

#### 1. New facilities planned or installed

\_ Construction of **new CEA (Controlled Environment Agriculture) Greenhouse Research facility** (6000 ft<sup>2</sup>) was complete. The facility will consist of 2 environmental zones and include natural ventilation, fog and pad/fan evaporative cooling systems, computer-based control within a double polyethylene covered structure, and it will be used for water use studies.

#### 2. New control systems and instruments

\_ A 450 ft<sup>2</sup> **Food Growth Chamber for the Amundson-Scott South Pole Research Station** was constructed, tested, and shipped to the South Pole, for NSF and Raytheon Polar Services Corporation.

\_ A **remote sensing system** with an automatic moving cart that travel between crop rows was installed in a greenhouse where tomato plants were grown under various salinity levels of hydroponic nutrient solution. Four reflectance bands (blue, green, red, and NIR) and one thermal band (TIR) are going to be used to detect plant stress.

#### 3. Cooperative/interdisciplinary projects

\_ Aeroponics of medicinal plants [Chris Pagliarulo, Plant Sciences]

\_ Aeroponics of medicinal plants [Dr. Joel L. Cuello, Agricultural and Biosystems Engineering]

\_ Biomass and Quality Evaluation of Basil in a Retractable Shade Structure in Semi-Arid Climate [Jennifer Nelkin, Plant Sciences]

\_ Controlled environment somatic embryogenesis [Dr. Chieri Kubota, Plant Sciences]

\_ Development of a compact and robust HID water-jacketed plant lighting system [Dr. Gene Giacomelli, Agric. Biosystems Engineering]

\_ Effects of greenhouse environmental conditions on tomato growth yield and fruit quality [Paula Costa, Agric. Biosystems Engineering]

\_ Evaluation of Water Usage for Crop Production and Environmental Cooling in Arizona Greenhouses [Nadia Sabeih, Agric. Biosystems Engineering]

\_ Evaluation of retractable roof greenhouse for vegetable production [Armando Suarez, Agric. Biosystems Engineering]

\_ Evaluation of Performance of Water-Cooled Light-Emitting Diode (LED) Arrays [Dr. Joel L. Cuello, Agricultural and Biosystems Engineering]

\_ Monitoring EC Effects on Greenhouse Tomatoes with Remote Sensing [Mohammed Al Shitawi, Agric. Biosystems Engineering]

\_ Optimization of transplants transportation environments [Dr. Chieri Kubota, Plant Sciences]

\_ Physiology of grafted plants of hydroponic tomato [Mark Kroggel, Dept. Plant Sciences]

\_ Production of high quality cherry tomatoes under semiarid climate [Johann Buck, Plant Sciences]

\_ Production of high sugar and high lycopene tomatoes under semiarid climate [Min Wu, Plant Sciences]

\_ Tomato grafted plants and variety trials [Dr. Pat Rorabaugh, Plant Sciences]

\_ Water Use by Greenhouse Tomato Plants [Dr. Allan Mattias, Soil Water Environ. Science]

\_ 'A Day in the Life of a Plant', Learner-Centered, Web-based Education CEA Website and Simulation Modules, funded by USDA Higher Education Challenge grant program. [Efren Fitz, Agric. Biosystems Engineering]

#### 4. Workshops/colloquia/symposia

\_ A **Greenhouse Crop Production and Engineering Design Short Course** was held for January 18 to 21, 2003, as a continuing professional education short course from the University of Arizona. The course programs can be viewed at <http://www.ag.arizona.edu/ceac/extension/cpesJan04.htm>. The meeting included a tour to EuroFresh Co. (Wilcox, AZ).

\_ **Curso Internacional de Invernaderos (International Greenhouse Course)** May 26 - 30, 2003 at Universidad Autonoma Chapingo Ingeniera Mecanica Agricola in Chapingo, Mexico was coordinated with Dr. Raquel Salazar Moreno, and Drs. Giacomelli, Jensen and Waller as part of an interchange agreement between Chapingo Autonomous University and The University of Arizona.

#### 5. Recent Publications

Costa, G.J.C. and **J. L. Cuello**. 2004. The Phytometric System: A New Concept of Light Measurement for Plants. *Journal of the Illuminating Engineering Society of North America*. 33(1): 34-42.

Costa, G.J.C. and **J. L. Cuello**. 2003. Designing a Phytometric System of Light Measurement for Plants. *Proceedings of the 33rd International Conference on Environmental Systems. SAE: Engineering Society for Advanced Mobility in Land, Sea, Air and Space*. 03ICES-286.

**Cuello, J.L.**, P.N. Walker and W.R. Curtis. 2003. Design of Ebb-and-Flow Bioreactor (EFBR) for Immobilized "Hairy Root" Cultures, Part I: Preliminary Design Models and Culture Parameters. *Transactions of the ASAE*. 46(5): 1457-1468.

**Cuello, J.L.**, P.N. Walker and W.R. Curtis. 2003. Design of Ebb-and-Flow Bioreactor (EFBR) for Immobilized "Hairy Root" Cultures, Part II: Growth Studies and Model Verifications. *Transactions of the ASAE*. 46(5): 1469-1476.

