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The Indiana Flower Grower

In This Issue

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Roberto's Message

Message from Roberto

Garden Mums

Dr. Roberto G. Lopez,
Assist. Professor and Floriculture Extension Specialist

Dear flower growers, businesses, distributors, organizations, and colleagues,

Has anyone seen a nice flowering mum crop this year? The few plants that are showing color are moving fast. The high temperatures we have been experiencing this summer compared to last year's cool temperatures are providing a different set of challenges for hardy garden mum growers across the region. This year, many growers are finding that garden mum cultivars that typically are marketable in mid-September are delayed by 1 to 3 weeks (Figure 1). Natural flower initiation in garden mums occurs in late July when daylengths (photoperiod) are shorter than earlier in the season. Mums are often categorized as early-, mid-, and late-season cultivars, with respect to flowering. Research at Kansas State University has shown that flower bud initiation is also influenced by temperature and is most sensitive during the first 2 weeks of short days. High night temperatures, such as those experienced this summer, have contributed to this "heat delay" or delayed flowering. In addition, some cultivars have uneven flowering (Figure 2), flower bud deformation, irregular floret arrangements, or crown buds (Figure 3) which is also associated with high temperatures during flower initiation and/or development.

Unfortunately, we cannot predict if next summer will be hot or cool. By selecting cultivars that are heat tolerant or not sensitive to extreme temperatures, you can potentially avoid the compact plants and early flowering problems of 2009 (cool night temperatures) and the delayed flowering of 2010 (high night temperatures).

Figure 1. Flowering delay of garden mums due to heat delay.

Figure 2. Uneven flowering due to high night temperatures.

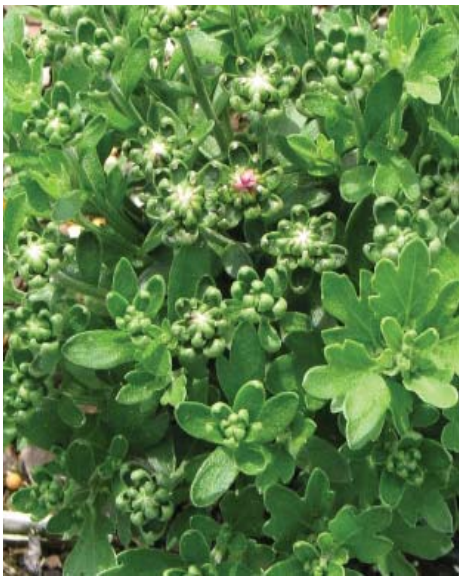

Figure 3. Crown bud formation.

Indiana Greenhouse Grower Spotlight – Heller Nursery

By Dr. Roberto G. Lopez
Assist. Professor and Floriculture Extension Specialist

Heller Nursery is a third generation retail greenhouse and nursery operation located in Decatur, IN. It can trace its roots to the backyard of Bobby Heller parents. In 1946, Bobby started the small nursery which quickly grew beyond the confines of the backyard and moved to its current location in 1950. Ten years later, Bobby married Mary and they continued to expand the business while raising their family. Bobby and Mary to this day continue to be active members of the Northeast Indiana Flower Grower Association (NIFGA). Their oldest son, John Heller after graduating with a degree in Horticulture and Landscape Management from Purdue University in 1988, became the head of the landscaping division and many of the managerial components of the business. In 2009, the third generation, Jessie Myers joined the family business as the greenhouse manger. She followed her father's footsteps and graduated with a Horticulture Science degree from Purdue and was the first recipient of the IFGA Allen Hammer Scholarship in 2008 (Figure 1). Jessie was instrumental in helping me start some of my first experiments when I started at Purdue.

Heller Nursery has 11 unique brick and glass greenhouses unlike any you have ever seen (Figure 2)! They specialize in growing geraniums and other bedding plants, poinsettias, and Easter lilies. In addition, they have 90 acres of nursery stock that includes perennials, ornamental and fruit trees, shrubs and other landscaping materials. With over 20 seasonal employees they look forward to continued growth into the future.
Visit the Heller Nursery website: www.hellernursery.com and also become a fan on Facebook.

Figure 1. Jessie Myers next to her poinsettia crop.

Figure 2. Heller's own brick and glass greenhouses.

Figure 3. Entrance to Heller Nursery.

The Indiana Flower Grower

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Roberto Lopez at: rglopez@purdue.edu

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Purdue Research Update - Poinsettia Height Can Be Controlled With Early Topflor Drenches

By Christopher J. Currey[1] and Dr. Roberto G. Lopez[2]
Graduate Student[1] and Assist. Professor and Floriculture Extension Specialist[2]

Controlling height is an important aspect of poinsettia production. Whether trying to fit plants on a rack or just grow a poinsettia with the right aesthetic appeal, growers must curb excessive stem elongation. Traditionally, plant growth retardant (PGR) sprays containing B-Nine or Dazide (daminozide), Cycocel or Citadel (chlormequat chloride), or Bonzi, Piccolo, or Paczol (paclobutrazol) are used to control height before the beginning of short days or first color. Another technique many growers utilize to control late stretch is low-dose drenches containing paclobutrazol later in the production cycle.

A new technique to inhibit stem elongation of poinsettia is to apply an early, low-dose PGR drench. As the name implies, early drenches are applied early in the production cycle, typically two weeks after pinching or when shoots are about an inch long. Compared to applying PGRs with foliar sprays, early drenches typically have less of a negative impact on bract size, provide more uniform results, and increased height control.

Topflor is one of the newest PGRs to be released on the market in the United States (U.S.). The active ingredient, flurprimidol, is related to other PGRs such as ancymidol, paclobutrazol, and uniconazole. Therefore, in addition to being effective as a foliar spray, it is also active when applied to the media. Our objectives were to determine how effective early Topflor drenches would be in controlling stem elongation of a high- and low-vigor poinsettia cultivar in the northern U.S.

