



## *Eye on Economics and Energy (E<sup>3</sup>): For the Small and the Experienced Grower 2009 Arizona Greenhouse Short Course*

The 9th Annual Greenhouse Crop Production and Engineering Design Short Course is now on a new date and in a new place!! On April 26-29, experts will gather at the beautiful, recently renovated Sheraton Tucson, in Tucson, Arizona to present focused information with an Eye on Economics and Energy (E<sup>3</sup>): For the Small and the Experienced Grower.

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The Greenhouse Crop Production & Engineering Design Short Course offers three days of intensive education and practical experiences in the science of hydroponic crop production, and the engineering of controlled environments. The Short Course's format gives attendees multiple opportunities to interact with some of the world's leading controlled environment agriculture engineers, scientists and commercial experts, including **A.J. Both, Ph.D.**, Rutgers University, and **Peter Ling, Ph.D.**, Ohio State University, and **Ted Carey, Ph.D.**, Kansas State. **Jonathan Frantz, Ph.D.**, ARS-USDA, **Dominique-Andre Demers**, with Biobest Canada, **Karin Tiffit**, IPM Specialist, Eurofresh Farms, **Mary Donnell**, Product Development Manager, GreenLine Foods, Inc., **Bryon Smith**, of Sunizona, **Peter Fynn, Ph.D.**, Vice President – Engineering, Pure O Tech, Inc., and **Gene Parsons**, VALCO, along with University of Arizona controlled environment faculty who round out the program by lending their expertise and experience to provide participants with a solid foundation in greenhouse crop production.

Participants will have a chance to choose the tour to Eurofresh Farms, North America's largest glass greenhouse vegetable operation covering over 318 acres near Willcox, Arizona. Eurofresh Farms is a leader in the greenhouse industry that produces a consistent, high volume supply of premium pesticide-free tomatoes. In 2004, Eurofresh Farms produced over 100 million pounds of tomatoes, representing a large share of the U.S. greenhouse tomato market! During the motor coach drive to Willcox, short course participants can enjoy southern Arizona's natural wonders.

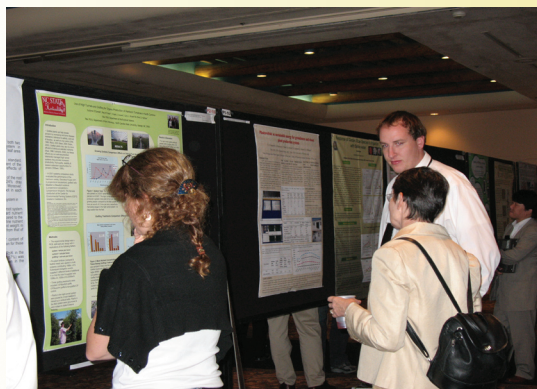
We are pleased to have an opportunity to present this course to you from the Sheraton Tucson, in Tucson, Arizona. A comfortable hotel, close in, with accommodating hotel staff and new renovations, the Sheraton will provide participants with a pleasant and memorable experience.

**Check out our website for more information about the Greenhouse Short Course program and registration process:**

[www.ag.arizona.edu/ceac](http://www.ag.arizona.edu/ceac)

## *ISHS International Workshop*

The ISHS International Workshop on Greenhouse Environmental Control and Crop Production in Semi-Arid Regions was held in Tucson on October 20-24. Members of the organizing committee were **Chieri Kubota**, **Murat Kacira**, and **Gene Giacomelli**. An Acta Horticultrae #797 (<http://www.actahort.org/books/797/>) was published and distributed at the Workshop by editors, Kubota and Kacira.



**Ian Justus presents poster**

**Dr. Stefania de Pascale** of Italy, Alternative Crops by **Dr. Guy Cardineau** of the US, and Greenhouse Cooling by **Dr. Sadanori Sase** of Japan. Poster and oral presentations followed each topic.

The Organizing Committee wants to thank all who attended and all the Arizona faculty, staff, students and volunteers who helped to make the Workshop a success!

**Gene Giacomelli**, convener;  
**Chieri Kubota** and  
**Murat Kacira**, Acta Editors

Twenty two countries were represented by a total of 160 participants, who attended the Workshop presentations, toured the CEAC, Biosphere2, or EuroFresh Farms commercial greenhouse, and who visited the desert climate of Arizona or the frozen desert of Mars via the Phoenix Mars Lander Science Center. There was an additional tour into Mexico to visit three major greenhouse facilities in the State of Northern Sonora.

