RUTGERS
New Jersey Agricultural Experiment Station

REPORT FOR THE NCERA-101 MEETING, April 19-21, 2023

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1. New Facilities and Equipment
   We have expanded the use of LED lighting in several sections of the NJ Ag Experiment Station Research Greenhouse. Installed fixtures were purchased from Fluence, General Electric, and P.L. Light Systems.
2. Unique Plant Responses
   None.
3. Accomplishment Summary
   We continue to evaluate a variety of lamp fixtures for light output, light distribution and power consumption using our 2-meter integrating sphere and a small darkroom. We completed a comprehensive evaluation of ventilation strategies for high tunnel crop production (David Lewus). We are continuing our work using life cycle assessment tools to assess the environmental impacts of switching from high-pressure sodium lighting to LED lighting (Farzana Afrose Lubna).
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 $25,000 in operating and maintenance costs annually. Energy conservation and crop lighting presentations as well as written materials on controlled environment crop production techniques 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

   Dissertation:

   Lewus, D.C. 2023. Simulation of high tunnel ventilation using computational fluid dynamics. Ph.D. Dissertation. Rutgers University Libraries. 189 pp.

   Book chapters:

   Both, A.J. 2022. Greenhouse energy efficiency and management, Chapter 11. In *Regional Perspectives on Farm Energy* (D. Ciolkosz, Ed.). Springer, Switzerland. pp. 85-93. https://link.springer.com/book/10.1007/978-3-030-90831-7

   Both, A.J. 2022. On-farm energy production – Solar, wind, geothermal, Chapter 12. In *Regional Perspectives on Farm Energy* (D. Ciolkosz, Ed.). Springer, Switzerland. pp. 95-105. https://link.springer.com/book/10.1007/978-3-030-90831-7

   Refereed journal articles:

   Lewus, D.C. and A.J. Both. 2022. Using computational fluid dynamics to evaluate high tunnel roof vent designs. AgriEngineering 4(3), 719-734; https://doi.org/10.3390/agriengineering4030046

   Lubna, F.A., D.C. Lewus, T.J. Shelford, and A.J. Both. 2022. What you may not realize about vertical farming. Horticulturae 8(4), 322. https://doi.org/10.3390/horticulturae8040322

   Refereed conference proceedings articles:

   Brumfield, R.G., M. Flahive Di Nardo, A.J. Both, J. Heckman, A. Rowe, R. VanVranken and M. Bravo. 20xx. Online workshop empowers women farmers to manage business risk during the pandemic. Accepted for publication in Acta Horticulturae.

   Llewellyn, D., T.J. Shelford, Y. Zheng, and A.J. Both. 2022. Measuring and reporting lighting

characteristics important for controlled environment plant production. Acta Horticulturae 1337:255-264. https://doi.org/10.17660/ActaHortic.2022.1337.34

Shelford, T., A.J. Both, and N. Mattson. 2022. A greenhouse daily light integral control algorithm that takes advantage of day ahead market electricity pricing. Acta Horticulturae 1337:277-282. https://doi.org/10.17660/ActaHortic.2022.1337.37

Trade journal article:

Shelford, T. and A.J. Both. 2023. Lighting: The design phase. *Consider six vital factors when designing sole-source or traditional greenhouse lighting*. Produce Grower, April issue.

6. Scientific and Outreach Oral Presentations

Both, A.J. 2023. Different controlled environment crop production systems. Annie Goes Online: Risk Management on Your Kitchen Table. Annie's Project of New Jersey. February 22. (webinar)

Lewus, D. 2023. Can we improve high tunnel ventilation? 68th New Jersey Agricultural Convention and Trade Show. February 7.

Both, A.J. 2023. High tunnel construction. 68th New Jersey Agricultural Convention and Trade Show. February 7.

Both, A.J. 2023. High tunnel control with sensors. 68th New Jersey Agricultural Convention and Trade Show. February 7.

Both, A.J. 2023. Humidity control. GLASE Short Course on Climate Control. February 2. (webinar)

Both, A.J. 2023. Overview of agrivoltaics. Webinar series: Planning with Agrivoltaics in Mind. Hosted by Penn State University, Cornell Cooperative Extension, and the Farm Bureaus of PA and NY. January 19. (webinar)

Both, A.J. 2023. Energy efficiency in greenhouse operations. Greenhouse Grower School, Cornell Cooperative Extension of Orange County. January 18. (webinar)

Both, A.J. 2023. How can you reduce your greenhouse energy bill? Long Island Greenhouse and Floriculture Conference. Riverhead, Long Island. January 17.

Both, A.J. 2022. Environmental sensors 101. Indoor Ag Science Café (USDA-SCRI project OptimIA). Columbus, OH. November 15. (webinar)

Both, A.J. 2022. Strategies to reduce greenhouse energy costs. GLASE Summit. Ithaca, NY. November 8.

7. Other Relevant Accomplishments and Activities

ADVANCEA: Advancing controlled environment agriculture through data-driven decision making and workforce development.

Starting in the fall of 2022, the USDA-NIFA Specialty Crop Research Initiative program funded the ADVANCEA project. This $3.7M, 4-year project is co-led by Chieri Kubota (The Ohio State University) and A.J. Both. The team consists of researchers from The Ohio State University, Rutgers University, Cornell University, and the University of Arizona. Commercial team members include Koidra, Inc. and Hort Americas.

Agrivoltaics

NJ has ambitious renewable energy goals and has a history of promoting photovoltaics. A logical option would be to allow for more solar farming. However, solar farming typically takes the land out of agricultural production. In a small and densely populated state like NJ, that is a less attractive option. Raising the photovoltaic panels on taller posts and reducing their density would allow for a combination of agricultural production and electricity generation with photovoltaic panels. The NJ Agricultural Experiment Station and the state legislature have provided over $2M of funding to a team of researchers to develop a number of research and demonstration facilities at various university farms across the state. Construction started in the spring of 2023. In addition, the team worked with collaborators from Delaware State University, American Farmland Trust, and the National Renewable Energy Laboratory to secure a $1.6M research grant from the U.S. Department of Energy (FARMS).