NC STATE UNIVERSITY College of Agriculture and Life Sciences

2020 CALS Research Committee Equipment Grants Awards

Evaluating the Effects of Cold and Heat Damage to Plants using a Temperature Cycling Chamber

Equipment to be purchased: ESPEC Global-N Chamber (EGNZ16-7.5NWL Global-N Series Temp-only Chamber, 16 cu. ft., cascade)

PI: Gina Fernandez, Horticultural Science,

Co-PIs: Colleen Doherty, Hamid Ashrafi, Mark Hoffmann

Primary Users: Susana Mila-Lewis, David Livingston

Location: Kilgore Hall, Lab 1

Climate resilience is needed for sustained agricultural crop production. The increasing incidence of both extreme hot and cold temperature events affect plant growth and performance in a wide range of crops. This award is for acquisition of an ESPEC temperature cycling chamber enabling researchers to gradually reduce or increase temperature to simulate a frosty night, cold day, warm night and a hot day. Temperature can change from 5°C to 20°C per minute. In addition, controlled humidity from 10 to 95% can be programmed. The chamber can accommodate large potted plants such as blueberries, caneberries and grapes.

Matching funds: 51% of total cost was provided from the John D. and Nell R. Leazar Distinguished Professorship, and contributions from individual research programs of co-PIs.

Optical Color Sorter: Enabling Diverse Research Opportunities

Equipment to be purchased: Optical Color Sorting Machine (Model: Pikasen FMS2000-Feeder)

PI: Rebecca Irwin

Primary Users: Adam Fahrenholz, Katie Jennings, Danesha Seth-Carley, Anna Stepanova, David Tarpy, Elsa Youngsteadt

Location: David Clark Labs

This equipment detects small differences in the optical properties of material using photoelectronic detection technology to sort the heterochromatic material from the target material. Currently, researchers are spending valuable time doing this sorting by hand, paying to have other labs out of state do this sorting, or not doing the sorting do to the cost associated with the available methods. This equipment purchase will advance CALS research by allowing faculty to measure more response variables in genetic and breeding studies, determine critical factors controlling weed population biology in agricultural systems, identify key factors related to pest resistance, and determine appropriate pollen diets for bees and their medicinal properties. This award will purchase an Optical Color Sorter from Satake Vision

Systems Operation, Stafford, TX, USA. The model is a Pikasen FMS2000-Feeder with full color RGB camera (0.14mm pixel resolution) and a vibratory feeder system which provides gentle sorting of more delicate material, such as pollen pellets, relative to a cascade feeder system. The user interface is touch screen, and outputs downloaded to computers can include a variety of data such as numbers and proportions of color accepted or rejected, etc. If a researcher needs multiple colors sorted, the material can be run through the machine multiple times, with color re-programming between runs. The machine has the capability of running 4000 pounds of material per hour, comes on roller wheels and has a small footprint which allows for easy placement in a lab and/or linear equipment room (only needs about the space a stand-up refrigerator or freezer requires).

Matching funds: 43% of the total cost was provided by the Department of Applied Ecology. Information about capabilities, location, user material and sign-up for the instrument will be available through a link on the Applied Ecology webpage.

A Tethered Airship for High-Resolution, Long-Term Atmospheric and Environmental Monitoring in the Sky

Equipment to be Purchased: Aero Drum Ltd Aerostat, 10 kg payload ellipsoid shape

PI: Chadi Sayde

Co-PIs: Sierra Young, Lingjuan Li

Location: Expected near-continuous deployment on main campus or research farms.

Access to the aerostat: PI/co-PIs will build and manage a website containing an online signup form. The website will also include basic information on the system capability and limitations, as well as training videos and material on proper operation and maintenance of the system. The requests will be assessed for suitability and safety by the Pi/Co-PIs who will work with other users on providing shared access to the system.

Access to the generated data: If data are being collected at a shared location, for example the NCDA or NCSU research farms, all basic weather data will be shared with personnel working at that site through the system website.

