1. Impact Nuggets
- The University of Arizona developed a low temperature storage method for grafted cantaloupe seedlings (up to four weeks) that would save labor requirement of grafting propagators significantly.
- We have developed a computer vision guided crop sensing and monitoring system and a methodology to monitor nutrient deficiency which could eventually save labor to monitor crop quality and yield, as well as improve resource use efficiency.
- We have designed and developed the ACCORDION photobioreactor for production of photosynthetic algae and plant cell, tissue or organ cultures. We have confirmed in green algae that growth and chlorophyll content can be significantly increased using the same amount of light energy by implementing a composite lighting profile. We will be testing a prototype for the spectral phytometric light meter, a four-in-one light meter that measures and reports radiation in phytometric, quantum, radiometric and photometric units.

2. New Facilities and Equipment
- Dr. Kacira continues to work on advancing the sensing and control lab at CEAC to assess plant growth, quality and health. A masters student has been working on development of a machine vision guided system. Initially, the monitoring system was used to autonomously monitor textural, color, and temporal features of lettuce crop growing in a floating hydroponics system for detection of tipburn induced by calcium deficiency. The project continues on improving the system capability with multisensory/sensing based platform development.
- Dr. Kacira and Dr. Giacomelli with small business Sadler Machine Co. have developed a prototype inflatable greenhouse system for algae production to use for biofuels production. The system is a closed circulating system and has necessary sensor/instrumentation to both monitor alga culture (EC, pH, temperature, optical density) and aerial environment. The system is capable of controlling the rate of nutrient and CO₂ injections. The capability of the system is being evaluated.
- Prototype Lunar Greenhouse (LGH): With the NASA Steckler Phase I grant, Drs. Giacomelli and Kacira with Mr. Phil Sadler (Sadler Machine Co.) has been working on further improvement of the LGH’s sensor/instrumentation capabilities to monitor the system. A new weighing platform has been installed to be able to continuously monitor biomass change and crew labor time. The system is operable, instrumented, and closure experiments are about to start to evaluate water recycling, atmosphere revitalization (CO₂-O₂), biomass production with a multi-crop cable-culture production system, energy use. The project also focused on documenting the system operational requirements, capabilities and weaknesses. For more information: http://ag.arizona.edu/ceac/live/CEAC_live.htm; http://www.youtube.com/watch?v=Z-0qJ4eZhs4.
- Dr. Kubota has completed her USDA SBIR Phase I project with Dr. Takashi Nakamura (Physical Sciences Inc.). This collaborative project was to test a PSI’s solar lighting system for value added transplant production. The solar lighting system consisted with solar tracking system, spectral reflectors, and fiber optical cables.
- Dr. Kubota has a small set up of strawberry raised trough culture system (Ishiguro Strawberry culture system imported from Japan) to evaluate the productivity and fruit quality of hydroponic strawberry in semi-arid greenhouse. She also evaluates the effect of crown temperature control in collaboration with Dr. Makoto Okimura (Kyushu/Okinawa Agricultural Research Center, Japan) for cultural practices and Dr. Murat Karcira for engineering analysis. The goal will be to develop root zone temperature control system/strategy for energy savings in the production.
- Dr. Joel Cuello with collaborator Prof. Gilberto da Costa of Brazil will be testing a prototype for the spectral phytometric light meter developed by the company Everfine based on Dr. Cuello and Prof. Costa’s theoretical development of the phytometric system, a correct Watt-based light measurement system for plant applications. The new spectral phytometric meter is a four-in-one light meter, measuring and reporting radiation readings in all four systems of light measurement – phytometric, quantum, radiometric and photometric – and thus will meet the needs of plant growers, lighting engineers, architects, etc.
- Dr. Joel Cuello with M.S. student Joseph Ley designed and developed the ACCORDION photobioreactor for production of photosynthetic algae and plant cell, tissue or organ cultures. The ACCORDION is a vertical series of angled flat plates for optimal lighting and hydrodynamic mixing. It is currently being optimized. For more information: http://www.youtube.com/watch?v=kz99Qnp74lA.

3. Unique Plant Responses.
Dr. Joel Cuello with Ph.D. student Takashi Hoshino successfully demonstrated a 20% increase in both dry mass and chlorophyll concentration in a green algae species using a composite lighting profile. The control of conventional
lighting profile and the treatment of composite lighting profile both received equal quantities of light energy. The study confirmed in green algae the same results obtained earlier in lettuce, that is, that growth and chlorophyll content can be significantly increased using the same amount of light energy by implementing a composite lighting profile.

4. Accomplishment Summaries

Prototype Lunar Greenhouse and CEAC, Documentary video by Chip Prosser, ChipPro, LLC
http://www.youtube.com/user/chippro#p/a/0/F4Dbh0nvh-4 July 2009.

New spectral phytometric meter for light measurement, reporting radiation readings in all four systems of light measurement (phytometric, quantum, radiometric and photometric), to be tested by Dr. Joel Cuello and Prof. Gilberto Costa.

ACCORDION photobioreactor for production of photosynthetic algae and plant cell, tissue or organ cultures.
http://www.youtube.com/watch?v=kz99Qnp74LA

Composite lighting applied to green algae increased both growth and chlorophyll content by 20%.

5. Impact Statements
The four-week low temperature storage method developed at the University of Arizona (PI: Kubota) is estimated to increase one’s propagation capacity of grafted seedlings up to 20 times without significantly increasing number of laborers. Further investigation is necessary to test various combinations of scion and rootstocks, but this will help propagators establish a sizable capacity to serve for vegetable industry in the US, as labor input and seasonal demand are considered limiting factors of the technology transfer.

6. Published Written Works


5. Scientific and Outreach Oral Presentations


Cuello, J.L. 2009. The Power of Algae: Strategies for Harnessing Algae as Feedstock for Biofuel Production in China. Zhejiang University, Department of Biosystems Engineering and Food Science, Hangzhou, China. 12/24/09


