

The Georgia Envirotron: Multidisciplinary studies of plant stresses using controlled environment chambers.

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Introduction

The Georgia Envirotron is a multi-disciplinary research facility located at the Griffin campus of the University of Georgia, and available to both on and off campus researchers as well as visiting scientists. The facility comprises multiple controlled environment areas, allowing researchers to study plant/environment interactions under a variety of controlled conditions and at different scales. There are nine walk-in growth chambers (Conviron CG-72 and PGW 36) and in addition three moveable sunlit chambers are available for field research. The facility also includes eight greenhouses with temperature control and supplementary lighting, and four reach-in chambers with sub-freezing capability.

The Envirotron is available for the research projects of all UGA scientists and students that conform to the objectives and priorities of the Envirotron. We also invite collaboration with scientists from other institutions in the US and from abroad.

Reach-in Sub-zero Sunlit Chambers

Cold tolerance may be studied using the reach in chambers developed by the University of Georgia. A five ton glycol chilling unit cools four chambers with a combined floor area of 6 m². The top of each chamber has an acrylic (to be replaced with Teflon) panel to provide natural illumination; if lower temperatures are required the chambers may be brought indoors and illuminated artificially.

Reach-in chamber environmental control

Control temperature to within 2°C down to -10°C (artificial lighting)
No humidity or CO₂ control.

Research Objectives

- Multidisciplinary research -- including biological, physical, and social sciences.
- Understanding of interactions among environmental stresses -- including temperature extremes and air pollutants, and their relationships with other stresses and changes, such as water stress, pests and diseases, and enhanced CO₂.
- Integrated approach -- study how processes in the soil - plant - atmosphere continuum respond to environmental variables, with emphasis on measurements of both soil and root processes and shoot processes.
- Multiple scales -- having several controlled environment spaces allows researchers to conduct experiments at a scale most appropriate to their research needs; from plants grown in containers in the Conviron chambers, to plants grown directly in the soil within a sunlit moveable chamber.



Conviron Growth Chambers

- Each chamber provides separate control of light level, temperature, humidity and CO₂.
- Lighting is provided by a mixture of metal halide and high pressure sodium lamps.
- Dehumidification in the CG72 chambers is achieved with Cargocaire 150 dehumidifiers.
- Controllers are connected by a local area network, which is connected to the internet giving researchers real time remote access to chamber conditions.
- A system for measuring carbon dioxide exchange that includes twelve canopy chambers is available for use inside chambers.
- Additional equipment includes an ozone generator and monitors. Also available are irrigation and nutrient solution mixing pumps.



Nutrient film system with automatic environmental sensing and irrigation with nutrient solutions of different EC

Growth chamber environmental control

Conviron growth chambers have the following environmental control:

Lighting control up to 1000 $\mu\text{mol m}^{-2} \text{s}^{-1}$ PAR
Temperature control $\pm 1.0^\circ\text{C}$
Humidity control $\pm 10\%$
Carbon dioxide control $\pm 25 \mu\text{L/L}$

Sunlit Moveable Chambers

The chambers were developed by the University of Georgia, with temperature, humidity, and CO₂ control comparable to that obtained in the walk-in chambers. Each chamber covers 4 m² of ground and may be placed directly over an existing plant canopy. They are designed to be moveable yet large enough to cover a representative area of a field or research plot. The chamber panels are clad with Teflon film which transmits 95% of PAR and is relatively transparent in the infra-red. Cooling is controlled by a ten ton chiller unit.



Sunlit moveable chamber environmental control

Control temperature either to a set point or with respect to ambient within 0.5°C.
Control humidity within 5 %.
Control CO₂ within 25 $\mu\text{L/L}$

Greenhouses

There are eight greenhouses, all are 6.77 m x 7.38 m (22 x 24 ft) with temperature control supplied by ridge vents, evaporative cooling pads and gas heaters, and supplementary lighting provided by 1000 W metal halide lamps.

Management and Operation

- The facility is overseen by a committee comprised of faculty members from each department on the Griffin campus. Among other tasks, the committee approves research proposals to use the facility and allocates space within the facility.
- A dedicated facility manager is responsible for daily operation of the Envirotron, including repair and maintenance of chambers and greenhouses and the implementation of a quality assurance plan.
- In a multi-user facility, it is essential to have a formal quality assurance plan that establishes protocols for equipment maintenance and calibration, quantitative measures of data accuracy and repeatability, procedures for data collection and storage, and experimental procedures. A draft of the quality assurance plan is posted at the Envirotron web site.

Contacts

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or visit the Envirotron web site at <http://www.griffin.peachnet.edu/envirotron.html>

