



COLLEGE OF AGRICULTURE AND LIFE SCIENCES



CEAC Quarterly Newsletter

Summer 2013 Issue

>> January 5 – 12, 2014: Tomato and Lettuce Intensive Courses <<
>> March 23 – 28, 2014: Greenhouse Short Course <<

CEAC Holds Annual Summer Research Retreat

On August 23, 2013 CEAC Faculty, Students, Staff and Guests participated in the CEAC Summer Research Retreat. Twenty-five presentations were given by the faculty, staff and students, highlighting their current research and talking about how they spent the summer of 2013. Presentations were followed by lunch and the retreat concluded with an entertaining night of bowling.



In the picture is most of the people involved in the Research Retreat. Student's giving presentations included Diana Vercillo, Michael Whalen, Ricardo Hernandez, Kristen Hanson, Brunno Cerozi, David Story, Polly Juang, Fei Jia (Jeff), Caitlyn Hall, Jacob Hodeaux, Stacy Tollefson, Erica Hernandez, Tyler Jensen, Sean Gellenbeck, and Marianna Yanes. Dr. Kacira, Dr. Rorabaugh, Dr. Giacomelli, and Dr. Kubota all gave brief talks as well as CEAC research specialists Myles Lewis and Mark Kroggel. Mike Munday discussed CEAC outreach, while Tara O'Heir talked about the Controlled Environment Agriculture Student Association (CEASA) and greenhouse volunteers Deb Dobias and Karen Geores spoke of their work at the CEAC

Presentations topics included grafting, strawberry production, LED lighting, high tunnels, aquaponics, sensors, CEAC outreach, the lunar greenhouse, and more. It was remarkable to see what the students accomplished during the course of the 2012-2013 school year and what is to come in the future. We cannot mention in detail every presentation during the retreat, but we did want to highlight the work of recent graduate of the CEAC, Polly Juang.

Polly Juang recently graduated with a Master's degree in Agriculture & Biosystems Engineering, working under Dr. Murat Kacira. Her master's project focused on the technical and economic feasibility of using an off-grid controlled environment crop production system. [Story Continued on Page 2...](#)

CEAC Experts Prepare For 2014 Intensive Courses



Dr. Pat Rorabaugh giving a lesson in her teaching greenhouse at the 2013 Tomato Intensive

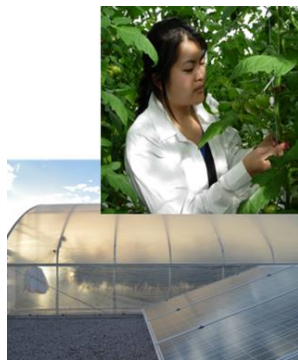
The University of Arizona's Controlled Environment Agriculture Center (CEAC) will be hosting their annual **Intensive Greenhouse Crop Production Courses** from **January 5th, 2014 to January 12th, 2014**. The course will have an emphasis on growing **tomatoes** and **lettuce**. The course will be taught by hydroponic specialist **Dr. Pat Rorabaugh** and business expert **Myles Lewis**, with a guest lecture from a legend in the world of Controlled Environment Agriculture, **Dr. Merle Jensen**. Students will receive a blend of classroom time and hands-on time in a hydroponic greenhouse in order to successfully grow crops on their own. Other useful events include a **round table discussion** with greenhouse engineers, where students can ask these experts questions regarding their greenhouse design and operations, and a **marketing lesson** from Myles Lewis at one of Tucson's best farmers market. The official program and registration form for the January Intensives are now open and for the first time we are accepting credit cards for this event. More information can be found on our website at <https://ag.arizona.edu/ceac/hydroponic-greenhouse-crop-production-intensive>.

Please also save the dates of our 2014 Greenhouse Short Course, **March 23 – 28**. More detailed information can be found at <https://ag.arizona.edu/ceac/Spring-Short-Course>, with more information posted periodically.



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The world's resources such as water, land, fertilizers and energy are becoming scarcer, especially in semi-arid and arid regions. Innovative technology must go beyond increasing yields; it should include integrated and appropriate production systems & strategies, resource recycling, and alternative energy integration in CEA food production systems.



Communities all over the world are interested in growing safe, local and fresh produce. However, this is more difficult to do in remote locations, challenged regions, and disaster zones where immediate access to re-sources for sustainable crop production is limited. The off-grid greenhouse project that Polly worked on can offer the potential to alleviate food and energy problems without having to connect to the city grid for communities in remote, challenged, and semi-arid locations. Polly found that with certain crops she could produce virtually identical yields while providing the desired climate for the crops and working as an off-grid greenhouse, compared to a traditional grid connected greenhouse. Congratulations to Polly, she will be missed and we wish her best of successes moving onto bigger accomplishments.

