PURDUE UNIVERSITY

PURDUE EXTENSION

The Indiana Flower Grower

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Roberto's Message

How Can Purdue Help You?

Ruth Shelburne, Purdue floriculture student, explaining the wonders of the calcoleria plant to Amelia Earhart, ca. 1935-1937

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

After ten months as your floriculture extension specialist, I have had the pleasure to meet many of you, tour your operations and determine how I can better serve your needs through my research and extension programs. I hope to meet many more of you this fall.

Please visit the new Purdue Floriculture website that is available at: https://sharepoint.agriculture.purdue.edu/agriculture/flowers/default.aspx to view floriculture research and trade articles, production guide sheets, bulletins, newsletters and more.

As many of you are aware, this spring season has been challenging for many growers across the state due to the extreme weather, and increasing transportation and heating costs. For this reason, the Indiana Flower Growers Association (IFGA) and Purdue are committing our efforts to bring you educational programs that are focused on energy and sustainability. As you begin to make plans for the rest of 2008 and early 2009, please mark you calendars for several IFGA and Purdue Floriculture events. On October 8th and 9th, IFGA will hold a new and improved annual meeting with a golf outing, banquet, and a conference theme titled; "Surviving the Energy Crisis." We will also have a tour of the annual and poinsettia trials at Purdue. The National Poinsettia Cultivar Trials will return to Purdue this fall and our open house is scheduled for Saturday, December 6, 2008. In addition, on January 12 and 13, 2009, IFGA will co-host the Indiana Green Expo in Indianapolis. Steve Dewald will provide us with more information on this event in the growers column section.

Roberto G. Lopez, Ph.D.

Growers Column – Update on IFGA involvement in 2009 Indiana Green Expo (IGE) Indianapolis Convention Center, January 12 & 13 2009

The Indiana Flower Growers Association (IFGA) has officially joined forces with the Indiana Nursery and Landscape Association (INLA) and the Midwest Regional Turf Association (MRTA) to sponsor this year's Indiana Green Expo (IGE). Joining forces with two other like-minded green organizations will allow

us to be part of a large local trade show and educational event. The central location of the Expo should increase accessibility to our membership as well as other flower growers from nearby states. Being part of the Green Expo will also allow us to maintain the level of excellence in educational programs that IFGA members have become used to. We are now in the process of actively recruiting our suppliers to sign up for booth space. It is also a great opportunity for wholesale greenhouse operations to have a booth where they can be exposed to a large number of landscape firms. Last year, Heartland Growers had a booth and they were quite pleased with the business activity that they were able to generate from the show. Please encourage your vendors to join the trade show. We are also soliciting input for topics and speakers for the educational portion of the trade. E-mail your ideas directly to Dr. Roberto Lopez who is the educational chair of the IFGA. Being part of this large venue also has the potential of generating increased revenue for our association, which may be used to support such worthwhile projects as; floral research, student scholar ships and subsidizing travel to plant trials and places of horticultural interest.

Steve DeWald

Indiana Greenhouse Grower Spotlight

Elsbury's Greenhouses and Garden Center in Hope, IN is a tourist's attraction that has steadily grown during the past 35 years. The success of the operation can be attributed to the hard work and dedication of owners Gordon and Nancy and their children Ann and David (Figure 1).

Figure 1. From left to right, Gordon, Ann, Nancy and David Elsbury

Initially, the greenhouse focused on seasonal items such as bedding plants, vegetables, geraniums, and a few hanging baskets.

They since have expanded from 1,000 square feet of production to over 1,000 varieties of annuals, 250 varieties of herbs and scented geraniums, and over 500 varieties of perennials under 70,000 square feet of covered production.

Before opening the doors, Gordon began his professional career as a Purdue Extension Educator in youth education in Bartholomew County after receiving a Master of Science degree in Horticulture from Purdue University. As a greenhouse grower, Gordon has been actively involved with the Indiana Flower Growers Association and was recognized with the 1994 Grower of the Year Award.

