NCR-101 Purdue Report for 2001

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Facilities. The Department of Horticulture & Landscape Architecture (HLA) has continued to expand and improve the building and control systems of the new plant-growth facility.. Ten Percival AR-75L chambers were installed in the Whistler Agricultural Research Building and can be monitored and controlled remotely from the manager's office in the Horticulture Greenhouse 200 yards away using Norton PCAnywhere (version 8.0) software--a first according to Percival Scientific. Though located in 4 separate rooms, the chambers are networked and controlled using PACES software that was designed by Watlow Electric Manufacturing Company for use with their series 982 microprocessors. We hope to purchase new software being developed by Percival called Intellus, which reportedly will be web-based and much easier to use than the PACES software. Each 2-tiered chamber has 19 ft^2 (1.77 m^2) of growing space, with fluorescent and incandescent lighting, and evaporative-pan humidification. These chambers complete the School of Agriculture's installation of a 33-chamber facility funded by the National Science Foundation and matching funds from the University, co-managed by the greenhouse managers of the HLA and Botany Departments.

HLA has taken several steps to improve the longevity of the chambers. We have purchased extended-warranty agreements with Conviron and Percival to provide parts and labor for repairs until the end of 2002. The cost was approximately 10% the value of the chambers, and has proven cost effective as unforeseen problems with the site, such as poor water quality and problem components from the chamber vendor have required many repairs. We have arranged for Purdue Facility Services to conduct this warranty-authorized repair work, ensuring that we have a well-trained mechanical crew when the costs of repair are our responsibility. In addition, we pay for these mechanics to provide routine maintenance to the chambers every 6 months, and have trained our staff to conduct daily, weekly, monthly, and quarterly maintenance and cleaning routines.

A 3,400 ft^2 (316 m^2) greenhouse structure was built attached to the east corridor of our Nexus ridge-and-furrow design glass greenhouses. The new structure was designed to simulate commercial greenhouse and nursery environments, with 14 ft (4.3 m) polycarbonate sidewalls and double layer, UV-resistant polyethylene film roof. The structure was meant to be a long-term facility--not often the case with commercial sites--so was built with a 0.6-meter gravel base, a central sidewalk, concrete foundation walls, electric and hydronics utilities as well as independent tap water and fertilizer water plumbing. The heating and cooling equipment is controlled by a Wadsworth Envirostep Controller rather than the Priva system that controls the rest of the facility, though a redundant Priva sensor was installed for page-out alarming and calibration. Our comparison of the two sensors indicated the Wadsworth sensor is much slower to respond due to a lead-polymer encasement around the sensor. We replaced the sensor with one customized by Wadsworth for faster response and improved measurement and control.

Control Systems. We upgraded our Priva software to the newly-released Windows 95-environment Version 9.0 in November, 2000; only the second facility in the United States to have installed it. The new software gives the excellent control of the former QNX-based system while adding easier use, expanded graphics, and more flexible programming. Worth noting is the pesticide control program for ventilation following a fumigation and the custom-control feature that allows for any output to be activated from any input being measured, the latter being a powerful research tool for investigators.

Technologies. Two technologies worth noting include the installation of a Trueleaf/Biotherm supplemental, bottom-heat system in our mist propagation greenhouse and a custom-made photoperiod system in our poinsettia-growing greenhouses. The bottom heat system controls six zones of heating independently across the greenhouse benches, opening hot water valves as needed to maintain programmed temperature as measured by soil probes. The system is intefaced to the existing Priva computer, for graphing, remote-control and alarming capability. Germination period has been reduced for most species due to the heated soil, allowing for faster flow of material through this multi-user area. The photoperiod system allows 2-3 individual benches to be covered, so that the greenhouse can be split into two

photoperiods for accurate flowering timing. Since we could not find a vender that designs such systems for individual benches, we built the system using Ludvig-Svensson ULS Obscura A&B fabric suspended from curtain track designed for use on theater stages.

Activities. The plant-growth facility manager attended the 2001 Association of Educational and Research Greenhouse Curators annual conference, and plans on hosting the group at Purdue University in August 2002. Consultations included three facilities who visited our facility design in preparation for their own construction projects: Clemson University, The University ofIllinois, and the Donald Danforth Plant-Science Center. We designed a web page for use by the general public, other facility operators and department staff at www.hort.purdue.edu/hort/facilities/greenhouse/HGRH.htm. The site has complete descriptions and pictures of the facility and equipment, along with policy manuals and request forms for our users. Technical enquiries regarding the Purdue facility should be directed to Plant-Growth Facilities Manager Rob Eddy at eddy@hort.purdue.edu.

- **Plant Responses.** Attempts to develop a reliable, repeatable mutant screen for the responsivity of growth to mechano-stimulation using *Arabidopsis thaliana* on a scale required to screen hundreds of thousands of insertional mutants were frustrated by greenhouse environments, most probably variable irradiance and day temperature falling outside the range of optimal sensitivity for the growth/stress response. Although plants accumulated 4-6 times more dry weight in a standardized, HID-lighted growth room (PPF=123-150 μmol• m^{-2}• s^{-1}, temp=22°C) than in a shaded, fan-and-pad-cooled greenhouse, growth response to stress still was problematic. Static impedance treatments actually stimulated rosette expansion, whereas rolling and/or brushing treatments had inconsistent effects on plant growth. Some combination of PPF, spectral quality, air currents, and growth habit likely account for failures to get uniform growth responses to mechanical stress needed in the growth room on the extensive scale needed for mutant screening.

Publications.

Frantz, J., R. Joly, and C. Mitchell. 2001. Intracanopy lighting reduces electrical energy utilization by closed cowpea stands. Life Support & Biosphere Sci.7:283-290.
Frantz, J., R. Joly, and C. Mitchell. 2000. Intracanopy lighting influences radiation capture, productivity, and leaf senescence in cowpea canopies. J. Am. Soc. Hort. Sci. 125:694-701.