CEASA Students Excited For the New School Year



The Controlled Environment Agriculture Student Association (CEASA) is a group of undergraduate and graduate students interested in hydroponics and controlled environment agriculture. Members are from many majors, some not even in the sciences. All students with an interest in CEA are welcome.

The Fall Semester is upon us, and that means a lot of things are happening with the CEASA. Upcoming CEASA events include selling their fresh produce at St. Phillips Farmers Market, pumpkin training and pollination demonstrations, and collaborations with the new Plant Science Club.

The CEASA meets every Saturday from 11:00 AM to 2:00PM at the CEAC. If you would like to subscribe to the CEASA's weekly newsletter or have any questions about the club please email CEASA President Tara O'Heir at taoheir@email.arizona.edu or visit <http://ag.arizona.edu/ceac/cea-student-association>.

Indoor CEA "Mini Veggie Box"

Dr. Kubota's new collaboration with Japanese organizations and industry brought an opportunity to evaluate a commercial unit for growing leafy crops indoors under LED lighting. The "Veggie Box" was shipped from Yokohama, Japan in July and arrived at CEAC in August. Thanks to the Campus Ag Center crew (Dan Nelson, Ken Pruitt, and John Bauer) for moving and powering the box.



This 65-ft² system is equipped with a vertically stacked multi-layer hydroponic growing system and LED lighting. CO₂ concentration can be elevated without releasing it to the outside for maximizing crop growth. Air temperature is maintained with a heat-pump unit. The system is well insulated to minimize electric energy use. Water consumed by plants can be recovered and recycled to increase the water use efficiency. Our students will be involved in the project and gain experience in growing various leafy crops (such as lettuce and herbs) and collecting data of crop productivity and resource use. The production unit was manufactured by Sankyo Frontier Co. (<http://www.sankyofrontier.com/eng/>), specializing in modular house building in Japan. Chiba University (http://www.h.chiba-u.jp/english/7/index_e.htm) and Plant Factory Association of Japan (<http://npoplantfactory.org/>) are supporting the project and will initiate a student and faculty exchange program around this high-tech CEA.



Dr. Chieri Kubota's "Veggie Box," as seen at its current location at the UA-CEAC

Class Resumes in the CEAC Teaching Greenhouse

PLS 217: The introductory greenhouse hydroponic course, taught by Dr. Pat Rorabaugh, is almost full to capacity this Fall semester with 26 registered students. We also have 3 undergraduate student workers and Rick Cupples (former research assistant to Dr. Bernie Kratky in Hawaii for 30 years) has returned to help out with the class. We have already started to harvest cucumbers and the tomato fruit is starting to set – we're about 2 months away from harvest. See the crop on the CEAC website "Tomatoes Live" section or click the link: <http://ag.arizona.edu/tomlive/>. The class is usually in the greenhouse Tuesdays & Thursdays from about 4 to 5:30pm. See you in the greenhouse!



Two of Dr. Rorabaugh's past students, Damien Solomon of DeRuiter (left) and Nick Earls (right) of Denver Relief

CEAC Volunteers

The group met for the first time this season on Saturday, 9/14/13. We're planning educational presentations, round-table discussions and tours for the coming year. Come join us on the second Saturday of each month (from September through May) at the CEAC from 11:30 to 12 noon for a social and 12 to 2:30 pm for the meeting and tours. During the harvest season there will be produce for all (as available). We have a core group that meets to take care of the CEAC Demonstration Greenhouse on Monday mornings at 9am. Also, CEAC volunteers help with other greenhouse projects as needed. For more information on how you can become involved, please contact Dr. Pat Rorabaugh, patrora@ag.arizona.edu, 520-626-9953.



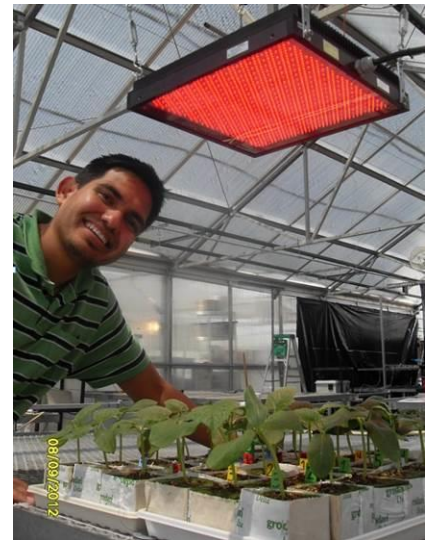
The Monday Morning 'Inner Circle' of CEAC Volunteers in the CEAC Demo Greenhouse

CEAC Students Successfully Defend Their Dissertations



-David L. Story successfully defended his dissertation recently and completed his PhD degree in the Agricultural & Biosystems Engineering Department. David, working in Dr. Murat Kacira's Lab, developed a "Computer vision guided crop diagnostics and web-based decision support system." Using plants as "sensors" to communicate their true status and needs, the developed system aimed at detecting crop deviations from normal development and crop stress timely, and ultimately targeting autonomous monitoring and identification of plant health and growth in CEA systems for improved production and optimized resource use efficiency. Congratulations to David, we will miss him and wish him best of successes in his future endeavors.

