New Concepts for Fuel-Efficient Poinsettia Production

Cold poinsettia production is a widespread technique among growers today — but are there more efficient, more cost-effective alternative strategies available?

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Figure 1. 'Advent Red' cyathia display following two weeks in a cold hold treatment (50-55° F) and two weeks in a simulated postharvest environment (50 foot-candles and 72° F).

Figure 2. Green leaves that develop at the base of the youngest cyathia following three or four weeks in the cold hold environment (50-55° F).

Many growers have incorporated reduced temperature, fuel-efficient poinsettia production into their standard growing procedures in the past few years. At Clemson University, we have conducted experiments to identify the limits of cold poinsettia production. Last year, we introduced the Ecke Bract Meter to provide growers with tools to assist in the temperature decision-making process.

This year we have developed three additional concepts that will be discussed in this article. First, we will introduce the concept of cold hold, which aims to grow a crop at normal temperatures then hold it at 50° F until it is scheduled to be shipped. Second, we examined the potential for using Fascination to expand bracts of cold-finished poinsettias to overcome the reduction in bract size and slow bract expansion that occurs at cold temperatures. Third, we have proposed the use of a degree-day model to track temperatures and bract development. Finally, we will address the question, "Does reduced temperature production actually save money?"

Cold Hold

Growers have become more familiar with the concept of cold finish over the past few years. We define cold finish as reducing the temperatures from the point of first color until market. For cold finish, we are usually considering 24-hour average daily temperatures from 60-64° F. At these temperatures, the crop matures slowly, but it does continue to mature. In contrast, cold hold is defined as reducing the temperature after the crop is ready for market. In this situation, the crop is grown at normal production temperatures (65-70° F) until it is ready for market, then the temperature is dropped to a minimum "holding" temperature (50-55° F), at which point further bract and cyathia development is minimal.

To achieve a cold hold environment, we set the heating at 50° F and cooling at 55° F, so our night temperatures were consistently 50° F, while the day temperatures would increase to 55-60° F. The average daily temperatures ranged from 51-58° F with 54° F being typical during our cold hold treatment. The retractable shade curtain was permanently engaged to assist with maintaining cool plant temperatures especially on sunny days. Plants were placed into the cold hold environment for one, two, three or four weeks then transferred to a simulated postharvest environment. The postharvest environment consisted of a classroom with no sunlight and fluorescent lamps that provided approximately 50 foot-candles for 24 hours a day. A control group was taken directly from the production environment to the postharvest environment. Ten cultivars were used in this study: 'Advent Red', 'Autumn Red', Early Freedom (Pink, Red, White), 'Early Joy Pink', 'Freedom Red', 'Polar Bear', 'Polly's Pink', 'Prestige Red' and 'Snow Cap'.

Postharvest longevity was evaluated based on the overall display of cyathia and bract color. We did not observe any decline in cyathia longevity with the extended period of time in the cold hold environment once the plants were moved to a postharvest environment. In other words, the cyathia display lasted nine to 12 days in the postharvest environment, regardless of how long it spent in the preceding cold hold environment. The exception was 'Advent Red', which has exceptional cyathia retention characteristics as demonstrated by the 12 to 20 days that the cyathia persisted in the postharvest environment. Figure 1 shows an Advent Red flower after two weeks in the cold hold environment and two weeks in the postharvest environment.

While cyathia retention was acceptable even with four weeks in the cold hold environment, bract display proved to be a limiting factor.

We observed small green leaves developing below the youngest cyathia on plants that were in the cold hold treatment for more than two weeks (Figure 2). It appeared that while poinsettias were held in a cold environment, additional cyathia developed. These cyathia had small (½- to 1 inch long) green leaves that developed from the base of the cyathia. In contrast, poinsettias that were moved to a low-light postharvest environment with only one or two weeks of a cold hold treatment did not have significant additional cyathia development, so no green leaves were observed.

Based on this first year of cold hold experiments, it appears that poinsettias can be successfully held in a cold (50-55° F) greenhouse for up to two weeks without sacrificing postharvest performance. In-house trials are recommended to verify these results in your climate.