Gordon attributes the success of Elsbury's Greenhouse to innovation and community involvement. Over the past several years, Elsbury's has used several strategies to help lower heating costs including reducing the spacing between some crops, as well as investing in a corn furnace that is fed with second grade corn (Figure 2).

Fig.2
Corn Furnace

This has helped ease the pain of rising propane costs that have increased from 0.35 cents to over $1.70 per gallon in the past ten years. In fact, just this month Elsbury's was one of the stops for the 2008 Farm Management Tour for its unique production and marketing efforts. To help monitor and control growing conditions and manage time, the Elsbury's invested in an Argus Computer system that has made growing their crops easier and much more efficient. Gordon states the computer system paid for itself in as little as six months.

The Elsbury's love for their community and outgoing nature has helped to promote the business and make it an integral part of the greater Hope and Columbus communities. They have a great working relationship with the master gardeners in the area and use these resources to create word of mouth

The Indiana Flower Grower
is an electronic e-bulletin for commercial and advanced flower growers. It provides timely information on pest control, production practices, and other topics likely to be of interest to flower growers. All growers and interested persons are welcome to subscribe. Subsrciption is free of charge.

To subscribe, send your name, company name and email address to:

Tammy Goodale at: tgoodale@purdue.edu

Subject line: *Indiana Flower Growers*

This e-bulletin can be accessed free at https://sharepoint.agriculture.purdue.edu/agriculture/flowers/bulletins.aspx

advertising and networking opportunities. The Elsbury's have actively been involved in the America and Columbus in Bloom programs and have increased the awareness of community beautification using flowers. In addition, it has helped increase sales for them.

For more information about Elsbury's Greenhouse, please visit: http://www.elsburygreenhouses.com/about.html

Roberto G. Lopez, Ph.D.
Jennifer Dennis, Ph.D.

Poinsettia Propagation

It is important to remember that successful poinsettia propagation begins with high-quality cuttings and an ideal rooting environment. Prior to harvesting or receiving non-rooted cuttings from your supplier, check that misting or fog systems are properly functioning and not clogged and thoroughly clean your propagation area to ensure it is free of pathogens, insects, algae, weeds, debris, and freestanding water. At this time it is important to measure your water pH, EC and alkalinity and make necessary adjustments. Upon harvest or receipt, visually inspect cuttings to make sure they are vegetative, disease and insect free, and uniform in length, caliper and maturity. Cuttings that are not vegetative or uniform in size will root and develop differently and lead to a delayed crop.

Roberto G. Lopez, Ph.D.

Harvesting or Receiving Cuttings

Cuttings of most cultivars can be harvested from stock plants approximately 5 to 7 weeks after the last pinch depending on your environmental growing conditions. However, cutting quality and maturity at harvest is often determined by the time elapsed from the last pinch. For most cultivars, quality (i.e., rooting) is greatest when cuttings are harvested 5 to 6 weeks after pinch. Industry specification call for terminal stem cuttings with short internodes that are approximately 2 to 2.5 inches (5 to 6 cm) in length and have 2 to 3 mature cuttings. Stem diameter (caliper) of 0.16 to 0.24 inches (4 to 6 mm) is desirable, but can vary by cultivar. When harvesting cuttings, disinfect tools between stock plants and avoid damaging cutting leaves or stems. Care should be taken so that exuding latex does not contact adjacent leaves as distortions can occur. Keep cuttings shaded during harvest and quickly transfer them to a cool location upon harvest.

Most growers receive non-rooted cuttings from offshore cutting production facilities in Costa Rica, Guatemala, Kenya, or Mexico. The cuttings are often wrapped in moistened paper and packaged in boxes with ice packs. Upon receipt, unpack cuttings, inspect, and stick immediately in your propagation area, or place opened boxes overnight in a humid cooler at 50 to 55 °F (10 to 13 °C) and stick the following morning. The cutting should not be allowed to dehydrate at any point.

