1. New Facilities

**Open-roof greenhouse**
An open-roof greenhouse (Van Wingerden Greenhouse Company, MX-II, four gutter-connected bays, 17.7 by 18.3 m floor area) is undergoing a renovation process. Plastic heating pipes were embedded in a new ebb and flood floor irrigation system. All side-walls of the greenhouse were outfitted with 8 mm thick, twin-walled acrylic panels. Roof segments are clad with double poly film. In addition to the roof vents, two motorized side vents were installed along the east and west sidewalls. These side vents will allow for ventilation during high wind or rainy conditions. A gas-fired, hot-water boiler will be installed to supply warm water to the greenhouse floor, and to a perimeter and an overhead heating loop.

**Ebb and flood floor irrigation system**
Two independently operated ebb and flood floor sections (13.7 by 7.3 m each) were installed in the open-roof greenhouse. The nutrient solutions will be stored in two separate underground concrete tanks (5,678 L each). Submergible pumps pump the stored nutrient solutions onto the floor and pneumatic valves will allow the nutrient solution to return to the storage tank after the irrigation cycle is completed. Each nutrient solution tank is equipped with an automatic (time delayed) supply of make-up water. Fertilizer injectors will add the appropriate amount of nutrients to the make-up water.

2. Sensors and Instruments

**Continuous, Real-Time Measurement of Plant Photosynthesis and Transpiration by Gas Analysis for a Soybean Crop (NJ-NSCORT)**
In order to provide non-destructive growth data useful for crop modeling efforts, four environmentally controlled plant growth chambers (located inside a walk-in plant growth chamber and each measuring 91 x 64 x 76 cm, L x W x H) have been used to monitor canopy net photosynthesis and dark cycle respiration rates of soybean. Ninety-day experiments were conducted to produce data including short and long-term effects of air temperature, atmospheric carbon dioxide concentration, and irradiance on CO₂ exchange rates. The collected data are being analyzed as part of Konomi Kumasaka’s M.S. thesis project. Additional experiments with lettuce are being conducted. One of the biggest challenges during the experiments proved to be the proper operation of the gas analyzer (ADC 2250 Gas Analyzer, ADC BioScientific Ltd., Hoddesdon, England), particularly during the 90-day soybean experiments.
3. **Cooperative/Interdisciplinary Projects**

**Crop Modeling for Multiple Crop Production and Control for Advanced Life Support Systems**

As part of David Fleisher’s PhD dissertation research, a computerized algorithm was developed to simulate and compensate for effects of environmental perturbations on production and scheduling of hydroponically grown wheat, soybean, and white potato in controlled environments. A white potato field model, SUBSTOR, was modified based on experimental data of potato growth in growth chambers. The modified SUBSTOR model was combined with similar models for wheat and soybean and used to simulate crop growth and development data. A methodology was developed to fit this data using Multivariate Polynomial Regression (MPR). A model-based predictive control algorithm was constructed using the MPR crop models to predict future crop response. The algorithm was integrated with a Visual Basic computer program to simulate crop growth and compensate for disturbances in light intensity, air temperature, and CO₂ concentration.

**Top-level Modeling of Advanced Life Support Systems and Component Systems**

As part of Luis Rodriguez’ PhD dissertation research, efforts were undertaken towards the development of acceptable, flexible, and dynamic mathematical computer modeling tools capable of system level analysis. Object oriented techniques were adopted to develop a top-level model of an advanced life support system such as a space station or a planetary base. An advantage of this approach is that object oriented abstractions of systems are inherently modular in architecture. Thus, models can initially be somewhat simplistic, while allowing for incorporation of adjustments and improvements. In addition, by coding the model in Java, the model can be implemented across the Web, greatly encouraging the utilization of the model. The sub-models of the overall advanced life support system model include Crew, Biomass Production, Waste Processing and Resource Recovery, and Food Processing and Nutrition. At present, the BP and WP&RR sub-models are the most complete, and are the first to be incorporated. This constitutes the initial step towards the integration of all the sub-models to form an overall top-level model of an entire advanced life support system.

**Supplemental Lighting for Plug Production**

A collaborative research project under the leadership of Dr. Paul Fisher (University of New Hampshire) was initiated. The project investigates the economic feasibility of supplemental lighting (HPS) for plug production and specifically studies the effects of supplemental lighting on production time and post-production plant quality. Part of the research is conducted at a commercial greenhouse operation in Allentown, New Jersey (Kube Pak, Bill Swanekamp).

4. **Committees and sub-committees served**

NE-164 Regional Committee on Decision Support for Design and Control of Plant Growth Systems: A.J. Both, Chair (2001)

CEA Advisory Board, Cornell University: A.J. Both, member

SE-303 Committee on Environment of Plant Structures, ASAE: David Fleisher, Chair (2001)

5. **Recent Publications**


6. Internet Site
http://aesop.rutgers.edu/~horteng