Four Workshop themes presented by the invited keynote lecturers, included:

Environmental Control by **Dr. Nicholas Castilla** of Spain, Plant

Stress Management by

**Dr. Stefania de Pascale** of Italy, Alternative Crops by **Dr. Guy Cardineau** of the US, and Greenhouse Cooling by **Dr. Sadanori Sase** of Japan. Poster and oral presentations followed each topic.



**Chieri Kubota presents research on Baby Salad Leaf Production for "Food for Health" to tour during workshop**

*Thank you to the following ISHS Workshop Sponsors:*

**Berkus Design Studio**

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**Svensson**

**Village Farms**

**Desert Glory**

**Eurofresh Farms**

**Rough Brothers**

**Li-Cor Biosciences**

**Argus Control Systems**

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**Bio5**

## *South Pole Food Growth Chamber Training*

**Lane Patterson**, an employee of Raytheon Polar Services and U of A Biosystems Engineering Masters student, conducted the South Pole Food Growth Chamber training at the Controlled Environment Agriculture Center. **Joseph F. Romagnano, Ph. D.** in Crop Physiology from Utah State University, has been studying to become the operator of the South Pole Food Growth Chamber during the next Antarctic winter (Feb09 - Oct09). In addition to learning operations of the SPFGC, Joe met the Controlled Environment Ag Center Staff and students that will help support him remotely, by means of telepresence, from Tucson, Arizona 8,200 miles [13,100 kilometers] north by means of phone, email, web camera, and Argus Climate Control system. Lane was assisted by **Phil Sadler**,

**Neal Barto**, and **Dr. Gene Giacomelli**, and utilized the SPFGC remote Help Desk, as well as, the Extreme Environment Laboratory controlled environment demonstration facility located at the CEAC.



Joe Romagnano and Lane Patterson

## *Focus on Staff*

**Neal Barto** graduated from The Pennsylvania State University in 1981 with a BS in Horticulture. He worked for a year in a wholesale greenhouse operation in New Hampshire. He then attended North Carolina State University and graduated in 1985 with a BS in Biological and Agricultural Engineering. Neal worked for several years in consulting engineering on various



municipal wastewater projects and then matriculated to The Pennsylvania State University again for a MS degree in Biological and Agricultural Engineering. Neal graduated in 1993 and began a PhD program in Penn State's Horticulture Department. He became increasingly involved with greenhouse and growth chamber operation and management, as well as

instrumentation for plant physiology experimentation. In 2002, Neal began working full-time as a greenhouse technician. He joined CEAC in September 2006 as a Research Specialist providing technical support, mostly in the area of data acquisition and control.

Here at CEAC, Neal installs the data loggers and sensors for various projects. He troubleshoots problems on graduate projects. He sets up the web cameras. He constructs or fabricates components for projects. Additionally, he tends to the needs of the electronic (computerized) aspects of the greenhouses at the CEAC. He ensures that the TomatoesLive! website is in working order, and that the environmental data is being sent properly and that the cameras are working. Should you find a problem with any of the cameras, he is the man to inform! He's planning on learning Java and AutoCAD. He says he likes the job a lot because "it's a nice blend of mental and physical labor."

## *Focus on Industry-Academic Relationships*

### **The Growstones Story**

The mission of the newly created **Growstone, LLC** is to develop the market and sell substrate for horticultural/hydroponic use that is made from recycled glass. In conjunction with the CEAC, Growstone has been studying greenhouse tomato production, which has been a part of the PhD dissertation of Jose Chen-Lopez. Jose's research has been valuable in helping Growstone demonstrate the equivalent commercial production yields and exceptional quality of fruit size and Brix, thus providing a strong incentive to commercialize.

The successful conclusion to this R&D story can be found in a news story at: <http://www.santafenewmexican.com/Local%20News/Giving-new-life-to-glass>.

The foresight started with Earthstone International and the original vision of **Andrew Ungerleider** and **Gay Dillingham**, New Mexico based eco-entrepreneurs. This vision has grown into Growstone, LLC a company dedicated to having a positive environmental and scientific impact on the controlled environment agriculture, greenhouse and nursery industries.

About 3 years ago, **Dr Gene Ramsey** of Earthstone contacted CEAC with the potential use of a recycled glass product for a root zone substrate in greenhouse crop production as a replacement for perlite and other "mined" substrates. After an initial test evaluation by graduate student **Paula Costa** (now, Dr. Costa and Director of Research & Development and Technical Support at Growstone, LLC) and supporting CEAC faculty, a grant contract with Growstone was signed, providing support for a multi-year evaluation program of the potential product. **Jose Chen-Lopez** (see related story below) led the study to evaluate the new substrate for greenhouse hydroponic tomato production, with support from CEAC faculty and Growstone personnel.