Propagation Media

Poinsettia cuttings can be rooted directly into the finished container (direct stick) or rooted in a peat and perlite mix, foam, Rockwool, or Oasis propagation trays, strips, or liners shaped as cubes, plugs, wedges or pellets. Regardless of medium choice, a pH of 5.8 to 6.3 is desirable. It is also important that the medium supports the cuttings, and has good porosity and water holding capacity. Avoid saturating the medium as this will delay rooting and increase the risk of fungus gnats and diseases. Approximately one inch of the cuttings should be inserted into the rooting media. Only lower leaves that will be below the rooting media should be removed at this time. Large leaves should not be allowed to cover the stem apices of adjacent cuttings.

Rooting Hormone

Poinsettia cuttings generally root well without the need of a rooting hormone. To improve rooting uniformity, dip the lower ¾-inch of the stem into a rooting solution or powder. Suggested concentrations of rooting hormones are:

Indole-3-butyric acid (IBA) at 1,500 to 2,000 ppm

IBA at 1500 ppm plus naphthaleneacetic acid (NAA) at 500 ppm

Avoid any contact of the rooting hormone with leaves or petiole. Contact with the leaves or petiole can lead to epinasty (twisted or distorted leaves).

Stage 1: Callus Formation

Misting

Seven to ten days after placing cuttings in propagation, callus tissue will begin to form around the base (Figure 1).

Fig.1 Callus Formation after 10 days (photo courtesy of Royal Heins)

This is considered to be the most critical stage of poinsettia propagation; therefore a thin layer of moisture should be maintained around the leaf surfaces to prevent excessive wilting and desiccation. This can be achieved by keeping air circulation low by turning off all horizontal air flow fans and keeping humidity high (90 to 100 %) in the propagation area. Mist frequency will be dependent upon your misting system and environmental greenhouse conditions (light intensity, temperature, humidity, and air movement). Misting should occur most frequently between 10 a.m. to 6 p.m. (Figure 2).

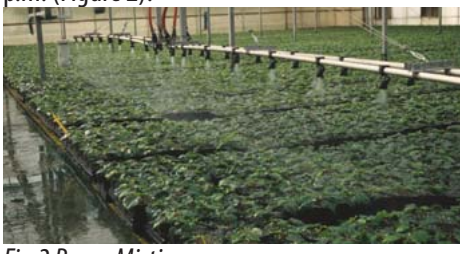

Fig.2 Boom Misting

Misting during the night is only required during the first three to four nights. Reduce misting frequency as much as possible after the cuttings have callused.

The application of a spreader-stick such as CapSil will reduce the surface tension and beading of water (Figure 3) and help create a uniform coverage of moisture across the leaf surface (Figure 4). Apply CapSil until run-off at a rate of 300 ppm or 4 fluid ounces/ 100 gallons of water.

Fig. 3 Water beading on leaves

Fig.4 Use of a Spreader-Sticker

Light Intensity and Temperature

Light transmission through the propagation house should be indirect or diffuse. White wash or exterior shade in combination with retractable shade curtains can provide a good system for light modulation, especially during the summer. The maximum light intensity during stage 1 is 1,000 to 1,250 foot-candles (200 to 250 $\mu mol \cdot m^{-2} \cdot s^{-1}$) or a daily light integral (DLI) of 4 to 5 $mol \cdot m^{-2} \cdot d^{-1}$. To ensure optimal rooting, media temperatures should be maintained between 79 to 83 °F (26 to 28 °C). This can be achieved with bottom heating. Maintain air temperatures between 76 to 82 °F (24 to 28 °C) during the day and 70 to 74 °F (21 to 23 °C) at night. During the first three nights, maintaining air temperatures of 68 to 70 °F (20 to 21 °C) may help reduce moisture loss and desiccation.

Growth Regulators

The use of growth retardant sprays such as chlormequat chloride (Cycocel) or chlormequat chloride plus daminozide (B-Nine) or (Dazide) will help prevent stretch in propagation. Apply growth regulators early in the morning or in the evening when the mist system can be turned off for approximately 30 minutes without stressing the cuttings. Make the first application 6 to 7 days after placing the cuttings in propagation.

