PURDUE UNIVERSITY

PURDUE EXTENSION

# The Indiana Flower Grower

## In This Issue



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Roberto's Message

## *IFGA Conference Highlights*

By Roberto G. Lopez, Ph.D.

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

A few weeks ago we had a successful 26th Annual Indiana Flower Growers Association (IFGA) Conference in West Lafayette, IN. We had a record turn out for the golf classic with 9 teams despite a rainy start. Ken Kuhajda from O.H.P., Ashley Smith and John McGowan from Landmark Plastic were on the winning team (Figure 1). Yours truly also played golf for the first time and led the team to last place!

*Figure 1. 1st place IFGA winning team of Ken Kuhajda, Ashley Smith and John McGowan.*

Golfing was followed by a banquet and presentation of the IFGA Allen Hammer scholarship which was awarded to Purdue Horticulture Science undergraduate student, Jessie Heller. Jessie received a $750 scholarship and a plaque. As a 3rd generation greenhouse grower, her career interest is to be next in line to manage the family business, Heller's Nursery (http://www.hellernursery.com/) which was started in 1946 by her grandfather Bobby Heller in Decatur, Indiana. Jessie is well rounded with internship experience at the Ball Horticulture Co., Bailey's Nursery and in my lab at Purdue.

Vice President, Steve Dewald of Dewald Gardens and Dean Bemis of GoldSmith Seeds presented the new Indiana Floriculture Person of the year award to IFGA president Larry Houser for his many years of dedication to the floriculture industry in Indiana and across the nation.

*Figure 2. Presentation of the IFGA Floriculture Person of the Year Award to Larry Houser.*

The presentation included a slide show highlighting Larry's many achievements and a roast from his friends and colleagues. As you may know, in early September Larry was diagnosed with pancreatic cancer and consequently was unable to attend the conference. A few days ago, Colleen Martin, Steve

Weller and I had the pleasure of visiting Larry and presenting him with a plaque (Figure 2) and DVD of the banquet presentation. Larry is doing well and is in good spirits as he goes through treatments. For those of you that would like to leave a message for Larry and find out how he is doing, please visit: http://caringbridge.org/visit/larryhouser.

On Thursday, the conference centered around the theme of Surviving the Energy Crisis with presentations on Cold Poinsettia Finishing, Greenhouse Production Energy Saving Opportunities, USDA Renewable Energy and Energy Efficiency Programs, Saving Energy with a Self Evaluation: How Virtual Grower Software Can Help, Energy Efficiency Improvements in Greenhouses, Scheduling Greenhouse Crops Energy Efficiently and Alternative Energy Opportunities. The day ended with a tour of the National Poinsettia Cultivar Trials and the Horticulture Gardens.

A round of applause for the following individuals for making your 2008 conference a success: Colleen Martin for helping organize the conference, Doug Hackbarth for organizing the golf classic and awards, Bev Galema for the beautiful displays and centerpieces, Joyce Ross for ordering the golf plaques, Purdue HLA support staff Tammy Goodale, Carl Geiger and Dave Stotler for behind the scenes preparations.

## Growers Column: Sustainability for Growers, Landscapers and Garden Centers

By Kenneth L. Hensch

IFGA Immediate Past President

As a Greenhouse owner it was very necessary to become sustainable in the 21st century. With less than an acre of greenhouse, automation was a must in the area of watering, disease control and fertilization. The addition of overhead watering for spring crops saved twelve hours a day allowing three greenhouse staff to do other production work. The adding of oxide and Daniel's organic fertilizer reduced disease and improved quality. Improving the injector system to control pH and EC has also improved quality and efficiency. Our spring production is custom growing for our landscapers and quality garden center clients. The introduction of the Ball Easy Scape Program in 2006 made production for spring 2007 and 2008 much more sustainable for the greenhouse and the landscaper, less plastic and greenhouse labor was an immediate plus. Filling trays was no longer an issue, just bring them in, set them out and water them in with the new watering system. (I do have to thank the Ball Horticulture Company "Team" for all their assistance.)

Landscapers pre-order their product in the fall, hopefully by winter's end, so we can plan production for the coming spring. Most of our landscapers use 6" pots, 4" Ellie in a ten tray or the L-18 tray. I have been told that a crew planting an estate saved two hours with the use of Ellie pots. Another landscaper, with the use of the 18 tray over the 36 or 32 trays, saved one half the time and achieved a superior quality finish look. They used a few more plants, but the labor savings more than compensated for the three trays of flowers. Most importantly, the customer was very happy with the finished flowerscape install.

The Garden Center is another important client. They know their customer so they can select the type of container and plant selection. I like the saying, "Tell me what to plant in that container and we'll grow it for you." This is not always the case and some need assistance in the plant selection. The choice of soil or the use of moisture mats for hanging baskets is an important concern for the quality of the finished product and end user. Each individual Garden Center has their own special niche to be sustainable, but I wonder if the consumer in these economic times can pay for the additional cost. Even more, do they understand the sustainability of our products? The industry needs to train the consumer about sustainability products, much like we did with the Landscaper. Purdue research, test results and industry feed back will be important to increase the sustainability of our Garden Center businesses. Important questions remain, such as, did or will the rice hull and wheat pots sell? Did or will the pots go into the landfill or the compost? Sustain-

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ability to me is the best use of our products, while being cost effective without harming our environment, while making a profit. I will be presenting some of my "sustainable growing experiences" at the Indiana Green Expo at 11 AM on Monday, January 12th along with Greg Trapka from the Ball Horticulture Company.

## Indiana Greenhouse Grower Spotlight

By Roberto G. Lopez, Ph.D.

Assist. Professor and Floriculture Extension Specialist

Galema's Greenhouse in West Lafayette, Indiana was founded in 1991 by Tim and Bev Galema on Tim's Grandfathers farm (Figure 1).

*Figure 1. Galema's Greenhouse in West Lafayette, IN*

The greenhouse has grown from 2 small greenhouses to over 75,000 sq. ft. under cover and a mum field of over 40,000 pots. Thus, most of their customers are garden centers, farm markets, landscapers, and other greenhouses. They deliver across the state of Indiana, mainly within a 60-mile radius including Indianapolis, Noblesville, Kokomo, Logansport, Kentland, and Crawfordsville.

