

NCERA-101: Committee on Controlled Environment Technology and Use 2024 Station Report

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Mark Lefsrud and Philip Addo, March 30, 2024

- **New Facilities and Equipment.**

The Macdonald Campus is in the process of building a new greenhouse for teaching on campus. The greenhouse is expected to be open for summer of 2024. It is planned to replace our earlier teaching greenhouse with 6 bays, headhouse and meeting room.

- **Unique Plant Responses.**

We have been doing research work on using green light to manage post harvest storage of leafy greens. Our research has show that the addition of small amounts of green light (at the light compensation point) can extend shelf life of these leafy greens by more than double and can change the quality of the produce to make it more nutritious and sweeter. More will come next year.

- **Accomplishment Summaries.**

- **3.A. Short-term Outcomes:** The differential effects of light quality and quantity are under scrutiny so that energy-efficient plant production may be optimized. This study aimed to determine the combined effects of amber (595 nm), red (635 nm), and blue (445 nm) wavelengths at different light intensities on tomato plant growth.
- **3.B. Outputs:** Mean fresh mass of tomato plants treated with amber-red light (AR) was 22% greater than plants treated with blue-amber (BA) light and 67% greater than blue-red (BR) light. Plants treated with BA exhibited 36% greater fresh mass than plants treated with BR light. Mean dry mass of plants treated with AR light was 30% greater compared to BR light, and the dry mass of plants treated with BA and BR was statistically similar. Plants grown under BR had 28% and 35% smaller leaf area compared with those grown under BA and AR, respectively. Mean height of the plants treated with AR increased by 24 and 52% compared to plants grown under BA and BR lights, respectively. Plants treated with BR light had 25 and 38% higher chlorophyll content compared to plants treated with BA and AR light, respectively.
- **3.C. Activities:** Plants were treated for 12 days with combined light-emitting diode (LED) wavelengths, at a photosynthetic photon flux density (PPFD) ranging from 232 to 1660 $\mu\text{mol m}^{-2} \text{s}^{-1}$ with a 16 h d^{-1} photoperiod.
- **3.D. Milestones:** Findings suggest that a high percentage of amber light (>75%) in a full-spectrum LED regimen may augment controlled environment crop production. Further research is ongoing with amber light and will be outlined as this work progresses.

- **Impact Statements.**

The use of amber light (595 nm) has had a major impact on the growth and development of all plant species we have tested and we hope that other will begin to use this promising wavelength.

- **Published Written Works.**

- Mansoori, M., B.-S. Wu, P. W. Addo, S. MacPherson, M. Lefsrud. 2023. Growth responses of tomato plants to different wavelength ratios of amber, red, and blue light. *Scientia Horticulturae* 322(2023):112459.
- Rahman, M. S., S. MacPherson, M. Lefsrud. 2023. A study on evaporative cooling capacity of a novel green wall to control ventilating air temperature. *Journal of Building Engineering* 77(2023):107466.
- Luo, L., X. Jiang, Y. Yu, E.R.A. Samy, M. Lefsrud, S. Sun. 2023. Eff-3DPSEg: 3D organ-level plant shoot segmentation using annotation-efficient point clouds. *Plant Phenomics* 5 (0080)
- Wu, B.-S., M. Mansoori, K. Trumpler, P.W. Addo, S. MacPherson, M. Lefsrud. 2023. Amber (595-nm) light supplemented with narrow blue (430-nm) light yields greater tomato biomass than white LEDs. *Plants* 12(13), 2457
- Addo, P.W., Z. Poudineh, M. Shearer, N. Taylor, S. MacPherson, V. Raghavan, V. Orsat, M. Lefsrud. 2023. Relationship between total antioxidant capacity, cannabinoids and terpenoids in hops and cannabis. *Plants* 12(6):1225
- Hitti, Y., S. MacPherson, M. Lefsrud. 2023. Separate Effects of Sodium on Germination in Saline-Sodic and Alkaline form at Different Concentrations. *Plants* 12(1234):1-13.
- Warner, R., B.-S. Wu, S. MacPherson, M. Lefsrud. 2023. How the distribution of photon delivery impacts crops in indoor plant environments: a review. *Sustainability* 5(5):4645.
- **Other relevant accomplishments and activities.**
Our campus was recently given a campus wide cannabis license to preform research on cannabis from seed, plant production, post harvest processing, and extraction. We are working with researchers in the medical school to use these extracts for human cell line testing.