The Study

In August, 2009, rooted cuttings of 'Classic Red' and 'Freedom Salmon' poinsettias were delivered to Purdue University (West Lafayette, IN). The plants were grown in a glass-glazed greenhouse with day and night temperature set points of 75 and 67 °F, respectively, under natural day lengths with day-extension lighting provided from high-pressure sodium lamps. Short-days (SD) were initiated 45 days after pinching and delivered by pulling black cloth over the plants at 4:00 p.m. and retracting it at 8:00 a.m. Plants were irrigated as necessary with acidified water containing 200 ppm N from a 15-3-16 Cal-Mag feed.

Plants were transplanted into 6.5-in. round pots filled with soilless media comprised of sphagnum peat and perlite (Fafard 1P Mix; Conrad Fafard, Inc, Agawam, MA). Two weeks after planting plants were pinched back to six nodes. When shoots were ~1 in. long (2 weeks after pinching), a 4 fl. oz. solution containing 0, 0.05, 0.1 or 0.15 ppm Topflor (flurprimidol; SePRO Inc., Carmel, IN) was applied to the media surface or plants were sprayed with a tank mix containing 1,250 ppm Dazide (daminozide; Fine Americas, Walnut Creek, CA) and 750 ppm Citadel (chlormequat chloride; Fine Americas). 'Classic Red' plants were treated again five weeks after pinching, as average height exceeded the graphical tracking curve.

Plant height was measured weekly. When two branches reached visible anthesis (first pollen shed) final height was recorded. Additionally, the length and width of the two tallest bracts on the two flowering stems were recorded and bract area was determined by using the formula for the area of an ellipse [(long axis × short axis × π)/4]. As a measure of aesthetic appearance we determined the amount of bract color in relation to final plant height. This bract area:height ratio was calculated by dividing bract area by final height. Days to flowering was calculated as the number of days to flowering from the beginning of SD.

The Results

'*Classic Red.*' All PGR treatments reduced final height when compared to untreated control plants. Control plants were 19.5 in. tall and as Topflor drench concentration increased from 0.05 to 0.15 ppm height decreased from 14.9 to 11.7 in., while the tank mix sprays resulted in plants that were 16.7 in. tall (Fig. 1). All Topflor drenches suppressed final plant height more than the tank mix spray of Dazide and Citadel. The bract area was reduced for all plants treated with Topflor compared to untreated plants. Topflor concentrations of 0.05, 0.1 and 0.15 ppm resulted in bract areas of 132, 109, and 99 in^2 respectively. Bract area of plants sprayed with Dazide and Citadel (171 in^2) were similar to the untreated plants (193 in^2) (Figure 2). Although treatments did affect the bract area:height ratio, there were no significant differences among treatments. Applying 0.5 ppm Topflor drenches or the tank mix sprays did not delay flowering compared to untreated plants (55 d). Flowering was delayed by 5 or 4 days when 0.1 or 0.15 ppm Topflor drenches were applied.

'*Freedom Salmon*.' All Topflor treatments reduced height compared to untreated plants (15.3 in.), while the tank mix spray did not (14.1 in.). As Topflor concentration increased from 0.05 to 0.15 ppm height decreased from 13.7 to 12.4 in. (Figure 1). Among 'Freedom Salmon' treated with PGRs, plants treated with 0.05 and 0.1 ppm Topflor drenches were similar to plants sprayed with 1,250 ppm Dazide and 750 ppm Citadel. When Topflor concentration increased to 0.15 ppm plants were shorter than those sprayed with the tank mix. The average bract area of all plants treated with Topflor was reduced compared to untreated plants (128 in^2), while plants sprayed with Dazide and Citadel were unaffected (128 in^2). As Topflor concentration increased from 0.05 ppm to 0.15 ppm bract area decreased from 105 to 96 in^2 (Figure 3). Neither early Topflor drenches nor the tank mix spray affected the ratio of bract area to final plant height or days to flowering.

What did we find?

Our research demonstrates that Topflor can be used effectively as an early drench to control final poinsettia height in the North. However, there were differences between 'Classic Red' and 'Freedom Salmon' in regards to their need for PGR treatments. 'Classic Red,' a vigorous cultivar, required an additional PGR drench than 'Freedom Salmon,' a lower-vigor cultivar, required. By using graphical tracing, we were able to see that 'Classic Red' grew out of the first PGR application, requiring a second application. 'Freedom Salmon' did not require any PGR, as final height of untreated plants was between the 14 to 16 in. final target height. This demonstrates the difficulty in applying a preventative height control measure such as early drenches.

For both 'Classic Red' and 'Freedom Salmon' we observed a reduction in bract area with plants treated with early Topflor drenches compared to untreated plants. Though you would think applying PGRs so early in the production cycle would not affect bract development, Topflor may act similarly to paclobutrazol products applied as drenches. When applied to the media, paclobutrazol binds to organic media components then releases over time. Topflor could have a similar pattern of release when applied as an early drench, therefore releasing chemical during SD and affecting bract development.

Though bract area was reduced as a result of Topflor drenches, we observed no reduction in ornamental appearance of plants treated with Topflor. With both 'Classic Red' and 'Freedom Salmon' there were no differences in bract area:height ratios between untreated plants and plants treated with Topflor. This demonstrates that while bract area is reduced with early Topflor drenches, the reduction in bract area and plant height are proportional to each other and does not negatively impact the aesthetic quality of finished plants (Figures 2 and 3).

The effect of Topflor drenches on days to anthesis varied with cultivar. Flowering of 'Freedom Salmon' was not delayed when treated with Topflor. When 'Classic Red' was treated with Topflor flowering was delayed by up to 5 days. This may not be commercially significant, as we measured flowering at pollen shed, when bracts would have been nearly fully-developed.

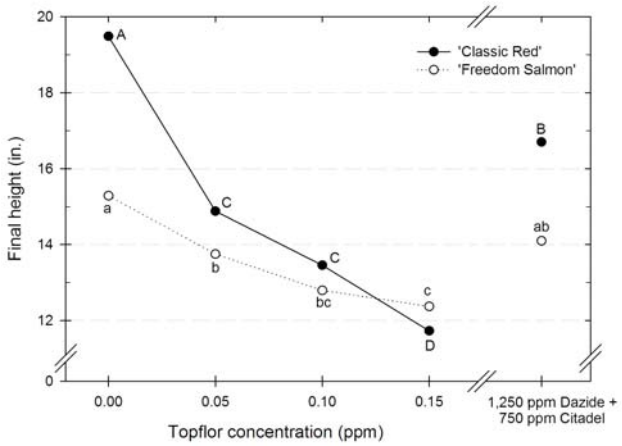

Figure 1. Final height of 'Classic Red' and 'Freedom Salmon' poinsettias treated with 0, 0.05, 0.10, or 0.15 ppm Topflor drenches or sprayed with a 1,250 ppm Dazide and 750 ppm Citadel tank mix two and five weeks after pinching. Upper- and lower-case letters indicate significantly different means for 'Classic Red' and 'Freedom Salmon,' respectively.

