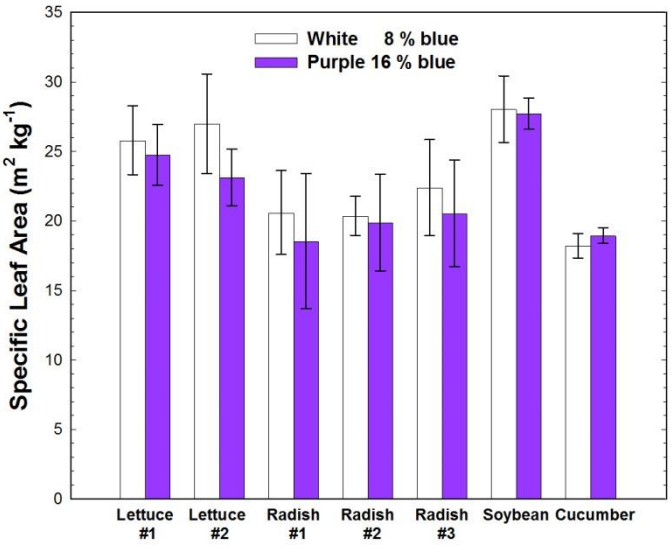


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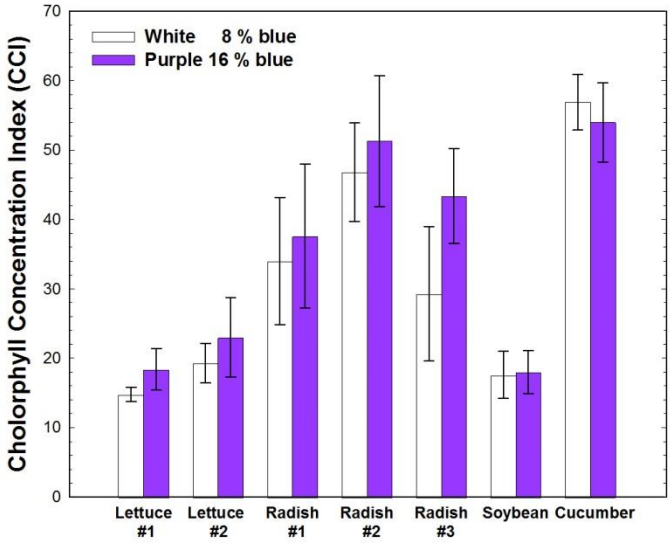


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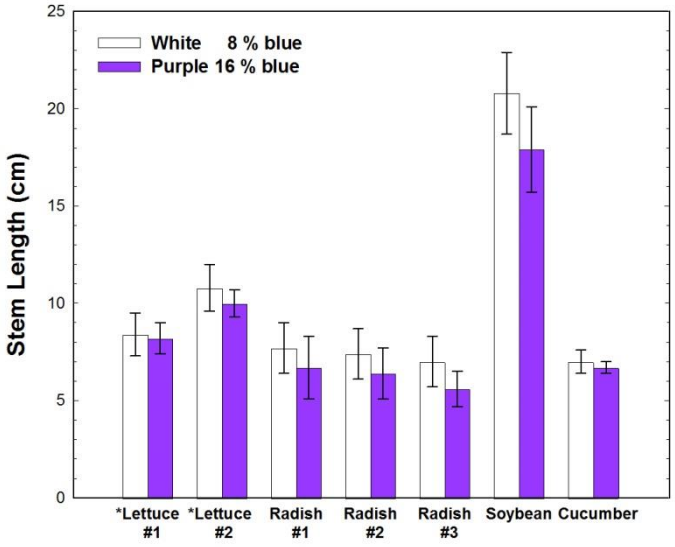


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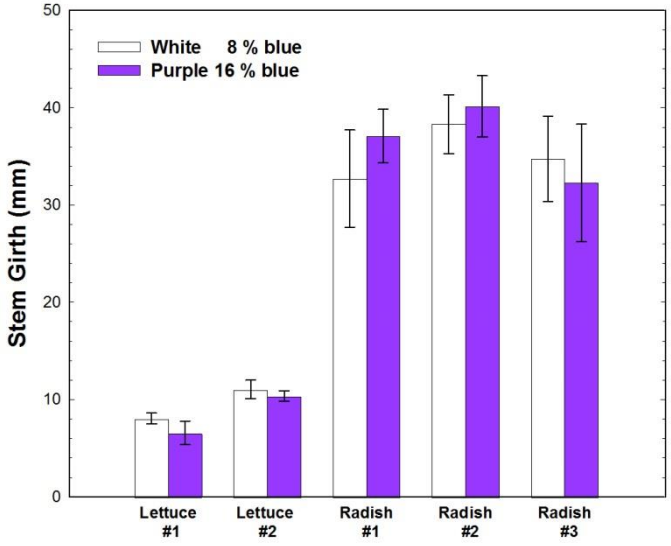


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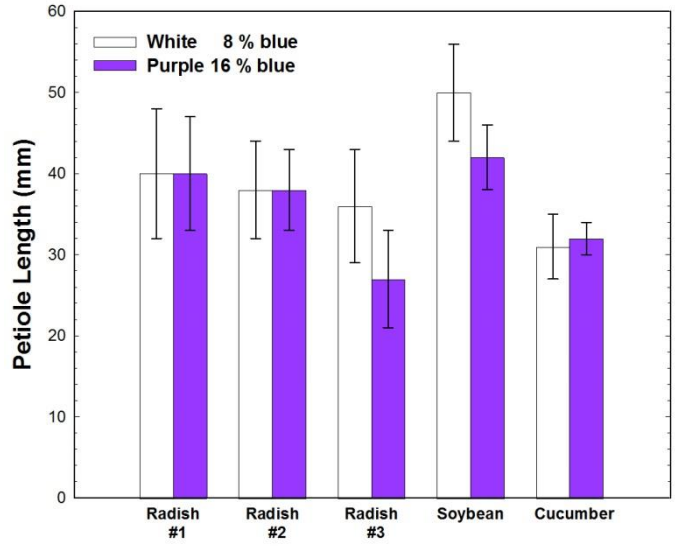


