THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

REPORT FOR THE NCR-101 MEETING, April 26-29, 2003

Faculty: A.J. Both, Jim Cavazzoni, David Fleisher, David Mears
Bioresource Engineering, Department of Plant Biology and Pathology
Phone; (732) 932-9753 http://aesop.rutgers.edu/~horteng
both@aesop.rutgers.edu; cavazzon@bioresource.rutgers.edu
fleisher@aesop.rutgers.edu; mears@bioresource.rutgers.edu

1. New Facilities

Open-Roof Greenhouse

Our open-roof greenhouse (Van Wingerden, MX-II, four gutter-connected bays, 17.7 by 18.3 m floor area, 4 m to the gutters, 2 independently controlled growing areas of 7.3 by 13.7 m) construction is complete. Experiments are underway to investigate: 1) the natural ventilation system, 2) the floor heating system, and 3) the ebb and flood floor irrigation system. Crops grown to date are chrysanthemum, poinsettia, and Easter lily. Significant changes in light intensity are observed when plants are either experiencing full sun or light that passed through one or two layers of roof sections.

High Tunnels

Six high tunnels were constructed at two research sites in NJ. These high tunnels will be used for staked (heirloom) tomato production in beds covered with black plastic mulch and irrigated with drip tape. Temperature, humidity, and light sensors will be mounted inside and outside the tunnels to monitor environmental conditions. Two of the tunnels are outfitted with thermostatically controlled automatic roll-up sides and the effectiveness of this control system will be compared with the manual operation of other roll-up sides.

2. Cooperative/Interdisciplinary Projects

Tomato Response to Short-term Environmental Perturbations

In order to develop improved environmental control strategies for controlled environment agriculture, it is important to understand and predict the response of crops to short and long-term environmental changes. An interdisciplinary project involving horticultural engineers and plant and food scientists was assembled to study effects of environmental input perturbations on tomato fruit quality at harvest. Tomatoes (cv. Laura) were grown in 6” pots filled with perlite in growth chambers retrofitted with a trickle irrigation system. Plants were pruned so as to maintain a single cluster. The first two experiments introduced a two-week air temperature perturbation (± 5°C from the control day/night air temperature of 23°C/18°C) starting at ten days post fruit-set. Following the two-week period, the air temperature for all plants was restored to the control set point and plants were allowed to grow to maturity. Individual tomato fruits were harvested from the plants based on three distinct vine-ripening stages, breaker stage, breaker stage plus three days, and breaker stage plus six days. Fruits are being evaluated for a variety of characteristics including dry mass, diameter, color, firmness, starch content, soluble solids, acidity, viscosity, and lycopene content.

Initial analysis of the fruit quality measurements indicates that there was a significant effect of temperature perturbation on the development and quality of the harvested tomato fruit. In general, the use of color to indicate fruit physiological age (as is the general practice) was uncoupled from other internal ripening characteristics. Significant differences and trends were also found for several fruit quality parameters depending on vine ripening stage and temperature treatment. There does not appear to be significant differences in fruit yield but the temperature disturbances have a dramatic impact on fruit maturity rate. These findings are valuable because they demonstrate how simple environmental control strategies can be used to affect yield and production time in a horticulturally useful way. The fruit measurements will provide a second level of information by which to assess the usefulness or consequence of these treatments.

3. Committees and sub-committees served

Controlled Environment Agriculture Advisory Board, Cornell University: A.J. Both, member.
SE-303 Committee on Environment of Plant Structures, ASAE: David Fleisher, past Chair (2002).
SE-303 Committee on Environment of Plant Structures, ASAE: A.J. Both, vice Chair (2003)

4. Recent Publications

Both, A.J., D.E. Ciolkosz, and L.D. Albright. 2002. Evaluation of light uniformity underneath supplemental lighting systems. Acta Horticulturae 580:183-190.

Fleisher, D.H., J. Cavazzoni, G.A. Giacomelli, and K.C. Ting. 2003. Adaptation of SUBSTOR for Hydroponic Production of White Potato in Controlled Environments. Transactions of the ASAE (1), IET597 (in press)

Fleisher, D.H. 2002. Preliminary analysis of plant response to environmental disturbances in controlled environments. ASAE paper No. 02-4076. ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA. NJAES Paper No. P-12130-06-02. 10 pp.

Fleisher, D.H., L.F. Rodriguez, A.J. Both, J. Cavazzoni, and K.C. Ting. 2002. Advanced life support systems in space. Submitted to CIGR Handbook of Agricultural Engineering. Volume 6: Information Technology.

Fleisher, D.H., K.C. Ting, and G.A. Giacomelli. 2002. Decision support software for phytoremediation systems using rhizofiltration processes. Transactions of the Chinese Society of Agricultural Engineering. NJAES Paper No. D-12130-07-02. 18(5):210-215.

Goudarzi, S. 2003. Dynamic crew performance model for long-duration space missions. M.S. Thesis. Rutgers University Libraries, New Brunswick, NJ 08901. 78 pp.

Goudarzi, S., J. Cavazzoni, and A.J. Both. 2002. Dynamic modeling of crew performance for long duration space missions. Presented at the 32nd International Conference on Environmental Systems, July 15-18, San Antonio, Texas. SAE Technical Paper No. 2002-01-2497. NJAES Paper No. H-70501-01-02.

Hsiang, H. 2002. Top-level modeling of a food processing and nutrition (FPN) component of an advanced life support system (ALSS). M.S. Thesis. Rutgers University Libraries. New Brunswick, NJ 08901. 120 pp.

Kang, S. and A.J. Both. 2002. A management information system for food nutritional analysis and biomass production in an advanced life support system. Journal of Life Support and Biosphere Science 8(3/4):191-197. NJAES Paper No. D-70501-03-02.

Kumasaka, K. 2003. Canopy gas-exchange of soybean [Glycine Max (L.) Merr., cv. Hoyt] in response to air temperature, light intensity, and aerial CO_2 concentration in controlled hydroponic environments. M.S. Thesis. Rutgers University Libraries, New Brunswick, NJ 08901. 138 pp.

Lefrud, M.G., G.A. Giacomelli, H.W. Janes, and M.H. Kliss. Development of the microgravity plant growth pocket. Submitted to the Transactions of the ASAE. NJAES Paper No. D-70501-05-02.

Mears, D.R. and A.J. Both. 2002. A positive pressure ventilation system with insect screening for tropical and subtropical greenhouse facilities. Acta Horticulturae 578:125-132. NJAES Paper No. P-03130-06-01.

Rodriguez, L.F. 2002. A dynamic object oriented top-level advanced life support system model. Ph.D. Dissertation. Rutgers University Libraries, New Brunswick, NJ 08901. 165 pp.

Sase, S., E. Reiss, A.J. Both, and W.J. Roberts. 2002. A natural ventilation model for open-roof greenhouses. ASAE paper No. 02-4010. ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA. NJAES Paper No. P-12232-04-02. 9 pp.

Extension Bulletins:

E.F. Wheeler and A.J. Both. 2002. Principles of evaluating greenhouse aerial environments: Part 1 of 3. Rutgers University Extension Bulletin No. E275.

E.F. Wheeler and A.J. Both. 2002. Instruments for monitoring the greenhouse aerial environment: Part 2 of 3. Rutgers University Extension Bulletin No. E276.

E.F. Wheeler and A.J. Both. 2003. Evaluating greenhouse mechanical ventilation system performance: Part 3 of 3. Rutgers University Extension Bulletin No. E277.

5. Internet Sites

http://aesop.rutgers.edu/~horteng
http://aesop.rutgers.edu/~fleisher