- Fitz-Rodríguez, E, **G. A. Giacomelli**, **C. Kubota**, and C. Pagliarulo. 2003. Asynchronous Education in Controlled Environment Agriculture. Association for the Advancement of Computing in Education (AACE). Proceedings of E-Learn 2003, abstract pps. 27, manuscript on CD
- Fleisher, D.H., J. Cavazzoni, **G.A. Giacomelli**, and K.C. Ting. 2003. Adaptation of SUBSTOR for Hydroponic Production of White Potato in Controlled Environments. Transactions of the ASAE 46(2):1-8
- Fujiwara, M., **C. Kubota**, T. Kozai, and K. Samami. 2003. Air temperature effect on leaf development in vegetative propagation of sweetpotato single node cutting under artificial lighting. Scientia Horticulturae. 99:249-256.
- Fujiwara, M., **C. Kubota**, T. Kozai, M. Takagaki and K. Sakami. 2003. Number of sweetpotato propagules produced, electric energy consumption and storage root yield after transplanting in the field as affected by planting density in the closed type transplant production system. Japanese Journal of Tropical Agriculture 47:286-297.
- Giacomelli, G.A.**, 2003. (1)Heating Systems. (2)Evaporative Cooling: Pad and Fan. (3)Evaporative Cooling: Mist and Fog (4)Cooling System: Natural Ventilation and Shading. (5)Environmental Control. Proceedings of the Mississippi Greenhouse Tomato Short Course, Jackson, MS, March 11 – 13.
- Giacomelli, G.A.**, 2003. Engineering Design of Plant Nutrient Delivery Systems. Presentation and paper at the ISHS South Pacific Soilless Culture Conference, Palmerston North, New Zealand. February 10-13. (ACTA Horticulturae in press)
- Giacomelli, G.A.**, 2003. Introduction to Greenhouse Glazing. Chris Beytes, editor, Ball Redbook 17(1):35-41.
- Giacomelli, G.A.**, Chris Pagliarulo, Efen Fitz-Rodriquez, **Chieri Kubota**, and Patricia Rorabaugh, 2003. Learner-Centered, Web-Based Education Website and Simulation Modules for Controlled Environment Agriculture Program. NACTA Journal 47(4):67.
- Giacomelli, G.A.**, R. L. Patterson, P. Sadler, and **D. J. Barta**. 2003. Development and Evaluation of an Advanced Water-Jacketed High Intensity Discharge Lamp. Proceedings of the 33<sup>rd</sup> International Conference on Environmental Systems (ICES), International Bioregenerative Life Support Session 33<sup>rd</sup> International Conference on Environmental Systems, July 7-10, 2003, in Vancouver, Canada.
- Kubota, C.** 2003. Environmental control for growth suppression and quality preservation of transplants. Environ. Control. in Biol. 41:97-105.
- Kubota, C.** 2004. Controlled Environment Agriculture Program at the University of Arizona. Hydroponics (in press)
- Kubota, C.** and M. Kroggel. 2003. A preliminary study on the effects of EC and grafting on growth, gas exchange and fruit quality of hydroponic tomato (*Lycopersicon esculentum*). HortScience 38:789.
- Kubota, C.**, P. Rorabaugh, and M. Wu. 2003. Effects of high EC, planting location inside the greenhouse, and cultivar on leaf gas exchange and fruit quality of hydroponic tomato (*Lycopersicon esculentum*). HortScience 38:789-790.
- Lefsrud, M. G., **G. A. Giacomelli**, H. W. Janes, M. H. Kliss. 2003. Development of the Micro Gravity Plant Growth Pocket. Transaction of the ASAE 46(6) 1647-1651
- Ohyama, K., K. Manabe, Y. Amura, **C. Kubota**, and T. Kozai. 2003. A comparison between closed-type and open-type transplant production systems with respect to quality of tomato plug transplants and resource consumption during summer. J. Environ. Control in Biology 41:57-61.
- Ono, E. and **J.L. Cuello**. 2003. Selection of optimal microalgae species for CO<sub>2</sub> sequestration. Proceedings of the 2nd annual conference on carbon sequestration. Washington, D.C.: Exchange/Monitor Publications, Inc.
- Ono, E. and **J.L. Cuello**. 2004. Design parameters of solar concentrating systems for CO<sub>2</sub>-mitigating algal photobioreactors. *Energy Journal. In Press.*
- Ono, E., K. Jordan and **J.L. Cuello**. 2003. Monitoring the Temporal Variations of Nitrate, Potassium and Manganese in Sweetpotato Hydroponic Solutions for Space Life Support Application. *Proceedings of the 33rd International Conference on Environmental Systems. SAE: Engineering Society for Advanced Mobility in Land, Sea, Air and Space.* 03ICES-191.
- Suárez-Romero, A., **G. Giacomelli**, M. Jensen, U. Schuch, and S. Kania. 2003. Environmental and Plant Growth Experiences in a Retractable Roof Greenhouse Under Semi-Arid Conditions. Proceedings of the 31st National Agricultural Plastics Congress, pps. 17-25.
- Toida, H. Y. Omura, **C. Kubota**, and T. Kozai. 2003. Growth and development of tomato seedlings under constant light-dark period with random light periods. J. Environ. Control in Biology 41:369-375.
- Uno, A., K. Ohyama, T. Kozai, and **C. Kubota**. 2004. Photoautotrophic culture with CO<sub>2</sub> enrichment for improving micropropagation of Coffea arabusta using somatic embryos. Acta Horticulturae (peer-reviewed edition) (in press)
- Yokoi, S., T. Kozai, K. Ohyama, T. Hasegawa, C. Chun and **C. Kubota**. 2003. Effects of leaf area index of tomato seedling populations on energy utilization efficiencies in a closed transplant production system. J. of Soc. High Technology in Agriculture. 15:231-238.

## 6. Internet Sites

\_ The University of Arizona Controlled Environment Agriculture Center home page: <http://ag.arizona.edu/ceac>

\_ Tomato Live! Website: <http://ag.arizona.edu/ceac/tomlive/index.htm>

## 7. Video

Greenhouse Hydroponics From Seed to Harvest, CEAC, College of Agriculture and Life Sciences, The University of Arizona (Available for sale online at <http://ag.arizona.edu/calsmart>)