Stage 2: Root Initiation and Development

Light Intensity and Temperature

Fig. 5 Root Initiation after 14 days (below) and after 17days (above)

Fig. 6 Rooting after 21 days (below) and after 24 days (above)

Once roots have initiated (Figure 5: generally 10 to 14 days after placing in propagation), maximum light intensity can be increased to 1,250 to 1,500 foot- candles (250 to 300 $\mu mol \cdot m^{-2} \cdot s^{-1}$) or a DLI of 5 to 6 $mol \cdot m^{-2} \cdot d^{-1}$.

Again, the light should be diffuse. Media temperatures can be reduced to 72 to 79 °F (22 to 26 °C). Air temperatures during the day can also be reduced to 75 to 80 °F (24 to 27 °C) and 68 to 70 °F (20 to 21 °C) at night.

Fertilization

To prevent nutritional deficiencies from media leaching, a fertilizer should be incorporated (50 to 75 ppm nitrogen and potassium with micronutrients) into the mist system 10 days after placing in propagation. Alternatively, cuttings can be watered with fertilizer every 4 to 5 days beginning with 150 to 200 ppm nitrogen and potassium with micronutrients. Do not use fertilizers containing phosphorus as a foliar application as leaf distortions can occur.

Toning

Seventeen to twenty-one days after placing in propagation, cuttings should have a root system that can withstand drier and brighter conditions. At this time, air circulation will help tone the cuttings and get them acclimated to the finishing environment. Maximum light levels can be increased to 2,000 to 3,000 foot-candles (400 to 600 $\mu mol \cdot m^{-2} \cdot s^{-1}$) or a DLI of 7 to 8 $mol \cdot m^{-2} \cdot d^{-1}$. Air temperatures at this point can be reduced to 72 to 75 °F (22 to 24 °C). A second growth regulator application can be applied at this time. Misting should be minimal (i.e., every 30 to 40 minutes from 8 a.m. to 6 p.m.). Cuttings should be ready to be taken out of propagation 21 to 28 days after placing in propagation (Figure 6).

Insect and Diseases

Poinsettia cuttings are susceptible to several diseases during propagation, including Botrytis (Figure 7), bacterial soft rot (*Erwinia*), and *Rhizoctonia*. They are also susceptible to insects such as fungus gnats, shore flies, and whiteflies.

Fig.7 Botrytis on Poinsettia Cuttings

The warm, wet and humid conditions in propagation are excellent environments for diseases and fungus gnat development. Fungus gnat larvae damage poinsettia cuttings by feeding on young roots and callus tissue as well as by transmitting diseases.

Energy Tax Incentives

Many growers are tightening their belts to conserve fuel in preparation for another long and potentially expensive winter. If you are considering purchasing new technology to save fuel (and money!), one additional saving to consider is tax reductions. New federal, and in some cases, state tax laws, allow commercial greenhouse growers who invest in energy saving technologies to apply for certain tax incentives. In this article, we will explain some federal tax incentives. In addition, we will provide examples of state tax exemptions in Indiana.

Federal Tax Incentives

Federal legislators initiated several energy tax incentives in the energy policy act passed in 2005. Many of these tax incentives have been continued through the end of 2008. These incentives apply to commercial businesses, including greenhouses. Federal tax incentives include both tax credits and tax deductions. Those incentives differ because deductions reduce taxable income and hence, total taxes due. Tax credits on the other hand, are subtracted from the total amount of taxes due but do not reduce taxable income. Both are beneficial, but a tax credit is worth more money to the tax payer than a tax deduction, because a tax credit reduces tax dollar-for-dollar, while a tax deduction reduces the tax load by only a percentage.