Aerostats, or lighter-than-air aircraft, are well-suited for extended-term environmental monitoring tasks. They are safer, more stable, require less power, sustain high wind, and are capable of extended operation compared to other aircraft. The aerostat will serve as a deployment system for environmental sensors to gather valuable data across a wide range of disciplines, which can be categorized into atmospheric data and terrestrial data. The primary and first use-case of this system will be to deploy actively heater fiber optic (AHFO) cables along the aerostat tether for collecting environmental data, primarily temperature and wind speed, at thousands of locations continuously (every 0.1 m, every 1 s along the suspended AHFO cables). Additionally, the aerostat will deploy air quality sensors for measuring pollutants, such as PM, CO, NO2, and O3, within air volumes and at altitudes that are otherwise inaccessible. The aerostat will also be capable of deploying LIDAR and image sensors, including RGB and multispectral cameras, at the base of the system with a focus on precision agriculture, including estimating yield, crop health, and stress. While immediately useful as a research tool, the aerostat system has potential as an educational and outreach tool. A real-time monitoring station can be built that will be capable of sending aerostat data to a website that can be accessed by any NCSU personnel for integration into coursework.

Matching funds: 17% of acquisition costs and year 1 maintenance was provided (with additional $6,000 in service contract support from the Dept. of Biological and Agricultural Engineering for years 2-6 and $10,650 in sensors and payload equipment from the PI and co-PIs that will be available for use with the instrument).

Printing better plants: Acquisition of a 3D bioprinting system to facilitate innovative research in plant sciences

Equipment to be Purchased: CELLINK BIO X 3D Bioprinter

PI: Ross Sozzani

Co-PIs: Tim Horn, Rohan Shirwaiker, Michael Daniele

Primary Users: Terri A. Long, Anna Stepanova, Jose Alonso, Christine Hawkes, Candace Heigler, Rubén Rellán Álvarez, David Muddiman, Anna Locke, Marcella Rojas-Pierce, Colleen Doherty, Deyu Xie, Mike Kudenov, Cranos Williams.

Location: 2nd floor Thomas Hall, Sozzani Lab

Cell deposition with high throughput, high accuracy, and real-time material interchangeability via 3D bioprinting has nearly limitless applications, allowing for the implementation of both bottom-up and top-down experimental approaches. Bottom-up experiments can be used to gain an understanding of mechanisms such as cell-to-cell signaling, positional cues and geometrical structure. Using 3D bioprinting, all of these parameters (cell type, cell density, cell position, and geometrics) can be explored and optimized to maximize plant regeneration. Top-down experiments can be used to solve specific problems by testing model-informed parameters such as material choice. Since plant growth and biomass is largely determined by spatial signals that control cell proliferation and differentiation, cutting edge 3D bioprinting technology can be utilized to precisely deposit cells layer-by-layer and study the cell-to-cell communications and positional cues underlying plant growth. Researchers will be able to investigate fundamental relationships between biomaterials, bioprinting processes, and functional quality attributes of engineered tissues using computational and experimental approaches across a broad spectrum of length-scales, processing principles, and biomaterials.

Matching funds: 46% of the total budget was provided by 10 faculty members (PI and primary users) and as well as in-kind assistance to save $2,900 in installation charges.

Accelerating Post-Harvest Research through Improved Monitoring of Curing and Drying Conditions for Specialty and Field Crops

Equipment to be Purchased: Temperature and Humidity Monitoring Equipment drying/curing chambers. HOBO thermocouple data loggers, temperature sensors, software, base station and required accessory connectors and installation supplies.

PI: Matthew Vann

Co-PIs: Charlie Cahoon, Ralph Dewey, Grant Ellington, Cathy Herring, Anders Huseth, Katie Jennings, Ramsey Lewis, Rachel Vann, Jonathan Schultheis, David Suchoff, Lindsey Thiessen, Alex Woodley, Location: Central Crops Research Station. Dr. Matthew Vann’s research team will administer a dryer calendar that is visible to those faculty with relevant projects.

With expanded research effort, existing facilities and resources have exceeded capacity – particularly for post-harvest curing and drying of crops such as industrial hemp, sweet potato, and tobacco. To address this research and extension limitation, the PI will purchase new temperature and humidity monitoring equipment that will be used for small-scale post-harvest curing and storage research at Central Crops Research Station located in Clayton, NC. User-friendly temperature and humidity monitoring systems will enable straightforward implementation of curing and storage research. To improve accessibility, each unit will be equipped with a digital screen that will report internal conditions. In addition to the curing unit control system, continuous data recording instrumentation will be integrated to evaluate curing/drying conditions within each individual monitoring unit. This project addresses a key barrier to user access through a harmonized control and data acquisition strategy that leverages ongoing investment in NC State Research Station Infrastructure against the initiative to accelerate post-harvest research through improved curing and drying monitoring capabilities for specialty and field crops.

Matching Funds: 16% of the total cost was provided as matching funds by two of the co-PIs. Dr. Grant Ellington’s team in the Department of Biological and Agricultural Engineering will be responsible for installation. Use of this equipment will require a small usage fee.