

NCERA-101: Committee on Controlled Environment Technology and Use Michigan State University 2009 Station Report

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Impact Nugget

Michigan State University has identified how light duration and quantity influence flowering of range of ornamental garden plants grown in greenhouses. This information is being used by greenhouse growers to improve their scheduling of crops so that plants flower on time.

New Facilities and Equipment

In the past year, Michigan State University added 15 new growth chambers, for a total of 166 growth chambers. The basement of a plant science building expansion, which breaks ground in May 2010, is designed for 60 additional growth chambers. Plans are in place to submit proposals to fund these additional chambers in the next 12 to 24 months. For more information, visit the MSU Growth Chamber Facility website at: <http://growthchamber.prl.msu.edu>.



Accomplishment Summaries

Researchers at Michigan State University developed mathematical models that predicted the influence of photosynthetic daily light integral (DLI) on flowering of approximately 30 annual bedding plants grown in greenhouses. Experiments were performed over 3 years and plants were grown under four different mean DLIs that ranged from 3 to 20 mol·m⁻²·d⁻¹ using a 16-hour photoperiod. Flower development rate increased as DLI increased until saturation, which varied among species. For example, *Petunia* 'Dreams Neon Rose' had a saturation DLI of 10.6 mol·m⁻²·d⁻¹, while *Verbena* 'Quartz Waterfall Mix' had a DLI of 19.5 mol·m⁻²·d⁻¹. The estimated saturation DLI for flower development rate in most species studied ranged from 8 to 15 mol·m⁻²·d⁻¹.

A new Michigan State University floriculture website, <http://www.flor.hrt.msu.edu>, was developed and is now online. The website contains over 100 trade magazine articles written by MSU faculty and graduate students on the greenhouse production of ornamentals, including articles that focus on managing light and temperature. Additional website content includes greenhouse energy and floriculture marketing resources, as well information on MSU outreach activities such as the Michigan Garden Plant Tour and the Michigan Agriculture Environmental Assurance Program for greenhouses.

Impact Statements

We published a 12-part series of articles in [Greenhouse Grower magazine](#) that focused on temperature management of approximately 20 different popular annual bedding plants. Each article was circulated to 20,000 greenhouse employees, educators, and industry leaders. Articles are also available in electronic format. Research information was presented on how temperature and daily light integral influence crop timing and quality of representative cultivars. That

information was used with the [Virtual Grower](#) computer program to predict heating costs for each crop in seven different climates in the U.S. From that information, energy-efficient production temperatures were identified for different flowering dates and locations.

Published Written Works (*denotes peer-reviewed scientific manuscript)