## *Focus on Students*

### **Graduate Focus: Jose Chen Lopez, Ph.D. Student**

After graduating from the University of Sinaloa with a BS in Irrigation and Soils, **Jose Chen Lopez** began a Masters program in ABE at the University of Arizona in the fall of 2003. By 2007, he completed his Masters and is working towards his PhD in Agricultural & Biosystems engineering, with a focus on Controlled Environments and a minor in Soils, Water, and Environmental Sciences.

Jose's dissertation study, "**Characterization and Management of New Growing Media for Greenhouse Tomatoes**" provided empirical data by analyzing, evaluating, and implementing the physical properties of Growstones, a soil substrate made of recycled glass, while incorporating an emphasis on irrigation water management. This work provided environmentally sound solutions. Rockwool, which is typically used worldwide as a root zone substrate, is mined, and is currently difficult to dispose after use. It is rarely practical to recycle. Coco Coir, and alternative substrate holds water well, but less air than Rockwool. An improved balance between air and water is provided with Growstones. The Growstone product is a lightweight aggregate substrate with consistent particle size (See related story). (continued next page)



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For the past 2 years, Jose's tomatoes were very popular. At the peak of the research, he was harvesting an average of 250 pounds per week, or 50 kg per square meter for the full 6-month harvest. The truss-type tomato clusters of 5 – 6 fruit had typical weights of nearly 1 kilogram and were perfectly formed.

The success of the project can, in part, be attributed to the commitment of Growstone and especially **Dr Paula Costa** and **Dr Gene Ramsey**, who were regularly involved in operations for maintaining focused research direction.

Throughout the study, Jose was also supported by UA faculty, including: **Dr. Merle Jensen**, crop consultant, **Dr. Pete Waller**, ABE, design of irrigation system and root zone substrate bag dimensions and composition, **Dr. Marcus Tuller**, Soil Water and Environmental Sciences Department, simulation of water flow and water content in the bag/growing media, and **Dr. Gene Giacomelli**, graduate advisor.

## *Craig Wheeler arrives at the South Pole*



Craig is a University of Arizona student currently living and working in Antarctica. He is earning internship credits while working for RPSC (Raytheon Polar Services Company), which is contracted by the National Science Foundation to operate the South Pole Station. As an undergraduate pursuing a bachelors of science in plant sciences, Craig has worked at the Controlled Environment Agriculture Center helping to support the South Pole Food Growth Chamber by Telepresence. Telepresence, is the use of technologies that enables remote monitoring and remote control of the South Pole Food Growth Chamber plant growing environment. For now, he is “really-present” as he arrived at the South Pole on November 5th, and sends along this photo and greetings.

*Greetings CEAC,*

*I would like to inform you all that I am the new operator of the South Pole Food Growth Chamber in Antarctica. I feel that I have the best job on site with the chamber reaching temperatures of 77°F while outside temperatures are -42°F with a balmy wind chill of -70°F.*

*Antarctica is beautiful but seeing the sun up at midnight is a little weird. The flight down was great and the food is really good here. This place is thick with science and there are a lot of people studying the universe. The new station is a marvel of engineering but a big part of that is definitely the South Pole Food Growth Chamber.*

*I am enjoying my job very much and I would like to thank the UofA and especially the CEAC for having an opportunity to grow crops on the bottom of the world.*

*Thanks,*

*Craig Wheeler, Plant Sciences Undergrad*



## *Seminars*

### **Automated Plant Detection**

**David Story**, ABE MS Student presented a seminar on “Plant nutrient deficiency detection using automated morphology-based sensing in controlled environments” on Monday, Nov. 10th, in the Shantz building on campus.