The take home message

Topflor is clearly effective when applied as an early drench. For high-vigor cultivars grown in the north, we recommend using either multiple early drenches at the lower rates or a single early drench at a higher concentration with late-season PGR applications made based on crop needs. For less-vigorous cultivars grown in the north, we recommend a single low-concentration early drench for cultivars that usually need some type of chemical height control. Growers in the south will most likely need higher concentrations for adequate height control. While we feel our results on early Topflor drenches are clear, we always caution growers to do their own trials to determine what is effective in production for them.

Acknowledgements

The authors would like to thank the Paul Ecke Ranch for plant material, Conrad Fafard, Inc. for media, SePRO, Inc. for PGR and funding, Fine Americas, Inc. for PGRs, and Scotts' Co. for fertilizer.

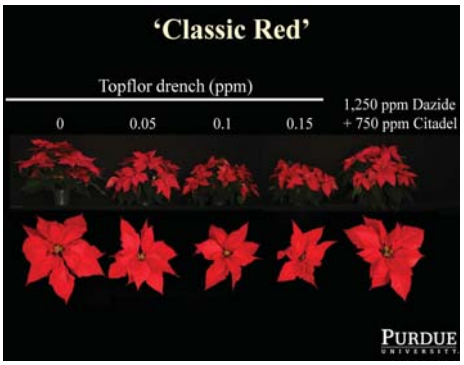

Figure 2. Flowering plants and bracts of an individual stem of 'Classic Red' poinsettia treated with 0, 0.05, 0.10, or 0.15 ppm Topflor drenches or sprayed with a 1,250 ppm Dazide and 750 ppm Citadel tank mix two and five weeks after pinching. Photos taken at flowering.

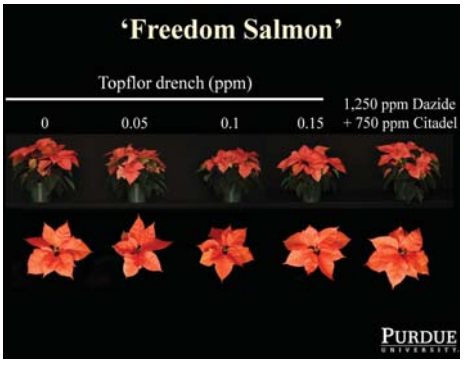

Figure 3. Flowering plants and bracts of an individual stem of 'Freedom Salmon' poinsettia treated with 0, 0.05, 0.10, or 0.15 ppm Topflor drenches or sprayed with a 1,250 ppm Dazide and 750 ppm Citadel tank mix two weeks after pinching. Photos taken at flowering.

Spring Trials 2010 Review: California Dreamin'

By Christopher J. Currey[1], Diane M. Camberato[2], and Dr. Roberto G. Lopez[3]
Graduate Student[1], Greenhouse Technician[2] and Assist. Professor and Floriculture Extension Specialist[3]

In April we saw another spectacular show from a cornerstone of the floriculture industry – the California Spring Trials, formally known as Pack Trials. How can you summarize an experience such as the Spring Trials? As always, there was stunning plant material along with a variety of marketing programs, hard goods, and services on display. With 36 locations, there was no shortage of innovative products and interesting ideas, though it is impossible to recall every detail from each location. The Spring Trials create a crystal ball from which you can see where the floriculture industry is headed over the next 1, 5, or even 10 years! As the OFA group headed from south to north and the Purdue-Cornell-University of New Hampshire bus tour headed north to south, here are some of the trends that caught our eye.

It's All about the Show

It would be impossible to visit any one of the 36 trial sites and not notice that companies are breeding and marketing for great visual impact. For anyone with deep gardening roots, the expansion of color selection (Dümmen's 'Cappuccino' Potunia®) and opportunities for wide choices in size (Pan American's 'Gryphon' begonia; Figure 1) and form (Tomaccio™ tomato from Hishtil) make you wonder if you are gardening on the same planet.

Flower and foliage color was being used to convey mood, compliment decorating scheme, and connect to causes. The color scheme theme, which dates back to the 1980s, was taken to a new level. Syngenta featured the color wheel, and one can "Spice it up with Orange" using impatiens, begonias, calibrachoa, gerberas, and lantana, in addition to the standard marigold (Figure 2). Those with a keen decorating sense can do a lot with Ball Flora Plant's 'Black Velvet' petunia and its cousins 'Phantom' and 'Pinstripe'. These petunias definitely caught our Boilermaker eye for Purdue black and gold (Figure 3)!

If you have done any home improvement projects in the last 10 years, you likely have noticed that plant colors and names are now as varied and creative as those used for paints. Westhoff introduced 'Voodoo Red Star' verbena, more descriptive than what might have been called 'Red and White Stripe' in past decades (Figure 4), and Fides' Margarita 'Sunset' osteospermum tries to do justice to the combination of bronze and yellow displayed by its petals. Which mimulus would you rather purchase, 'Dark Red' or 'Kissable Dark Red'? Ball is betting on the latter. These highly descriptive names are a marketing tool, but also do justice to the complicated breeding work it takes to produce these plant marvels.

Foliage can be just as fetching. Succulents were well represented, and are a varied and practical group with much potential. Proven Winners has a Retro Succulents™ line of over 50 cultivars. Queen™ Wildflowers™ (Greenex) had an interesting succulent display, also noteworthy due to their demure size. I can picture one sitting on my desk.