Tim's formal training is in Horticulture from Purdue University. More importantly, he notes is his practical experience in Junior High when he started working for Vandergraff's Greenhouse. He continued working there through high school, college and after graduating from college. Through this experience, he learned many things about the greenhouse business - customer contacts, diagnosing plant problems, and servicing the needs of both customers and employees. This experience aided the start up of the business in a great way. Tim has served on the board of the Indiana Flower Growers Association and currently is a member of the Ohio Florists' Association as well. Tim adds "Keeping involved with organizations such as these is vital to remaining abreast of changes in the industry and in customer wants". Bev Galema also graduated from Purdue with a degree in Management in 1991 and joined Tim in the greenhouse full-time in 1998. She heads up the office by handling all the books, scheduling deliveries, and keeping the paperwork under control. She is assisted by children, Alex and Molly, the real bosses of the place! Chuck and Marilyn, Tim's parents also spend their days helping out in the greenhouse. Marilyn is in charge of watering. Chuck joined the greenhouse after retiring in 1998. He fills in wherever needed, repairing equipment, on the road delivering, or babysitting the grandkids.

Tim and Bev say the operation has grown much faster than anticipated and see more growth in the future. "We will continue to automate processes and improve efficiencies to promote more healthy plant growth and thus improve the quality of our product." The Galema's success comes from their innovation, family, strategic location, moderate pricing and a reputation as a quality grower. In 1998, they were designated "Grower of the Year" by Grower Talks magazine, and in 1999 they were named GMPro Innovator for their Integrated Pest Management program.

For more information about Galema's Greenhouse, please visit: http://www.galemas.com/

## Poinsettia Trials

**National Poinsettia Trials**
**http://www.poinsettiatrial.org/**

| NCSU | Purdue University | U. of Florida |
|---|---|---|
| December 4, 2008 | December 6, 2008 | December 9, 2008 |
| 9:00 AM to 2:00 PM | 9:00 AM to 3:00 PM | 9:00 AM to 3:00 PM |
| HFL Greenhouse | Research Greenhouse | Fifield Hall |

**Regional Trials**

OSU Howlett Greenhouses
December 3 and 4, 2008
8:30 AM to 4:00 PM
680 Tharp Street
Columbus, OH 43210

Krueger Maddux
December 3, 2008
1:30 to 4:00 PM
8166 North State Road
Sunmam, IN 47041

Bostdorff Greenhouse Acres
December 8, 2008
1:00 to 3:30 PM
18832 N. Dixie Highway
Bowling Green, OH 43402

Dill's Greenhouses
December 10, 2008
1:30 to 4:00 PM
5800 Rager Rd.
Groveport, OH 43125

Barco & Sons, Inc.
December 12, 2008
1:00 to 3:30 PM
Barco & Sons, Inc.
6650 Branch Road
Medina, OH 44256

## Poinsettia Production Problems, Disorders and Diseases

By Roberto G. Lopez, Ph.D.

Assist. Professor and Floriculture Extension Specialist

By Janna Beckerman, Ph.D.

Assist. Professor and Ornamental Plant Pathology Extension Specialist

### *Poor and Uneven Branching*

Poor branching is a disorder that results in uneven lateral shoot breaking (top breaks are larger and stronger than bottom breaks, Figure 1)

*Figure 1. Poinsettia with uneven branching*

or lack of breaks on branched plants. Often growers wait too long to pinch their plants resulting in poor and uneven branching. In such instances, plants become tall and lateral shoots emerge before pinch and break unevenly after pinch. For most cultivars, 14 days is the maximum recommended time from planting to pinching. Certain cultivars are more susceptible to this disorder and a reduction in time to pinch will minimize irregular branching. In addition, production temperatures >75 °F during growth can cause blind shoots, or reduced branching. Uniform poinsettia branching can be achieved with proper plant spacing, pinch timing and technique, and temperature management.

### *Leaf Curl and Desiccation*

Symptoms of leaf curl, scorch or desiccation typically occur on leaves in the middle portion of the plants. As your poinsettia crop is actively growing when greenhouse temperatures and light levels are high, it is essential that you provide adequate irrigation to avoid extreme conditions (excessively dry or wet) that can result in leaf desiccation (Figure 2),

*Figure 2. Poinsettia leaf curl and desiccation.*

poor growth, and disease susceptibility. Excessively dry plants should not be irrigated with cold water as uptake and transport by the roots can be inhibited for a short interval. Under extended drought stress, lower leaves will turn yellow and senesce.

### *Leaf Distortions*

Poinsettia leaf distortions (Figure 3) often occur on young or immature leaves and are believed to be caused by many factors. Physical damage during pinching, ruptured cells and latex residue can cause the expanding leaf to become distorted.

*Figure 3. Poinsettia leaf distortions*

Environmental stresses, overhead fertilization with phosphorus fertilizers during propagation or production, abrasion or thrips may lead to distorted leaves. Leaf distortion can also results from dramatic temperature and humidity changes as plants are moved from propagation to production. Typically, as plants grow, mature leaves will cover the distorted or damaged young leaves and not influence the marketability of the crop.

### *Split Bracts*

*Figure 4. Poinsettia with Split bract.*

Split bracts (Figure 4) occur when a poinsettia plant is exposed to a period of short days (malfunctioning day extension or night interruption lighting, stock plants exposed to short days) that lead to flower initiation followed by long days. Cool night temperatures in late September can cause flower initiation and a subsequent period of very hot nights can induce vegetative growth, leading to split bracts. Certain cultivars can be more susceptible to split bracts than others.

## *Mechanical Injury*

This type of injury can occur at any point during production. However, it is most typically seen when plants are individually handled (spaced, sleeved, and shipped). In addition, if your crop is hand watered, water nozzles can also cause mechanical injury. Symptoms include the wilting of the lower branch(s) (Figure 5) that were damaged during the handling. Careful handling, plant rings or supports can be an insurance against mechanical injury.

*Figure 5. Poinsettia with mechanical injury.*

## *Pythium Root and Stem Rot*

Pythium root and stem rot (Pythium spp.), sometimes called black leg, is a disease that is spread easily by water and can occur any time during the propagation and production of poinsettia. The first appearance of Pythium commonly occurs during the rooting of cuttings, where the wound provides an easy infection court for Pythium. Symptoms of Pythium at this stage can be easily confused with Rhizoctonia root rot, or Erwinia soft rot. Be sure your diagnosis is correct as the fungicides that effectively control Pythium are distinct from the fungicides that control Rhizoctonia.

