REPORT FOR THE NCERA-101 MEETING, March 15-18, 2020

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1. New Facilities and Equipment

   We purchased a handheld Gigahetrz-Optik spectroradiometer model BTS256-EF that can measure illuminance (photopic, scotopic, melanopic), PAR, spectrum, light color, color rendering index, and flicker (range: 360 nm to 830 nm). We also purchased a neutral density filter attachment for our integrating sphere that allows us to measure higher intensity lighting fixtures.

2. Unique Plant Responses

   Yuan Li observed increased frost protection for basil plants grown in a floating hydroponic system and supplied with a Si amended nutrient solution.

3. Accomplishment Summary

   We continue to evaluate a variety of lamps for light output, light distribution and power consumption using our 2-meter integrating sphere and a small darkroom. We evaluated the spectral output of a variety of lamp technologies and compared various waveband ratios with sunlight. We are continuing our work on a comprehensive evaluation of ventilation strategies for high tunnel crop production. We are continuing our work on the evaluation of energy use in commercial greenhouses and comparing the information to model-based predictions. We started work on life cycle assessments of supplemental lighting systems. A variety of outreach presentations on the engineering aspects of high tunnels, greenhouse production, and energy consumption have been delivered at local and out-of-state venues.

4. Impact Statement

   Nationwide, Extension and NRCS personnel and commercial greenhouse growers have been exposed to research and outreach efforts through various presentations and publications. We estimate that this information has led to improved designs of controlled environment plant production facilities and to updated operational strategies that saved an average sized (1-acre) business a total of $30,000 in operating and maintenance costs annually. Greenhouse energy conservation presentations and written materials have been prepared and delivered to local and regional audiences. Greenhouse growers who implemented the information resulting from our research and outreach materials have been able to realize energy savings between 5 and 25%.

5. Published Written Works

   Dissertation:

   Li, Y. 2020. The effects of Silicon on hydroponically grown lettuce, bok choy, and basil. Rutgers University Libraries. 218 pp.

   Journal articles:

   Li, Y., A.J. Both, C.A. Wyenandt, E.F. Durner, and J.R. Heckman. 2019. Applying Wollastonite to soil to adjust pH and suppress powdery mildew on pumpkin. HortTechnology. https://doi.org/10.21273/HORTTECH04391-19. 10 pp.

   Lewus, D. and A.J. Both. 2019. Using computational fluid dynamics (CFD) to improve high tunnel ventilation. Accepted for publication in Acta Horticulturae. GreenSys, Angers, France.

   Manning, T.O. 2019. Energy modeling in greenhouses: Suitability and utility for specific applications. Accepted for publication in Acta Horticulturae. GreenSys, Angers, France.

   Shelford, T., C. Wallace, and A.J. Both. 2019. Calculating and reporting key light ratios for plant research. Accepted for publication in Acta Horticulturae. GreenSys, Angers, France.

Extension publication:

Both, A.J., K. Demchak, E. Hanson, C. Heidenreich, G. Loeb, L. McDermott, M, Pritts, and C. Weber. 2019. High tunnel production guide for raspberries and blackberries. Available at: https://www.tunnelberries.org/

Trade article:

Both, A.J. 2019. Revisiting the measurement of light. GLASE Technical Article Series. Available at: https://glase.org/

6. Scientific and Outreach Oral Presentations

Mattson, N. and A.J. Both. 2020. Greenhouse lighting costs. Webinar hosted by the GLASE project. February 20.

Both, A.J. 2020. High tunnel design and control. Abstract in the Proceedings of the 65th New Jersey Agricultural Convention and Trade Show. February 4. Atlantic City, NJ. pp. 48-52.

Lewus, D.C. and A.J. Both, 2020. Using CFD to improve high tunnel ventilation. Abstract in the Proceedings of the 65th New Jersey Agricultural Convention and Trade Show. February 4. Atlantic City, NJ. pp. 47.

Both, A.J. 2019. Hydroponics: Benefits and risks. Presentation for Annie's Project workshop: Farming in New Jersey's Cities and the Urban Fringe. December 17. New Brunswick, NJ.

Both, A.J. 2019. Rutgers FlexFarm. Presentation for the Rutgers University Research Ideation Forum. December 12. New Brunswick, NJ.

Both, A.J. 2019. Greenhouses: An overview. Department of Veterans Affairs Medical Center. May 3. East Orange, NJ.

7. Other Relevant Accomplishments and Activities

Grant funding

Both, A.J. and X. Morin. 2020. Establishing a food system guardian network in the Northeast Corridor of the United States of America. Submission to the Rockefeller Foundation as part of the Food System Vision Prize 2050.

Awards

Lubna, F. 2020. Travel award and poster presentation prize for attending the Northeastern Plant, Pest, and Soils Conference. Poster title: Life cycle assessment (LCA) of supplemental lighting systems used for controlled environment crop production. January 6-9, Philadelphia, PA.

ASABE Standards Development Award. 2019. ANSI/ASABE S642 SEP2018, Recommended Methods for Measurement and Testing of LED Products for Plant Growth and Development. A.J. Both served on the ES-311 Committee that wrote the new standard.

Pending publications

Llewellyn, D., T.S. Shelford, Y. Zheng, and A.J. Both. 2020. Measuring and reporting lighting characteristics important for controlled environment plant production. Refereed conference proceedings article to be presented at the upcoming LightSym meeting in Malmö, Sweden (June).

Shelford, T., A.J. Both, and N.S. Mattson. 2020. A greenhouse daily light integral control algorithm that takes advantage of day ahead market electricity pricing. Refereed conference proceedings article to be presented at the upcoming LightSym meeting in Malmö, Sweden (June).

Shelford, T. and A.J. Both. 2020. Plant production in controlled environments. Book chapter submitted for review to ASABE for a new textbook aimed at undergraduate engineering students. 28 pages.

Both, A.J. 2020. Crop irrigation. Contribution to the 19th edition of the Ball Redbook. 4 pages.

Both, A.J. 2020. Glazing. Contribution to the 19th edition of the Ball Redbook. 6 pages.