Even pots have become colorful, as a way to brand and make product stand out as variety expands exponentially. There is the pink container associated with Wave® petunias at Ball, the lime green with Dümmen's Potunia® petunia (Figure 5a), and the deep blue of Fides' Hypnotica® dahlias (Figure 5b). These containers help sell. Color can be used as a marketing tool well beyond the underskirt for a petunia or dahlia. Ecke is breeding non-traditional euphorbias with pink bracts that can be marketed in promotions supporting breast cancer awareness.

Size Does Matter

Coleus is not the only annual that has been supersized. Dümmen displayed 'White Night' bacopa and 'Magnum' New Guinea impatiens that showed almost more flower than foliage (Figure 6), as did the Patchwork™ collection impatiens from Ball. Judging by Takii's F1 Royal series, gerbera flowers have gotten big and showy, too.

Bigger is not always better; do not underestimate the "cute" factor. Helianthus, including Syngenta's 'Constellation™' and 'F1 Sunny Smile' and 'Big Smile' from Takii, are less than 20 inches tall. 'Sunny Smile' can be produced in small pots under short days and marketed at just 6 inches for impulse sales. Schoneveld Breeding displayed the 'Allure' cyclamen Super Series® Micro, which fit in the palm of your hand (Figure 7). Similarly, Kieft-Pro-Seeds offers a Mega or Mini Revolution® gerbera. No more one size fits all.

The range of available sizes was also noticeable. Speedling offers its line of vegetables in multiple sizes, to fit every budget. Jiffy also demonstrated this, from Preforma® plant plugs to 11-in. diameter Jiffypot®s with multiple sizes in-between. The availability of cultivars, containers, and production schedules to produce and market plant materials over a range of sizes allows for customization for the myriad of growing operations.

Making Combos Easy

One consistent theme seen throughout Spring Trials was making combination pots easier for everyone, from the grower to the consumer. For the grower, the most popular product was multiple cuttings rooted in a single liner. The pioneer in this area is Dümmen, with their Confetti Gardens. Others are now offering similar programs, including Syngenta's Kwik Kombos, Ball® FloraPlant's Patio Ensembles, Hort Couture's® Ready to Wear™, and Selecta's TrixiLiner™ (Figure 8). Oro Farms' new Combos Made Easy program is focusing on providing combinations that grow well together and

have similar PGR requirements but also appeal to consumers. Oro will provide the "planting recipes" of the top-rated (by growers and consumers) combinations to growers to ease combo planning, planting, and production. These programs, whether finished liners or un-rooted cuttings, provide an advantage for growers who traditionally put together their own containers. By ordering the combinations they won't find one plant out of the combination out of stock or unavailable.

The pre-packaged combinations are not only for vegetatively-propagated plants. PanAmerican Seed was displaying their new Fuseable™ program (Figure 8). Similar in functionality to the Confetti Liner, Kwik Kombos, and TrixiLiners™, Fuseables™ are a single pellet containing seeds of complimentary material such as multiple cultivars of either one species or three different species. The pellets can be sown then transplanted, providing a simple seed-propagated mixture of species for flowering-combo containers. This allows plant material to grow together from the beginning and gives combo planters a natural look. In addition to flowers, the Simply Salad Fuseable™ line contained multiple types of lettuce seed pelleted together, providing an instant and simple containerized salad mix!

In addition to making combination planters easier for the growers, there were some programs designed to make combination planters easier for the consumer who wants to design their own. Both Master Tag and Goldsmith were promoting programs for use in garden centers to simplify container design and construction by consumers. Master Tag's Container Creations uses color coding to identify which plants are upright, mounding, or trailing, ensuring customers include all the structural elements necessary for a good mixed container. Goldsmith had a similar program called Make It Simple, which identified plants as having a focal, filler, or cascading habit that corresponded to a planting pattern on display next to the plant materials.

Hort Couture® offered what must be the simplest instant container program ever for consumers - Easy 1, 2, 3. This program includes container designs, branded as Cities of Fashion, grown in a 14-inch container similar to a hanging basket. However, it had a large hole in the bottom of the container allowing consumers to "pop out" the fully grown plants as one large mass by pushing up through the hole and planting it in the final container (Figure 9). This produces a container that looks completely filled-out immediately after planting!

Eco-Friendly Products, Plants, and Marketing Programs

Sustainability was a recurring theme again this year at Spring Trials. We saw several examples of sustainable and eco-friendly products from packaging to plant material to marketing programs. Jiffy® was promoting their new Plant In a Jiffy® program (Figure 10). By starting plants in Preforma® liners, slipping the liner into a paper sleeve with a tag attached, shipping them in wax-coated paper trays, and providing customers at the garden center with a paper carrying case, they aim to largely eliminate plastic from propagation to purchasing. Ball® was showcasing their biodegradable containers. These compostable and biodegradable pots include the OP47 pots made of wheat byproducts and rice hull pots, which featured a new plantable version with slotted sides to allow roots to grow out into the soil after planting. Western Pulp's® recycled paper and wood pulp ReCreation® pots were also on display at Ecke, straying from the natural brown with a hip new green color. The Eco tags by John Henry® offer a large selection of tag materials, so growers can choose something that works for their program. These tags are produced from a variety of materials, including recycled plastics, corn, recycled paper, and wood pulp (Figure 11).

In addition to sustainable containers and other products, we saw new breeding directed toward reducing inputs for growers and homeowners. Ecke was promoting the new Eck-O Collection™ of plant material that offers sustainable solutions by reducing: 1) the need for PGR applications; 2) irrigation requirements; 3) energy inputs by growing well at cool temperatures; or 4) overall inputs due to a short bench time. There was also plant material being promoted as sustainable due to the minimal irrigation requirements in the landscape or container. Selecta's 'Soleil Purple' petunia is a new Wave-type, long-day cultivar that thrives under minimal irrigation in the landscape. Plug Connection®, among others, had succulents from many genera on display. These succulents offer season-long color for landscapes and containers while reducing the need for water.

