Managing Energy Resources and Costs
to Enable the Michigan Floriculture Industry to Remain Competitive

Project Summary
Michigan is the third largest producing state of floriculture crops, with annual wholesale sales of $400 million. Most floriculture crops are grown inside greenhouses, where the environment and culture can be carefully managed to produce crops with specific attributes at specific times of the year. Many greenhouse crops are grown in Michigan during the winter and early spring, when temperatures outside are low and when the days are short and cloudy. Therefore, energy to power heaters and lights is a significant expense in the production of greenhouse ornamentals. Unfortunately, high greenhouse energy inputs put growers in Michigan at a competitive disadvantage to growers in warmer climates, such as in the mid-South.

There are several ways to reduce greenhouse energy consumption including crop management strategies as well as investments in greenhouse technologies. To better manage energy resources and lower energy costs, greenhouse growers in Michigan need up-to-date, unbiased information written in grower-friendly terms. This can be accomplished by developing and then disseminating a booklet, in print and electronic formats, that summarizes strategies to lower greenhouse energy inputs. However, there is relatively little research-based information on some of the newest technologies being developed for greenhouse applications, including the use of light-emitting diodes (LEDs) for plant applications. Therefore, lighting research is also needed to improve greenhouse energy efficiency.

Many common ornamental crops, including many garden plants, flower faster when provided with a particular day length, or photoperiod. When the natural day length is short, a low intensity of artificial lighting provided at the end of the day or during the middle of the night can create a long day. This low-intensity lighting can promote flowering of long-day plants (LDP) such as petunia, pansy, snapdragon, and strawberry. Previous research indicates that many LDPs flower most rapidly when artificial lighting contains red and far-red light. When LDPs are grown under a light source deficient in far red, such as compact fluorescent lamps, flower initiation and development can be delayed.

Traditionally, greenhouse growers of photoperiodic crops have used incandescent lamps to create artificial long days. Incandescent lamps are inexpensive, are easy to install and maintain, and emit light that is rich in red and far-red light. However, incandescent lamps are being phased out of production because of their energy inefficiency; they convert less than 10% of the energy they consume into visible light. LEDs provide an attractive option for photoperiodic lighting of floriculture crops; they have a very long operating life, solid state construction, and electrical efficiencies that continue to improve. However, growers need unbiased, research-based information to determine advantages of and identify challenges to using LEDs on ornamental crops.

In this project, the Michigan Floriculture Growers Council (MFGC) contracted with Dr. Erik Runkle in the Department of Horticulture at Michigan State University (MSU) to 1) create a grower-friendly summary that contains the most recent, research-based information on how greenhouse growers can reduce greenhouse energy costs and 2) to perform research that determines how the spectral quality of light from LEDs influences flowering of common floriculture crops. This information will help Michigan greenhouse growers maintain their competitiveness and profitability by reducing energy costs. MFGC Executive Director Mr. Gale
Arent met with Erik Runkle in January, March, June, September, October, and December of 2011 and in January 2012 to discuss this project.

**Project Approach**

**Greenhouse Energy Summary**

Runkle and Dr. A.J. Both (agricultural engineer at Rutgers University) identified thirteen strategies for greenhouse growers to consume less energy. During the project period, they developed the summary that included photographs and resources for more information. The first draft was reviewed by two external colleagues and then provided to the Communications Office of MSU’s College of Agriculture and Natural Resources for editing and formatting. The document was finalized in November and printed in December 2011. In January 2012, paper copies were distributed to floriculture and nursery growers at meetings in Belleville, Grand Rapids, Hudsonville, Kalamazoo, and Oxford, MI. Paper copies are being distributed to growers throughout the state.

The document is also available online at [www.flor.hrt.msu.edu/energy](http://www.flor.hrt.msu.edu/energy) and is being promoted through MSU newsletters and greenhouse trade magazines.

**LED Flowering Research**

Custom-built LEDs that emit specific qualities of light were obtained from an LED manufacturer in Japan for research at MSU. Once the lamps were installed, light output was carefully characterized. Plants were grown under the different lighting treatments throughout 2011 in two different sets of experiments (see photo right). Runkle, graduate student Daedre Craig, and MSU floriculture research technicians worked on this project. Results indicate that LEDs are effective when both red and far-red light are delivered. In addition, the LEDs consume about one fourth the amount of electricity of incandescent lamps. A four-page summary of this LED research was provided to growers at the meetings previously described.

**Goals and Outcomes Achieved**

The primary goals of this project were accomplished. The greenhouse energy guide was developed and is being disseminated to growers throughout Michigan, and is available electronically on the MSU website “Greenhouse Energy Cost Reduction Strategies” to growers in other states. Approximately 500 paper copies of the summary will be distributed by the end of 2012. We do not yet have statistics or measurable impacts of the summary because of its recent completion date and distribution of the guides is still in progress. However, the guide presented examples of energy savings by implementing some of the energy savings measures, many with potential savings of 10 to 20% and some even more.

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1 No funds from the Specialty Crop Block Grant will be used for activities performed after December 31, 2011.
The research with LEDs performed at MSU has shown that a mixture of red and far-red light is needed for the most rapid flowering of crops. LED fixtures have not yet been developed for photoperiodic lighting of plants in the U.S., so the information generated in this project will help provide guidelines on desirable lamp characteristics. When LEDs are available for long-day lighting to greenhouse growers, they will consume one fourth (or less) the electricity of the incandescent lamps they will replace. They will also last much longer and will be more durable.

**Beneficiaries**

The primary benefactor of this project is the $400 million floriculture industry in Michigan. However, much of this information is applicable to greenhouse-produced nursery and landscape plants, as well as greenhouses located in other temperate climates, which collectively is a multi-billion dollar industry. Energy for heating and lighting typically accounts for 10 to 15% of the cost to produce greenhouse crops, which in Michigan equates to an annual cost of at least $36 million. The research-based energy guide generated in this project will allow growers to identify the most energy-efficient greenhouse environment and production schedule, potentially lowering fuel costs by 10 to 40%. If only 20% of the industry adjusts their growing practices based on this project, and if energy is reduced by 15% as a result (a conservative estimate), the annual cost savings to floriculture crop growers in Michigan would be $1.08 million.

**Lessons Learned**

There are a number of cost-effective greenhouse investments, as well as changes to how crops are grown, that can substantially lower heating and lighting costs. Some of the strategies identified in the energy guide had a quick return on investment. For example, a Minnesota study referenced in the energy guide estimated that the return on investment for installing a certain kind of plastic as the inside layer of a double-layer greenhouse was less than 2 months. It is challenging however to quantify the impact that the guide will have on modifying grower practices and investments; likely, implemented changes by growers can be attributed to multiple factors.

The LED research being performed at MSU is exciting, but the lamps are not yet available for commercial use. The first LED lamps that are developed will likely be expensive and so their return on investment will be quicker for companies that use low-intensity lighting during much of the year. However, as more LEDs are manufactured and as their production costs continue to decrease, they will become a more viable lighting option.

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