

## 2011 NCERA-101 Station Report - University of Maryland

### 1. Impact Nuggets:

As previously reported in 2010, Maryland is leading a Specialty Crops Research Initiative (SCRI) Grant to investigate Precision Irrigation and Nutrient Management for Nursery, Greenhouse and Green Roof Systems, using Wireless Sensor Networks. The SCRI-MINDS project is a 5-year project funded by USDA-NIFA and brings together scientists, engineers and economists from five universities (Maryland, Carnegie Mellon, Georgia, Colorado State and Cornell) and two companies (Decagon Devices and Antir Software), to develop and deploy smart sensor networks for specialty crop growers, and provide producers with real-time information to make better irrigation decisions every day. Full activity reports for years 1 and 2 can be accessed from <http://smart-farms.net/impacts>

#### A. Engineering Research and Development: (Carnegie Mellon University and Decagon Devices, as part of overall SCRI grant led by University of Maryland)

- We have developed a wireless node with the ability to monitor and control irrigation events both with powered devices (nR5) and non-powered latching solenoids (nR5-DC).
- We have developed a sophisticated software interface (Sensorweb) that allow growers to implement both schedule-based, set-point and mode-based control strategies, with the ability to update nR5 nodes in the field in real-time, over the internet.

#### B. Nursery and Greenhouse Research: (University of Maryland)

- We have implemented nR5 control in field (tree nursery), pot-in-pot nursery and greenhouse environments; we are currently testing various control strategies, comparing water applications between grower-operated irrigation regimes and set-point control.
- We are quantifying leaching, water savings and growth differences in *Acer rubrum* (Red Maple), *Cornus florida* (Dogwood), *Betula nigra* (River Birch) and *Antirrhinum majus* (Snapdragon) experiments
- We have started experimentation with the new Decagon GS3 (Electrical conductivity sensor) in these production environments, with a view to integrating real-time EC monitoring into irrigation control strategies.
- We have made significant progress on quantifying sensor variability in these production environments, to optimize sensor number and placement.

#### C. Green Roof Research: (University of Maryland)

- Continued green roof stormwater runoff model parameterization and verification with 2 years of data from an instrumented green roof platform (n=16) installation at UM.
- We are continuing with the validation of this stormwater model with a large-scale instrumented green roof at UM-Baltimore County.

#### D. Economic and Environmental Benefits Team: (University of Maryland)

- We have developed and are currently analyzing a large national irrigation and water use survey
- We are gathering further industry-specific information on irrigation/disease management, economic importance of reductions in water cost/disease losses, willingness to pay for sensors; development of specific farm cost-benefit analyses; case-studies.

## 2. New Facilities, Equipment, Personnel Changes:

University of Maryland Research Greenhouse Complex shade cloth replacement: Ranges A and B had new shade/heat retention cloth installed, completing the shade replacement for the entire greenhouse in 2011. Material used was Flame-retardant Revolux XLS15R with 50% shade factor.

The eight Environmental Growth Chambers at the Research Greenhouse Complex have had replacement C5 controllers installed over the past year. The new controller units are furnished with MS Windows XP-Embedded SP2 with 1 MB memory and an 8 GB Flash Drive, which replaces the originally-installed Windows 2000 Professional operating systems. This controller set-up is the latest offering from EGC.

The Norton-Brown Herbarium at the University of Maryland has a new curator:

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## 3. Publications and Presentations

### Book Chapters

1. Lea-Cox, J. D. 2012. Using Wireless Sensor Networks for Precision Irrigation Scheduling. Chapter 12. *In: Problems, Perspectives and Challenges of Agricultural Water Management*. M. Kumar (Ed.) InTech Press. Rijeka, Croatia. pp. 233-258. (Open Access at <http://www.intechopen.com>)

