



REPORT FOR THE NCERA-101 MEETING, April 6-8, 2025

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Graduate students: Farzana Afrose Lubna, Keiya Satoh

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1. New Facilities and Equipment

None to report.

2. Unique Plant Responses

None to report.

3. Accomplishments

a. Short-term outcomes

- As part of a USDA-funded multi-institutional research project (ADVANCEA), hydroponic lettuce trials were conducted in the NJAES Research Greenhouse to evaluate the impact of mechanically induced air movement on the occurrence of tipburn.

b. Outputs

- A collaboration with researchers at Cornell University resulted in a peer-reviewed scientific publication on life cycle assessment and techno-economic analysis of plant factories.

c. Activities

- As part of a collaboration with Cornell University (GLASE Consortium), we are continuing work on testing lighting fixtures for horticultural applications.
- We are continuing work using life cycle assessment tools to assess the environmental impacts of switching from high-pressure sodium lighting to LED lighting (Farzana Afrose Lubna).
- As part of the multi-institutional ADVANCEA project, we are continuing work on hydroponic lettuce production in an NFT system (Keiya Satoh).
- In collaboration with regional and national partners, we are performing research trials involving agrivoltaic systems installed at three university research farms across New Jersey.

d. Milestones

- Within the next year, we plan to complete a M.S. thesis (Keiya Satoh) and a Ph.D. dissertation (Farzana Afrose Lubna).
- Within the next year, we plan to publish another peer-reviewed publication about our life cycle assessment work.
- Within the next six months, we plan to present several conference proceedings papers about our agrivoltaics work.

4. Impact Statement

Nationwide, Extension personnel, commercial greenhouse growers, college students, and the public at large have been exposed to research and outreach efforts through various presentations and publications. It is estimated that the information provided has led to improved designs and retrofits of controlled environment plant production facilities and to updated operational strategies that saved an average sized (1-acre) greenhouse operation on average \$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, regional, and national audiences. Greenhouse growers who implemented the information resulting from our research and outreach materials have been able to realize energy savings of between 5 and 30%.

5. Published Written Works

Refereed journal articles:

Menon, R., A.J. Both, and F. You. 2025. A life cycle assessment and techno-economic analysis of plant factories. *Journal of Cleaner Production*. <https://doi.org/10.1016/j.jclepro.2025.144741>

Refereed conference proceedings article:

Both, A.J., B. Bamka, T. Besançon, D.P. Birnie, III, C. Burgher, D. Giménez, S. Guran, M. Kornitas, P. Nitzsche, D. Robinson, W.R. Rucker, E. Schoolman, D. Specca, K.P. Sullivan, D.L. Ward, M. Westendorf, and C.A. Wyenandt. 2025. Lessons learned from three agrivoltaic installations in New Jersey. Accepted for Publication. 2024 Agrivoltaics World Conference, Denver, CO.

6. Scientific and Outreach Oral Presentations

Both, A.J. 2025. Agrivoltaics 101. 70th New Jersey Agricultural Convention and Trade Show. February 5.

Both, A.J. 2025. Greenhouses for homeowners and gardeners. Home Gardeners School, Rutgers Office of Continuing Professional Education. March 15.

Both, A.J. 2024. Measuring and controlling light. Cultivate'24. July 13.

7. Other Relevant Accomplishments and Activities

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

In addition to ongoing research projects at The Ohio State University, Rutgers University, Cornell University, and the University of Arizona that include participation from commercial team members Koidra, Inc. and Hort Americas, the team is offering an online 14-week (two contact hours per week) introductory course on environmental control for greenhouse crop production. Approximately 40 participants are enrolled and the course is offered during the spring 2025 semester (completion date: April 10, 2025). For more information: <https://www.ceaforum.org/>

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 \$3M of funding to a team of faculty and staff to develop R&D facilities at three university farms located across the state. The systems installed include single-axis trackers (with a pivot point of 8 feet above the ground, with bifacial panels attached in the 1P (portrait) or 2P orientation, and with row spacings of 32 or 34 feet) and a vertical bifacial system (with a clearance height of 2 or 4 feet and row spacings of 20 or 40 feet). The total installed capacity is just over 500 kW. 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) for research and outreach activities involving the three R&D facilities at Rutgers University. During 2024 growing season, our research trials included hay production, beef-cattle grazing, growing specialty crops (tomato, pepper, and eggplant), and soybean. These trial will be repeated in 2025 and, at one of the sites, augmented with a trial involving another specialty crop (spinach). For more information: <https://agrivoltaics.rutgers.edu/>