Deductions

First, let's talk about deductions. Growers who make extensive changes to existing greenhouses would qualify for deductions. A grower who installs energy saving technologies that reduce energy costs by 50% or more qualifies for federal tax deductions. Energy saving technologies include anything that reduces heating, cooling, lighting, and ventilation costs. The savings from these technologies are additive and don't have to represent one large purchase. For example, upgrading from a single to double poly covering typically reduces energy use by 35%. To increase energy savings further, installation of reflective insulation may save up to another 10%, and installing a porous energy curtain could further save up to 20% (Bartok, 2001). The combined energy cost reductions from these upgrades could reduce heat use (and energy costs) by more than 50% and therefore qualify for tax deductions. Deductions will be calculated as \$0.30 to 1.80/ft^2 of the upgraded building. The total deduction amount will vary on a case by case basis and may be calculated using IRS approved software. For a list of software, visit: http://www1.eere.energy.gov/buildings/qualified_software.html.

If you have, or plan to, upgrade your greenhouse and wish to qualify for federal tax deductions, you must also receive certification from a 'qualified individual' that your upgrades will reduce energy costs by 50%. This certification must be kept on record, but it is not submitted with tax forms. For more information and ideas concerning energy saving greenhouse technologies, visit http://www.greenhousegrower.com/techs_mechs/index.html or refer to John Bartok's energy conservation book (Energy Conservation for Commercial Greenhouses NRAES-3) which may be ordered from http://www.nraes.org. Several resources for greenhouse energy conservation are also available at: http://www.hrt.msu.edu/Energy/Default.htm.

Credits

The other federal tax incentives are credits. They are exactly what it sounds like – monetary 'credit' for purchases of renewable energy devices or equipment. So, if you purchase new technologies, you may recover some of those expenses through credits on your taxes. Tax credits apply for purchases of a variety of equipment including solar systems, geothermal production and distribution equipment (excluding geothermal water heaters), and microturbines. While some renewable systems require significant capital investment or are not typically used in commercial greenhouses, you may still benefit from these tax credits. Many growers have found small ways to integrate renewable technologies in their greenhouses. For example, solar power may be used to open vents in your greenhouse. Or, you could purchase a solar water heater to provide root-zone heating to propagation benches. Purchases or improvements must be made between January 1, 2006 and December 31, 2008 and would be credited in either the 2007 or 2008 tax year.

Grants

Another federal incentive to purchase efficient or renewable energy equipment is grant money. In the new Farm Bill, Congress approved a grant program through the USDA called 'Rural Energy for America' (REAP). Growers and farmers may apply for grant funds to cover up to 25% of purchases that will improve energy efficiency or will utilize a renewable energy source. An additional 50% of expenses may be temporarily covered through a federal loan also available through REAP. Limited information is available on the grants for 2009, but, it is anticipated that \$55 million will be given to farmers and growers through this program. To find more information on this exciting opportunity, visit the

following page: http://www.rurdev.usda.gov/rbs/farmbill/index.html.

State Tax Incentives

Each state may offer additional exemptions (for descriptions of all the specific state and county tax incentives, visit http://www.dsireusa.org/. In Indiana, any renewable energy technology you purchase is exempt from property tax. In this case, renewable technologies include solar, wind, geothermal heat pumps, and others. Some growers may also receive utility rebates for purchases of certain renewable energy equipment. In most cases, these rebates apply only to purchases of geothermal heat pumps, and, many utility corporations only provide rebates for residential properties. However, the following energy corporations will give rebates to businesses purchasing geothermal heat pumps: Duke Energy, Kosciusko Rural Electric Membership Corporation (REMC), Rush Shelby REMC, Tipmont REMC, and White County REMC. For more information, contact your local utility corporation.

References

Bartok, J.W., Jr. 2001. Energy conservation for commercial greenhouses.

Faulkner, D.L. 2006. New energy tax credits. Home Power 112:April & May.