Pythium infections can develop yet again at the end of production when conditions are ideal (cooler temperatures, overcast weather, poorly drained and excessively wet media). It is also important to remember that fungus gnats can disseminate Pythium and other soilborne pathogens, and should be closely monitored and managed. Symptoms of Pythium infection late in production include wilting; chlorosis of the mid-vein region and lower foliage (Figure 6); stunting; black or brown cankers at the soil line; blackened, mushy roots, and eventual plant death. It is important to periodically check the roots of your plants even if none of the above symptoms are observed. As with most root rots, the outer surface of roots infected with Pythium will typically slide off exposing a thread-like root (Figure 7). Once symptoms are observed, infected plants should be immediately discarded and care should be taken to avoid scattering debris and media of infected plants.

*Figure 6. Wilted poinsettia foliage due to pythium root rot.*

**Table 1. Fungicides used to prevent pythium**

| Fungicide | Active Ingredients | FRAC CODE | Rate |
|---|---|---|---|
| Banol | Propamocarb hydrochloride | 28 | 20-30 fl. oz/100 gal water |
| Banrot 40W | etridiazole + thiophanate-methyl | 1 + 14 | 6 to 12 oz/ 100 gal water |
| Pageant* | pyraclostrobin + boscalid | 11 + 7 | 12 to 18 oz/ 100 gal water |
| Fenstop | Fenamidone | 11 | 7 to 14 oz/ 50 to 100 gal water |
| Subdue MAXX** | Mefenoxam | 4 | ½ to 1 oz/ 100 gal water |
| Truban 30WP | etridiazole 14 | | 3 to 10 oz/ 100 gal water |
| Terrazole 350WP | | | 3.5 to 10 oz/ 100 gal water |
| Aliette, Agri-Fos, BioPhos | Fosetyl-Al or Phosphorous acid | M(33) | As per specific label instructions |

*not recommended for the root rot phase of this disease
** resistance might be an issue

*Figure 7. Poinsettia with pythium root rot.*

Managing Pythium requires an integrated approach. As Pythium is a water mold, water management is essential, and the moisture holding capacity of the potting medium is critical. High moisture holding media (like highly decomposed peat) results in worse Pythium root rot compared to high quality peat that is not greatly decomposed. The incorporation of biologicals (RootShield, MycoStop, RootGuard) assists in the management of disease when the infection level is low. Research has found that the incidence and severity of the disease is worse when the pH of the medium is above 5.5.

Several fungicides are labeled for control of Pythium root and stem rot. As with all pesticides, it is important to rotate between chemical classes to prevent fungicide resistance. Table 1 provides fungicide drenches that are recommended for the prevention of pythium on poinsettia (Always consult labels carefully for exact rates and to see if the material is registered in your state). Reference to fungicides is supplied with the understanding that no discrimination is intended and no endorsement is implied by Purdue University.

## Whitefly Preference on Poinsettia

By Karla J. Medina-Ortega, Graduate Student and Luis A. Cañas, Ph.D. ,Graduate student and Assist. Professor, Insect Ecology in Controlled Environments

*Figure 1. Poinsettia with severe whitefly infestation.*

Poinsettias, rank as the 2nd most valuable potted flowering plant in the U.S. The silverleaf whitefly (B. tabaci biotype B), is one of the most important and prevalent insects attacking poinsettias. This insect feeds from the stems and leaves (Figure 1) weakening the plant and often causing aesthetic problems. Unfortunately, in recent years there have not been any studies evaluating B. tabaci preference for current poinsettias cultivars. Thus the industry could benefit from an in depth analysis of whitefly preferences for particular poinsettia cultivars. Our overall objective was to determine the preference and performance of B. tabaci to seven cultivars of poinsettias.

Preliminary results indicate that whitefly oviposition (laying of eggs) and adult settling are higher on light green leaf poinsettias compared to dark green leaf cultivars. Lighter green leaf cultivars showed a tendency to be preferred and be better hosts for whiteflies. In addition, whitefly adults settled significantly less on 'Freedom' compared to other cultivars (Early Prestige, Monet Twilight, Prestige, Snowcap White and Zapoteca). Identifying preferences could be instrumental in scouting practices and reducing naturally the number of whiteflies on poinsettias. Implications of this research could benefit the private industry and potentially help reduced the use of pesticides.

## Understanding Fungi and Fungicides

By Janna Beckerman, Ph.D.

Assist. Professor and Ornamental Plant Pathology Extension Specialist

Of all the pesticides used, fungicides seem to be the least understood. A great deal of this misunderstanding is due to the fact that there is little understanding of their target organism as well. A simple definition of a fungicide is any chemical that can inhibit the growth or development of a fungus. There are many ways (mechanisms) a chemical can kill a fungus, and there are many different fungi. In order to effectively use fungicides to manage fungal disease problems, it is important to understand a little bit about both fungi and fungicides.

Fungi (singular fungus) are a unique group of living organisms, distinct from plants and animals, and include mushrooms, molds, rusts, smuts, powdery mildews, scabs, and blights. Not all fungi cause disease, but it is important to know those that do if you work in the greenhouse, nursery or landscape industry. Unfortunately, fungi were once considered to be "primitive plants," when in fact we now know they are more closely related to animals! Like animals, and unlike most plants, fungi cannot produce their own food, and instead they absorb nutrients from their surroundings including the plants you are growing. Most fungi reproduce by spores, tiny, usually microscopic, seed-like structures that germinate and grow by producing thin threads called hyphae that grow over or in the infected plant. Some fungi are very obvious in this process, like the powdery mildew pathogens, or the fungus that causes Southern blight—you can actual see those fungal threads doing the dirty work (Figure 1). These hyphae secrete acids and enzymes that digest the plant into simple molecules like sugar, protein, and starch. These simple molecules are transported through the cell wall and absorbed by the hyphae as it feeds, allowing

*Figure 1. Sclerotium rolfsii, the fungus that causes Southern blight, "feeding" off a hosta petiole, and producing hyphae and sclerotia*

the fungus to continue to grow. Most of the time, this growth is not a problem; although, in some instances, this is undesirable and must be stopped. This is where fungicides are useful. However, it is important to recognize that fungi are a fundamental part of the ecosystem and the realistic goal of management, and not eradication of all fungi is necessary for success.