Technical Support, Production Recipes, and Cultural Information

One trend that caught our eye was on product-specific grower support which provides services similar to that offered by your local land grant University Extension Service. Ecke was one of the first to dedicate resources to grower support with its web-based Tech Help Bulletin Board, featured at the Ecke Techie Cafe. This year Syngenta introduced their integrated Technical Services Team, which brings together the collective expertise of S & G Flower, Syngenta Horticultural Services, and the recently acquired Goldsmith Seeds, Fischer, and Fafard (Figure 12). The team is composed of experts in disease diagnostics, substrates, biological and chemical controls, and plant genetics. One part of the team works with growers and brokers, while the other is focused on technical communications, research, and development.

As a grower, do you wish you could find a recipe card that included media, PGR, pH, insecticide, fungicide, and sales recommendations for new plant introductions or even new cultivars? Dream no more. Breeders at Spring Trials are now providing very detailed cultural information about the

newest members of their catalog family. For example, Syngenta had production and culture information adjacent to their plant material that indicated which media, pH, plant protection, PGRs, and biological controls they recommended for each species or series (Figure 13). At the Ball® Spring Trial site, culture research posters were placed next to the corresponding crop (Figure 14).

Though it is difficult to summarize an event like Spring Trials, certain themes and trends were apparent. It is clear that companies are trying to further develop their products with added value for growers and consumers alike. To support the ever-increasing number of varieties being grown, breeders are supplying growers with unprecedented information and resources. Sustainability is here to stay, as evident in not only the hard goods such as tags and containers, but also with plants that grow well with fewer inputs. Creative and successful plant combinations are becoming more common with the products available to growers and the point of purchase marketing designed for consumers. As always, the plant material was dazzling, displaying broadening variety of both color and texture to synch up to current fashion trends. While we hope this gives you an idea of what was happening this year and in the following years, with any luck we'll see you on the Spring Trials trail next year!

Figure 1. Pan American's 'Gryphon' begonia has outstanding foliage and stature.

Figure 2. Syngenta demonstrates how color can be successfully used as a marketing tool.

Figure 3. Ball's 'Phantom' petunia can dress up a container, especially if your school colors are black and gold.

Figure 4. Westhoff's unforgettably named Estrella verbena 'Voodoo Red Star'.

Figure 5a. Dümmen chose pot color as a way to help their Potunia® line stand out from the crowd.

Figure 5b. Fides' Hypnotica® dahlias have a hypnotic container as well.

Figure 6. Dümmen showcased its Magnum series New Guinea impatiens sporting unusually large and showy flowers.

Figure 7. Schoneveld Twello breeds cyclamen of varying flower and foliage color, and also size.

Figure 8. Having trouble with mixed containers? Here is a selection of the combination liner and plug products offered.

Figure 9. Hort Couture's® Easy 1,2,3 planter is ready to be planted by the consumer in a larger patio container.

Figure 10. Jiffy's® Plant In a Jiffy® program is striving to eliminate plastic from the entire production chain.

Figure 11. John Henry's® Eco tag products displaying a range of materials for tag production.

Figure 12. Harvey Lang explains Syngenta's Tech Services to the group.

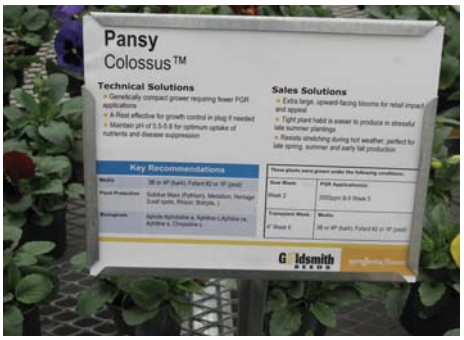

Figure 13. Plant production and sales recipes simplify growing and selling.

Figure 14. Which PGRs work the best on the newest cultivars? Ball® has done its research and shares this with Spring Trials visitors.

Upgrade Your Environmental Control Equipment

By Dr. John W. Bartok
Agricultural Engineer

Mechanical thermostats, the traditional temperature control devices common in greenhouses and other buildings having heating and cooling equipment, are being replaced by controllers and computers. These solid state devices can better manage the

complex interactions between the outdoor weather, plant requirements, and equipment to produce higher-quality plants while saving energy and labor compared to thermostats. Thermostats that are used principally to control heating and cooling equipment have improved over the years. They still have the disadvantage of a large differential between the on and off switch position which allows the temperature to exceed the set point by several degrees. For example, a thermostat that has a ± 3 °F differential will require a setting (set point) of 63 °F to maintain a 60 °F minimum temperature in the greenhouse. Heating equipment will not shut off until the greenhouse temperature reaches 66 °F. This six-degree override increases winter heat loss by creating a greater temperature difference between inside and outside. Controllers and computers, utilizing solid state technology, usually have a ±1 °F differential. Controllers integrate several pieces of equipment and are designed to accept input signals from sensors and send output signals to equipment that needs to be activated to adjust the environment. The simplest controllers utilize one input sensor for temperature. They may control from two to four heating equipment stages and three to five cooling equipment stages around a set point.

In a typical system, root zone heat may be activated as a first stage when the greenhouse starts to cool off. Unit heaters may be activated in Stage 2 and 3 if the greenhouse continues to cool down. During the day if the temperature exceeds the set point, intake louvers may be opened on Stage 1, fans may be started on Stages 2 and 3 and the evaporative cooling system activated on Stage 4. The air circulation fans may be operated with any stage but usually run at the set point stage and with some of the heating stages to prevent stratification.

Separate controllers are available to control misting, irrigation equipment, lighting, and carbon dioxide levels. These are individual controllers that operate specific equipment.

Some manufacturers have designed units that incorporate all the above controls into a single box. The larger units will accept 30 or more sensors and control 40 or more stages (Figure 1). With the menu driven program it is easy to input or change the set points. An optional weather station can record temperature, humidity, wind, precipitation, and light level for future reference (Figure 2).

Individual or multiple controller units can usually be interfaced with a personal computer (PC) that creates a history of a particular crop that can be used for future reference or duplication. Using the PC, changes to the greenhouse environment can be made from your home or office. Reports and graphs of sensor readings, equipment operation and maintenance scheduling can also be made.

Computers can Control and Record the Environment History

Environment control computers are usually designed to fit the requirements of a particular greenhouse installation. With the integral software, they provide anticipatory control in addition to control based on sensor readings.