Stephanie E. Burnett, Ph.D.
Lois Berg Stack, Ph.D

Energy Efficiency Improvements and Renewable Energy Systems Opportunities through the 2008 Farm Bill and the Rural Energy for America Program or REAP

There is an increasing concern for improving energy efficiency within several agricultural and rural business sectors including the greenhouse industry. The 2008 farm bill recently passed into law in May titled "Food, Conservation, and Energy Act of 2008" which contains the Rural Energy for America Program (REAP) funding available to provide financial assistance for rural small businesses and producers to make improvements in energy efficiency and or as well as the purchase of renewable energy systems. This funding support is available through grants and low interest loan guarantees. The REAP program was formerly the section 9006 grant program which was successful in assisting several improvements throughout rural communities over its five year life span in which the demand for the funding was three times the amount available. This new farm bill increases funding levels from $115 million in the 2002 farm bill to $255 million in 2008 to be utilized over the course of four years. This provides a unique opportunity for producers and small businesses in rural areas experiencing a crunch in input costs associated with high energy bills.

Energy efficiency improvement projects which have applied for these funding programs previously in Indiana include updating inefficient grain dryers and irrigation systems, installing reverse osmosis equipment to cut fuel oil costs of boiling maple sap into syrup, and multiple renewable energy projects including biofuels, wind energy, and biomass energy systems. (Figure 1)

Fig. 1 Wood Burning Furnaces for Heating Greenhouses

The greenhouse industry has certainly not been immune to the rising costs of propane and natural gas. Some greenhouse growers are so concerned about the substantial increase in costs of fuels that they are considering making reductions in winter greenhouse production which may lead to shortages of several floriculture crops. In an effort to assist with tapping into these program opportunities, Purdue resources are establishing collaborative efforts to assist this growing concern. Greenhouse growers are considering the installation of geothermal heating systems, energy curtains or biomass boiler units to assist in cutting their energy costs. Each has unique differences which should be carefully evaluated before making these substantial capital improvements.

To apply for energy efficiency improvement funds, a third party energy audit is required and should illustrate the energy consumption of existing systems, the energy consumption of the proposed improvement, the expected annual energy savings, and the payback period. The grant application process is lengthy; however a professional grant writer familiar with this USDA program may be a viable choice for producers to best take advantage of these program funds.

To learn more about the REAP program, go to the following websites:
USDA Rural Development Business Programs - www.rurdev.usda.gov/rbs/
Farm Energy Program of the Environmental Law and Policy Center - www.farmenergy.org

Contact Chad Martin regarding any questions you may have about making energy efficiency improvements or about how these incentives may allow energy efficiency improvements and installing renewable energy systems to become financial viable.

References

USDA Rural Development and the Farm Energy Program of the Environmental Law and Policy Center

Chad Martin

New Alliance Helps Greenhouse and Nursery Growers Manage Water

Water conservation and recycling can be challenging for even the most experienced growers. The Water Education Alliance for Horticulture will help growers find the best solution for their operation.

A new industry-university consortium, the Water Education Alliance for Horticulture, promises to bring straightforward information on water treatment technologies to horticultural growers through its interactive website: http://watereducationalliance.org/, articles, and on-site workshops.

"On-site water treatment and recycling will be key strategies for horticultural operations in the coming years," explains Paul Fisher, one of the Alliance leaders. "Drought, urbanization, and competing resource demands have already led to water restrictions in some locations. Recycling irrigation water is one way to meet these restrictions, but recycled water must be treated to manage pathogens and algae."

A survey of leading greenhouse operations in the Young Plant Research Center: http://hort.ifas.ufl.edu/yprc/ found that improved information on water treatment is a top priority for growers. Fisher states, "Much of the research on water treatment technologies so far has been for pools and spas, municipal water supplies, or post-harvest crop treatment. The findings of this research often apply to horticulture too, but it's just not accessible."

The new website aims to close this knowledge gap with information on topics such as:

- Recycling water and managing water quality at greenhouses or nurseries
- Using water treatment technologies to maintain water quality and prevent pathogens
- Monitoring water quality and treatment efficacy

In addition to the website, the Water Education Alliance for Horticulture also organizes workshops on the topic of water management. The first Alliance workshop was held in Apopka, FL, in November 2007. Building on this success, the Alliance is planning two more workshops in New Hampshire (August 20) and Michigan (October 15) for this fall.

"The key to these workshops is turning one operation's particular situation into a story that many can learn from," says Fisher. "We strive to ensure that everyone walks away from an Alliance activity - whether the website, a workshop, or an article - with new knowledge."

