

REPORT FOR THE NCERA-101 MEETING, April 15-18, 2018

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1. New Facilities and Equipment

As part of a new undergraduate course that focuses on controlled environment crop production, we equipped a 1,600 square foot section in the NJAES Research greenhouses with three different growing systems: Horizontal and vertical hydroponics as well as geponics. Students are growing a variety of crops in these systems and portions of the harvests are sold to University Dining Services.

2. Unique Plant Responses

Yuan Li continues to work on the effects of Silicon amendments to the nutrient solution used for hydroponically grown leafy greens.

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 dark room. We published a paper that proposes the use of a standardized product label for lighting products used in horticultural applications. We are working on a comprehensive evaluation of ventilation strategies for high tunnel crop production. We are working on an evaluation of energy use in commercial greenhouses and comparing the information to model-based predictions. 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. It is estimated that this information has led to proper designs of controlled environment plant production facilities and to updated operational strategies that saved an average sized (1-acre) business a total of \$20,000 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 30%.

5. Published Written Works

Book chapters:

Both, A.J. and J.E. Faust. 2017. Light transmission: The impact of glazing material and greenhouse design. Chapter 6 in *Light Management in Controlled Environments* (R. Lopez and E.S. Runkle, eds.), Meister Media Worldwide, Willoughby, OH.

Fisher, P., A.J. Both, and B. Bugbee. 2017. Supplemental lighting technology, costs and efficiency. Chapter 8 in *Light Management in Controlled Environments* (R. Lopez and E.S. Runkle, eds.), Meister Media Worldwide, Willoughby, OH.

Both, A.J., J.M. Frantz, B. Bugbee. 2017. Carbon dioxide enrichment in greenhouses. Chapter 9 in *Light Management in Controlled Environments* (R. Lopez and E.S. Runkle, eds.), Meister Media Worldwide, Willoughby, OH.

Runkle, E. and A.J. Both. 2017. Delivering long-day lighting – Technology options and costs. Chapter 10 in *Light Management in Controlled Environments* (R. Lopez and E.S. Runkle, eds.), Meister Media Worldwide, Willoughby, OH.

Refereed journal articles:

- Hernández, C.P., H.A. Imbuzeiro, L.D. Pimentel, P.J. Hamakawa, and A.J. Both. 2018. Morphological, physiological and nutritional effects of irrigation frequency on Macaúba palm seedlings. *Journal of Agricultural Research* 10(4):24-36.
- Roy, I., Y. Naumova, and A.J. Both. 2018. Assessment of electricity-free hydroponics in India: A proof of concept field study. *Journal of Agricultural Research* 10(1):45-55.
- A.J. Both, B. Bugbee, C. Kubota, R.G. Lopez, C. Mitchell, E.S. Runkle, and C. Wallace. 2017. Proposed product label for electric lamps used in the plant sciences. *HortTechnology* 27(4):544-549.

Refereed conference proceedings:

- Ishii, M., L. Okushima, H. Moriyama, S. Sase, N. Fukuchi, T. Maruo, and A.J. Both. 2017. Evaluating environmental conditions in open-roof greenhouses. *Acta Horticulturae* 1170: 897-904.

Trade journal article:

- Both, A.J., N. Mattson, and R. Lopez. 2018. Utilizing supplemental and sole-source lighting in urban crop production environments. *Produce Grower*. March issue. pp. 12-14.

6. Scientific and Outreach Oral Presentations

- Both, A.J. 2018. Presented six one-hour lectures during the 3.5-day NRCS workshop titled *Implement Energy Efficiency Upgrades in Greenhouses*, Orlando, FL.
- Specca, D. and A.J. Both. 2018. Organized a two-day short course titled *Greenhouse Crop Production for Beginning Farmers*. Bordentown, NJ. D. Specca and A.J. Both delivered presentations and hosted tours.
- Both, A.J. 2018. Lighting research at Rutgers. Presentation during the *Horticultural Lighting Meeting* hosted by the Next Generation Lighting Industry Alliance and the DOE.
- Both, A.J. 2017. Introduction to innovations in greenhouse technology. Presentation during the annual meeting of the NJ Farm Bureau. Princeton, NJ.
- Both, A.J. 2017. High Tunnels. Presentation during the Center for Environmental Transformation short course titled *Soil and Season Extender Training for Urban Gardens*, Camden NJ.
- Both, A.J. 2017. LED lighting. Presentation and panel discussion during the Indoor AgCon meeting, Philadelphia, PA.
- Both, A.J. 2017. HPS or LED? Presentation during the Canadian Greenhouse Conference. Niagara Falls, Canada.
- Callahan, C., T. Manning, D. Ciolkosz, and A.J. Both. 2017. Organized a three-day NRCS workshop titled *Introduction to Farm Energy Analysis*, Bordentown, NJ. T. Manning and A.J. Both delivered presentations and hosted tours.

7. Other Relevant Accomplishments and Activities

- Lewus, D. 2018. Spent three months working in the lab of Professor In-Bok Lee in Seoul, South Korea to learn computational fluid dynamics (CFD) techniques. David will use CFD analysis to evaluate high tunnel ventilation strategies as part our participation in the USDA-NIFA-SCRI project titled TunnelBerries (<https://www.tunnelberries.org/>).
- Both, A.J. 2017. GLASE Consortium (Cornell University, Rensselaer Polytechnic Institute and Rutgers University; <https://glase.cals.cornell.edu/>).

Pending publications

- Brumfield, R.G., L.B. Kenny, A.J. DeVincentis, A.K. Koeser, S. Verlinden, A.J. Both, G. Bi, S.T. Lovell, and J.R. Stewart. 2018. Economic analysis of growing *Petunia x hybrida* in a greenhouse production system using alternative containers. Submitted to *HortScience*.
- Li, Y., C.A. Wyenandt, A.J. Both, and J.R. Heckman. 2018. Applying Wollastonite to soil to suppress powdery mildew on pumpkin. In preparation.