For example, if the wind speed suddenly increased resulting in a cooling of the greenhouse, the computer would reduce the vent opening based on a signal from the temperature sensor. The computer software could also be programmed to anticipate that cooling would occur when the wind speed picked up and reduce the vent opening before the cooling was detected by the sensor at plant level. This would save heat and fuel usage. Anticipatory actions might also be programmed for light levels related to varying cloud cover, weather forecasts, heating pipe temperature and plant models.

Research to develop plant models is ongoing at many universities. These complex measurements and calculations try to anticipate how a plant grows and develops due to many factors. Models are continually improved as better data becomes available. With a model as a basis, the computer can compare actual plant growth to a model plant and make adjustments to the environment to speed up or slow down the growth.

Light is usually the limiting factor in plant growth so optimum values for other factors usually relate to it. Computers have the advantage that they can process large amounts of data very quickly and they can retain this data for future reference. They also have the capability of taking and recording frequent sensor readings. This offers the opportunity to control equipment with the average of many measurements.

For example, on partly cloudy day, light levels can rise or fall every few minutes. The computer can be programmed to store light sensor readings every minute and keep a running average over a 5 or 10 minute period. Using this average rather than individual readings could eliminate the frequent opening and closing of a movable shade screen inside the greenhouse.

The computer can also do a better job of controlling a heating system. We know that outside temperature and wind speed influence the amount of heat that has to be provided by the heat distribution system. The computer can be utilized to calculate this for varying weather conditions and modulate the water temperature in the pipes so that a uniform air temperature can be maintained. This is not possible with the standard thermostat that only turns on the circulating pump when the sensor indicates that the greenhouse is getting cold.

Developments in controller and computers continue to improve the control that we have over the environment in the greenhouse. The improved plant quality and reduced energy costs help to pay for these devices.

Figure 1. Some units will accept 30 or more sensors and control 40 or more stages.

Figure 2. Weather stations can record temperature, humidity, wind, precipitation, and light level to assist in greenhouse environmental control.

To Buy or Not to Buy… Influencing Your Customer's Purchases

By Dr. Debra Perosio
Senior Lecturer

Do you wonder what is going through a customer's mind when they come to your business, pick up a product, look it over carefully, and then put it back and walk out? Do you ask yourself, "What happened to that sale?" Consumer decision making is a complex science about how consumers make purchase decisions: is it impulse or planned, do consumers do research, do they consult a friend or use their own judgment (Figure 1)? Is there a way you can help convert a store visit into a sale? Consumer decision making can be broken down into several simple steps, many of which, as a business person, you can influence.

We all go through a process when making a decision. For routine items we buy every day, we know well, and that have a relatively low price tag, that decision can be very quick. For other items that are more complex, for which we really don't know much about, or that are very important the process can become complex and lengthy.

All buying decisions are sparked by a need (or an "I want"!): I just ran out of eggs, my car broke down, I love that flat screen TV. Marketers further develop our needs and wants. How? Certainly, forms of advertising greatly influence us. Advertising can take many forms, reminders for those everyday items, educational for those new items, or persuasive for those items that you may not really need but would love to have. Often sales promotions help, buy one get one free, new flavors, sizes and packages can grab their attention (Figure 2). Signage at the point of sale is a great tool to draw consumer attention. Loyalty programs also help but make sure it delivers real benefits to your customers (some of the best loyalty programs right now are with supermarkets offering discounts on gas). Once consumers recognize a need, they begin an information search. For the eggs that I just ran out of that search is relatively easy. I quickly scan my internal memory for how to get eggs quickly and easily, and I think of the closest place I can go to get eggs. Not much thought or involvement there. But what about a need for a medical procedure or a purchase of an expensive patio set? These types of decisions require an "external" search. You might start talking to friends, do some research on the web, etc. High risk and high prices typically produce longer and more extensive information searches.

How can you, as a marketer, influence your customers' decisions? Make sure your website is up to date and easy to navigate and make sure the resources on it are helpful and easy to read. Today, many people start their information search on the web, and if you don't have a presence there, you may be over looked. Complex decisions require clear information, education, and often extensive customer service. Have educational information readily available, be helpful, offer tours and demonstrations, but maybe most important, offer yourself as a personal consultant for your customer, providing information and follow up throughout the information search process.

Once consumers have collected their information, the next step is to evaluate the alternatives. Which doctor should I select for the procedure, which hospital is best, what garden center has the best patio furniture selection, which brand has the best warranty, and who has the most competitive price? Usually in these complex situations we decide what attributes are most important to us and set criteria, say maximum price, or best doctor, as our most important attribute when making the decision. As a marketer how can you help your customers work through the evaluation of all of the alternatives? You can find out from them what is most important and work toward attribute. You can boldly compare your product against your competitors and easily illustrate the differences for your customers (think about insurance companies who do this a lot).

Once consumers have carefully weighed their alternatives, a purchase usually results. Wait! Your marketing commitment is not over yet. Now is the time to help your customers avoid suffering from "buyer's remorse," that nagging feeling you get after making a major purchase; when you start to wonder if it really was a good decision. Consumers want reassurance that they made the right decision, and marketers can help their customers feel confident about their purchases. How about

follow-up emails, letters, thank you postcards that can also provide additional information about the product they just bought? And how about a phone call a month or two after the sale…does the customer have any questions, is everything working properly? This is also a good time to remind them of other services/products that you have that may complement or enhance the product they just purchased from you.

Remember, the more complex, risky and/or expensive a purchase decision is, the more "help" a consumer needs in making that decision. As a marketer your chances of converting a visit to a sale is much better if you can influence a customer from need recognition to alleviating buyer's remorse.

(Reprinted from January 2010 Smart Marketing Newsletter,<http://marketingpwt.aem.cornell.edu/publications.html#smart>).

Figure 1. Impulse or planned shopping?

Figure 2. Customers love loyalty programs!