### **Grafting Heirloom Tomatoes**

**Dr. Mary M. Peet**, Professor, Department of Horticultural Science, North Carolina State University presented a lecture on “Grafting Heirloom Tomatoes for Field and High Tunnel Production Using Organic Practices” at the Controlled Environment Agriculture Building (CEAC) on Tuesday, October 28, 2008. This can viewed at [mms://150/135/40/125/media/ceac/marypeet\\_heirloomtomatoes.wmv](mms://150/135/40/125/media/ceac/marypeet_heirloomtomatoes.wmv)

### **Nano-Technology for Tomorrow**

On September 19th, **Dr. John (Jack) Hughes** presented a special seminar on “A Discussion on Controlled Environment - the International Overview to the Nano-Technological Horizons for Tomorrow” which was webcast from CEAC. This can viewed at [mms://150.135.40.125/media/ceac/cntl\\_env&nanotech.wmv](mms://150.135.40.125/media/ceac/cntl_env&nanotech.wmv)

On December 5, he returned to present another seminar titled “Nanotechnology Examines Issues of Plant Growth: Air, Water, Soil, Photons, and the Processing of Nutrients.” This was also webcast from CEAC. This can viewed at [mms://150.135.40.125/media/ceac/hughes\\_nanotechnology.wmv](mms://150.135.40.125/media/ceac/hughes_nanotechnology.wmv)

## *CEAC Visitors*

### **Green (Red and even Purple) Power Rangers Overrun the CEAC**

1st graders from the classes of **Mss. Jacobs, Jurgenson and McGroarty**, in their easily identifiable colored “Rangers” shirts from Sunrise Elementary School, arrived on Monday, November 17th. Approximately 75 energetic children visited the CEAC to learn about the South Pole Food Chamber, and how hydroponics vegetable production (**Dr Rorabaugh**) in greenhouses will help feed them in the future. Fortunately the CEAC volunteers, including “**Dr Ed**” were available to enjoy the morning with the visitors



### **Variety Trial Tomato, Pepper (and Organic Lettuce) Tasting**

Sales and management personnel of Eurofresh Farms met at CEAC for their annual meeting, and **Dr. Pat Rorabaugh** did not miss the opportunity to have them “taste test” the varieties of tomato and sweet pepper that she and Plant Sciences student **Casey Lohrenz** have been evaluating as part of a CEAC project for Eurofresh Farms.

**Dwight Ferguson, Johan vanden Berg and Frank van Stralin** and others enjoy the flavor and sweetness of greenhouse grown tomatoes and peppers

### *CEAC Visitors (cont.)*

On December 11-12, **Can Sirin**, **Peter Fynn** and **Peter Friesen** of Pure-O-Tech, Inc. visited the CEAC, where they toured the facilities and projects, and discussed the challenges of maintaining appropriate water quality requirements in food production systems. Pure-O-Tech, Inc. is an engineering and manufacturing company that provides water purification technologies.



**Paul Newman**, AZ Corporation Commission (center), with **Peter Fynn** (right) and **Peter Friesen** of Pure-O-Tech, Inc at CEAC



### *CEAC Volunteers*

CEAC Volunteers **Karen Geores**, **Pat Richardson** and **Kay Eacker** prepare salads for the taste testing event.



### *Anywhere, Any Time?*

In the category of CEA - any crop, anywhere, at any time, Volunteer, **Leo Pullara** knows the drill! He started growing the fig tree in the greenhouse when it was about 3 feet tall. It is now about 7 feet. It was originally propagated outdoors by the Master Gardener program, then Leo introduced it into CEA, and hydroponic nutrient and water as part of the CEAC volunteer program. Thanks to community effort by the volunteers, it is growing very successfully, and there has been a regular crop of high quality figs!!



## *Out and About – Around the Globe*

**Dr. Chieri Kubota** recently attended the **Methyl Bromide Alternatives Conference** that was held in Orlando from November 10 through the 14th.

The website for the conference is <http://mbao.org/>

(From the website, general description follows)

Under the Clean Air Act and Montreal Protocol, production of methyl bromide, a widely used fumigant in agriculture and forestry that is also an ozone-depleting substance, was phased out as of January 1, 2005 but there are allowable exemptions for users who do not have technically or economically feasible alternatives, see EPA Web Site. It is critical that current efforts continue to quickly develop and implement economically viable and environmentally sound alternatives. Since 1994, agricultural and forestry researchers from governmental, academic and private institutions, as well as extension agents and users, have gathered together in this forum to share information on a variety of laboratory, field, and on-farm research and technology transfer topics.

This conference is devoted to the sharing of information on current and ongoing research into methyl bromide alternatives. The conference will feature concurrent sessions concerning research on alternatives to methyl bromide for preplant, post-harvest, and structural uses.