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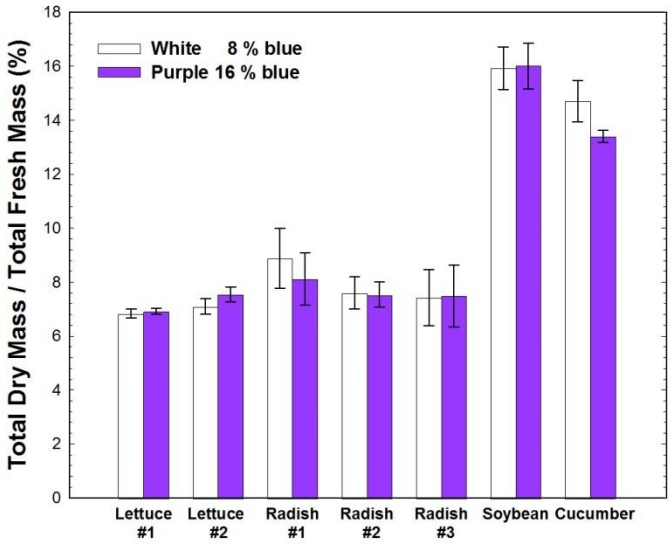


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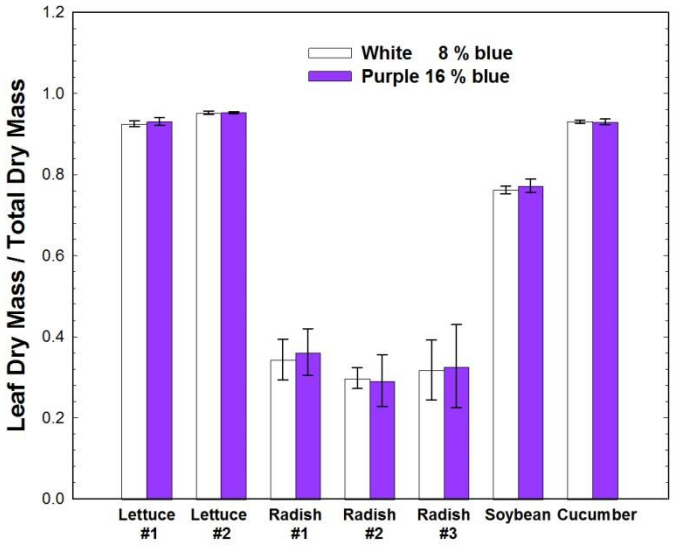


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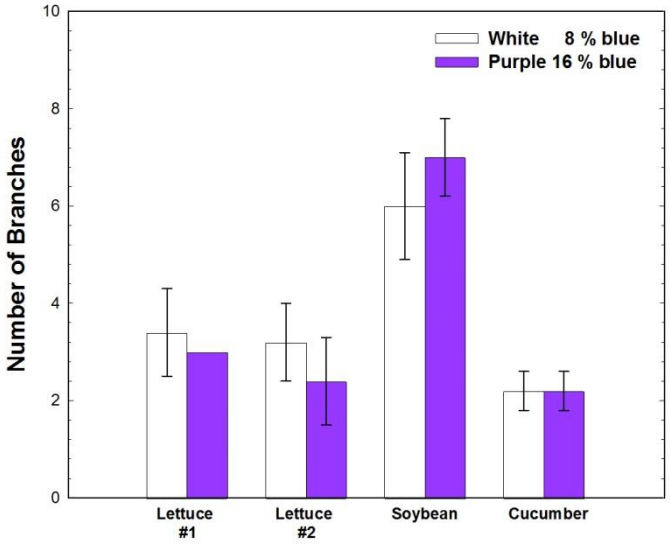


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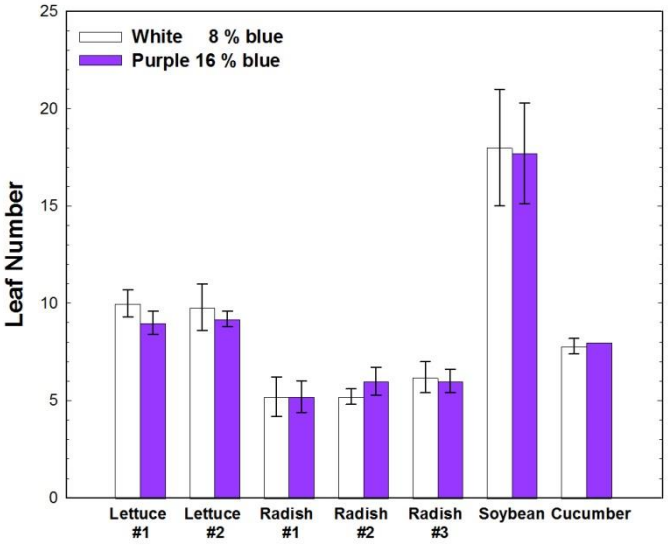


**Figure 16**