Western Flower Thrips Pupa: A Difficult Life Stage to Regulate

By Dr. Raymond A. Cloyd
Professor of Entomology

Greenhouse producers worldwide are very familiar with the western flower thrips (*Frankliniella occidentalis*), which is a destructive insect pest that feeds on many greenhouse-grown crops. The western flower thrips (WFT) lifecycle consists of an egg, two nymphal stages (instars), two "pupal" stages, and an adult. After the second nymphal stage, western flower thrips undergo a prepupae (or propupae) and pupae stage that is typically located in the soil or growing medium (Figure 1). In fact, one-third of the WFT development time is located in the soil or growing medium. Unfortunately, the pupae stage is very tolerant or immune to most insecticides commonly applied to regulate WFT populations, and many are not even labeled for drench applications to the growing medium. The product Limestone F® (active ingredient = dolomitic limestone) was used by greenhouse producers and applied to the soil underneath benches as a means of dealing with the pupae stage of WFT. Supposedly, this increased the pH of the soil above 7, which created an inhospitable environment for development; presumably affecting adult emergence. However, there was no data to substantiate the effectiveness of this technique. Concrete floors and the use of weed-fabric barriers may be more applicable in reducing the ability of WFT to pupate underneath benches, thus lowering the number of adults in the next generation. Placing yellow or blue sticky cards approximately 2 to 3 inches above the soil underneath benches will assist greenhouse producers in detecting and assessing the abundance of adults that emerged from the pupae stage. In fact, a New Mexico greenhouse operation captured approximately 8 times as many thrips (most likely WFT) on sticky cards positioned just above the floor than were captured on sticky cards placed among the main crop.

The use of biological control agents (= natural enemies) such as soil-dwelling predatory mites, rove beetles, entomopathogenic (or insect-killing) nematodes, and entomogenous fungi have been utilized to create some level of mortality on the pupae stage. The soil-dwelling predatory mite, *Hypoaspis miles* (= *Stratiolaelaps scimitus*) will feed on the pupae stage of WFT and has been successful in both the U.S. and Europe in reducing adult emergence from the soil in greenhouse production systems. However, the mites may not consume enough pupae to significantly impact the population growth of WFT. The rove beetle, *Atheta coriaria* may feed on WFT pupae although additional studies are needed to produce quantitative data in order to substantiate using them in greenhouse production systems. The major insect-killing nematodes belong to the families Steinernematidae and Heterorhabditidae with the primary species being *Steinernema feltiae* and *Heterorhabditis bacteriophora*. The prepupae and pupae are supposedly susceptible to infection by these two species. The insect-killing nematodes directly penetrate the pupae stages and then release a bacterium that consumes the internal contents of the pupae. The efficacy of insect-killing nematodes depends on the concentration applied (dose-response), and activity may be associated with where WFT are pupating in relation to the location of insect-killing nematodes within the growing medium profile. For example, S. *feltiae*, in general, prefer to reside near the surface of the growing medium, whereas *H. bacteriophora* may attack pupae deeper in the growing medium profile. The ability of *H. bacteriophora* to search deeper in the growing medium profile may allow the insect-killing nematode to find more WFT pupae over a longer period of time. In addition to reducing WFT survival, sub-lethal infections by insect-killing nematodes may lower the number of offspring produced by surviving

adult females.

Despite the success of insect-killing nematodes in some studies, which are primarily conducted in artificial environments (petri-dishes), the application rates used were extremely "high" and may not be economically feasible. Furthermore, it has been proposed that differences in efficacy between the two insect-killing nematode species may be due to the prepupae and pupae having a stronger immune system response than the nymphs, and possessing a hardened cuticle that may reduce penetration by infective juveniles. Moisture content of the growing medium is a major factor that will impact the efficacy of insect-killing nematodes because they require moist conditions in order to migrate through the micro- and macropores of growing media. The growing medium type (e.g. peat vs. bark) may also affect the effectiveness of insect-killing nematodes in attacking the pupae stage of WFT. It is interesting to note that combinations of *H. miles* and insect-killing nematodes have been reported to be more effective in killing WFT pupae than when either biological control agent is applied separately.

The entomogenous fungus, *Metarhizium anisopliae,* has been reported to kill WFT pupae in a range of growing media containing peat, coir, bark and peat-blends with composted green waste. It appears that premixing growing media with spores of *M. anisopliae* provided better regulation than drench application based on WTF pupae mortality. What happens is that as the second instar nymphs burrow into the growing medium to pupate, fungual spores (conidia) adhere to their bodies, and then penetrate the cuticle and initiate an infection. As such, the fungus is not really attacking the pupae stage. As with the insect-killing nematodes, efficacy of the fungus is dependent on temperature and moisture content of the growing medium.

In most cases, WFT pupates in the soil underneath benches or in the growing medium in containers. However, WFT may pupate inside the floral tube of certain plants such as chrysanthemum. This is not uncommon as certain thrips species such as the citrus thrips (*Scirtothrips citri*) pupate on the host plant. In addition, factors that may influence where WFT pupate include relative humidity and abundance of natural enemies (e.g., predatory mites and bugs). Pupating in flowers may allow WFT to escape exposure from natural enemies, especially predators. Under these circumstances *H. miles* and *A. coriaria* will not be effective in regulating WFT populations that are located in flowers. Applications of the insect-killing nematodes may be an option as long as a sufficient concentration reaches the pupae stage in the flowers. The pupation behavior of WFT will vary depending on the host plant, flower age, and complexity of the flower structure. For example, it has been reported that WFT will pupate in the complex inflorescences of chrysanthemum.

In conclusion, WFT will continue to be a major insect pest to contend with in greenhouses, and with the issues associated with resistance to standard insecticides such as spinosad (Conserve), it will be important to develop cultural and biological control techniques that target the pupa, which is resilient to typical insecticide applications.

Figure 1. Western flower thrips pupa.

OSU Research Update - Greenhouse Disinfectants

By Dr. Dennis Lewandowski
Assist. Professor and Plant Pathology Extension Specialist

Sanitation is one of the most important components for a successful greenhouse operation. During vegetative propagation, the use of an effective disinfectant can make a big difference. How does one choose an effective disinfectant? Ideally, a greenhouse disinfectant should be quick acting, have broad-spectrum activity, readily available, cost-effective, and safe for plants, people and equipment. Unfortunately, there are very few studies comparing disinfectants side-by-side. One key to effective disinfection of a hard surface is that it be reasonably free from organic matter, which rapidly inactivates many disinfectant compounds.

