# Duke University Phytotron
# Station Report to the NCR-101 Committee for 2000
# David Tremmel

## CHAMBER RENOVATIONS AND NEW CHAMBERS

The first phase of our planned major renovations and upgrades to the Phytotron – funded by an NSF facilities grant – is complete. We are now looking for funding for the next phase of these upgrades. The University also continues to plan, fund, and carry out replacements of old and failing systems in the Phytotron.

### A. Projects completed over the past year:

1. **Glycol chiller replacement (Duke funding):** Our entire glycol chiller system – which supplies cooling for all of our walk-in growth chambers – was replaced. This project necessitated a two-month shutdown of the 22 walk-in growth chambers at the Phytotron.

2. **Greenhouse glass replacement (Duke funding):** All glass panels in our six greenhouse units were replaced this summer. Panels were replaced with a low-iron glass (per original specifications) having the trade name Optiwhite. Transmission of PAR through our greenhouse glass has improved from 74% to 85% with the new glass. The only problem we have encountered is that we have been unable to get water from our roof spray system to spread out properly on the new glass.

3. **Installation of four new tall chambers (NSF funding):** A total of four new tall growth height (12 ft) chambers were installed (specifics were described in our 1997 report). One chamber has been running for a year and a half; the remaining three chambers have been installed and are awaiting testing.

4. **Beta-testing new Conviron controllers and host system:** We are in the final stages of beta-testing Conviron CMP-4050 controllers and the CCS98 host system. Both offer increased speed both for local operations and network communication. As part of our host testing, Conviron provided us with a computer with a built-in CD-RW drive and automatic back-up software. We have successfully set these up so that all of the data collected by the host system are automatically backed up to a CD at the time files are created or changed.

### B. Projects pending funding:

1. **Replacement of all 20 reach-in chambers:** In February 1999 we submitted a proposal to NSF's Major Research Instrumentation (MRI) program to replace our existing (31-year-old) reach-in growth chambers with more energy-efficient and sophisticated units. The proposal received excellent reviews, but just missed getting funded. Our proposal was not selected by Duke as one of the three allowed annually per institution for this year's MRI competition; we expect to re-apply in 2001.

## NSF SITE REVIEW

In July 1999 we submitted a renewal proposal to NSF of our Operations grant, which funds roughly one-third of the Phytotron's operating expenses. As part of the review process, NSF decided to perform an external review of our facility. Our proposal was reviewed by two NSF panels, and received very good marks from both. The review team, consisting of four NSF personnel and four external reviewers, visited the Phytotron in mid-February 2000.

While the reviewers recommended that the Phytotron needs a more formal external advisory panel and suggested that we re-evaluate our role in the ecological research community, they did recommend to approve continued operational funding for the Phytotron through April 2005. We are awaiting the final written report of the review team and NSF's final decision.

## MASS SPECTROSCOPY FACILITY

Over the past decade the mass spectroscopy facility located in the Phytotron has become widely recognized not only for its sample processing service but also for its unique ability to do on-line oxygen isotope discrimination. Experiments using this system suggest that the cyanide-resistant, alternative pathway of respiration in plants does not simply act as an overflow mechanism, but that it can be triggered in response to certain environmental conditions in mitochondria. Data from these and similar experiments have indicated that other techniques commonly used to examine the activity of this pathway may not always be valid; it was concluded that the technique developed using the Phytotron's mass spectrometry facility is the only method presently available to accurately measure alternative pathway activity.

Larry Giles, a long-time Phytotron staff member and NCR-101 participant, has been primarily responsible for running this mass spectroscopy facility since its inception. Last year he requested to relinquish his Phytotron duties so that he could devote all of his time to mass spectroscopy research. In early February 2000 Duke University created the Laboratory for Isotope Ratio Mass Spectroscopy and named Larry its Technical Director. Fortunately for the Phytotron he is still located in our building and is readily available for consultation, since he has extensive knowledge about the Phytotron and controlled environment research.

## RESEARCH

Use of the Phytotron was lower than usual in 1999 due to renovations which shut down growth chambers and greenhouses for long periods. The prevalent research topics remained the same, however, with $CO_2$ concentration (both superambient and subambient) as the most commonly used treatment factor, generally in interaction with other resources or controllers. Promising results are also being obtained from the ongoing corn breeding research program aimed at making this important crop resistant to corn rootworm using novel hybrids of corn ancestors.

## WEB SITE

The Phytotron's web site is **www.botany.duke.edu/phytotron**.

## SELECTED PUBLICATIONS


Gonzalaz-Meler, M.A., M. Ribas-Carbos, L. Giles, and J.N. Siedow. 1999. The effect of growth and measurement temperature on the activity of the alternative respiratory pathway. *Plant Physiology* 120: 763-772..

Olesniewicz, K.S., and R.B. Thomas. 1999. Effects of mycorrhizal colonization on biomass production and $N_2$ fixation of black locust (*Robinia pseudoacacia* L.) seedlings grown under elevated atmospheric $CO_2$. *New Phytologist* 142: 133-140.

Uselman, S.M., R.G. Qualls, and R.B. Thomas. 1999. A test of a potential short cut in the nitrogen cycle: the role of exudation of symbiotically fixed nitrogen from the roots of a N-fixing tree and the effects of increased atmospheric $CO_2$ and temperature. *Plant and Soil* 210: 21-32.

Ward, Joy K. and Boyd R. Strain, 1999. Elevated $CO_2$ studies: past, present and future. *Tree Physiology* 19:211-220.