-Ricardo Hernandez also successfully defended his dissertation recently and received his PhD in The School of Plant Sciences. Ricardo worked under Dr. Chieri Kubota on his research project titled "Growth and Development of Greenhouse Vegetable Seedlings under Supplemental LED Light." Ricardo is continuing his research at the CEAC as he is now working on his post-Doctoral project. Ricardo's extensive work with LED lighting led him to teach the workshop "LED Lighting for Vegetable Transplant Production" at the 2013 Greenhouse Short Course and hopefully for years to come. Congratulations to Ricardo, we are fortunate that he will still be a part of the CEAC team.



New Students at the CEAC

-Sean Gellenbeck is the most recent addition to the Steckler Lunar Greenhouse team. He is originally from Poway, California and recently finished his degree in Aerospace Engineering at the U of A. Although Sean has been with the Lunar Greenhouse project for only a few months, he has many responsibilities around the lab.

His primary responsibility is the Himawari project which is an additional project associated with the Lunar Greenhouse. The Himawari is a solar array concentrating device that focuses sunlight onto the ends of fiber optic cables in order to transport this light into an enclosed environment. The main purpose of this is to grow plants indoors and eliminate the need for direct sunlight. The other wavelengths of light collected by the Himawari can have a number of other uses including the generation of electricity and heating. This project has recently entered the data collection phase and has the eventual goal of providing supplemental lighting for the growth chamber(s) thereby reducing the need for artificial lighting and lowering electric costs.



Sean using the Himawari device

Sean plans to attend graduate school and earn a Master's and/or a PhD in an Engineering discipline through which he can focus on some of the principles of long-term human spaceflight. He hopes to eventually work in the field of interplanetary habitation with the ultimate goal of working towards the permanent colonization of other celestial bodies.

-Fei (Jeff) Jia (PhD Student), **Wenyue Li** (MS Student) and **Caitlyn Hall** (Undergrad Student) recently joined Dr. Kacira's Lab. Jeff's research focuses on Multi-Parameter Based Autonomous Algae Production System Monitoring and Control for Optimal Resource Use Efficiency. Wenyue will be working in a project evaluating resource use efficiency in alternative energy integrated greenhouse system using new glazing technology.



Fei (Jeff) Jia



Wenyue Li

Scholars Visit the CEAC

-Dr. Paula Costa, ABE Alumnus and one of CEAC first PhDs visited the Lunar Greenhouse Project with Dr. Gene Giacomelli on September 19th, while attending the 2013 Aquaponics Association Conference. Dr. Costa is Director of R&D at Growstone Inc., a company based in New Mexico, which manufactures rigid foam root substrates made from recycled glass.

The connection between the CEAC, Dr. Costa, and Growstone is a long and interesting one. In 2006, a CEAC team led by Dr. Gene Giacomelli, and Dr. Costa at Growstone were instrumental in applying Growstone's open cell foam glass technology to develop Growstones aggregates for hydroponic crop production through two long term tomato greenhouse trials.

These trials, and others conducted at the Wageningen Applied Plant Research in The Netherlands, resulted in a substrate with uniquely balanced water to air ratios, which allow for tighter and faster root zone moisture control avoiding problems associated with excessive root moisture. Today, Growstones substrates are successfully used in hydroponics and aquaponics. This strong connection continues 7 years later with current CEAC student, Tyler Jensen testing Growstones to germinate and establish deep root seedlings for the Lunar Greenhouse module.



Dr. Paula Costa and CEAC student Tyler Jensen in the Lunar Greenhouse

-Dr. Guoqiang Zhang, senior scientist in the Department of Biosystems Engineering, Aarhus University, Denmark, and **Georgia Pahlitzanakis**, Head of Administration in the Institute for Research & Technology Thessaly (IRETETH)/Center for Research & Technology Hellas (CERTH), Greece,



visited the UA-CEAC under the frame work of international consortium (University of Thessaly, IRETETH, Wageningen UR, Seoul National University, Aarhus University, INRA-France, University of Arizona) project "*Smart CEA systems*" funded by the European Union Marie Curie Researcher Exchange Program under controlled environments. The project, in which Drs. Murat Kacira and Gene Giacomelli are involved, aims to form an excellent center of synergy in research, innovation and technology transfer in the area of agriculture production

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1951 E. Roger Rd., Tucson AZ 85719 (520) 626-9566 <http://ag.arizona.edu/ceac/>

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