At this point, it is important to stress that sole reliance of fungicides for any disease management issue is doomed to failure. Multiple tactics, termed integrated plant management (or integrated pest management or IPM), should be used if you want to successfully manage plant disease. Without an underlying strategy that incorporates resistant cultivars, good cultural practice, and correct diagnosis, success is unlikely, no matter how good your fungicide is.

## Understanding the Fungicide Label

Pick a fungicide and look at the label carefully. You'll see that all fungicides posses three names: The chemical name is the scientific name of the active ingredient of the fungicide; The common name is a shortened version that everyone can recognize and usually pronounce, and the trade name that is used by companies to market the active ingredient; a single active ingredient can be marketed under more than one trade name by different companies or for different crops.

### *For example:*

Chemical Name: tetrachloroisopthalonitrile

Common Name: Chlorothalonil

Trade Name: Daconil Weatherstik®, Daconil Ultra®, Bravo®, Echo 90 DF®, Equus DF®

Unfortunately, labels don't often exactly tell you what type of fungicide you have, or how they work.

## How Fungicides Work

All fungicides work by coming in contact with the fungus. When contact occurs, how a fungicide interacts or kills a fungus has a great deal to do with how the fungicide moves in the plant.

All fungicides work to protect plants; however those fungicides termed protectant or contact fungicides work like a coating of paint preventing infection from occurring, and do not penetrate plant tissues. Therefore, a fungicide that is effective prior to infection and the initiation of the disease cycle is referred to as a protectant or contact. Protectants must be applied to healthy plants before infection to prevent the germination and penetration of fungal spores (Figure 2). New plant tissue that develops after application should be considered unprotected. Because these fungicides do not penetrate the plant, nor cure existing infections, they require repeated applications with careful coverage, to make sure new growth is protected. Most of these fungicides have multi-site modes of action, so resistance is not likely to be an issue. Some common protectant fungicides are Daconil, Captan, copper, mancozeb products like Protect T/O® or Dithane®, and sulfur.

Unlike protectants, systemic fungicides prevent disease from developing on parts of the plant away from the site of application. These fungicides penetrate plant tissue and become redistributed inside the plant. Plants are sprayed or drenched with a chemical that moves throughout the plant, killing the early infections (up to 96 hours after infection has occurred) and/or preventing germination of spores. This activity is commonly referred to as "kick-back," or curative, and these fungicides usually have a very specific mode of action against fungi, meaning the risk of fungicide resistance developing is high.

The type and degree of redistribution depends upon the unique chemical nature of each systemic fungicide's active ingredient. Some fungicides are listed as locally systemic, and are capable of moving only a few cells away from the point of contact. There are several classes of systemic fungicides (See Table 1) and include:

- Demethylase-inhibitors (DMI) like Eagle®/ Systhane®, Banner Maxx®/ Propiconazole®, or Strike®/ Bayleton®.
- Subdue® and Subdue Maxx®, which control the 'water molds', Phytophthora, Pythium, and downy mildew pathogens. Mefenoxam/Metalaxyl, the active ingredient in Subdue products, is a fungicide that can be taken up by roots and translocated throughout the plant—but only upwards.
- The phosphonates, including but not limited to Aliette, Agri-Fos, Biophos, and Vital. Are also primarily used for control of water molds, is "truly systemic," meaning it goes up and down, throughout the plant from the point of application. It also appears to induce the plant to initiate a defense response as opposed to directly killing the

Fungicides are classified by: 1). How they protect the plant, 2). How they move in a plant, 3). How they kill a fungus, and 4). Their chemical family. Understanding these four factors is key to a proper fungicide rotation, as plant pathologists recommend that you alternate or tank-mix fungicides with different modes of action to prevent or delay the buildup of resistant fungi.

pathogen, or agent of disease.

The strobilurins (also referred to as QOI fungicides) including Cygnus, Heritage, Compass, and Insignia.

In the case of strobilurins, our terminology fails us. All strobilurins (Cygnus®, Heritage®, Insignia®, Compass®) have what is referred to as 'mesosystemic' or 'translaminar' movement, terms that describe the ability of the fungicide to move through adjacent green tissue, but not systemically throughout the plant. This means leaves sprayed on the upper leaf surface are protected on the underside of the leaf due to the translaminar movement of the fungicide (and vica versa), even if the fungicide did not directly contact that side of the leaf. It is important to note that Heritage® (but not the other strobilurins) also has true systemic properties, and is able to move systemically beyond the point of contact. This also allows it to be used as a drench, and that applications will move into the roots, and throughout the plant.

Fungicides are also classified based upon their mode of action in killing a fungus. The active ingredients in fungicides kill fungi in a variety of different ways, by preventing spore germination, disrupting membranes, and by disrupting key biochemical processes (i.e., energy production, reproduction, cell division). Using fungicides with different modes of action is key to developing effective fungicide rotations, and acts to delay fungicide resistance development. Simply put, rotating or tank-mixing fungicides provides a "one-two" punch, instead of the same punch over and over.  Some fungicides attack fungi by multiple modes of action. These fungicides are called broad spectrum, or multi-site, and include inorganic fungicides like sulfur and copper, and synthetic fungicides like Mancozeb, Chlorothalonil, and Captan. Other fungicides, although highly effective, have a single mode of action and are at high risk for the development of resistance. Fungicides with a single mode of action, like mefenoxam/metalaxyl, thiophanate-methyl, the strobilurins, and demethylase inhibitors (DMIs) are incredibly effective, but the development of resistance is a very real threat. Therefore it is important to recognize that very different fungicides, and differently named fungicides, can have similar modes of action, meaning that although the chemistry is different, they kill fungi the same way. Care must be taken to prevent accidentally rotating between differently named fungicides that happen to have the same mode of action.

Fungicide classes, also referred to as fungicide families, are yet another way fungicides are classified. In this instance, fungicides with similar chemical structures are grouped together. It is important to note that some fungicides are from different classes, but have similar modes of action—therefore, you shouldn't rotate between those fungicides.

