

**NCERA-101**  
*Committee on Controlled Environment Technology and Use*  
**2005-2006 Annual Station Report**

**State of Ohio, USA**

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**New facilities planned or installed**

The USDA-ARS, Greenhouse Production Research Group (USDA-ARS GPRG) installed the following facilities:

Our past purchase of a walk-in growth chamber, from Environmental Growth Chambers, was installed in a new controlled environment room, renovated to house a total of eight reach-in chambers in addition to the walk-in chamber. All nine chambers have been purchased within the last 2 years and are functional. The walk-in is being retrofitted with smaller Plexiglas chambers similar to the ones in Utah State and U of Georgia.

**New/different control systems**

The OSU Biosystem Phytotron 12-chamber facility on Wooster Campus suffered significant damage from an accident that occurred during a public tour. The system was repaired and upgraded with a new computer operating system and communication software.

A prototype precision nutrient delivery system has been developed at OSU specifically for small treatment sizes required for research plots. The system is being evaluated for performance.

**Sensors and instruments**

A novel tissue preparation procedure was developed by USDA-ARS GPRG for analysis of Si in an ICP-OES that allows us to detect and quantify tissue Si at concentrations of <10 ppm dry weight and <0.1 ppm in solution.

USDA-ARS GPRG continues to develop Virtual Grower software, a decision support tool for greenhouse growers. In the last 12 months, a shade curtain feature, detailed scheduling, and additional fuel types were added. Current versions are being tested that have plant's growth reacting to set points and photoperiods, more shade curtain options, and better descriptions of infiltration. More than 1,200 copies have been distributed.

USDA-ARS GPRG and OSU Extension developed a sensor package using the NCR-101 sensor package as a model, to be used by greenhouse growers in the NW Ohio area. A line quantum sensor and dual radiation sensor (Apogee Instruments), a CO<sub>2</sub> sensor (Spectrum Technologies), hot wire anemometer (Extech), and infrared temperature sensor (Extech) have been purchased so far. This will enable greenhouse growers to spot check their environment with common instruments and enable better communication between researchers, extension agents, and stakeholders.

OSU is developing a precision whole plant photosynthesis measurement system. One of the research objectives is to establish minimum sensor sensitivity requirements for the CO<sub>2</sub> dynamics monitoring.

### **Unique plant responses**

USDA-ARS GPRG has tested 15 floriculture species for their ability to take up and accumulate Si with zinnia (1.5% dry weight) and verbena (0.8% dry weight) accumulating the most.

Effect of water barrier between light sources and plants in a chamber was evaluated at OSU. Water barriers are sometime used with artificial lighting to reduce heat load in chambers. It was found that the barrier cuts down long wave energy but does not affect PAR intensity. As a result, plant canopy temperature is lower compared to that without the barrier. Lower canopy temperature, in otherwise similar environment (e.g. air temperature, air relative humidity, and PAR level) in the chamber, is likely to reduce transpiration that may have further implications on the plant's growth and development.

### **Cooperative/Interdisciplinary Projects**

- Biomonitoring of nutritional status of bedding plants; John Gray and Scott Heckathorn, University of Toledo, Jonathan Frantz, USDA/ARS, began April, 2004.
- Determining the factors controlling sudden pH decline in geranium production; Paul Nelson, North Carolina State University, Jonathan Frantz, USDA/ARS, began May 2004.
- The use of silicon as a beneficial nutrient in bedding plant production; Lawrence Datnoff, University of Florida, James Locke, USDA/ARS, began March 2005.
- Nutrient uptake and partitioning in petunia as influenced by environment; Peter Ling, The Ohio State University, Jonathan Frantz, USDA/ARS, began March 2005.
- Determining the fate of agrochemicals in the greenhouse; Alison Spongberg, University of Toledo and Jonathan Frantz, USDA/ARS, began May 2005.
- Susceptibility of floricultural crops to viral pathogens as a function of plant nutrition; Scott Leisner, University of Toledo, James Locke, USDA/ARS, began August 2005.

- Economic evaluation and technical support of new hydroponic vegetable growers using HID supplemental lighting via personal visits and interactive web-site tools at <http://www.oardc.ohio-state.edu/hydroponics/>, Ohio State University Research & Extension, Ted Short and Mary Donnell.
- Development of a State-of-the-Art Computer-Controlled Nutrient Delivery System for Container-Grown Landscape Nursery Crop Research; Dan Herms of Entomology Department, OSU, Robert Hansen of Food, Agricultural and Biological Engineering Department, and Alec Mackenzie, Argus Control Systems LTD.

