



REPORT FOR THE NCERA-101 MEETING, March 23-26, 2024

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1. New Facilities and Equipment

As part of the ADVANCEA project, we are converting a compartment of the NJ Ag Experiment Station Research Greenhouse for lettuce production in an NFT system. The available HPS fixtures were rearranged to increase the uniformity of their output. Additional sensors are being purchased, including an infrared camera, RGB camera, canopy temperature sensor, and flow sensors to record energy consumption. Several sensors will wirelessly transmit recordings to the Argus control system, which will make data available to Koidra's AI platform for processing, optimization, and returning recommendations for future control system settings.

2. Unique Plant Responses

Work performed as part of a NASA grant showed that lettuce roots growing in rockwool and exposed to an electric field associated with the electrostatic deposition of nutrient solution do not perform well. This challenge can be overcome by proper shielding of the rooting medium making the electrostatic deposition a potential solution for nutrient solution delivery in low- or zero-gravity environments.

3. Accomplishments

a. Short-term outcomes

- Our research on the ventilation efficiency of free-standing high tunnels showed there is little additional benefits of installing a roof vent opening in addition to roll-up side wall openings.

b. Outputs

- We completed a project on electrostatic spraying of the nutrient solution onto rockwool growing media. The project resulted in a patent application and a peer-reviewed scientific publication.

c. Activities

- 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).
- We are continuing work on hydroponic lettuce production in an NFT system.
- We are continuing work on agrivoltaics at three university research farms across New Jersey.

d. Milestones

- Within the next six months, we plan to start conducting hydroponic lettuce experiments in a greenhouse as soon as the experimental system is completed.
- Within the next year, we plan to publish at least two peer-reviewed publications about our life cycle assessment work.
- Within the next six months, we plan to publish a scientific paper about our agrivoltaics work.

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

Patent application:

Singer, J., S.R. Pejman, A.J. Both, D. Specca, and M.J. Grzenda. U.S. Application 18/236,765 filed on August 22, 2023. Title: Plant-safe electro-spray water and nutrient delivery system.

Refereed journal articles:

Sereshkeh, S.R.P., B. Llumiquinga, S. Bapatla, M.J. Grzenda, D. Specca, A.J. Both, and J. Singer. 2024. Staticaponics: Electro-spray delivery of nutrients and water to the plant root zone. *Journal of Electrostatics* 128: article 103902. <https://doi.org/10.1016/j.elstat.2024.103902>

Brumfield, R.G., D. Greenwood, M. Flahive DiNardo, A.J. Both, J.R. Heckman, R. Govindasamy, N. Polanin, A.A. Rouff, A. Rowe, R. VanVranken, and S. Arumugam. 2023. A risk management training program designed to empower urban women farmers. *HortScience* 58(11):1291-1296. <https://doi.org/10.21273/HORTSCI17305-23>

Refereed conference proceedings article:

Brumfield, R.G., M. Flahive Di Nardo, A.J. Both, J. Heckman, A. Rowe, R. VanVranken and M. Bravo. 2023. Online workshop empowers women farmers to manage business risk during the pandemic. *Acta Horticulturae* 1368:315-321. <https://doi.org/10.17660/ActaHortic.2023.1368.40>

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. 2024. High tunnel and hoop house construction. 69th New Jersey Agricultural Convention and Trade Show. February 7.

Both, A.J. 2023. Supplemental lighting technology for crop production. *Cultivate*'23. July 15.

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 13-week (two contact hours per week) introductory course on environmental control for greenhouse crop production. Approximately 130 participants are enrolled and the course is offered during the spring 2024 semester.

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 researchers to develop R&D facilities at three university farms located across the state. Two of the three installations are currently exporting power to the local utility grid and the third one is expected to be online by the start of the 2024 growing season. 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.

Retirement

After 36 years of service, Dr. Robin Brumfield, Professor and Extension Specialist in Farm Management and member of the Department of Agricultural, Food, and Resource Economics at Rutgers University has retired and received emeritus status.