

The University of Arizona NCERA-101 Station Report 2013

1. UA NCERA-101 members:

- Chieri Kubota (ckubota@ag.arizona.edu)
- Ricardo Hernandez (ricahdez@email.arizona.edu)
- Mark Kroggel (kroggel@ag.arizona.edu)
- Murat Kacira (mkacira@ag.arizona.edu)
- Gene Giacomelli (giacomel@ag.arizona.edu)
- Joel Cuello (cuelloj@email.arizona.edu)

2. New Facilities and Equipment

- Dr. Kubota had a 1000 sq ft greenhouse re-glazed with 'F-Clean' ETFE film (diffuse, UV transmitting; AGC Green Tech, Tokyo, Japan) for testing plant responses under the film.
- Ricardo Hernandez and Hans Spalholz led a project of developing a bookcase salad-green production system, installed in the hallway of CEAC Annex building to produce fresh greens 24/7. The system was designed based on a surplus steel bookcase and equipped with plant lighting (LEDs, fluorescent lamps), NFT nutrient delivery system, circulation fans, and environmental sensors. Sensor feedback was used to operate the extra fans to maintain the air temperature close to the ambient. The system was also used for an outreach event (Plant Sciences Family Night).
- LGH-OTM, Lunar Greenhouse – Outreach & Teaching Module was developed with collaboration of the Controlled Environment Agriculture Center, together with its partners Hungry Planets, LLC and Sadler Machine Company [Arizona], and Aero-Sekur [Italy], with goals to provide platforms presenting science, technology, education, food security and production, with educational demonstrations. The LGH-OTM, a portable version of the lab design LGH, will be exhibited around the US to demonstrate and provide outreach and training for audiences of all ages. The portable device represents a live demonstration and educational tool that includes hydroponic plant production and CEA within a Bioregenerative Life Support setting.

3. Unique Plant Responses.

- Ricardo Hernandez (PhD candidate) and Dr. Kubota examined young seedlings of four vegetable plant species under supplemental LED lighting (100% red or 100% blue), compared with the conventional lighting (HPS). The first set of experiments indicated that plant growth was enhanced under HPS, mainly due to the increased plant temperature. Effective radiation (net long wave radiation) during the night was negative (losing energy) under LEDs while it was positive under HPS. The difference in plant response between 100% red and 100% blue LED was species specific. More comprehensive report will follow after repeating the experiment.
- Dr. Kubota and Mark Kroggel worked on optimizing transportation conditions for unrooted grafted cuttings. While their growth chamber based experiments suggest that cuttings quality was best maintained when they were oriented topside down, packing them so for actual shipping created increased bending of the scion epicotyls, indicating need for improved packing design.

4. Accomplishment Summaries

- Based on the success in the pilot course offered to a private company with 54 students, Dr. Kubota offered non-credit online Greenhouse Plant Physiology to meet the educational needs of growers and farm managers working in horticultural industries as well as academic staff, to learn whole plant physiology (plant responses) under controlled environment. The first session was nearly complete with 20 students including those from UK, Australia, China and Mexico. The course will be taught two more times this year. (<http://www.ag.arizona.edu/ceac/ceac-courses>)
- Patent: Waller, P., R. Ryan, M. Kacira, P. Li. 2010. Aquaculture raceway integrated design. US Patent Application Publication No: US2011/0023360A1

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- LGH-OTM, Lunar Greenhouse – Outreach & Teaching Module was displayed at (1) the Chicago Museum of Science & Industry (CMS&I) (July 2012 – January 2013) entitled: "Life In Space - The Lunar Greenhouse". It was accessible to more than 690,000 visitors; and, at (2) the San Diego County Fair (June 5 – July 5, 2012) entitled, "Out of this World," where nearly 10,000 students in 400 lower, middle and high school classes attended. <http://www.youtube.com/watch?v=PM10W2aIcKA>

5. Impact Statements

- Kacira Lab developed a computer vision guided crop sensing and monitoring system for crop diagnostics and for potential use in phenotyping applications. This multi sensor based sensing platform uses a color, NIR and thermal camera to acquire and process canopy images, and the system ultimately providing both microclimate and canopy based information. A web based decision support system is being developed to access the data to help growers for improved production management.
- Kacira lab concluded a one year study with the off the grid greenhouse crop production systems. This alternative energy integrated crop production system study helped acquiring all resources input and system outputs related information for techno-economical analysis of the system evaluated. The project continues to collect data with a winter crop grown also from the PV power production system.

