NCERA-101 Station Report
Orbital Technologies Corporation, Madison WI

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1. Impact Nugget:

ORBITEC is working with NASA Kennedy Space Center on the development of two controlled environment plant growth systems for research aboard the International Space Station.

2. New Facilities and Equipment.

ORBITEC renovated their Large-Scale Development Facility: This facility is equipped with a 3,000 ft^2 hardware assembly area used to build larger scale spaceflight hardware. This area is operated as a class 100,000 clean room.

ORBITEC Large-Scale Development Facility

Life Support System Test Bed: ORBITEC maintains an environmental controlled structure for closed volume, integrated testing of select environmental control and life support equipment that are functionally representative of systems designed for Environmental Control and Life Support Systems (ECLSS) in human spacecraft. The value of this closed loop testing (which can include human subjects for human-in-the-loop testing) is to understand and demonstrate that subsystems are sufficiently mature and ready for the next phase of implementation.

Life Support System Testbed

3. Unique Plant Responses.

We are having problems growing some Pak Choi/Bok Choy varieties in our LED growth rooms. The plants show chlorosis and poor growth. We don't know if this is related to light quality or air contaminants in the rooms.

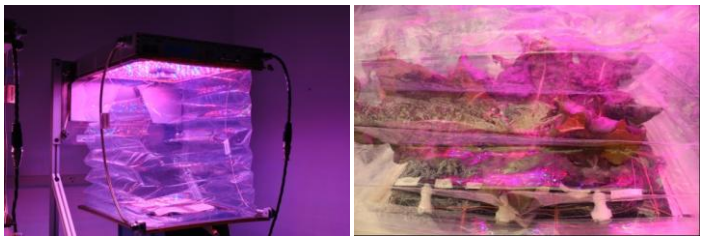
4. Accomplishment Summaries.

Greenhouse lighting

We are developing larger scale supplemental lighting systems for greenhouse productivity testing. These systems will be about 80ft^2 in area with multiple control zones and waveband options. They will be also used to investigate the impact of light quality on secondary plant metabolites.

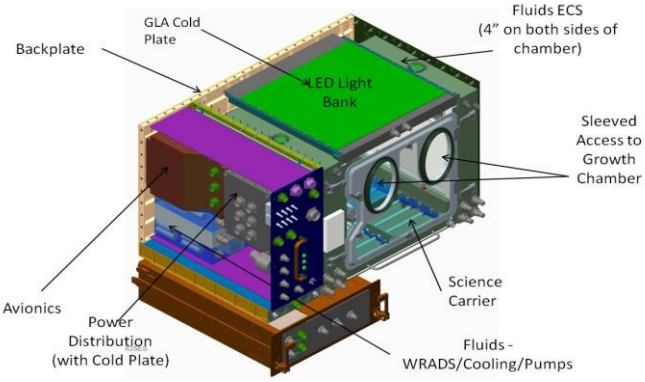
Space Plant Biology

ORBITEC is working with the Kennedy Space Center (KSC) to fly our Veggie plant growth system hardware. It is currently loaded aboard the Space-X Dragon Capsule and scheduled for flight at any time (after 2 scrubs so far). The ultimate goal is to supplement the ISS crew diet with fresh produce.



Veggie plant growth unit. (L) Veggie flight unit, (R) 'Outredgeous' lettuce growing in Veggie unit.

ORBITEC is also supporting KSC to design and fabricate the Advanced Plant Habitat system that will be used for plant research aboard the International Space Station. One of the subsystems ORBITEC is developing is the solid state lighting subsystem. When flown, this system will be the largest plant growth system put in space to date. It is expected to fly in 2015.



Plant Habitat Assembly Model

Plant Habitat LED Light Cap Test Unit

Aerospace Environmental Control

ORBITEC is working with Commercial Crew Integration Capabilities partners for development of human Life Support and Thermal Control systems.

5. Impact Statements.

- ORBITEC is advancing the technology of controlled environment systems to meet the performance and quality needs of long duration space applications. Some of this technology may be transferable and scalable to protected agriculture systems.
- ORBITEC is developing LED lighting configurations and control strategies that provide increased lighting system utility in addition to increased operating efficiency.

- ORBITEC is using its space biology controlled environment work to spark interest in high school and college students in protected agriculture technology and STEM.

6. Published Written Works.

Kopsell, D., C. Sams, T. C. Barickman, and R. Morrow. 2014. Sprouting broccoli accumulate higher concentrations of nutritionally important metabolites under narrow band LED lighting than under fluorescent/incandescent lighting in controlled environments. Submitted to Journal of ASHS.

Massa, G.D., G. Newsham, M.E. Hummerick, J. L. Caro, G. W. Stutte, R.C. Morrow, R.M. Wheeler. 2013. Preliminary species and media selection for the Veggie space hardware. Gravitational and Space Research 1:95-106.

7. Scientific and Outreach Oral Presentations.

Presented three invited talks related to LED plant lighting:

- An International Seminar on Indoor Agriculture and Future Farming in Urban Areas for Food and Recycling Resource Use was hosted for a Goodwill Delegation of 21 people from Chiba, Japan (Wisconsin's Sister State) in Milwaukee WI. ORBITEC Topic: LEDs for Urban Agriculture and Space.
- University of Tennessee-Knoxville Dept. of Plant Sciences Seminar Series: Topic: LED Lighting for Horticulture.
- Dept. Horticulture & Landscape Architecture seminar series, Purdue Univ. Topic: LED Lighting for Horticulture.

ORBITEC provided tours of our facilities and projects, including those related to controlled environments, to the following groups during the last year.

- AIAA student chapters from the University of Wisconsin and University of Michigan (included engineers interested in life support systems)
- Edgewood high school (Science students)
- Kettle Moraine Middle School (Science students)

Mock up of plant based life support system built by middle school students for class project after ORBITEC visit.

8. Other relevant accomplishments and activities.

- ORBITEC continues to be a vendor for Space Gardens (an outreach/education plant growth system) and lunar and mars regolith simulant materials.

9. Websites:

www.orbitec.com