- *Blanchard, M. G., Runkle, E.S. 2009. Effects of a new cyclical lighting system on flower induction in long-day plants: A preliminary investigation. [Acta Hort. 813:623-630](#).
- *Blanchard, M.G. and E.S. Runkle. 2009. Influence of short-term storage temperature and duration of canna rhizomes on subsequent greenhouse forcing. [Acta Hort. 847:313-319](#).
- *Blanchard, M.G., Runkle, E.S. 2009. Use of a cyclic high-pressure sodium lamp to inhibit flowering of chrysanthemum and velvet sage. [Sci. Hort. 122:448-454](#).
- Blanchard, M., Runkle, E.S., Fisher, P., Erwin, J. 2009. Energy-efficient annuals, Part 1: Perfecting temps & light. [Greenhouse Grower 27\(3\):38-42](#).
- Blanchard, M., Runkle, E.S. 2009. Energy-efficient annuals, Part 3: Timing marigolds. [Greenhouse Grower 27\(5\):58-61](#).
- Blanchard, M., Runkle, E.S. 2009. Energy-efficient annuals, Part 4: Dianthus & snapdragon. [Greenhouse Grower 27\(7\):30-34](#).
- Blanchard, M., Runkle, E.S. 2009. Energy-efficient annuals, Part 5: Ageratum & cosmos. [Greenhouse Grower 27\(8\):40-46](#).
- Blanchard, M., Runkle, E.S. 2009. Energy-efficient annuals, Part 6: Petunias. [Greenhouse Grower 27\(9\):36-41](#).
- Blanchard, M., Runkle, E.S. 2009. Energy-efficient annuals, Part 7: Geraniums & zinnias. [Greenhouse Grower 27\(10\):44-48](#).
- Blanchard, M., Runkle, E.S. 2009. Energy-efficient annuals, Part 8: Redbeckia & viola. [Greenhouse Grower 27\(12\):38-44](#).
- Blanchard, M., Runkle, E.S. 2009. Energy-efficient annuals, Part 9: Dahlia & osteospermum. [Greenhouse Grower 27\(13\):36-42](#).
- Blanchard, M., Runkle, E.S. 2009. Energy-efficient annuals, Part 10: Vinca & wax begonia. [Greenhouse Grower 27\(14\):28-34](#).
- Blanchard, M., Runkle, E.S. 2009. Manipulating light in the greenhouse. [Greenhouse Product News 19\(6\):22-27](#).
- *Lopez, R.G., Blanchard, M.G., Runkle, E.S. 2009. Propagation and production of *Zamioculcas zamiifolia*. [Acta Hort. 813:559-564](#).
- *Newton, L.A., Runkle, E.S. 2009. High-temperature inhibition of flowering of *Phalaenopsis* and *Doritaenopsis* orchids. [HortScience 44:1271-1276](#).
- *Oh, W., Cheon, I. H., Kim, K. S., Runkle, E.S. 2009. Photosynthetic daily light integral influences flowering time and crop characteristics of *Cyclamen persicum*. [HortScience 44:341-344](#).
- Padhye, S., Runkle, E.S. 2009. Providing long-days with CFLs. [GrowerTalks 72\(11\), 58-62](#).
- *Runkle, E.S., Allen, S. J., Dudek, T. A., Himmelein, J. M., Krauskopf, D. M. 2009. The Floriculture College of Knowledge: A certificate program for greenhouse growers. [Acta Hort. 832:195-202](#).
- Runkle, E.S., Frantz, J., Blanchard, M. 2009. Energy-efficient annuals, Part 2: Scheduling bedding plants. [Greenhouse Grower 27\(4\):40-44](#).
- Runkle, E.S. 2009. Technically speaking: ABA coming to floriculture. [Greenhouse Product News 19\(5\):42](#).

- Runkle, E.S. 2009. Technically speaking: Brushing plants for height control. [Greenhouse Product News 19\(2\):58](#).
- Runkle, E.S. 2009. Technically speaking: Controlling height with temperature drops. [Greenhouse Product News 25\(4\):50](#).
- Runkle, E.S. 2009. Technically speaking: Going beyond the surface. [Greenhouse Product News 19\(9\):54](#).
- Runkle, E.S. 2009. Technically speaking: Grow warm or grow cool? [Greenhouse Product News 19\(7\):70](#).
- Runkle, E.S. 2009. Technically speaking: LEDs in floriculture. [Greenhouse Product News 19\(6\):54](#).
- Runkle, E.S. 2009. Technically speaking: Opening strategies for energy curtains. [Greenhouse Product News 19\(8\):58](#).
- Runkle, Erik S. 2009. Technically speaking: Problems with petunia production? [Greenhouse Product News 19\(12\):50](#).
- Runkle, E.S. 2009. Technically speaking: Strategies for supplemental lighting. [Greenhouse Product News 19\(11\):50](#).
- Runkle, E.S. 2009. Technically speaking: The case for space. [Greenhouse Product News 19\(3\):50](#).
- Runkle, E.S. 2009. Technically speaking: Tips for using light sensors. [Greenhouse Product News 19\(1\):66](#).
- Runkle, E.S., Frantz, J. 2009. Technically speaking: Why use Virtual Grower? [Greenhouse Product News 19\(10\):50](#).
- *Walworth, A.E. and R.M. Warner. 2009. Differential cold-acclimation ability of *Petunia* species. [HortScience 44: 1219-1222](#).
- *Warner, R.M. (2009). Determination of the photoperiod sensitive stages of development of the short-day plant celosia. [HortScience 44: 328-333](#).
- Warner, R.M., Oh, W., Runkle, E.S. 2009. Maximizing greenhouse lighting. [Greenhouse Management & Production 25\(4\):22-25](#).