### Refereed Papers

1. Ghimire, S.R., P. A. Richardson, P. Kong, J. Hu, J. D. Lea-Cox, D. S. Ross, G. W. Moorman and C. X. Hong. 2011. Distribution and diversity of *Phytophthora* species in nursery irrigation reservoir adopting water recycling system during winter months. *J. Phytopathology* 159:713-719.
2. Hong, C.X., P. A. Richardson, W. Hao, S. R. Ghimire, P. Kong, G. W. Moorman, J. D. Lea-Cox and D. S. Ross. 2012. *Phytophthora aquimorbida* sp. nov. and *Phytophthora taxon 'aquatilis'* recovered from irrigation reservoirs and a stream in Virginia, USA. *Mycologia*. Doi:10.3852/11-055.
3. Kong, P., J. D. Lea-Cox and C. X. Hong. 2012. Effect of electrical conductivity on survival of *Phytophthora alni*, *P. kernoviae* and *P. ramorum* in a simulated aquatic environment. *Plant Pathology* Doi: 10.1111/j.1365-3059.2012.02614.x.
4. Kong, P., J. D. Lea-Cox, G. W. Moorman and C. X. Hong. 2012. Survival of *Phytophthora alni*, *P. kernoviae* and *P. ramorum* in a simulated aquatic environment at different levels of pH. *FEMS Microbiology Letters* 332: 54–60.

### Conference Proceedings

1. Chappell, M., M. van Iersel, E. Lichtenberg, J. Majsztrik, P. Thomas, J. Ruter and S. Wells. (2012). Benefits of Precision Irrigation of *Gardenia augusta* 'Heaven Scent'<sup>™</sup>: Reducing Shrinkage, Shortening the Cropping Cycle, and Economic Impact. *Proc. Southern Nursery Assoc. Res. Conf.* 57:321-323.
2. Kim, J., B. Belayneh and J. D. Lea-Cox. 2012. Estimating daily water use of snapdragon in a hydroponic production system. *Proc. Southern Nursery Assoc. Res. Conf.* 57:336-340.

3. Lea-Cox, J. D, B. Belayneh, J. Kim and J. C. Majsztrik. 2012. The Value of Weather Data for Daily Nursery Management Decisions. *Proc. Southern Nursery Assoc. Res. Conf.* 57:87-93.
4. Lea-Cox, J. D., A. G. Ristvey, D.S. Ross and G. Kantor. 2011. Wireless Sensor Networks to Precisely Monitor Substrate Moisture and Electrical Conductivity Dynamics in a Cut-Flower Greenhouse Operation. *Acta Hort.* 893:1057-1063.
5. Lea-Cox, J. D., F. R. Arguedas-Rodriguez, A. G. Ristvey and D.S. Ross. 2011. Relating Real-time Substrate Matric Potential Measurements to Plant Water Use, for Precision Irrigation. *Acta Hort.* 891: 201-208.
6. Majsztrik, J. C., A. G. Ristvey and J. D Lea-Cox. 2012. An In-Depth look at Fertilizer and Irrigation Practices in Maryland's Ornamental Nursery Industry. *Proc. Southern Nursery Assoc. Res. Conf.* 57:35-42.
7. Starry, O., J. D. Lea-Cox, A. G. Ristvey and S. Cohan. 2011. Utilizing Sensor Networks to Assess Stormwater Retention by Greenroofs. *ASABE Annual International Meeting*. Louisville, KY. Paper #1111202. 7p.

#### **Trade Articles and Reports**

1. Lea-Cox, J. D. 2011. Smart Irrigation Strategies: Growers get high-tech help with irrigation frequency and leaching reduction. *Nursery Management Pro*. April 2011. pp. 16-20.
2. van Iersel, M., S. Burnett, J. Lea-Cox, and P. Thomas. 2011. Improving irrigation with sensors. *Greenhouse Management* 31(9): 56-59.

