



The Greenhouse Environment: Boilermaking Solutions

RECENT RESEARCH AT PURDUE AIMS TO IMPROVE ENERGY USE AND CROPPING EFFICIENCY.

By Christopher J. Currey and Roberto G. Lopez

The greenhouse environment, including light and temperature, has a large impact on our ability to grow and schedule high-quality greenhouse crops. Additionally, energy costs are second only to labor for many in today's greenhouse industry. As a result, growers want to make sure that heating and lighting are used efficiently and profitably. Whether identifying how to schedule and produce new flowering crops or reduce energy inputs for old standbys, research at Purdue aims to increase the effectiveness and efficiency of environmental inputs.

This article is the second in a series of articles highlighting the Floriculture team in the Department of Horticulture and Landscape Architecture (HLA) at Purdue University. The first article focused on floriculture and ornamental horticulture at Purdue and summarized our teaching and Extension outreach programs, while subsequent articles will focus on greenhouse cultural, sustainability and consumer preference, and ornamental pest and pathogen research, services provided by the Purdue Plant and Pest Diagnostic Lab, and the Horticulture Gardens, greenhouses and Master Gardener programs. This article will highlight some of the recent research conducted at Purdue that aims to improve energy use and cropping efficiency with the greenhouse environment.

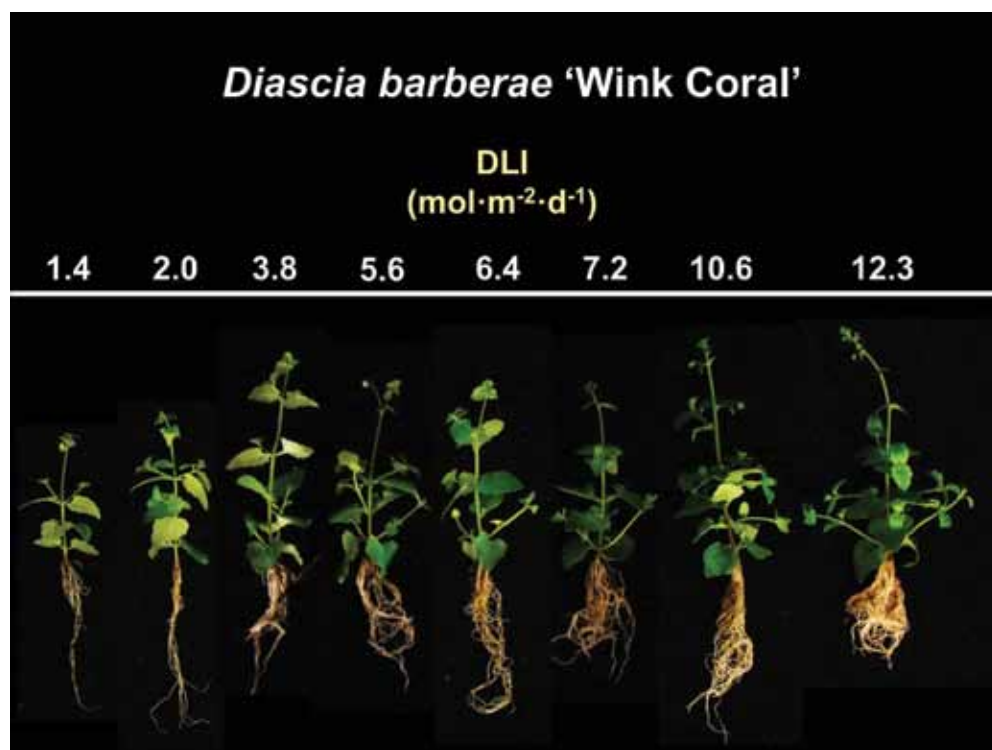
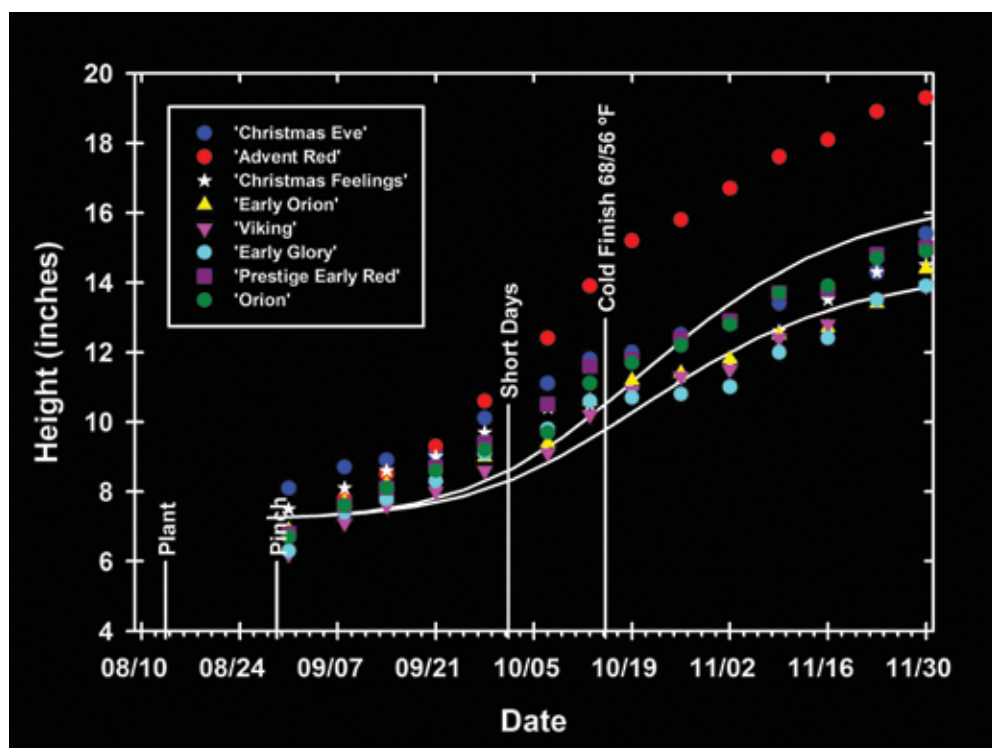


