Summary Report to NCR-101: Controlled Environment Technology and Use

Cornell University

April, 2003

New Facilities:

Ownership of the commercial demonstration hydroponic lettuce greenhouse (see at www.cornellcea.com) has been transferred to Cornell University. The greenhouse is now operated through the CEA (Controlled Environment Agriculture) Program within the Department of Biological and Environmental Engineering. The greenhouse is an 8064 square feet glasshouse with an attached 4000 square feet head house. Current operation is to produce hydroponic lettuce using deep trough technology, with a production capacity of 1245 heads of lettuce every day of the year in 6384 square feet of ponds.

New/Different Control Systems:

A concerted effort is underway to work with an environmental control company new to the greenhouse market to develop a computerized environmental control system that includes control of lights to a consistent daily integral. The software is written; the hardware is installed; the program has been operating successfully for approximately two months. Operation has been in Cornell's commercial demonstration hydroponic greenhouse described above. Air temperature control in the greenhouse has been superior to that provided by the previous commercial greenhouse control software, and light integral control has been excellent.

Sensors and Instruments:

Nothing to report

Unique Plant Responses:

Nothing to report

Technology Transfer:

Intellectual property owned by Cornell University is managed through a corporation wholly owned by Cornell, the Cornell Research Foundation (CRF). The CRF has formed a unique relationship with a local firm, CEA Systems of Ithaca, NY, to transfer CEA technologies from the university to the private sector. CEA Systems has been actively engaged during the past year in developing relationships to license IP developed at Cornell, related to CEA, to private sector businesses. Ultimately, the licensing arrangements will provide a flow of funds back to the University, and the CEA Program, to support on-going research activities.

Cooperative/Interdisciplinary Projects:

Based on work begun during his sabbatical at Cornell (Apr-Sep, 2002) continued optimization efforts are underway with Dr. Ido Seginer of Technion related to optimized environmental control for greenhouses, particularly with regard to optimized control of carbon dioxide and supplemental light integrals.

Workshops, etc.:

A special workshop was created for three Raytheon Corporation employees who operate the small greenhouse at the South Pole Research Station. Dr. Corey Johnson Rutzke led the three-day workshop. The objective was to transfer information and skills to increase fresh produce production at the South Pole Station greenhouse significantly. The greenhouse is now being operated with much greater productivity of fresh vegetables, making the long winters more acceptable to the personnel who spend the winter at the station - which is eight months without resupply.

Publications:

Ciolkosz, D.E., A.J. Both, and L.D. Albright. 2002. Selection and placement of greenhouse luminaires for uniformity. Applied Engr. in Agr. 17(6):106-113.

Ciolkosz, D.E., L.D. Albright, J.C. Sager and R.W. Langhans. 2002. A model for plant lighting system selection. Trans. of the ASAE 45(1):215-221.

Johnson-Rutzke, C.F., R.P. Glahn, M.A. Rutzke, R.M. Wheeler, R.M. Welch, R. Wl Langhans, L.D. Albright and G.F. Combs, Jr. 2002. Light quality effects on the nutritional value of spinach plants. NASA Technical Memorandum 2002-210268. J.F. Kennedy Space Center, FL. 17 pp. Plus figures.

Ferentinos, K.P. and L.D. Albright. 2002. Predictive neural network modeling of pH and electrical conductivity in deep-trough hydroponics. Trans. ASAE 45(6):2007-2015.

Ferentinos, K.P. and L.D. Albright. 2003. Fault detection and diagnosis in deep-trough hydroponics using intelligent computational tools. Biosystems Engineering 84(1): 13-30.

Mathieu, J.J., A.R. Leed and L.D. Albright. 2003. A stand-alone light integral controller. Acta Horticulturae (in press).

Ferentinos, K.P. and L.D. Albright. 2003. Modeling pH and electrical conductivity in hydroponics using artificial neural networks. Acta Horticulturae (in press).

Sortware/video presentations developed:

Nothing to report

Internet sites:

www.cornellcea.com