THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

REPORT FOR THE NCR-101 MEETING, March 14-17, 2004

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

1. New Facilities Installed

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) has been in operation for a couple of years. Our major research effort concentrates on the floor heating system. Temperature measurements collected under a range of environmental conditions will be used to develop a heating simulation model that in turn will be used to determine optimum control strategies for greenhouse floor heating systems. Crops grown to date are chrysanthemum,

High Tunnels

Six high tunnels were constructed at two research sites in NJ. These high tunnels are used for staked tomato production in beds covered with differently colored plastic mulches and irrigated with drip tape. Temperature, humidity, and light sensors are used to monitor inside and outside environmental conditions. Two of the tunnels are outfitted with thermostatically controlled automatic roll-up sides. Such automatic roll-up sides can be a labor saver compared to the manual roll-up sides.

2. Cooperative/Interdisciplinary Projects

Tomato Response to Short-term Environmental Perturbations

Growth chamber experiments were performed with tomato (cv. Laura) aiming to study the influence of air temperature perturbations during fruit set on fruit quality at maturity, the time to harvest, and the harvest window. Plants were grown in 6" pots filled with a perlite. Nutrients were provided through a drip irrigation system. All plants were grown under the same environmental conditions (23/18°C day/night temperature, 650 µmol/mol CO_2 concentration, 16-hour photoperiod, 415 µmol/(m^2s) fluorescent and incandescent light, and 80% relative humidity) except for a two-week period beginning 10 days after fruit-set during which plants were assigned to one of three day/night temperature treatments, 28/23°C, 23/18°C, and 18/13°C. Five tomato fruits were harvested from each plant at three distinct physiological ages; breaker stage (taken as the point at which 25% of the fruit begins to turn red), breaker stage plus three days, and breaker stage plus six days. Harvested fruits were analyzed for mass, size, color, soluble solids content, pH, acidity, viscosity, and other quality parameters. Initial results show significant temperature effects on fruit size, mass, developmental rate, and fruit processing characteristics. The results are applicable towards the development of more efficient plant production strategies for greenhouse growers and for NASA's advanced life support research program.

Structural analysis of pipe frame greenhouses

A collaboration has been undertaken with the Laboratory of Controlled Environment Agriculture, National Institute for Rural Engineering, Tsukuba, Japan on the structural analysis of pipe frame greenhouse structures to develop simple and low-cost methods of bracing against wind and snow loads. Finite element analysis is utilized to develop designs, which are then laboratory and field tested in Japan.

Growing tropical plants in greenhouses in New Jersey

Another collaboration is underway with the National Taiwan University and several private sector companies in Taiwan and New Jersey focusing on environmental control issues in tropical and semi-tropical conditions and on adaptations needed in New Jersey for selected tropical flowers of potential interest for production in the US.

3. Committees and sub-committees served

International Committee for Controlled Environment Guidelines: A.J. Both, member.
Controlled Environment Agriculture Advisory Board, Cornell University: A.J. Both, member.
SE-303 Committee on Environment of Plant Structures, ASAE: A.J. Both, Chair (2004)

4. Recent Publications

Both, A.J. and J.E. Faust. 2003. Light transmission: greenhouse design and coverings. Greenhouse Grower. December issue. pp. 82-86.

Both, A.J. 2003. Oil or gas? Strategies to reduce greenhouse energy bills. Mid-Atlantic Grower (5)11 October issue. pp. 18-19.

Both, A.J. 2003. Supplemental Lighting: Part 2. OFA Bulletin. September/October issue. pp. 1, 10-11.

Both, A.J. 2003. Supplemental Lighting. OFA Bulletin. July/August issue. pp. 16-18.

Both, A.J. 2003. Hydroponic lettuce research. Practical Hydroponics and Greenhouses. May/June issue. pp. 40-47.

Both, A.J. 2003. Considering supplemental lighting? Here are some data that may help you decide. International Cut Flower Growers Association Bulletin. April issue. pp. 24-28.

Both, A.J. 2003. Supplemental lighting. Can it help you grow better crops? Greenhouse Management and Production (GMPRO). Spring Edition. pp. 34-37.

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 46(2):531-538.

Fleisher, D.H., A.J. Both, C. Moraru, L. Logendra, T. Gianfagna, T.C. Lee, H. Janes and J. Cavazzoni. 2003. Manipulation of tomato fruit quality through temperature perturbations in controlled environments. ASAE Paper No. 03-4102. ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA. 9 pp.

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

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.

Lefsrud, M.G., G.A. Giacomelli, H.W. Janes, and M.H. Kliss. Development of the microgravity plant growth pocket. Transactions of the ASAE 46(6)1647-1651.

Moriyama, H., D.R. Mears, S. Sase, H. Kowata and M. Ishii. 2003. Design Considerations for Small-Scale Pipe Greenhouses to Prevent Arch Buckling Under Snow Load. ASAE Paper No. 03-4047 ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA. 8 pp.

Reiss, E., D.R. Mears and A.J. Both. 2003. Greenhouse floor heating. ASAE Paper No. 03-4039. ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA. 14 pp.

5. Internet Sites

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