### **Workshops/Colloquia/Symposia**

- Ling, P.P. Organizer. Greenhouse Management Workshop. 2/6-7/2007. Wooster, OH.
- Ling, P.P. and J.M. Frantz Co-organizers. NCR-101 committee on controlled environments. 4/8-11/2006. Wooster, OH
- CEWG, J. Frantz, hosted ASHS colloquium entitled “Photosynthesis: from Chloroplast to Ecosystem” in New Orleans, LA, 7/2006

### **Committees and Sub-committees Served**

- Brugger, M. Associate Editor. Transactions of the ASABE
- Ling, P.P. Associate Editor. HortTechnology
- Frantz, J.M. Chair of Controlled Environment Working Group, ASHS
- Hansen, R.C. Chair: SE-406 Nursery & Greenhouse Systems Committee, ASABE

### **Publications**

- Buenrostro-Nava, M. T. P. P. Ling and John J. Finer. 2006. Comparative analysis of 35S and lectin promoters in transgenic soybean tissue using an automated image acquisition system and image analysis. Plant Cell Reports: <http://dx.doi.org/10.1007/s00299-006-0142-5>.
- Chiera, J.M., R.A. Bouchard, S.L. Dorsey, E. Park, M.T. Buenrostro-Nava, P.P. Ling, and J.J. Finer. 2007. Isolation of two highly active soybean (*Glycine max* (L.) Merr.) promoters and their characterization using a new automated image collection and analysis system. Plant Cell Reports (in print).
- Finer JJ, Beck S, Buenrostro MT, Chi Y & Ling P. 2006. Monitoring gene expression in plant tissues Using green fluorescent protein with automated image collection and analysis. In: Plant tissue culture engineering. Eds. S. Dutta Gupta and Y. Ibaraki, Springer, The Netherlands. pp. 31-46.
- Frantz, J.M., J.C. Locke, D. Pitchay. 2007. Improving the growth of calibrachoa in hanging pouches. HortTechnology. Accepted 12-2006.
- Frantz, J.M., N.N. Cometti, M.W. van Iersel, B. Bugbee. 2007. Rethinking Acclimation of Growth and Maintenance Respiration of Tomato in Elevated CO<sub>2</sub>: Effects of a Sudden Change in Light at Different Temperatures. Accepted 2-2007. J Plant Ecology.

- Gazula, A., M.D. Kleinhenz, P.P. Ling, and, J.C. Scheerens. 2007. Transplanting date effects on anthocyanin concentrations in nine lettuce (*Lactuca sativa*) cultivars and relationships among anthocyanin levels and instrumented and visual assessments of color. HortScience (in print).
- Hansen, R.C., J.C. Christman and R.C. Derksen. 2006. Statistical evaluation of instruments designed to measure volumetric water content of soilless container media. *Applied Engineering in Agriculture* 22(5): 753-763. .
- Kondo, N., N. Kazuhiko, N. Kentaro, P.P. Ling, and M. Mitsuji. 2006. An illumination system for machine vision inspection of agricultural products. ASABE Paper No. 063078. St Joseph, Mich: ASABE.
- Ling, P.P. 2006. Tips for the upcoming winter season. *Resource*. Volume 2(8):5. Ohio State University Extension and Agricultural Business Enhancement Center. Bowling Green, OH.
- Ling, P.P., C. Pasian, and M. Jones. 2006. Tightening up your Greenhouse to Save Energy: The Horticultural Considerations. GM Pro. Volume 26(8):74:79.
- Omer, M., J.C. Locke, J.M. Frantz. 2007. Using leaf temperature as a non-destructive procedure to detect root rot stress in geranium. Accepted 2-2007. HortTechnology.
- Pitchay, D.S., J. Frantz, J.C. Locke, Krause, C.R. 2007. Impact of nitrogen supply on uptake, utilization, growth, and development of begonia and New Guinea impatiens, and susceptibility of begonia to *Botrytis cinerea*. 132:193-201.
- Rofkar, J.R., D.F. Dwyer, J.M. Frantz. 2007. Analysis of arsenic uptake by plant species selected for growth in northwest Ohio by ICP-OES. Accepted 12-2006, Communications in Soil Science and Plant Analysis.
- Takahashi, Noriko, Peter P. Ling, and Haruhiko Murase. 2006. Prediction of Panicle Silica Content Under Elevated Atmospheric Carbon Dioxide Concentration Using a Neural Network Model. Proceedings of Bio-robotics III 3<sup>rd</sup> IFAC International Workshop on Bio-Robotics, Information Technology and Intelligent Control for Bioproduction Systems, Japan. September 9-10. pp. 112-116.
- Zhu, H., J. Frantz, C. Krause. 2007. Investigation of Drainage and Plant Growth from Nursery Container Substrate. Journal of Agricultural Engineering and Horticulture. Accepted 12-2006.

#### **Internet sites of interest**

- Hydroponics: <http://www.oardc.ohio-state.edu/hydroponics/>
- Virtual Grower: <http://www.ars.usda.gov/Research/docs.htm?docid=11449>

#### **Announcements**

- Retirement: Dr. Michael Brugger (2006); Dr. Robert Hansen (2007)
- July 14-17, 2007 Columbus Ohio (USA): **OFA Short Course**. Info: <http://ofa.org/>