Fungicides are also classified by whether a compound is inorganic fungicide, like copper or sulfur, or synthetic fungicide, like chlorothalonil, azoxystrobin, or myclobutanil. It's important to note that another name for synthetic fungicides is "organic," as these compounds contain carbon. This differs from the term "organic" used to describe a system of growing plants that does not use synthetic pesticides. In organic agriculture systems, only biopesticides (e.g., Bacillius subtilis) and inorganic compounds are used to manage plant health problems.

Lastly, in addition to active ingredients, fungicides are also packaged with adjuvants, or carriers. An adjuvant improves penetration, coverage, and adsorption of the separately added pesticide. Most fungicides are packaged with a proprietary mix of adjuvants referred to as "inert ingredients" on the label. Companies that develop fungicides test many different carriers to determine which works the best.

When deciding rotations, always base your decision on active ingredient—Many fungicides have the same active ingredient but different trade names (like the above example of Daconil!), and then examine to what family they belong, making sure that your choices are in different families, and finally that their modes of action are different. Keep in mind that some fungicides are packaged together as pre-mixes [e.g., Spectro 90® is a mixture of chlorothalonil (Daconil) and thiophanate-methyl (Cleary's 3336®)]

Although confusing, it is essential that every grower knows and understands fungicide chemistry, and mode of action to prevent the development of fungicide resistance in major plant pathogens. Fortunately, chemical companies are beginning to realize that confusing their clients is not in their best interest, and that fungicide resistance management is critically important to extend the period of time that an at-risk fungicide is effective.

Fungicides with a high risk of resistance are some of our best tools for disease management. The key to resistance management is to minimize the use of the at-risk fungicide without sacrificing good disease control. This is accomplished by 1) a good IPM program with resistant cultivars when available, 2) good cultural practices to minimize disease, and 3) using the fungicides with a high risk of resistance as part of a tank mix, or alternated with fungicides that have multi-site modes of action to develop an integrated disease management program.

To help growers develop these rotations, chemical companies are partaking in a voluntary label guideline. As part of these guidelines, group codes using numbers and letters for designating chemical groups were developed, and allow users to easily distinguish between groups, as seen in Table 1 of: http://www.extension.purdue.edu/extmedia/BP/BP-71-W.pdf These numbers and letters are called FRAC codes. Not every label possesses such a code, but more and more companies are adopting this program. All you need to develop a good fungicide rotation is to:

What's an adjuvant? These compounds improve penetration, coverage, and adsorption of the separately added pesticide. Most fungicides are packaged with a propriety mix of adjuvants referred to as"inert ingredients" on the label (Think Daconil WeatherStik), and do not require additional adjuvants. Adjuvants are added to improve the physical qualities and therefore the effectiveness of the pesticide used.

Carefully read the label, making sure the chemical you are about to apply is labeled for the disease you are trying to manage. Labels are history lessons: Check to make sure your crop, or any chemical you might tank mix, isn't listed in the warning section!

Record the FRAC code, the number or letter associated with the label.

Unless the code is M, make sure you that you tank-mix, or rotate to a fungicide with a different code.

For more information on FRAC codes, go to the FRAC website at: http://www.frac.info/ Codes should be updated regularly as part of keeping growers informed about new chemistries, and assisting in proper rotations.

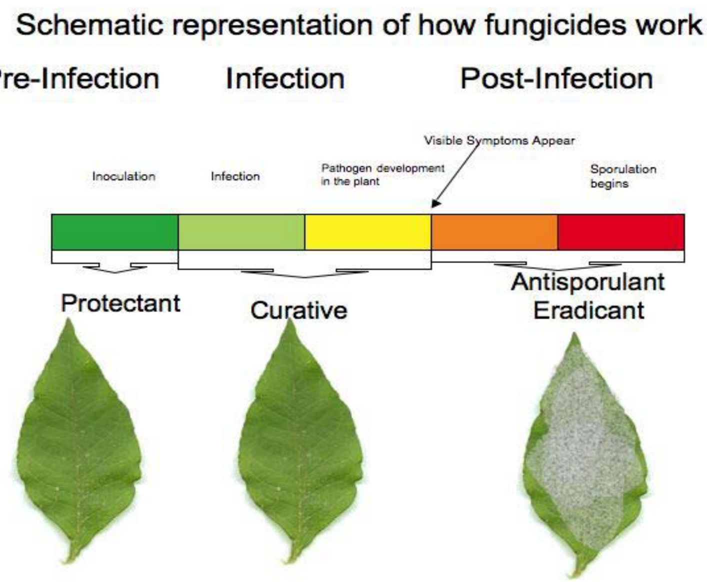


*Figure 2. Incorrect timing of fungicides is a leading cause of disease control failure. If you wait to apply fungicides until the symptom are severe it will be too late!*

## Easter Lily Growth Regulation

By Roberto G. Lopez, Ph.D.

Assist. Professor and Floriculture Extension Specialist

### *Comparison of the Growth Regulators Concise and Sumagic*

The objective of this experiment was to compare two products containing uniconazole: Concise from Fine Americas, Inc. and Sumagic from Valent USA Corp. Bulbs of Easter lily (*Lilium longiflorum 'Nellie White'*) were delivered from the Easter Lily Research Foundation (Harbor, OR) to Purdue University (West Lafayette, IN, lat. 40 °N). Upon arrival on 18 October 2007, the cases of lilies were immediately placed in a walk-in cooler set at 41 °F (5 °C) for 6 weeks of vernalization. On 29 November 2007, the bulbs were removed from the cooler and planted directly into 15-cm (6 inch) standard round plastic containers (1.6-L volume) filled with a commercial soiless medium of composted bark, horticultural vermiculite, bark ash, and Canadian sphagnum peat (Metro-Mix 510; SunGrow Horticulture, Inc., Bellevue, WA) and placed in a glass-glazed greenhouse with fan and pad cooling. The temperature was a constant 16 to 19 °C (60 to 66 ºF) and the photoperiod was 16-hour (0600 to 2200 hr) consisting of natural daylengths with day-extension lighting provided from high-pressure sodium lamps. On 5 January 2008, when >90% of the lilies were 3 to 8 cm (1 to 3 inches) in height the uniconazole applications were made. Spray rates of Concise or Sumagic were 30, 60, or 90 ppm and drench rates of Concise or Sumagic were 1, 2, or 4 ppm with a volume of 4 fluid ounces per 6-inch pot.