Using Fascination to Compensate for Cold Finishing Temperatures

Many growers have become comfortable applying Fascination to promote bract expansion late in the poinsettia production season. It can be especially useful if bracts haven't sufficiently expanded because of excessive PGR application. We wanted to address whether Fascination could compensate for the reduction in bract expansion that is observed when poinsettias are cold finished. Can we save energy by growing poinsettias cold but use Fascination to get the bract expansion of a "warm" poinsettia?

Our approach was to grow poinsettias at the coldest feasible temperature. The plants were grown under normal conditions until first color, at which time the temperatures were set to 65° F days and 55° F nights, or an average daily temperature of 60° F. Our previous work showed that we could achieve acceptable commercial plants at this temperature. Perhaps the greater limitation at 60° F is that the time from first color to market typically doubled from four to eight weeks. This likely pushes the market date too far back for most cultivars and production situations. So our objective was to observe how well Fascination could expand bracts under relatively cool

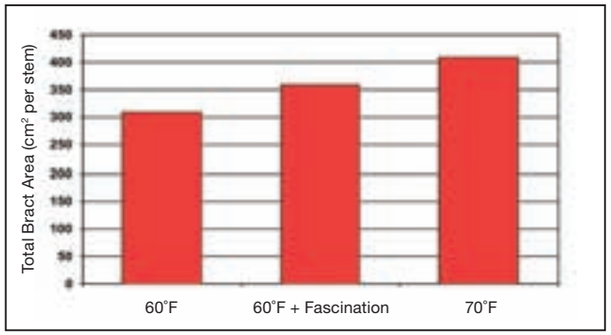
'Polar Bear'

greenhouse temperatures.

Fascination was applied as a 5-ppm spray along with CapSil as a wetting agent. This rate is higher than those typically used for bract-expansion purposes, but we thought this would be necessary because cooler temperatures would likely reduce the efficacy. Trials conducted the previous year also had suggested that this rate would be effective.

Fascination applications were made either three, four or five weeks after first color. These applications increased final bract area by about 15 percent, which significantly improved the final plant appearance. However, the bracts still weren't as large as poinsettias grown at 70° F (Figure 3). The Fascination applications reduced time to flower by up to one week, which was an improvement, but flowering was still relatively slow compared to normal warm temperature production.

Cold finish poinsettia production has been proven to be successful in commercial situations. In most cases, growers will be satisfied with crops finished at 62-64° F average daily temperatures if a one to two week delay in market date is anticipated. While colder temperatures (60-61° F) are possible, the delays in bract expansion are likely



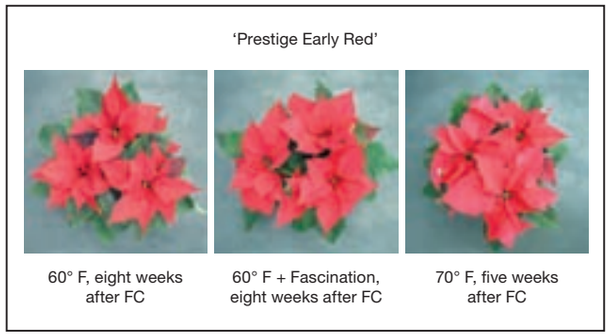


Figure 3. *The effect of temperature and Fascination on bract development of 'Prestige Early Red'. For poinsettias finished at 60° F, Fascination applied as a 5-ppm spray with CapSil increased bract expansion by 15 percent and decreased the time to market by three to seven days. However, bract expansion was not comparable to plants finished at 70° F.*

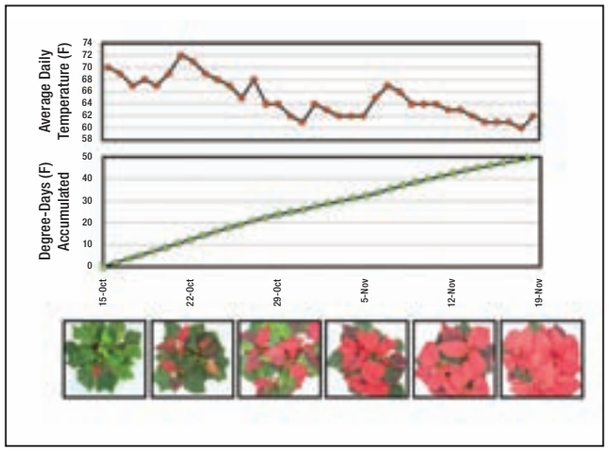


Figure 4. *Demonstration of the effect of average daily temperatures on the accumulation of degree-days (thermal time) and corresponding bract development. For poinsettia, we estimate that about 500 degree-days are required from first color to market. The model that was used to calculate degree-days is described in the text.*