Figure 1 (top right). Graphical tracking of eight poinsettia cultivars that were planted on Aug. 13 (week 33) and cold finished at 68/56° F day/night (average daily temperature of 62° F).

Figure 2 (bottom right). 'Wink Coral' diascia grown under daily light integrals (DLI) ranging from 1.4 to 12.3 mol·m⁻²·d⁻¹ for two weeks after a week of callusing (photo taken 21 days after sticking cuttings).



Poinsettia Cold Finishing

While the holiday poinsettia recently took second fiddle to orchids on a per-pot-value, it is still the number one potted plant produced in the United States in terms of units sold. With increasing energy prices, poinsettia producers are looking for ways to increase profitability for a crop with razor-thin margins. One strategy to save money is to reduce the greenhouse air temperature. However, the impact of lower air temperatures starting in mid-October on poinsettia growth, development, and quality was not clear. As a result, researchers at Purdue teamed up with Dr. Brian Krug (University of New Hampshire) to assess cold-finishing poinsettias in northern locations using cultivars that are marketable early in the season (six- to eight-week response time), moderate- to high-vigor, and with naturally large bracts.

Eight cultivars were selected from each of the major breeders, including Dümme, Selecta First Class, Syngenta Flowers, and the Ecke Ranch. Rooted cuttings of each cultivar were planted on weeks 31, 32 and 33 and plants of each cultivar from each planting date were transferred to greenhouses with day/night temperature (12 hour/12 hour) set points of 68/56° F, 70/62° F, and 75/67° F on Oct. 15 at Purdue and the University of New Hampshire.