Additionally, Dr. Kubota and the collaborators on her **USDA Methyl Bromide Alternatives** grant organized a trip to and workshop at the USDA/ARS research station in Ft. Pierce FL, where they are conducting their Florida-based research on the use of grafting onto resistant rootstocks for tomato and melon to overcome soil-borne diseases and pests. Tomato is one of the most economically important crops in Florida, and non-grafted plants would not survive in non-fumigated fields. The workshop was attended by over 20 people from 4 different continents and consisted of many presentations of the on-going work being done by many researchers around the globe on the use of vegetable grafting as a methyl bromide alternative. Much interesting information was presented, and there were discussions on the results so far, and on what steps need to be taken next. The USDA/ARS scientists collaborating on the project then provided a tour of the field research being conducted there, and gave a presentation of a grafting robot used to produce the grafted plants for the field. The growth chambers and greenhouses where the grafting is done, and where rootstocks are being evaluated were also toured.

On Sept 24 – 25, **Gene Giacomelli** was invited to St. Louis to the “**All Things Green**”, an innovative forum, organized by the TTL/Vanguard Conference. He presented an interactive discussion entitled, “Controlled Environments: Plant Production Technology Addresses Global Issues” to a unique cross-section of leaders in the manufacturing industry, financial institutions, service providers, government agencies, etc who met at the conference and focused on emerging technologies as presented by third-party perspective. It was private, no press, but everyone was equipped with microphones, so interactive discussion began almost immediately.

He began with the broad statement that CE systems will feed the world, improve the world, and create new worlds, and then focused on examples of plants as biochemical and biomechanical processors that either create “Products” such as food, feed, fiber & fuel, or provide “Processes” such as life-support, bioremediation, and biosynthesis. A robust discussion followed. A summary of the presentation is available on the CEAC web site.

On Oct 6-9th, **Gene Giacomelli** was invited to the Canadian Greenhouse Conference in Toronto, and presented “**Greenhouse Sustainability: What’s New in Technology, and How will Controlled Environment Plant Production Technology Address Global Issues**” to their 30th anniversary conference event. The take-home message was that the most effective innovations in greenhouse engineering design, operations and management, will incorporate input from partnerships with the academic, private and public sectors of society. Furthermore, successful applications include, at least to some degree a multi-disciplinary approach of the sciences, engineering and economics.



## *Other Greenhouse Vegetable Crops Courses*

March 10-12, 2009, 19th Annual **Mississippi Greenhouse Tomato Short Course**, Raymond, Mississippi. For more information contact Dr. Rick Snyder (601) 892-3731  
ricks@ext.msstate.edu <http://www.greenhousetomatosc.com>

HS 543 **Greenhouse and High Tunnel Food Production** (3cr) will be offered Spring Semester 2009. This is a graduate credit course offered for a grade (ABCD) which meets requirements for the Certificate Program in Horticultural Science. Information is available at: <http://web.mac.com/kpaigel/certificate/Home.html>.  
Contact: Mary Peet 919-515-5362; mary\_peat@ncsu.edu.

March 16-17, 2009, "**Starting a Successful Hydroponic Business**" a new training opportunity for greenhouse hydroponic growers. Contact: Bob Hochmuth, Live Oak FL 386-362-1725 x103; bobhoch@ufl.edu; [http://smallfarms.ifas.ufl.edu/current\\_issues/HydroponicSC.html](http://smallfarms.ifas.ufl.edu/current_issues/HydroponicSC.html)

January 8, 2009 **High tunnel workshop** at St. Joseph MO. St. Joseph, MO at the Great Plains Vegetable Growers Conference See the full program and register at: <http://extension.missouri.edu/buchanan/GPVGC.shtml>  
Contact: Ted Carey,

January 25, 2009, **Greenhouse Management Workshop**, Sustainable Practices for Ornamental and Vegetable Greenhouse Production.. Columbus Convention Center, Columbus, OH. Contact: Peter Ling, ling.23@osu.edu

*We extend our appreciation to the following supporters of CEAC:*



**Tell us what you want!**  
CEAC seeks your comments and suggestions for changes, new topics, and features in future editions of CEAC, the quarterly newsletter of the Controlled Environment Agriculture Center.  
Contact Connie Hackathorn, Editor, at [connieh1@email.arizona.edu](mailto:connieh1@email.arizona.edu) or at 520/626-9566.

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Program Director: Dr. Gene Giacomelli For more information or to subscribe, email us at [connieh1@email.arizona.edu](mailto:connieh1@email.arizona.edu)

### ***New materials***

A 10-page review of CEAC research activities, called **CEAC Today** is now available by contacting Connie at [connieh1@email.arizona.edu](mailto:connieh1@email.arizona.edu). Watch for it on our website soon!  
[www.growstone.com](http://www.growstone.com)  
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