Purdue University

NCR-101 Station Report for 2004

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Facilities. Purdue University's School of Agriculture is expanding its multi-user Plant-Growth Center. Since 1999, the Center has accommodated 33 plant-growth chambers in three campus buildings, with a daily recharge rate of $0.20/ft^2/day. This year, 31 additional growth chambers of various makes and ages have been moved to common-use areas and will be serviced and managed by the Center at a recharge rate of $0.07/ft^2/day. This charge will cover pest scouting and control, sanitation, access to growth supplies, parts/repairs, and refrigeration maintenance twice annually. Also to be "folded in" to the Center are 30 fluorescent light racks with three shelves per rack and a greenhouse with 530 ft^2 of bench space. The greenhouse has thirty 400-watt metal halide lamps and will be upgraded from a step controller to a Priva environmental control system. The expanded Center will increase longevity of equipment and usage.

Control Upgrades. The Priva software at the Horticulture Greenhouse was upgraded to Windows-based Priva Office 2.17, which improves interface, programming and graphing. One feature is the ability to control environments remotely using a Compaq Ipaq handheld computer with a CDMD cell phone card installed. Priva software allows a telnet session without graphics, but—working with a colleague at the Danforth Plant Science Center—we were able to achieve fully functional, remote operation using a service subscription to GoToMyPC remote control software. Any operation that could be done from the Priva host computer on campus (including overriding equipment) now can be done anywhere in the country where a cell-phone signal is available, greatly improving our alarm response. The Plant Growth Facilities Manager demonstrated this to colleagues in the Missouri Botanical Garden in St. Louis while attending the annual meeting of the Association of Education and Research Greenhouse Curators, titled "The Greenhouse and Beyond" last July. We also use this same remote control capability with the handheld computer on our Conviron growth chamber host computers on campus.

We tested a way to improve longevity of refrigeration solenoids designed to switch up to 3 million times per year. Our refrigeration mechanics had replaced several in 2002. Conviron technicians downloaded new code into one chamber's software that increased the cycle time of cooling and heating solenoid valves from 10 to 15 seconds. Although this theoretically increased temperature error from 0.1C to 0.3-0.4C, we did not observe such an increase. Temperature control that precise is not required for a majority of our chamber experiments. Since we did not replace any additional solenoid valves in the unmodified 22 Conviron models in 2003, the procedure may be unnecessary.

Automation. In the Horticulture Greenhouse, a poinsettia crop was grown for the National Poinsettia Cultivar Trials using automated irrigation triggered by accumulated sunlight. Rooted cuttings were potted in late August and hand watered until placed on a drip system with final plant spacing on October 10. A single, pinched plant was used per 6.5-inch azalea-style pot using Pro-Mix soilless mix. Initially, the Priva computer activated irrigation every 100,000 micromols/m^2 of accumulated sun, or 90 hours, whichever came first. For reference, a sunny summer day's worth of accumulation is

about 50,000 μmol/m^2. The 90-h maximum was required because pots dried by evapo-transpiration even if cumulative sunlight had not reached the irrigation trigger level. As the crop grew, more frequent irrigation was necessary. From December 1 to crop termination , the irrigation trigger was 38,000 μmol/m^2, or 55 hours. The researcher in charge, Allen Hammer, felt this was the best crop of poinsettias we have produced in the facility and credited the irrigation programming for much of that quality.

New Materials. Also in the greenhouses, we tested a new cellulose pad for our evaporative cooling system. The Mi-T-edg® by Munters has a black-colored protective coating on the interior side of the pad that is reported to reduce deposits of minerals and algae growth. The composition of the coating is proprietary, but is non-porous, quick drying, and makes the pad edge harder, so it can't be readily chipped or damaged by cleaning. Our ground-water quality results in hard mineral deposits and also reduces effectiveness of algaecides. Unsightly algae and minerals build up, reducing longevity and cooling capacity. Compared with the non-coated pads in the rest of our greenhouses--even brand new ones installed at the same time--the Mi-T-edg® pad stayed the cleanest. We will replace all our pads with this product over the next three years.

Observations. In a greenhouse assigned for Advanced Life Support crop testing by the Mitchell lab, the outer glass envelop encasing a metal halide lamp used for supplemental lighting cracked, and part of the lower glass fell away, creating a "hole" in the bulb that exposed soybean plants on the bench to short-wavelength UV from the still-energized arc tube. This "holey radiation" caused severe russeting and subsequent abscission of upper-canopy leaves. Mutually shaded, inner-canopy leaves remained green and healthy. It was not until peanut and basil plants on an adjacent bench also started showing burn symptoms that we realized the damage was coming from a hole in the still-functioning MH lamp. Though no visible light was being emitted, the exposed arc tube continued to emit damaging UV onto the affected plants, effectively scorching everything in a 7' radius. We now check often for broken MH bulbs.

Other troubleshooting concerns occurred in one of our recently renovated EGC walk-in growth chambers, where we were trying to grow hydroponic lettuce. Soon after germination, the seedlings developed purple spotting and sluggish growth, both signs of environmental stress. These symptoms disappeared when we moved the hydropnic units to the greenhouse. We systematically traced those symptoms back to the "all-plastic" humidifiers that we requested during chamber renovation. When water from the humidifier kettles was analyzed by ICP spectrometry, high concentrations of copper and zinc were found, though the water feeding the humidifiers was building RO water and was ion-free. Upon disassembly, we found small brass screws, copper wires holding the filter in place, and galvanized motor housing-all corroded by the RO water! The University's high-quality-water specialist explained that the more pure the water, the more aggressive it becomes, and when our building switched to RO, we switched from a problem of having salt build-up to a problem of corrosion. Even the polished aluminum walls of the chamber have become permanently clouded from attacks of the RO water. To partially mitigate this problem, we have coated all metal parts of the humidifier with a two-part epoxy paint designed for aquatic environments. Also, any connection parts that

could be were replaced with plastic fittings. So far, the new lettuce crop looks much healthier.

New Technology. The Mitchell lab working on the development of two novel LED-based plant lighting systems in collaboration with our partners at Orbitec (Madison. WI). Both lighting systems are designed to minimize energy input into CEA plant growth by applying light only where there is plant tissue, and to irradiate all plant tissue. One system will consist of intracanopy (IC) "lightcicles" that hang within the canopy of planophile crops and switch on in pace with stand height. The IC system will reconfigure into a second lighting system that will form a close-canopy (CC) "glowplate", illuminating in roughly concentric rings close above rosette or erectophile crops as plants expand horizontally. Target date for the first IC prototype system is April 1, 2004.

Cultivar Selections. Additional work commencing in the Mitchell lab focuses on cultivar selection and cultivation methods for ALS target herbs, basil, and mint, as well as berries. We are beginning to examine strawberry cultivar productivity and yield comparisons. Dwarf blueberries and cranberries are not presently on the ALS candidate species list, although research has shown that their antioxidant benefits might strongly mitigate some effects of space radiation, so we have decided to examine dwarf cultivars of small fruits for "ever-bearing" potential and productivity. Cranberries would have the additional benefit of adding a new flavor – tart – to the ALS dietary pallet. Stay tuned on the soon-to-be-released Mitchell lab website for details!

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