

NCERA-101 Station Report
Orbital Technologies Corporation, Madison WI

April 1, 2007 –March 1, 2008

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1. New Facilities and Equipment.

ORBITEC has completed one LED growth room with a 60 square foot red/blue LED array divided into four subarrays, each containing three light control zones (Figure 1). The arrays are water cooled so they remain near room temperature and can be operated very close to the plant canopy. Light level and red/blue ratio for each of the 12 lighting zones can be independently controlled. The room also provides control of photoperiod, temperature, humidity, and carbon dioxide levels and was designed for operation up to Biosafety Level 2P. Two additional rooms with similar capabilities are nearing completion. To date, tobacco (3 types), corn, lettuce, dwarf rice, and dwarf tomatoes have been successfully grown in this room.



Figure 1. ORBITEC LED based plant growth room (10 x 13 ft).

ORBITEC has also developed a prototype LED lighting system for greenhouse supplemental lighting applications (Figure 2).



Figure 2. Bar-type LED array prototype for greenhouse supplemental lighting system.

2. Unique Plant Responses.

We have been testing the effect of low levels of UV light from UV LEDs on the development of a physiological disorder, intumescence injury (or oedema). It is known that UV light from fluorescent lamps will prevent it, but are trying to develop LED lighting arrays that incorporate the necessary UV

wavelengths. Currently, UV LED outputs are very low and the devices are expensive. However, if they follow the general trend of LED development both output and cost should improve annually. To date we have found that 360 nm LEDs will not prevent intumescence injury (oedema) on tomato when tested using a leaf disk assay, but that 340 nm LEDs will prevent it from occurring. Additional work is being conducted to determine the minimal level of 340nm UV light necessary to prevent this disorder.

3. Unique Human Responses

During the operation of our large LED plant growth room, we have found that the “purplish” light that is produced by the large red/blue LED arrays annoys some personnel working in the growth room and makes maintenance work related to electronics difficult (primarily due to inability to determine “correct” wire color). Therefore our second generation LED panels were redesigned to include a small number of green LEDs. This allows us to put the LED arrays into a “white light mode” that can be used when someone is working in the chamber. This mode is also useful for photographic purposes.

4. Accomplishment Summaries.

ORBITEC has developed two LED systems for commercial sale, a small six color unit for photobiology and educational applications, and a 1'x2' lighting unit designed for use in reach in plant growth chambers.

5. Impact Statements.

The large scale LED units developed by ORBITEC will advance LED lighting technology for use in horticultural applications including growth chamber lighting, tissue culture lighting, and supplemental greenhouse lighting. These arrays are being used to develop design refinements, hopefully leading to the production of affordable large LED lighting systems. Testing indicates that LED systems can potentially reduce energy consumption for lighting by >30% depending on the specific application.

6. Published Written Works.

Morrow, R.C. J.T. Iverson, R.C. Manzke, L.K. Tuominen, and J.D. Neubauer. 2007. Education Payload Operations Kit C: A Miniature, Low ESM Hobby Garden for Space-Based Educational Activities. SAE Technical Paper Series Paper 2007-01-3067.

Iverson, J.T. 2007. The Humidity Validation Payload and Distributed Humidity Control. SAE Technical Paper Series Paper 2007-01-3206.

Ma, Y., C. Thomas, H. Jiang, S. Manolache, and M. Weislogel. 2007. Results of Plasma-Generated Hydrophilic and Antimicrobial Surfaces for Fluid Management Applications. SAE Technical Paper Series Paper 2007-01-3139.

Ma, Y., C. Thomas, R. Remiker and S. Manolache. 2007. Submerged Electrical Discharges for Water Decontamination and Disinfection. SAE Technical Paper Series Paper 2007-01-3175.

7. Scientific and Outreach Oral Presentations.

- ♦ “LEDs in Horticulture” presented by R. Morrow as part of the LED lighting workshop at the 2007 ASHS Annual Meeting.
- ♦ “An Introduction to LEDs” presented by M. Bourget as part of the LED lighting workshop at the 2007 ASHS Annual Meeting.
- ♦ R. Morrow chaired the 2007 International Conference on Environmental Systems session entitled “Biotechnology” for the AIAA Life Sciences & Systems Technical Committee.
- ♦ R. Morrow and M. Gustafson spoke at the NASA/NSTA Symposium: Igniting the Flame of Knowledge: Human Space Flight (Detroit, October 19, 2007).

8. Any other relevant accomplishments and activities.

ORBITEC had two small plant growth units (Astro Gardens™) included in the Education Payload Operations (EPO) Kit C that was flown on STS-118 to the International Space Station in August of 2007.

9. Websites:

www.orbitec.com, www.planet-llc.com, www.hypercosm.com, <http://www.lunarmarssimulant.com>