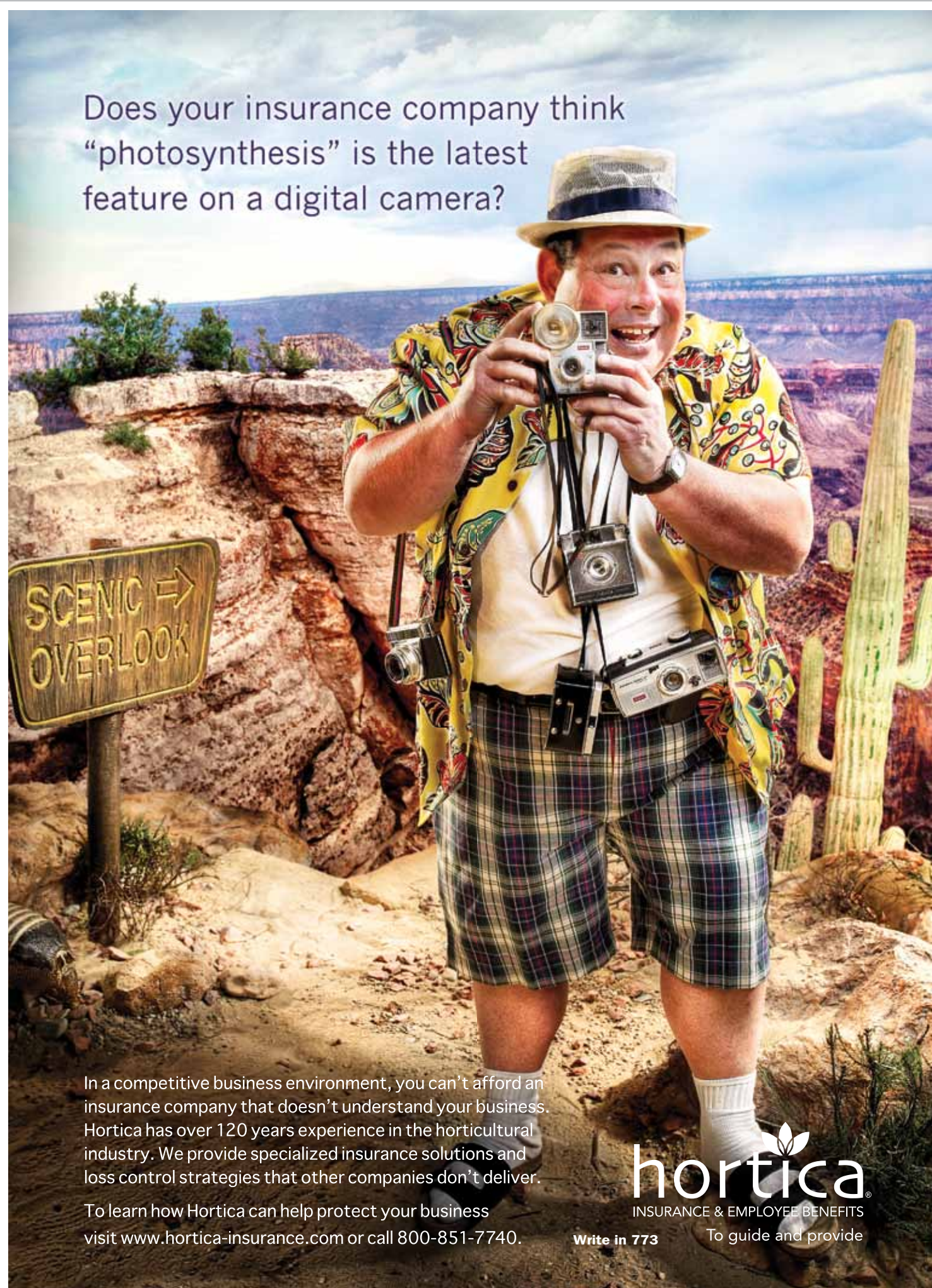
For all the poinsettia cultivars tested, cold finishing did not adversely affect bract size, time to marketability, or plant height as it was within the commercially acceptable range (Figure 1). Growers utilizing cold finishing may be able to reduce heating costs by 20 to 55 percent, depending on their greenhouse location, structure, fuel source, etc.

Lighting During Propagation

Young plants, including plugs and liners, are produced in late winter and early spring. Propagation of young plants occurs when outdoor light is at seasonally low levels, while further reductions of up to 50 percent can occur due to greenhouse glazing material, superstructure, and hanging baskets. Research at Purdue

is shedding some light on the benefits of providing supplemental light during propagation and exploring new alternatives for providing supplemental light.

We have propagated a number of species of specialty annuals, from argyranthemum to verbena, under a range of daily light integrals (DLIs) during rooting. As DLI during propagation



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increased, root growth increased for all species (Figure 2). In addition to increasing root growth and rooted liner quality, the DLI during propagation can also influence growth and flowering after transplant. For example, flowering can be hastened by several days to weeks by increasing DLI during propagation. Our research indicates that by increasing the DLI during propagation growers may be able to reduce time until rooted cuttings are considered salable or transplantable, as well as finishing time after transplant.