### *Results Uniconazole Sprays*

One single foliar spray application of Concise or Sumagic at 5 ppm on 'Nellie White' maintained height slightly below the maximum acceptable height of 56 cm (22 inches) at flower. Plant height was effectively maintained between 48 to 56 cm (19 to 22 inches) at flower after one spray application of Concise or Sumagic at 10 ppm. For example, one spray application of Concise on 'Nellie White' at a rate of 5 or 10 ppm resulted in plants that were ≈9.1 to 14.1 cm (3.6 or 5.6 inches), respectively, shorter than the untreated control height of 65 cm (25.5 inches) (Figure 1). A single spray application of Concise at 20 ppm resulted in plants that were below the minimum acceptable height of 19 inches during forcing and at flowering.


*Figure 1. Easter lily plants (Lilium longiflorum 'Nellie White') were sprayed with either Concise (uniconazole, Fine Americas) or Sumagic (uniconazole, Valent USA) 37 days after bulbs were transplanted into 6-inch pots and grown at 60 to 66°F. The final marketable target height was between 19 and 22 inches.*

### *Uniconazole Drenches*

'Nellie White' drenched with Concise or Sumagic at 1 ppm were consistently above the maximum acceptable height during forcing and at flower. A single drench application of Concise or Sumagic at 2 or 4 ppm resulted in plants that were slightly above or at the maximum height of 22 inches. For example, a single drench application of Sumagic at 1, 2 or 4 ppm resulted in plants that were 1.9, 4.6 and 6.9 inches, respectively, shorter at flower than the untreated control height of 65 cm (25.5 inches) (Figure 2).

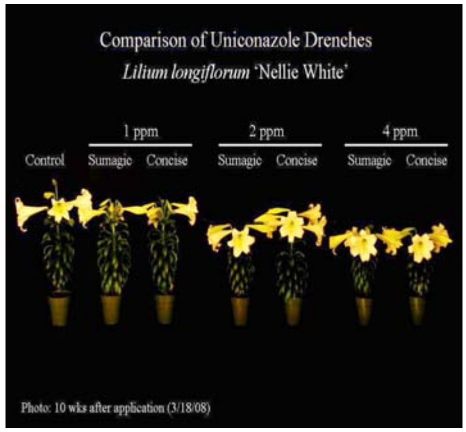


*Figure 2. Easter lily plants (Lilium longiflorum 'Nellie White') were drenched with either Concise (uniconazole, Fine Americas) or Sumagic (uniconazole, Valent USA) 37 days after bulbs were transplanted into 6-inch pots and grown at 60 to 66°F. The final marketable target height was between 19 and 22 inches.*

Our results indicate that a single foliar application of Concise or Sumagic at 5 to 10 ppm or a single drench application at 2 to 4 ppm when plants are between 1 to 3 inches in height is effective in maintaining final plant height between 19 to 22 inches. These results should be considered for Northern U.S. condition and rates for other parts of the country could vary.

We recommend that graphical tracking (http://www.plantdocs.biz/shopdisplayproducts.asp?id=8&cat=Software) be followed very closely to monitor the height of the entire greenhouse population and that subsequent applications should be applied conservatively when plant height is above the maximum acceptable market range. Time to flower and flower bud number were not influenced by Concise or Sumagic. For more information on comparing growth regulators view the Greenhouse Grower Article, Comparing PGRs: https://sharepoint.agriculture.purdue.edu/agriculture/flowers/Shared%20Documents/Comparing%20PGRs.pdf

## 2009 Easter Lily Production Guidelines

By Roberto G. Lopez, Ph.D.

Assist. Professor and Floriculture Extension Specialist

Easter 2009 will be on April 12 – three weeks later than last year. Since this is a mid-date Easter, growers will have plenty of time to schedule their crop. In terms of energy efficiency, the crops can be grown relatively cool for most of the schedule (Figure 1).

*Figure 1. Easter lily crop.*

### *Growing Media*

A good, well-drained and aerated medium (soil or soilless) is required for lilies to prevent root rot. Perlite and superphosphate should **NOT** be added to the media to avoid leaf scorch. Medium pH should be maintained between 6.5 to 7.0 for soil-based media and 6.0 to 6.5 for soilless media. Bulbs should be planted approximately 0.5 to 1 inches from the base of a 'standard' pot to encourage stem roots.

### *Fertilization*

Easter lilies require moderate fertility of 150 to 200 ppm nitrogen. A constant fertilization program throughout the production cycle is required. However, excessive salt levels can decrease plant height and increase the incidence of root rot.

### *Forcing Temperature*

After cooling (vernalization), potted bulbs should be forced at 60 to 65 °F for a late Easter such as this year and at 63 to 65 °F for an early Easter. Easter lilies grown in Indiana at a constant day/night temperature (0 DIF) 64 °F day/night as compared to 70/60 °F day/night produces an acceptable finished height and form. Once flower initiation has occurred, plant development can be controlled by leaf counting and adjusting temperatures (leaf unfolding rate increases linearly with average daily temperature). By counting the number of leaves that have unfolded each week and knowing the number of leaves that are left to unfold, you can determine if the crop is on track for your visible bud target date.

The rate of plant development from visible bud to flowering is only linear between 57 °F and 72 °F. For example, increasing the average daily temperature from 60 °F to 65 °F decreases time to flower by 4 days. An increase in temperature from 75 °F to 80 °F results in only a two-day decrease in time to flower. Table 1 shows the predicted time from visible bud to flower at average daily temperatures ranging from 55 °F to 85 °F. Temperatures above 75 °F should be avoided because flower buds may abort.

### *Height Control*

Easter lily plants will generally double in height between visible bud stage and flowering. For example, if your target height at flower is 22 to 24 inches including the pot, then the height at visible bud should be 14 to 15 inches including the pot. Graphical tracking should be used to monitor crop progress through flowering and height control strategies should be used to regulate stem elongation.

The amount of stem elongation is influenced by the difference between the day and night temperature setpoints (DIF). Stem elongation is promoted when the day temperature is warmer than the night temperature (positive DIF). During the opposite environmental conditions, where day temperature is cooler than the night temperature (negative DIF), stem elongation is inhibited.

