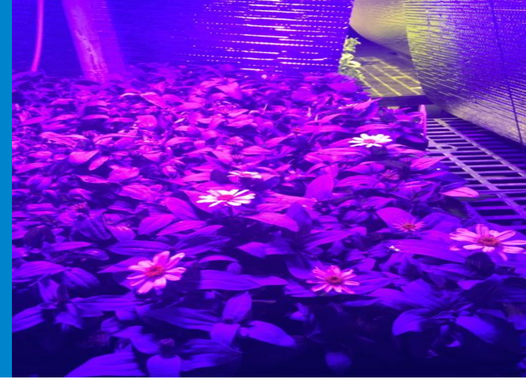
LEDs Control Growth and Flowering in Greenhouse Grown *Zinnia marylandia*

James Byrtus, Kalli Egan and Melanie Yelton
LumiGrow, Inc. Novato, California



Abstract

Using *Zinnia marylandica* as a model organism and LED lighting with independently controlled red, blue, and white light we evaluate four different light treatments in the greenhouse. In each condition natural light was supplemented with 250 µmol $m^{-2}s^{-1}$ of light. White light was provided at a constant level of 20 µmol $m^{-2}s^{-1}$ blue light was provided at 0, 20, 40 and 60 µmol $m^{-2}s^{-1}$, and red light was added to bring light to the final level of 250 µmol $m^{-2}s^{-1}$. Two additional treatments were evaluated: no supplemental lighting (NSL), and a 400 watt HPS. Results show that addition of increasing levels of blue light yielded a shorter plant, with a similar numbers of flower structures when compared to control plants grown under HPS. Results demonstrate that in the greenhouse environment supplemental light regimes can be created to control plant growth at different stages.

Materials and Methods

- *Zinnia marylandica* seeds, variety Zahara White Improved, were planted in four inch pots.
- Plants were grown in the greenhouse February - March under the following treatments:
  - No supplemental lighting (NSL)
  - 400-watt HPS (HPS)
  - 0:20:230 (Red, R)
  - 20:20:210 (Low Blue, LB)
  - 40:20:190 (Mid Blue, MB)
  - 60:20:180 (High Blue, HB)
- Measurements taken were:
  - Flowers Structures (buds + open flowers)
  - Height (mm)
  - Number of Branches
  - Above Ground Dry Mass (g) for R:S ratio
  - Root Dry Mass (g) for R:S ratio

Seed was planted into a 50% Peat and 50% sand mixture by weight. Plants were watered as needed to maintain adequate soil moisture throughout the study. Plants were fertilized using a standard Hoagland Solution on a biweekly basis with identical solution concentrations for each treatment. Ambient air temperatures and humidity were very similar throughout all of the treatments. To avoid light contamination from the treatments the light from each treatment was blocked using a reflective opaque shield. PAR measurements were taken using the LiCor LI-250A PAR meter. Light intensities were measured after darkness with only minimal ambient light from outside of the greenhouse.

Acknowledgements:
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University of California – Davis
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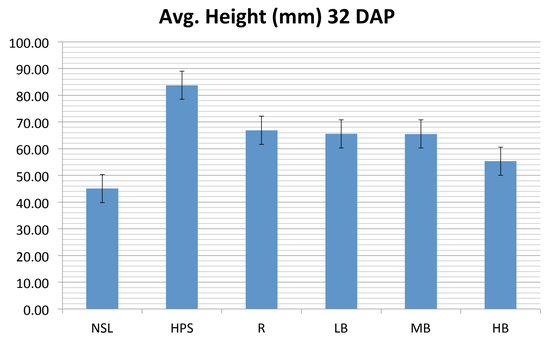
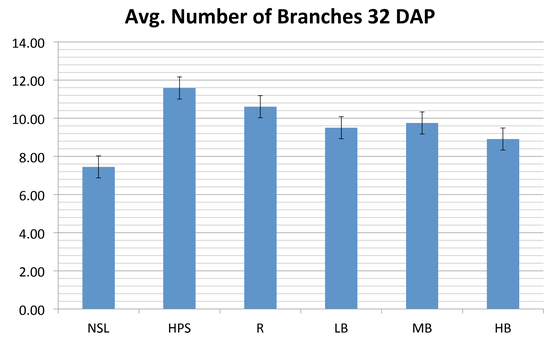
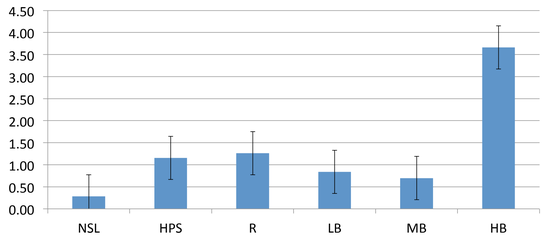
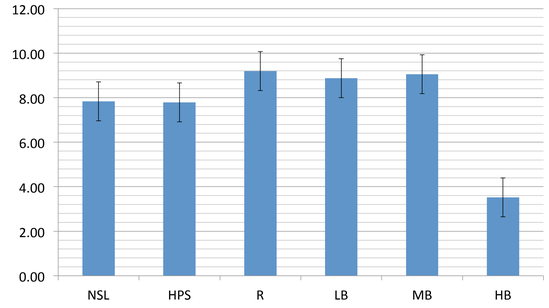
Results









Conclusion

Plant growth regulators, PGRs are commonly used to direct plant growth, generally Zinnias are sprayed at least once with PGRs when grown under traditional HPS lighting. Growers typically desire a compact plant for ease of shipped with uniform flowering. Our results demonstrate that specific light ratios can direct plant height and control time to flowering. This is clearly seen in the photograph above where using LED light ratios resulted in shorter plant with a comparable number of open flowers. For the grower and final consumer these are desired characteristics.

Also of note was the ability of high blue levels to drive root growth. This can be seen in the chart and graph above that describe the shoot to root ratio.

These experiments suggest that light ratios may be able reduce the need for PGRs to attain the desired plant characteristics for market. LED lighting could mean substantial savings to the grower — beyond the already-proven energy costs savings — in the form of reduced cost for chemicals, labor and safety equipment.