

## NCERA-101 Station Report Orbital Technologies Corporation, Madison WI

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### 1. Impact Nugget:

ORBITEC continues to develop custom solid state lighting systems for biological research applications. Systems have been developed for plant, algae, and aquarium related research.

### 2. New Facilities and Equipment.

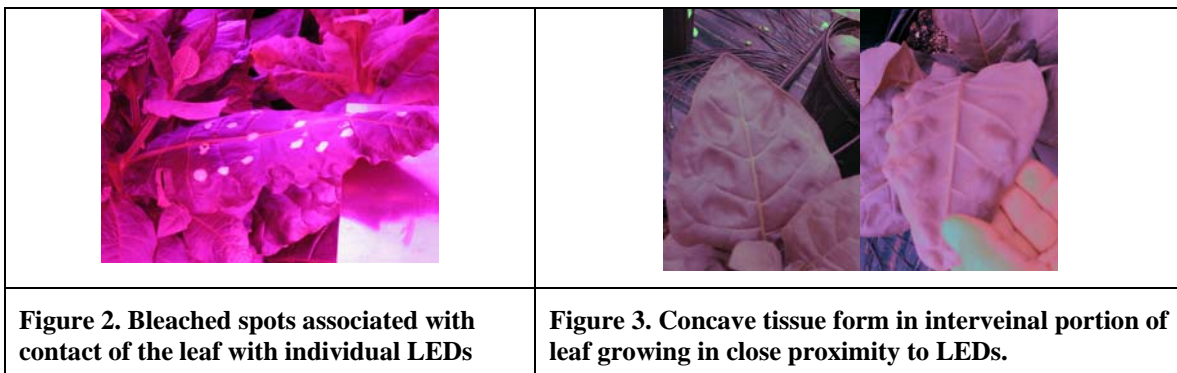
ORBITEC has purchased a second building to accommodate construction and testing of large scale flight hardware (Figure 1). The manufacturing and development complex includes a 3,000 ft<sup>2</sup> hardware assembly area that is operated as an ISO 14644 compliant clean room with an airborne particulate count less than 100,000 parts per million (ppm). NASA-STD-8739 workmanship standards are employed throughout the facility with an on-site NASA certified instructor. An additional 350 ft<sup>2</sup> is dedicated to a controlled environmental test chamber, a gas mixing facility, and a mass spectrometry laboratory. A 450 ft<sup>2</sup> reliability testing laboratory is currently being fabricated within the facility. Testing includes; mechanical shock, vibration, thermal cycling, humidity, powered-life testing, and space vacuum. A second room is being constructed as an anechoic chamber to accommodate acoustic emissions testing and acoustic loads for rocket launch simulation.



Figure 1. ORBITEC thermal chamber (left), test/assembly area (center), and GC – Mass Spec (right).

### 3. Unique Plant Responses.

We operate our LED lighting systems in close proximity to the plant tissue. When operating at high light levels ( $> 700 \mu\text{mol}/\text{m}^2/\text{s}$ ) we have seen the following responses when the tissue was too close to the LED array (within 1-2 cm). Figure 2 shows a tobacco leaf that was touching the LED array for about two days, with bleached spots corresponding to individual LEDs in the array. Figure 3 shows a response that seems to be related to leaves in close proximity to the LEDs where the leaf tissue forms a concave shape in the interveinal spaces. The tissue is the same thickness as the rest of the leaf.



#### 4. Accomplishment Summaries.

ORBITEC has begun testing of solid state greenhouse supplemental lighting systems (Figure 4). These are bar type LED arrays that allow sunlight to pass through. The arrays provide about 200-250 $\mu\text{mol}/\text{m}^2/\text{s}$  of lighting at the plant canopy. The current arrays use only red (627nm) LEDs, but we are fabricating additional test prototypes that will have both red and blue (450nm) LEDs.



**Figure 4. ORBITEC red LED greenhouse supplemental lighting prototype being tested in UW-Madison greenhouse.**

ORBITEC is continuing to investigate tobacco productivity in controlled environments (Figure 5). This work is being done in preparation for eventual production of industrial proteins using genetically modified plants.



**Figure 5. Tobacco plants in ORBITEC red/blue LED growth room.**

#### 5. Impact Statements.

ORBITEC is testing LED lighting configurations and control strategies with the goal of providing plant lighting with 50 to 60% less power than is currently required.

#### 6. Published Written Works.

Bourget, C.M. 2009. An introduction to lighting emitting diodes. 43:1944-1946.

Morrow, R.C. 2009. LED lighting in horticulture. HortScience 43:1947-1950.

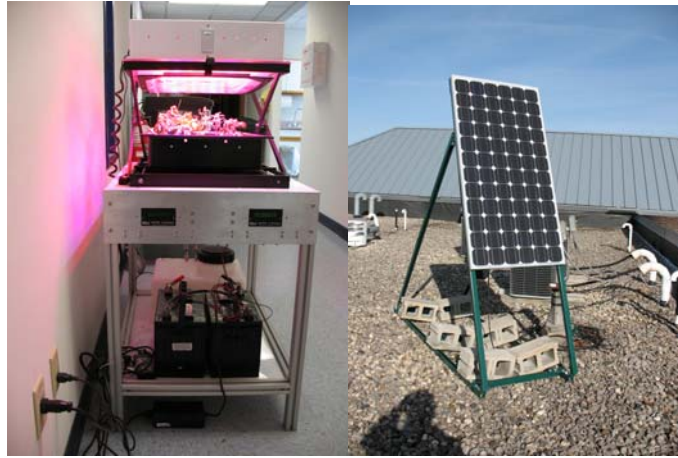
Arquiza, J. M. R. A., J. B. Hunter, R.C. Morrow and R.W. Remiker. Modeling and Simulation of the Drying of Cabin Solid Waste in Long-Term Space Missions. SAE Technical Paper Series Paper No. 2008-01-2194.

#### 7. Scientific and Outreach Oral Presentations.

None

## 8. Other relevant accomplishments and activities.

- ♦ ORBITEC built an “off grid” LED lighting system that operates off batteries charged through a solar panel (Figure 6) to allow us to explore energy storage issues for off grid lighting applications.



**Figure 6. LED lighting system and hydroponic growth system powered from batteries charged by solar panel. Charger uses 120VAC when solar is insufficient.**

- ♦ ORBITEC is developing an in house short run LED panel manufacturing capability and working with overseas sources to set up large scale manufacturing of LED systems.
- ♦ ORBITEC continues to be a vendor for Space Gardens (an outreach/education plant growth system) and lunar and mars regolith simulant materials.
- ♦ ORBITEC has recently reorganized into 5 core divisions:

### **1-Propulsion, Space Resources & Energy Systems**

Rocket propulsion technologies, testing and analysis services and systems for in-situ use of planetary resources.

### **2-Human Support Systems and- Instrumentation**

Components, systems and subsystems to sustain life in closed environments for space travel and habitation.

### **3-Emergency Response Systems**

Ultra High Pressure fire apparatus for situations where high-mobility and performance with limited water resources are a must.

### **4-BioProducts and BioProduction Systems**

Technologies to facilitate the use of biological organisms for economically useful products and services.

### **5-Interactive 3D Systems and Services**

3D simulation as a powerful medium for communicating information, dynamic procedures or hard-to visualize ideas.

## 9. Websites:

[www.orbitec.com](http://www.orbitec.com).