

**NCR-101 STATION REPORT, ORBITAL TECHNOLOGIES CORPORATION,  
MADISON, WI (MARCH 2005)**

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***New Facilities:***

A second 10,000 sq. ft. facility has been acquired and will serve mainly as an assembly and manufacturing facility. Research activities will continue to be housed in the main ORBITEC building.

***Equipment/Sensors/Control Systems:***

A build of a rooting module with active control of soil moisture, root zone oxygen, and root zone temperature was recently completed as part of the CANDS SBIR project. Several high density LED lighting arrays of various configurations are being fabricated for testing at ORBITEC and other facilities.

Science Evaluation Units developed for the Advanced Animal Habitat and Plant Research Unit are currently undergoing testing.

Recent equipment purchases-Apogee SPEC-UV/PAR spectroradiometer, Apogee UVM-SS ultraviolet meter.

***CE Related Projects:***

Advanced Animal Habitat – Development of animal habitat for ISS Centrifuge Facility.

Plant Research Unit –Development of plant habitat for ISS Centrifuge Facility.

Deployable Vegetable Production Unit – Plant growth unit that expands to 10 times its stowage volume.

Aseptic Plant Culture System – Environmental control systems for use at culture vessel level in sterile plant systems.

Advanced life support architecture studies – Trade studies on hybrid PC/bio systems.

BPS<sub>e</sub> and SpaceGarden – Education/outreach plant growth systems.

Heliac- Advanced control systems for LED lighting.

***Unique Plant Responses:***

We have found that a 2-3°C elevation of root zone temperature over shoot zone temperature has a severe impact on *Brassica rapa* development, even when the root zone temperature is well within acceptable limits for plant growth. High humidity alleviates the response.

Using wild type *Arabidopsis thaliana* var. Landsberg we have seen significant changes in rosette and stem morphology, coloration, and overall growth between plants grown at different soil moisture levels.

We are currently working on growing plants on thin fabric mats.

***Committees/Panels:***

ASHS CE Working Group (Morrow)

ASGSB Education Committee (Morrow, Tuominen)

AIAA Life Sciences & Systems Technical Committee (Morrow)  
AIAA Microgravity & Space Processes Technical Committee (Gustafson)  
AIAA Space Colonization Technical Committee (Rice, Gustafson, White)

**Recent Papers:**

- Musgrave, M.E., A. Kuang, L. Tuominen, L. Levine, and R. Morrow. 2005. Seed storage reserves and glucosinolates in *Brassica rapa* L. grown on the International Space Station. Submitted to J. Am. Soc. Hort. Sci.
- Stadler, J.J., R. W. Remiker, C. M. Westrich, J. R. Morell. 2005. Protecting the ISS Crew from Biological Hazards: The Advanced Animal Habitat (AAH) Containment Approach. SAE Technical Paper Series. 05ICES-125 (In review).
- R. C. Morrow, R.W. Remiker, M. J. Mischnick, L.K. Tuominen, M.C. Lee and T.M. Crabb. 2005. A Low Equivalent System Mass Plant Growth Unit for Space Exploration. SAE Technical Paper Series. 05ICES-119. (In review).
- Maldonado, J., M. Lee, R. Morrow, S. Guetschow, R. Remiker, J. Morell. 2005. Science Evaluation Units for the Plant Research Unit and the Advanced Animal Habitat. SAE Technical Paper Series. 05ICES-109. (In review).
- Iverson, J.T., M. C. Lee, J. C. Emmerich. 2005. AAH, The Latest Development in Microgravity Animal Research. SAE Technical Paper Series. 05ICES-110. (In review).
- Morrow, R.C., J.T. Iverson, R.C. Richter, J.J. Stadler. 2004. Biomass Production System (BPS) Technology Validation Test Results. SAE Technical Paper Series 2004-01-2460.
- Emmerich, J.C., R. C. Morrow, T. J. Clavette, L. J. Sirios and M.C. Lee. 2004. Plant Research Unit Lighting System Development. SAE Technical Paper Series 2004-01-2454.
- Emmerich, J.C., R.C. Richter and M. C. Lee. 2004. Plant Research Unit Control Architecture Overview. SAE Technical Paper Series 2004-01-2392.
- Maas, J. J. and Mischnick, M. J. 2004. Root Module Environmental Control System: Status of the Phase II SBIR Circulating, Aeration, Nutrient Delivery System (CANDS). SAE Technical Paper Series 2004-01-2433.
- Stadler J.J. and L.D. Brideau. 2004. Human Factors and Maintainability in the Plant Research Unit (PRU). SAE Technical Paper Series 2004-01-2583.
- Stadler, J.J., L.D. Brideau, J.C. Emmerich, N. N. Varma. 2004. Integrating Reliability Principles in the Design of the Plant Research Unit (PRU). SAE Technical Paper Series 2004-01-2393.
- Iverson, J.T., T. M. Crabb, M.C. Lee and B. Butrymowicz. 2004. Design of Temperature and Humidity Control Systems for Microgravity. SAE Technical Paper Series 2004-01-2457.
- Lee, M.C., R.W. Remiker, R.C. Morrow. 2004. Space Plants in the Classroom. SAE Technical Paper Series 2004-01-2417.
- Morrow, R.C. and R.J. Gustafson. 2004. ISRU Technologies to Support Human Space Exploration. SAE Technical Paper Series 2004-01-2315.
- Morrow, R.C., T. M. Crabb and M. C. Lee. 2004. Evolution of Space-Based Plant Growth Systems from Research to Life Support. AIAA Conference Publication AIAA-2004-6022.

**Website:**

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

[www.planet-llc.com](http://www.planet-llc.com)