Scientific and Outreach Presentations

- Runkle, E.S. (Presenter & Author). 2009. Greenhouse energy cost-reduction strategies. Great Lakes Trade Exhibition (Grand Rapids, MI), January.
- Runkle, E.S. 2009. Energy-efficient greenhouse production of ornamental crops. Agricultural Process Engineering department seminar, Kyoto University, March.
- Runkle, E.S. 2009. NCERA-101 2008 station report. NCERA-101 Annual Meeting (Park City, UT), April.
- Runkle, E.S., Blanchard, M.G. 2009. Energy-efficient production of annual crops in greenhouses by manipulation of temperature and photosynthetic daily light integral. ISHS GreenSys2009 (Quebec City, Canada), June.
- Runkle, E.S., Oh, W., Padhye, S. 2009. Use of compact fluorescent lamps to provide a long-day photoperiod to petunia and pansy. American Society for Horticultural Science Annual Conference (St. Louis, MO), July.
- Bradford, E., J. Hancock and R. Warner. 2009. Temperature tolerance, not photoperiod insensitivity, is the primary factor controlling repeat flowering (remontancy) in strawberry. American Society for Horticultural Science Annual Conference (St. Louis, MO), July.

- Stegmeier, T., R.M. Warner, C. Finn and J. Hancock. 2009. Performance of an elite strawberry population derived from wild germplasm of *Fragaria chiloensis* and *F. virginiana*. American Society for Horticultural Science Annual Conference (St. Louis, MO), July.
- Tychonievich, J. and R.M. Warner. 2009. Potential for crop improvement in ornamental salvia via interspecific hybridization. American Society for Horticultural Science Annual Conference (St. Louis, MO), July.
- Warner, R.M. 2009. Inheritance of crop timing and quality attributes in petunia interspecific populations. American Society for Horticultural Science Annual Conference (St. Louis, MO), July.
- Walworth, A.E and R.M Warner. 2009. Characterization of a CBF cold-response pathway in *Petunia*. American Society of Plant Biologists Annual Conference (Honolulu, HI), July.
- Runkle, E.S., Blanchard, M. 2009. Energy-efficient scheduling of bedding plants. OFA Short Course (Columbus, OH), July.
- Runkle, E.S., Warner, R.M. 2009. Lighting: bedding plant plugs & liners. OFA Short Course (Columbus, OH), July.
- Runkle, E.S., Padhye, S. 2009. The latest and greatest perennials: Production tips for success. OFA Short Course (Columbus, OH), July.
- Warner, R.M. and J.E. Erwin. 2009. The nuts and bolts of modifying light. OFA Short Course (Columbus, OH), July.
- Runkle, E.S., Allen, S.J., Dudek, T.A., Himmelein, J.M., Krauskopf, D.M. 2009. The Floriculture College of Knowledge: A certificate program for greenhouse growers. ISHS 5th International Symposium on Horticultural Research, Training, and Extension (Chiang Mai, Thailand), July.
- Runkle, E.S. 2009. Managing greenhouse temperature in an energy-efficient manner. 2009 MSU Garden Plant Showcase (East Lansing, MI), August.
- Cloyd, R., Daughtrey, M., Derr, J., Runkle, E. S. 2009. Perennial production problem solving. 2009 Perennial Production Conference (Buffalo, NY), September.
- Cloyd, R., Daughtrey, M., Pilon, P., Pyle, A., Runkle, E. S. 2009. Perennial production workshop. 2009 Perennial Production Conference (Buffalo, NY), September.
- Runkle, E.S., Blanchard, M. 2009. Putting the new Virtual Grower to use. Floriculture Research Alliance technical meeting (East Lansing, MI), September.
- Runkle, E.S., Padhye, S. 2009. Forcing perennials into flower: Beyond the Basics. 2009 Perennial Production Conference (Buffalo, NY), September.
- Runkle, E.S., Padhye, S. 2009. Taming the beasts: Strategies for perennial height management. 2009 Perennial Production Conference (Buffalo, NY), September.
- Runkle, E.S. 2009. Flowering physiology of ornamental greenhouse crops. Beijing Forestry University, Dept. of Ornamental Horticulture seminar (Beijing, China), September.
- Runkle, E.S. 2009. Flowering physiology of ornamental greenhouse crops. China Agricultural University, Dept. of Ornamental Horticulture and Landscape Architecture seminar (Beijing, China), September.
- Runkle, E.S., Padhye, S. R., Blanchard, M. G., Oh, W. 2009. Energy-efficient greenhouse lighting of ornamentals. ISHS 6th International Symposium on Light in Horticulture (Tsukuba, Japan), November. Invited speaker.
- Runkle, E. S. 2009. "Energy efficient greenhouse management options and assessment tools". Michigan Farm Energy Audit Workshop (East Lansing, MI), December.