How can we increase the DLI during propagation? Although supplemental light is traditionally provided by high-pressure sodium (HPS) lamps, light-emitting diodes (LEDs) are a technology with potential as a supplemental light source. However, there is little known about how effective LEDs are when used in a greenhouse during the production of plugs and liners. We are currently evaluating how effective and efficient LED light, composed of varying amounts of red and blue light, performs as a supplemental light source compared to HPS lamps during seed and cutting propagation. Additionally, we are evaluating the use of end of day red- and far-red light to suppress stem elongation to produce compact plugs.

High Tunnel Bedding Plants — No Heat, No Problem

While bedding plant production is the most valuable sector of the U.S. floriculture crop market, it is also a highly seasonal business. Therefore, many growers are looking to expand production without investing in infrastructure that may not be supported with year-round demand for production. The recent interest and subsequent expansion in local and sustainable agriculture has seen an increase in the construction and use of high tunnels. While high tunnels are commonly used for season extension for field-grown crops in the spring,

high tunnels are not designed to replace greenhouses for year-round production. However, we thought the seasonal nature of high tunnels may be used to produce bedding plants

finished for the spring without using any heat.

We teamed up with Dr. Neil Mattson (Cornell University) to grow common bedding plants such as pansy, petunia, osteospermum and

Spring's
perfect
Introduction

BAHIA BACOPA
Intensity in Pink and Purple!

Sarita
GERANIUM
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Great Balls of Fire
Goodness Gracious!

Dahlia XXL
Luxe Looks!

Queen Bee
PETUNIA
Viva la Diva!

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snapdragons in an unheated high tunnel and a traditional greenhouse starting at the beginning of April. While cold-sensitive species such as vinca didn't finish so well in the high tunnel, cold-tolerant

crops grown in the high tunnel were more compact with larger and more numerous flowers compared to plants grown in the greenhouse, with minimal delay in time to flower (Figure 3). This year we will be

looking at ways to reduce the risks associated with no heat tunnel production.

Hot New Crops for Cool Climates

New floriculture crops are introduced by breeding companies every year. While the availability of new and novel plant material is attractive to growers, it can be difficult to identify successful strategies to produce a high-quality crop on-time and efficiently. Purdue has teamed up with suppliers of new genetics to generate greenhouse lighting and heating strategies to provide growers with the resources to successfully propagate and finish new floriculture crops.

Tecoma (*Tecoma stans*) is a flowering tropical woody plant from Central and South America and Ball has recently developed a seed-propagated variety called 'Mayan Gold'. Our research indicates that increasing the DLI during propagation increases seedling root and shoot growth and quality. Many tropical plants are photoperiodic and flower in response to a certain day length and 'Mayan Gold' tecoma is no exception. After growing 'Mayan Gold' tecoma under day lengths ranging 9 to 16 hours long, it appears to be a facultative long day plant and days 14 hours or longer induces a strong flowering response. To produce high-quality plants, warm temperatures above 68° F and high DLI are required during finishing (Figure 4).

The Future

With energy prices on the rise, growers want to ensure every penny spent makes cents (pun intended!). Our goal is to increase the efficiency and profitability of greenhouse producers, and the Floriculture and Ornamentals group at Purdue University is committed to conducting research that provide growers with research-based solutions that address today's challenges within the greenhouse environment. Whether at Purdue or another land grant university,

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THE INSIGHTS.



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Petunia grandiflora 'Single Dreams Midnight'

Plugs were transplanted on 01 April

Greenhouse
ADT of 66.5 °F
DLI of 12.8 mol·m⁻²·d⁻¹

High Tunnel
ADT of 59.8 °F
DLI of 25.8 mol·m⁻²·d⁻¹



Water Soluble

Controlled Release

Water Soluble

Controlled Release

Marketable on
04 May 2011

Marketable on
07 May 2011

Tecoma stans 'Mayan Gold'

Photoperiod

A 9-h 12-h 14-h 16-h



Temperature (°F)

B 64 68 72



Figure 3 (top). 'Single Dreams Midnight' petunia grown in unheated high tunnels can be of similar quality compared to plants grown in a traditional heated greenhouse with minimal delay in time to flowering.

Figure 4 (bottom). 'Mayan Gold' tecoma (*Tecoma stans*) grown under (A) 9-, 12, 14-, or 16-hour day lengths or (B) finished at 64, 68 and 72 °F (photos taken 50 days after transplant).

the importance of industry, association and grower support of floriculture research programs is more important than ever and no donation is too small.

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