'Freedom Early Red'

In-house experimentation is absolutely necessary before making an application to a large number of plants. Don't be afraid to sacrifice a few plants to learn the potential pitfalls that can accompany any chemical application.

to be greater than most growers will desire. This experiment does demonstrate that Fascination can be an important tool for growers using the cold finish technique. Fascination does work at cooler temperatures to improve bract presentation and make crops marketable slightly earlier (up to one week faster); however, Fascination does not overcome the long delay in time to market caused by cold finish temperatures.

Again, in-house experimentation is absolutely necessary before making an application to a large number of plants. If you have never used Fascination on poinsettias before, begin with an experiment this season, then you will have some experience to draw upon if needed in future years. When experimenting, it is useful to try different rates and timing to get a feel for the limitations of a product. Don't be afraid to sacrifice a few plants to learn the potential pitfalls that can accompany any chemical application.

Tracking Degree-Days to Predict Bract Development

The degree-day concept has been around for decades, but it hasn't gained much traction in floriculture. We believe, however, that there is potential benefit for growers when it comes to manipulating greenhouse temperatures to track poinsettia bract development.

Flowering is a developmental process that results from the accumulation of cell division that occurs from flower initiation to open flower. Temperature is the key factor in cell division, so the accumulation of temperature is an important measurement if you want to predict flower development. Degree-days is a measure of temperature accumulated over time, or thermal time, calculated as the number of degrees Fahrenheit per day above a base temperature. The base temperature is the minimum temperature below which no development occurs. For poinsettias, we have estimated the base temperature to be 50° F. So, if the 24-hour average temperature for a particular day is 67° F, then the number of degree-days is 67 - 50 = 17. If the following day

averages 65° F, then that day accumulates 15 degree-days. The sum of the two days is 17 + 15 or 32 degree-days. One then simply continues to accumulate the number of degree-days until you reach a predetermined total.

We have estimated that poinsettia bract development requires a grand total of 500 degree-days from first color to a marketable stage. By tracking the number of degree-days starting at first color, one can estimate the time to market based on the projected temperatures (Figure 4).

One caveat: Our data suggest that average daily temperatures above 68° F do not result in any higher rate of development. For example, if the 24-hour temperature is 71° F, then the number of degree-days accumulated is 18 (68 - 50), not 21 (71 - 50). The beauty of the degree-day approach is the mathematics are simple to perform and accumulate over time.

As a starting point, consider monitoring average daily temperatures starting at first color. This can be done manually, with a minimum-maximum thermometer, or electronically, with a small data logger such as the Greenhouse Weather Tracker (Spectrum Technologies). Then you can verify how well the 500 degree-day target works for predicting the time from first color to market. You are welcome to share your data or observations with us as we seek to refine these techniques.

Does Cold Finish Save Money?

Answers to these questions usually start with, "It depends." Michigan State's Erik Runkle and I previously addressed this topic in the August 2008 issue of *GPN*. We used the Virtual Grower greenhouse software developed by Jonathan Frantz at the U.S. Department of Agriculture.

Our conclusions are: If one picks a cultivar and compares growing it cold or growing it warm, then growing warm is less expensive because of the additional time cold poinsettias spend in the greenhouse. However, if one compares an early- or very early–season cultivar grown cold to a mid- or late-season cultivar grown warm, then the cold production is more cost effective since both crops occupy greenhouse space for the same amount of time. So if you choose cultivars for your cold finish program that allow you simply to alter their normal response time to flower during your target market date, then cold finish poinsettias can result in significant energy savings. GPN

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