Some materials are labeled for treating particular surfaces (e.g. benches, pots, flats). Many recommend contact times (10 min), which is fine if you are treating benches or pots, but unreasonably long if you are sanitizing cutting tools. Research at The Ohio State University and that of a colleague, Dr. Scott Adkins, at the USDA, ARS, U.S. Horticultural Research Laboratory was recently published in Plant Disease (Lewandowski et al., 2010). In this study, we made several key findings, including:

1. Some isolates of TMV do not cause symptoms on many petunia cultivars
2. Clippers contaminated with TMV by one cut on an TMV-infected stem has the ability to infect many plants
3. TSP (Tri-sodium phosphate) was not effective at controlling TMV on cutting tools with a 1 min contact time
4. A 1:10 dilution of household bleach was effective at controlling TMV (remember – bleach has a 2 hr half-life when diluted, so it needs to be prepared often)

5. A 20% solution of non-fat dry milk with a surfactant was effective at preventing the spread of TMV from a contaminated blade
6. Some commercially available disinfectants were ineffective when used for a shorter time than labeled
7. Other promising materials were identified and continue to be evaluated against TMV and other pathogens

Remember, some virus particles are extremely stable and some can survive on hard surfaces for a long time. It is far easier to prevent their introduction, rather than to clean up after an outbreak. Workers who smoke can pick up viruses on their hands and transmit these viruses. Washing hands with soap before handling clean plant material is critical to reduce the risk of virus contamination. Infected plants should be destroyed, not composted near the operation. Pots and plug trays containing infected plants should not be reused (roots also contain viruses). Benches and other areas that came into contact with infected plants should be disinfected with one of the commercially available disinfectants (e.g. quaternary ammonium salts, hydrogen peroxide-based) and follow label recommendations. Tools used to take cuttings or clean up plants should be regularly disinfected (ideally between plants), at least every few minutes, and always between cultivars (Figure 1). Weed management is a component of a clean operation, both inside and outside of the structures.

This research was supported in part by the Floriculture and Nursery Research Initiative and the Fred C. Gloeckner Foundation

Figure 1. Tools used for harvesting cuttings should be disinfected regularly.

It's Chrysanthemum Season -- Be On the Lookout for Rust!

By Lin Schmale

Did you spend 30 minutes – and zero dollars – on the free Chrysanthemum White Rust (CWR) webinar offered by the Society of American Florists (SAF) earlier this summer? If you missed it, you can access the power point presentation at your leasure by visiting: http://www.safnow.org/pestsanddiseases.

If you grow mums, it is vital that you know how to recognize the disease symptoms, and how to protect your crops and your business from this quarantine disease (Figure 1). The power point has excellent photographs of the symptoms, as well as information on how to avoid the disease, and what you are required to do if you find it. Also available on the SAF website is Syngenta Flowers' updated CWR Bulletin.

What is the Status of the USDA Review of the Quarantine?

USDA's Animal & Plant Health Inspection Service (APHIS) is currently evaluating potential changes to its regulatory framework for CWR. SAF, the American Nursery & Landscape Association (ANLA) and the major chrysanthemum breeders have been involved in discussions with APHIS for several years, particularly on the possibility of modifying the quarantine requirements while still protecting commercial growers.

Some of the continued detections, particularly in the mid-Atlantic and northeast states, seem to suggest the possibility that CWR can overwinter, although this has yet to be demonstrated in a controlled experimental study. Some commercial growers, especially in that same region of the U.S., have experienced significant financial losses over the past several years when subjected to quarantines that required them to hold their mum crops until the marketing season had passed.

Any changes to the regulation would require a full rulemaking notice-and-comment process, and would likely take several years. In the meantime, APHIS will continue to engage the grower community in dialogue. Interested growers can receive information and notifications of availability of new analyses or proposals by joining the APHIS Stakeholder Registry at: https://web01.aphis.usda.gov/PPQStakeWeb2.nsf. In addition, APHIS encourages stakeholders to e-mail their thoughts and suggestions to APHIS at cwr-regs@aphis.usda.gov

For more information, contact SAF's Lin Schmale, lschmale@safnow.org.

Figure 1. Chrysanthemum White Rust (CWR) (photo courtesy of Jane Trollinger, Syngenta Flowers)

Upcoming 2010 Industry and University Events				
	Event	**Location**	**Speaker/Topic**	**Website/ E-mail**
Sept. 28-29	OFA Disease, Insect & Plant Growth	St. Louis, MO	Education and Trade Show	http://www.ofaconferences.org/
Oct. 6-7	IFGA Annual Conference	Lafayette, IN	Education and Golf	https://share point.agriculture.purdue.edu/agriculture/flowers/ifga.aspx
Oct. 6-7	Canadian Greenhouse Conference	Toronto, Canada	Education and Trade Show	http://www.canadiangreenhouseconference.com/
Oct. 13	NIFGA	Baker's Acres in Angola, IN	Chris Currey Flowering Perennials and tour	Facebook: Northeast Indiana Flower Growers
Nov. 10	NIFGA	TBA	Fall Banquet	Facebook: Northeast Indiana Flower Growers
Nov. 11	NWIFA Meeting	LE Garden, Wheatfield, IN	Chad Martin on Altern. Energy Sources & Funding	http://faculty.pnc.edu/emaynard/nwifa/nwifa.html
Jan. 12	NIFGA	Sandpoint GH, Fort Wayne, IN	Sandpoint Greenhouse	Facebook: Northeast Indiana Flower Growers
Jan. 17-19	Indiana Green Expo	Indianapolis, IN	Education and Trade Show	http://www.indianagreenexpo.com/
Jan. 18-20	Indiana Hort Congress	Wyndham West, Ind., IN	Educational and Trade Show	http://www.inhortcongress.org/
Jan. 19-21	Mid-America Horticultural Trade Show	Lakeside Ctr. Chicago, IL	Education and Demonstration	http://www.midam.org/
Feb. 16	IFGA Spring Conference	Heartland Growers, Westfield, IN	Bedding Plant Production	https://share point.agriculture.purdue.edu/agriculture/flowers/ifga.aspx

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