THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Paul C. and Edna H. Warner Endowment Fund for Sustainable Agriculture
Interdisciplinary Grant Program for On-Farm Research

Report Form

Project Title: Design Tool for Shallow Geothermal-Assisted Season Extension for Ohio Farmers

Summary (Describe your project, its objectives and results in one or two sentences)

This project sought to quantify the heating and cooling benefits of a pilot shallow geothermal earth-to-air heat exchange (EAHX) system for season extension in a high tunnel and to monitor the impacts on soil thermal reserves of operating the system 24/7. It also sought to improve the flexibility of the EAHX spreadsheet-based design tool for use at other sites.

What was done? (One paragraph describing the goals, experiments and how they were performed)

Additional soil temperature sensors were installed at the site of the pilot EAHX system at Oaks and Sprouts Limited in Urbana, Ohio and the EAHX was run under 24 hr/day operation for most of March 2023- present. This allowed us to observe seasonal changes to soil temperature and the differences in soil temperature adjacent to the EAHX tube and at 6ft distance at the same depth.

What were the results? (One paragraph on the outcome of the experiments, what was learned from them)

The additional sensing allowed us to observe the higher temperature fluctuation in the soil directly adjacent to the EAHX compared to the soil 6ft distance. We also observed how the air temperature and relative humidity was transformed between entering and leaving the EAHX. This allowed us to calculate the heating and cooling load delivered by the EAHX system in a BTU equivalent, which corresponded to a maximum cooling load approximating a ¼ ton air conditioning system, and a heating load equivalent to 4 gallons of propane per week for the first four weeks of fall. The additional heating provided by the system also allowed the partner farmer to continue production of tomatoes in the high tunnel until late November 2023, providing additional marketing and income opportunities.

How have the results contributed or will they contribute to sustainable agriculture? (One paragraph on how will farmers use this research information and what difference will it make on their farm?

Preliminary findings from research and monitoring were shared in July 2023 at the Annual International Meeting of the American Society of Agricultural and Biological Engineers in Omaha, Nebraska and in December 2023 at the Ohio Controlled Environment Agricultural Consortium. Additionally, a poster detailing our on-farm research efforts and community collaborations were presented at the OSU Office of Outreach and Engagement's first Engaged Scholar Symposium Event and was recognized with 3rd place in the Graduate Student Poster Competition.

Outreach and education around the further use of EAHX systems has been pursued through two outlets: a Field Day and Farm Tour demonstrating the pilot EAHX at Oaks and Sprouts Limited, coordinated by the CSA Coalition, and through a workshop at the Annual Ohio Ecological Food and Farm Association (OEFFA) Conference in February 2024. Additionally, fact sheets on (1) the background and potential of shallow geothermal systems for season extension and (2) an installation guide based on the pilot system are currently under peer review by OSU Faculty and Extension Faculty.

Finally, the results of this pilot project allowed us to attract additional local farm partners to form collaborations and strengthened our further grant applications, resulting in two ongoing funded projects from the Ohio State Energy Partners Program ($10,500 awarded), and the North Central Region USDA-SARE Graduate Student Grant Program ($15,000 awarded) to continue rigorous investigations to quantify costs and heating and cooling benefits in a controlled and experimental comparison.