Growth retarding chemicals can be used to reduce internode elongation, but caution should be exercised once plants have visible buds. Spray or drench applications of A-Rest or Abide (ancymidol) or Sumagic or Concise (uniconizole) can be used for height control of Easter lilies. Application should be made very early (3-inch stage) to avoid a "palm tree" lily. Early application also helps to even the crop. When used, the second application should be made at the 6-inch stage. Drenches are less active in root medium containing bark; therefore drenches need to be adjusted in such media. A spray treatment is often preferred on lilies grown in bark mixes. The need for lily height control varies greatly among greenhouses. As a general recommendation, 0.25 mg active ingredient A-Rest or Abide per pot as a drench or two spray applications of 50 ppm is recommend. Sumagic or Concise guidelines are 0.03-0.06 mg active ingredient per pot as a drench or one to two spray applications of 5 to 10 ppm. Several spray applications at lower concentrations always results in a more attractive plant than a single spray at higher concentration. Finally, the longer you wait to space plants, the taller plants will be at finish. Typically, plants should be spaced to their final density at least a week or two before visible bud.

### *Lower Leaf Yellowing*

Lowering leaf yellowing and leaf drop is commonly observed from visible bud to flowering in a tightly spaced crop or one that has been heavily treated with growth regulators (Figure 2).

*Figure 2. Easter lily lower leaf yellowing.*

An early-season application of Fascination or Fresco [gibberelins (GA4+7) and cytokinin (Benzyladenine 6BA)] 1 week before and 1 week after visible bud to the lower leaves will prevent lower leaf yellowing. Do not apply to the upper leaves as stem elongation can occur. A late-season application to the foliage and buds is recommended when the largest bud is 8 cm in length to reduce lower leaf yellowing and prolong post harvest life. Plants treated with either Fascination or Fresco maintain green lower leaves. Table 3 has suggested rates of Fascination and Fresco (again, carefully consult the label):

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### *Disease Prevention*

Easter lilies have the potential for developing root rot during production. Routinely remove plants from their pots and inspect the roots. The roots should have white root tips and any discoloration is likely a root rot pathogen (Figure 3). Preventive fungicides should be used on a regular schedule (every four to six weeks) to prevent Pythium, Phytophthora, and Rhizoctonia, especially late in the crop cycle. It is important to rotate between chemical classes to prevent fungicide resistance. Table 2 includes some recommended fungicide drenches (Always consult labels carefully for exact rates and to see if the material is registered in your state):

*Figure 3. Easter lily with healthy roots (top) and with Pythium root rot (bottom).*

Table 1. Time from visible buds to first open flower at various average daily temperature.

| Average daily temperature (°F) | Days from visible bud to flower |
|---|---|
| 55 | 42 |
| 60 | 38 |
| 65 | 34 |
| 70 | 31 |
| 75 | 27 |
| 80 | 25 |
| 85 | 24 |

Table 2. Fungicides for use on Easter lilies.

| Fungicide | | |
|---|---|---|
| **Alude** at 6.3 to 12.7 oz/100 gal water for control of Pythium only. Apply as a soil drench at a rate of 25 gal solution/100 sq ft. Follow application with irrigation. Use only once per month. 4-hr reentry | | |
| **Banol** at 2 to 3 fl oz/10 gal water for control of Pythium. 24-hr reentry | | |
| **Captan** 4L Fungicide at 1 gal/100 gal solution. Soak bulbs for a minimum of 15 min before planting, do not use alone | | |
| **Contrast 70 WSP** at 3 to 6 oz/100 gal water. Soak bulbs for 5 min for Rhizoctonia root rot. 12-hr reentry | | |
| **Fosphite** at 1 to 2 quarts/100 gal water. Do not use copper products within 20 days of treatment and do not use spray adjuvants. For control of Pythium only. 4-hr reentry | | |
| **Gustafson 42-S Thiram** at 1.5 pints/8 gal water. Agitate suspention before soaking bulbs. See label for details. 24 hr reentry | | |
| **Mefenoxam 2** at 0.2 to 0.5 oz/100 gal water as a soil drench at planting. Use only once. To control Pythium only. Resistant isolates have been detected in the northeastern United States. 48-hr reentry | | |
| **ProStar 70 WP** at 3 to 6 oz/100 gal water. Soak clean bulbs for 5 min and allow to dry prior to planting. For Rhizoctonia root rot. 12-hr reentry | | |
| **Subdue MAXX** at 1 fl oz/1,000 sq ft, irrigated in with 0.5 inch water for control of Pythium. Resistant isolates have been detected in the northeastern United States. No reentry interval | | |
| **Terraclor 75 WP** at 4 to 6 lb/100 gal water. Soak bulbs before planting. Before soaking, hose or dip bulbs in water to remove soil, which would reduce the soak's effectiveness. 12-hr reentry | | |
| **Vitavax 34** at 1.5 to 3 quarts/100 gal water. Soak bulbs at least 5 to 15 min. For Rhizoctonia root rot. 12-hr reentry | | |

Table 3. Suggested rates of Fascination or Fresco to prevent lower leaf yellowing.

| Application | Rate (6BA/GA4+7) | Ml or (oz) of Fascination or Fresco per 1 gal. water |
|---|---|---|
| Early-season | 10/10 ppm | 2.1 ml (0.07 oz) |
| Late-season | 100/100 ppm | 21 ml (0.71 oz) |

