

1. New Facilities and Equipment

A new landfill gas fired 250 kW microturbine was installed at the NJ EcoComplex greenhouse facility. The system generates electricity and heat for the 1-acre greenhouse facility. Excess electricity is sold back to the local utility grid.

2. Unique Plant Responses

A growth chamber photoperiod study using tomato plants confirmed the plant's requirement for a dark period, but found that the light period can be extended to 21 hrs while maintaining low intensity PAR (around 150 $\mu\text{mol}/(\text{m}^2\text{s})$, FCW plus INC) without apparent negative impact on plant growth and development through the flowering stage of the first cluster (cultivars Babilonia, Dundee, Starbuck, and Geronimo).

3. Accomplishment Summaries

Growth chamber experiments were conducted using LED lamps as the sole light source for tomato growth and development. Despite the increasing unevenness in wavelength uniformity as the canopy increased in height, tomato fruit developed and ripened normally.

4. Impact Statements

Nationwide, Extension personnel and commercial greenhouse growers have been exposed to research and outreach efforts through presentations, various publications and evaluation tools. It is estimated that this information has led to proper greenhouse designs and updated operational strategies that saved an average sized (one acre) greenhouse business a total of \$20,000 in operating and maintenance costs annually.

Greenhouse energy conservation presentations and written materials have been prepared and delivered to local, regional, national and international audiences. Growers who implemented the information resulting from our research and outreach materials have been able to realize energy savings between 5 and 30%.

5. Published Written Works

Both, A.J. 2009. Greenhouse energy conservation and efficiency (Abstract). Proceedings of the Annual NJ Vegetable Growers' Association Meeting. January 13-15. Atlantic City, NY. pp. 76-78.

Both, A.J. and D.R. Mears. 2008. Building and maintaining greenhouses for energy savings. In 'Horticulture: Principles and Practices', 4th ed. by G. Acquaah; included in Chapter 12 'Controlled-Environment Horticulture'. Prentice Hall, Inc. Upper Saddle River, NJ. pp. 406-417.

Lefsrud, M., D. Kopsell, C. Sams, J. Wills, and A.J. Both. 2008. Dry matter content and stability of carotenoids in kale and spinach during drying. HortScience 43(6):1731-1736.

Both, A.J. Energy efficiency: Learning to conserve. Greenhouse Grower 25th Anniversary Issue. December 2008. pp. 56, 58.

Both, A.J. and T. Manning. Solar and wind energy for greenhouses. OFA Bulletin No. 910. September/October 2008. pp. 1, 6-7.

Both, A.J.. 2008. Maintain ventilation equipment before warm weather starts. Greenhouse Management and Production (GMPro). April issue. pp. 21-24.

6. Scientific and Outreach Oral Presentations

- Both, A.J. 2009. Greenhouse energy considerations. 28th Long Island Agricultural Forum. Riverhead, NY. January 8.
- Both, A.J. 2008. Crop production in cooler environments. Canadian Greenhouse Conference. Toronto, Canada. October 9.
- Both, A.J. 2008. Technology and a green thumb make for great partners. Department of Plant and Soil Sciences. Michigan State University. East Lansing, MI. May 15.
- Both, A.J. 2008. Controlled environment crop production: Food, flowers, photons, and flow. Department of Environmental Sciences, New Brunswick, NJ. April 30, 2008.
- Both, A.J. 2008. The role of technology in commercial plant production. Department of Horticulture and Landscape Architecture. Purdue University. West Lafayette, IN. April 24.
- Both, A.J. 2008. High tunnel construction. Strawberry and Vegetable Crop Management Twilight Meeting. Bridgeton, NJ. April 22.
- Both, A.J. 2008. Greenhouse energy conservation. South Jersey Commercial Greenhouse Growers Conference. Clayton, NJ. February 19.

7. Other Relevant Accomplishments and Activities

- International Committee for Controlled Environment Guidelines: A.J. Both, Chair
- NE-1017 Developing and Integrating Components for Commercial Greenhouse Production: A.J. Both, Acting Chair (2008)