6. Published Written Works (since September 2012)

(1) Books

N/A

(2) Book Chapters

N/A

(3) Refereed Journal Articles

Kubota, C., M. Kroggel, M. Torabi, K.A. Dietrich, H.-J. Kim, and C.A. Thomson. 2012. Changes in selected quality attributes of greenhouse tomato fruit as affected by pre- and postharvest environmental conditions in year-round production. *HortScience* 47:1-7

Villarreal-Guerrero, F., M. Kacira, E. Fitz-Rodríguez, R. Linker, G. A. Giacomelli, A. Arbel, C. Kubota. 2013. Implementation of a greenhouse cooling strategy with natural ventilation and variable fogging rates. *Transactions of ASABE*. (In Press)

Sase, S., M. Kacira, T. Boulard, L. Okushima. 2012. Determination of porosity parameters for tomato canopy: An experimental study in a wind tunnel. *Transactions of the ASABE*. 55(5): 1921-1927

Lee, I.B., J. Pascual, P. Bitog, S. Hong, I. Seo, K. Kwon, T. Bartzanas, M. Kacira. 2012. The past, present and future of CFD for agro-environmental applications, *Computers and Electronics in Agriculture*. (In Press)

(4) Symposium Proceedings

Hernández, R. and C. Kubota. 2012. Tomato seedling growth and morphological responses to supplemental LED lighting red:blue ratios under varied daily solar light integrals. *Acta Horticulturae* 956:187-194.

Meng, C., X. Dong, Y.J. Son, and C. Kubota. 2012. Simulation-based economic feasibility analysis of grafting technology for propagation operation. In: (G. Lim and J.W. Herrmann, eds) *Proceedings of the 2012 Industrial and Systems Engineering Research Conference*.

Tamimi, E. and M. Kacira. 2012. Analysis of climate uniformity in a naturally vented greenhouse equipped with high pressure fogging system using computational fluid dynamics. *Acta Horticulturae* (In Press)

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Gene A. Giacomelli, Roberto Furfaro, Murat Kacira, Lane Patterson, David Story, Giorgio Boscheri, Cesare Lobascio, Phil Sadler, Marzia Pirolli, Roberta Remiddi, MadhuThangavelu, and Maria Catalina, 2012. Bio-Regenerative Life Support System Development for Lunar/Mars Habitats. 42nd ICES, July 2012, San Diego, CA.

(5) Poster Presentations

Li, Q. and C. Kubota. 2012. Combination of blue and far-red supplemental LEDs enhanced baby leaf lettuce yield without lowering nutritional phytochemical content. Light in Horticultural Systems, October, 2012, Wageningen, The Netherlands

Lewis, M.D., C. Kubota, and R. Tronstad. 2012. Scenario-based economic analysis of different grafting operation sizes. Vegetable Grafting Symposium, November, Orlando, FL.

Spalholz, H. and C. Kubota. 2012. Low temperature tolerance of cucurbitaceae and solanaceae seedlings toward development of storage techniques in vegetable grafting. Vegetable Grafting Symposium, November, Orlando, FL.

(6) Popular Articles and Trade Magazines

Kubota, C. 2013. Vegetable propagation nurseries in North America. CEA Structures and Horticulture. 160: 53-58 (in Japanese)

Both, A. J., R. Hansen, and M. Kacira. 2012. Hydroponics Give Growers Control. Greenhouse Grower Magazine. <http://www.greenhousegrower.com/article/27924/hydroponics-give-growers-control>.

Kacira, M. 2013. Choose The Right Greenhouse Style. Greenhouse Grower Magazine.

<http://www.growingproduce.com/article/32536/choose-the-right-greenhouse-style>

(7) Other Creative Works

Giacomelli, G.A. and M.F. Munday, Special Editors, Resource Special Issue on Urban Agriculture. March/April 2013. <http://bt.editionsbyfry.com/publication/?i=148288>

Videos, produced by Mike Munday, Desert Rain Research, describe and promote the activities of the CEAC and faculty who are directly involved. For example, "No Ordinary Tomorrows is a web-based promotional video of the UA-CEAC and its faculty, staff and student activities, including Chieri Kubota, Murat Kacira and Gene Giacomelli. <http://www.youtube.com/watch?v=2e0zw1TkZol>

7. Other relevant activities and information

- Chieri Kubota and Mark Kroggel serve as members of the growth chamber committee at School of Plant Sciences. A facility improvement proposal was developed and submitted to a UA Green Fund program; 1) to evaluate and select plant lighting technology that is more energy efficient, environmentally friendly, and suitable for growth chamber based faculty research programs, 2) convert the School's old growth chamber lighting systems to selected new lighting systems, and 3) developing and disseminating better growth chamber lighting practices and guidelines, without affecting faculty research productivities.
- NSF Workshop on Challenges in Vertical Farming, G. Giacomelli, Organizing Committee member, Sanjiv Singh, workshop organizer, Carnegie-Mellon University, September 25 - 26, 2012 at the University of Maryland.