Easter lily information adapted from Michigan State University and the University of Massachusetts bulletins:

http://www.ipm.msu.edu/grnhouse05/G2-04-05.htm#1

http://www.umass.edu/umext/floriculture/fact_sheets/specific_crops/elily09.html

| 2009 Easter Lily Production Guide | | | |
|---|---|---|---|
| Wks. before Easter | Week of | Case Cooled | CTF |
| 25 | Oct 19 | Bulbs are shipped | |
| 24 | Oct 26 | Start cooling of bulbs (41 to 44 °F) | Pot, place at 60 to 63 °F |
| 23 | Nov 2 | Cooling | Root |
| 22 | Nov 9 | | Root |
| 21 | Nov 16 | | Start cooling (41 to 44 °F) |
| 20 | Nov 23 | | Cooling |
| 19 | Nov 30 | | |
| 18 | Dec 7 | Plant bulbs and place pots in greenhouse (60 to 63 °F) | |
| 17 | Dec 14 | | |
| 16 | Dec 21 | | |
| 15 | Dec 28 | | Place pots in greenhouse (60 to 63 °F) |
| 14 | Jan 4 | Shoot emergence Fungicide drench (rotate chemical classes) | Fungicide drench (rotate chemical classes) |
| 13 | Jan 11 | Shoots 1″ to 3″ | |
| 12 | Jan 18 | Shoots 3″ to 5″ | |
| 11 | Jan 25 | Shoots 5″ to 9″, flower initiation | |
| 10 | Feb 1 | Shoots 9″ to 12″ Fungicide drench (rotate chemical classes) | |
| 9 | Feb 8 | Shoots 12″ to 15″, space plants to final spacing, | |
| 8 | Feb 15 | | |
| 7 | Feb 22 | Feel flower buds, Apply Fascination or Fresco 7 to 10 days before VB (5 to 10 ppm) to lower ½ of plant | |
| 6 | Mar 1 | Visible bud Fungicide drench (rotate chemical classes) | |
| 5 | Mar 8 | Apply Fascination or Fresco 7 to 10 days after VB (5 to 10 ppm) to lower ½ of plant | |
| 4 | Mar 15 | | |
| 3 | Mar 22 | Fungicide drench (rotate chemical classes) | |
| 2 | Mar 29 | Apply Fascination or Fresco (100 ppm) to entire plant | |
| 1 | Apr 5 | Ship | |
| 0 | Apr 12 | Easter | |

## Indiana GreenExpo

IFGA will co-host the Indiana Green Expo on January 12 and 13, 2009 in Indianapolis.

As an IFGA member you can receive the member rate. Register by December 31st and receive early bird registration rates: (http://www.indianagreenexpo.com/).

### *IGE Sessions of Interest to Greenhouse and Nursery Growers*

What Does It Takes To Be An Energy Efficient & Sustainable Business? (Mark Elzinga, Elzinga GH)

New and Improved Annuals That Offer Low Maintenance and a Big Show! (Heidi Doering, Syngenta Flowers, Inc.)

Improve Your Seasonal Color Program: Grower to Ground (Jeff Gibson, Ball Hort)

Perennials on Parade - Basic Steps to Flowering Perennials (Beth Fausey, OSU)

Promotion Strategies for Small Businesses (Maria Marshall, Purdue University)

Do's and Don't of Hiring Hispanic Workers (Allen Webb, Aztec Resources)

pH and EC Management (Jamie Gibson, Fafard)

Keep Them Coming Back for More: Keys to Great Customer Service (Beth Fausey OSU)

What You Need to Know About Tank-mixing Insecticides (Ray Cloyd, Kansas State)

Greenhouse Growth Regulators (Brian Krug, University of New Hampshire)

Insurance for Small Business (Kim Glass, M.J. Schuetz Agency, Inc)

Fertilizing Container Plants (Mike Micklebart, Purdue University)

Foliar Diseases (Janna Beckerman, Purdue University)

New Sustainable Products and Their Use(Greg Trapka, Ball Horticultural Company and Ken Hensch, Aesthetic Plant Specialists)

Biological Controls (Ray Cloyd, Kansas State)

New Ways to Control Old Pests (Cliff Sadof, Purdue University)

Ornamental Grasses (Matt Ross, Owens C. College/ Toledo Botanic Garden)

New Varieties for the Landscape: What Works, What Doesn't (Jeff Gibson, Ball Horticultural Co.)

Taxes for Small Business (George Patrick, Purdue University)

Top Picks for Natives (Mark O'Brien, JFNew)

Plant Problems: Getting the Right Diagnosis (Tom Creswell, PPDL)

Most Common Mistakes in Handling Pesticides (Fred Whitford, Purdue Pesticide Programs)

State Chemist Update (Joe Becovitz, Office of Indiana State Chemist)

Organic Production (Mark Elzinga, Elzinga GH)

Becoming Sustainable Without Certification (Brian Krug, Univ. of New Hampshire and Roberto Lopez, Purdue University)

Becoming A Quality Grower (Allan Hammer, Dummen)

Weed Control in Nurseries and Landscapes (Hannah Mathers, Ohio State)

| Upcoming 2008 - 09 Industry and University Events | | | | |
|---|---|---|---|---|
| **Date** | **Event** | **Location** | **Topic** | **Web site/ Email** |
| Nov. 6 | NWIFA Meeting | Kingma's GH | Credits for Private Ap. Recertification | http://faculty.pnc.edu/emaynard/nwifa/nwifa.html |
| Nov. 12 | NIFGA | Brookwood Golf Club | Annual Dinner | bernie.greenhouse@gmail.com |
| Dec. 6 | National Poinsettia Trials | Purdue Research Greenhouse | Tour from 9 AM – 3 PM | http://poinsettiatrial.org/ |
| Jan. 7 | NIFGA | Youngs GH Fort Wayne,IN | TBA | bernie.greenhouse@gmail.com |
| Jan. 15 | NWIFA Meeting | TBA | TBA | http://faculty.pnc.edu/emaynard/nwifa/nwifa.html |
| Jan. 12 – 13 | Indiana Green Expo | Indiana Convention Ctr, Indy, IN | Trade Show & Education Program | http://www.indianagreenexpo.com/ |
| Jan. 13 – 14 | Mid-States Hort Expo | Kentucky Expo Center, Louisville, KY | Spring Buying | http://www.mshe.org |
| Jan. 14 – 16 | Mid-Am Hort Trade Show | Lakeside Ctr. Chicago, IL | Education, Demonstration | http://www.midam.org |
| Jan. 19 – 21 | Hort Congress | Adams Mark Hotel, Indy, IN | Educational & Trade Show | http://www.inhortcongress.org/ |
| Feb. 17 | TAFVGA Bedding Plants Clinic | TBA | Bedding Plants Clinic | |

## America in Bloom

Indiana population category winners:

- Under 5,000 – Greendale, IN
- 5,001-10,000 – North Manchester, IN
- 25,001-50,000 – West Lafayette, IN
- Heritage Preservation Award – Lafayette, IN
- Gardens Alive's Environmental Awareness Award – West Lafayette, IN

http://www.americainbloom.org/

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