# Controlled Environment Systems Research Facility

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## 2009 Station Report to the NCERA-101 Committee

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1. **New Facilities and Equipment**

PPB-RAE 3000 portable gas monitor handheld photoionization detector (PID). This instrument can instantly measure gaseous contaminants down to ppb levels. This instrument will be used primarily to measure VOCs and gaseous ammonia inside occupied environments as well as gauging the efficacy of various contaminant removal processes.

2. **Unique Plant Responses**.

3. **Accomplishment Summaries**.

We have developed four organic growing substrates and successfully used these substrates for producing organic tomatoes in greenhouse environment. We also developed a system, including some organic growing substrates, for organic vegetable transplant production.

We have developed an automated irrigation system prototype using soil moisture sensor and wireless technologies. This system is particularly useful for research or commercial plant production in controlled environment.

The higher plant chamber prototype for the MELiSSA Pilot Plant was shipped and installed in Barcelona, Spain (Universitat Autonoma de Barcelona), one of our European collaborators.

4. **Impact Statements**.

For over 25 years UoG has offered viable solutions regarding fine control of CES environments that include levels and timing of artificial lighting, $CO_2$ enrichment, temperature, humidity, nutrient recycling and disease management of plants. Currently we are developing and testing sensors to help engineer a new generation of autonomous systems. In addition, new crop variants with lower light tolerance, better disease resistance and potential bioproduct synthesis offer new competitive advantages to our greenhouse industries that have expanded both domestically and as exporters in spite of stiff international competition.

A long-term objective at UoG in collaboration with NASA's Kennedy Space Center is to determine the lowest pressure and $O_2$ content for plant-based biological life support on the moon and Mars to reduce the mass and energy requirements for such systems. So far the teams have determined total pressure (10KPa) and $O_2$ pp (5KPa) thresholds for vegetative production.

Another, long-term objective is to understand and ameliorate the negative effects that climate change may have on biological systems and our economy that is plant based. The current focus of partnering with teams such as those at the "Biotron" at Univ. of Western Ontario and ESA's MELiSSA program in biological life support provides opportunities to better serve basic plant

science, increase competitiveness of our greenhouse industries and contribute to international space exploration initiatives in renewable life support.

Plant pest species and microbial plant pathogens are a serious concern in a production system. Recent results at UoGuelph indicate that aqueous (dissolved) ozone can be an effective root pathogen control agent as well as a potential control agent for the plant pest *Marchantia polymorpha*, a common greenhouse and nursery pest. Significant work has also been undertaken to employ ozone as a control strategy for the economically devastating plant pathogen *Phytopthora ramorum* (Sudden Oak Death). The development of the application and control strategies to safely and effectively apply aqueous ozone in a range of production strategies is not only key to helping Canadian farmers compete globally, it is also an important step in reducing our reliance on potentially toxic chemical pesticides.

5. **Published Written Works**.

**Refereed Journal Articles**


Huber J, Zheng Y and Dixon M. (2009). Hydroponic cucumber production using a new recyclable growth substrate and irrigation system. Acta Horticulturea (In Press).

Zheng Y, Dombrowsky M and Dixon M. (2009). The use of compost or composting process to suppress *Pythium Aphanitdermatum* in used rockwool. Acta Horticulturea (In Press).

Graham, T, Zheng Y, Zhang P, Dixon D. (2009). Phytotoxicity of Aqueous Ozone Irrigation Solutions on Five Economically Significant Perennial Nursery Species. HortScience (In press).

Bamsey, M., Dixon, M., Graham, T., Berinstain, A., Vuk, T.R., Stasiak, M., Scott, A., Canadian Advanced Life Support Capacities and Future Directions, Advances in Space Research (2009) (In Press), doi: 10.1016/j.asr.2009.03.024

Cayanan D, Llewellyn J, Dixon M and Zheng Y (2009). Response of Container-Grown Nursery Plants to Chlorine used to Disinfect Irrigation Water. *HortScience.* 44 (1): 164-167.

Cayanan D, Zhang P, Liu W, Dixon M and Zheng Y, (2009). Efficacy of Using Chlorine in Controlling Five Common Plant Diseases in Irrigation Water. *HortScience*. 44 (1): 157-163.

Robinson S, Zheng Y, Graham, T and Dixon, M. (2008). Aqueous ozone can extend vase life in cut rose. *Journal of Horticulture and Biotechnology*. 84: 97-101.

Cayanan DF, Dixon M and Zheng Y. 2008. Development of an automated irrigation system using wireless technology and root zone environment sensors. *Acta Horticulturae* 797: 167-171.

Cayanan D.F., Zheng Y, Chong C, Zhang P, Graham T, Llewellyn J and Dixon M. 2008. Overhead Irrigation with Chlorinated Water on Five Container-Grown Nursery Species. HortScience 43:1882-1887.


6. **Scientific and Outreach Presentations**


Cayanan. D.F. 2008. Sensitivity of nursery plants to free chlorine in the management of plant pathogens in irrigation water. MSc. Thesis. University of Guelph.

Zheng Y and Dixon M. 2008. How to chlorinate irrigation water for controlling pathogens without injury plants. The Combined Annual Meeting of the Eastern & Western Regions of the International Plant Propagators' Society. September 14-17, 2008. Denver, Colorado, USA. (Zheng was the invited speaker).

Zheng Y, Wang, L, Martinez S and Dixon M. 2008. Nutrient solution oxygenation in soilless production (Abstract). *HortScience* **43:** 1134.