#### **Presentations with Abstracts**

1. Kong, P., Lea-Cox, J. D., Moorman, G. W., and Hong, C. X. 2011. Survival of three quarantine pathogens in a simulated aquatic system at different levels of pH. *Phytopathology* 101:S93.
2. Lea-Cox, J.D. 2011. Measuring Spatial and Temporal Dynamics of Water in Soil and Soilless Substrates, to Enable Precise Scheduling of Irrigation Applications. *AGRI-SENSING 2011: International Symposium on Sensing in Agriculture in Memory of Dahlia Greidinger*. Technion- Israel Institute of Technology. 20 -24<sup>th</sup> February, 2011. Haifa, Israel. <http://agri-sensing.technion.ac.il/AbstractBook.html>
3. Lea-Cox, J. D. and J. C. Majsztrik. 2011. Considering the Value of Real-Time Sensor Information. *108<sup>th</sup> Annual American Society for Horticulture Science Conference*. Waikoloa, HI. HortScience 46(9): S210.
4. Majsztrik, J., J. D. Lea-Cox, D. S. Ross and A. G. Ristvey. 2011. Modeling Nitrogen, Phosphorus, and Water Dynamics in the Nursery and Greenhouse Industry. *108<sup>th</sup> Annual American Society for Horticulture Science Conference*. Waikoloa, HI. HortScience 46(9): S160-161.
5. Majsztrik, J., J. D. Lea-Cox, D. S. Ross and A. G. Ristvey. 2011. An In-Depth Analysis of Water and Nutrient Management in the Nursery and Greenhouse Industry in Maryland. *108<sup>th</sup> Annual American Society for Horticulture Science Conference*. Waikoloa, HI. HortScience 46(9): S220-221.

#### **Presentations without Abstracts**

1. Lea-Cox, J.D. 2011. Project Management and Outreach Using Web-Based Tools. SCRI Project Directors Workshop. *108<sup>th</sup> Annual American Society for Horticulture Science Conference*. 25 Sept., 2011. Waikoloa, HI.
2. Lea-Cox, J.D. 2011. Project Design with the End in Mind. Graduate Student Workshop. *108<sup>th</sup> Annual American Society for Horticulture Science Conference*. 26 Sept., 2011. Waikoloa, HI.
3. Lea-Cox, J.D. 2011. Visualizing and Interpreting Large Sensor Datasets for Daily Specialty Crop Management Decisions. Computer Applications in Horticulture Workshop. *108<sup>th</sup> Annual American Society for Horticulture Science Conference*. 26 Sept., 2011. Waikoloa, HI.

### **Workshops; Certification Classes**

1. Lea-Cox, J.D. 2011. What is the Big Picture with Water and its Availability? How Can You Cope with the Future Water Needs? 2011 Pest Management Conference. Carroll community College, Westminster, MD. 1 Dec. 2011.
2. Majsztrik, J., J. D. Lea-Cox, D. S. Ross and A. G. Ristvey. 2011. Sustainable Nursery Production: Choosing the Management Practices that Fit Your Nursery. Advanced Nutrient Management Twilight Session. Baltimore County Extension Office. Cockeysville MD. 7 Sept., 2011.
3. Majsztrik, J., J. D. Lea-Cox, D. S. Ross and A. G. Ristvey. 2011. Sustainable Nursery Production: Choosing the Management Practices that Fit Your Nursery. Advanced Nutrient Management Twilight Session. Wye Research and Education Center. Queenstown MD. 14 Sept., 2011.
4. Ristvey, A. G. and J. D. Lea-Cox. 2011. Grower Nutrient Management Plan Certification Training (Two-day training and plan-writing sessions). University of Maryland Extension and Maryland Department of Agriculture Wye REC, Queenstown, MD; MDA Headquarters, Annapolis, MD. 14 June, 2011 and 26 July, 2011.
5. Starry, O., A. G. Ristvey, S. Cohan and J. D. Lea-Cox 2011. Green Roof Workshop. Maryland Association for Environmental and Outdoor Education (MAEOE). University of Maryland, College Park. 10 Feb., 2011.

### **Websites**

1. Lea-Cox, J. D., T. Rhodus, L. Brewer and M. Neff, 2011. *American Society for Horticultural Science: Center for Horticultural Impact Statements*. <<http://ashsmedia.org>>

### **Impact Statements**

1. Lea-Cox, J. D., G.A. Kantor, Bauerle, W.L., M. van Iersel, C. Campbell, T. Bauerle, D.S. Ross, A. Ristvey, D. Parker, D. King, R. Bauer, S. Cohan, P.A. Thomas, J.M. Ruter, M. Chappell, S. Kampf, M.A. Lefsky, L. Bissey, and T. Martin. Increasing the Efficiency of Irrigation Water Applications with Smart Sensor Technology. *American Society for Horticultural Science: Center for Horticultural Impact Statements*. <<http://ashsmedia.org/?p=62>>