The Water Education Alliance for Horticulture is a new initiative that aims to help growers use water in an efficient and sustainable manner. Alliance sponsors contribute expertise and financial support to the Alliance goal, and include the University of Florida, Konjoian's Floriculture Education Services, Fischer EcoWorks, and several private water treatment, media, and fertilizer companies (Accu-Tab System by PPG, Regal Gas by Chlorinators Incorporated, Hanna Instruments, TrueLeaf Technologies, BioSafe Systems, Whitmire Micro-Gen, Aqua-Hort by LHT, Griffin Greenhouse & Nursery Supplies, The Blackmore Company, Premier Horticulture, Pindstrup, Greencare Fertilizers Inc., Sun Gro Horticulture, Quality Analytical Laboratories, Fafard, and Ellegaard). University contributors include Drs. Cheryl Smith (University of New Hampshire), Rob Wick (University of Massachusetts), Youbin Zheng (University of Guelph, Canada), Philip Harmon (University of Florida), Chuan Xue Hong (Virginia Polytechnic Institute and State University), Jinsheng Huang (University of Florida), Bruce MacKay (Massey University, New Zealand), and Loren Oki (University of California Davis). A new grant from the National Foliage Foundation is supporting research on water quality monitoring at the University of Florida.

For more information about water treatment technologies, or to register for upcoming Alliance workshops, visit:

http://watereducationalliance.org/

Paul Fisher, Ph.D.
Emily Austen

Miticides and Susceptible Twospotted Spider Mite Life Stages

Fig. 1
Twospotted Spider Mite Adult

Twospotted spider mite, Tetranychus urticae is a major arthropod pest of greenhouses feeding on over 300 plant species (Figure 1). Twospotted spider mite feeds within plant cells damaging the spongy mesophyll, palisade parenchyma, and chloroplasts, which reduces chlorophyll content and the plant's ability to photosynthesize resulting in characteristic symptoms such as leaf bleaching, yellow stippling, and bronzing of leaves(Figure 2).

Fig. 2 Spider Mite on Salvia

The primary means of maintaining twospotted spider mite populations below damaging levels, in greenhouses, is the use of commercially available miticides that either have contact or translaminar activity. Miticides with contact activity include acequinocyl (Shuttle), fenbutatin-oxide (ProMite), clofentezine (Ovation), hexythiazox (Hexygon), pyridaben (Sanmite), bifenazate (Floramite), and fenpyroximate (Akari). In general, these miticides either provide minimal or extended residual activity, depending on the physical and molecular characteristics of the miticide, once spray residues have dried. However, a number of miticides have translaminar properties, which mean that the material penetrates the leaf cuticle and the active ingredient resides within the leaf tissue including the spongy mesophyll and palisade parenchyma cells, resulting in a reservoir of active ingredient. This provides extended residual activity against twospotted spider mite even after spray residues have dried. Twospotted spider mites feeding on the leaves, even after spray residues have dissipated, may ingest a lethal dose of the active ingredient. This may lead to a decrease in the number of miticide applications thus reducing worker exposure and minimizing the potential for spider mite populations developing resistance. Furthermore, fewer miticide applications may decrease any harmful effects on natural enemies such as predatory mites. Miticides registered for use in greenhouses that have translaminar activity include abamectin (Avid), chlorfenapyr (Pylon), spiromesifen (Judo), and etoxazole (TetraSan).

In our research, we have demonstrated that translaminar miticides may provide control of twospotted spider mite even after applications had been made to plants 14 days prior to plants being artificially infested with twospotted spider mite. It is possible that translaminar miticides have extended residual activity with the active ingredient remaining in the plant tissues up to 70 days. Based on percent mortality of twospotted spider mites, etoxazole (80% to 97%), spiromesifen (89% to 92%), and chlorfenapyr (95%) were the most effective in our study.

Table 1 presents all the miticides registered for use in greenhouses and the susceptible life stages of twospotted spider mite. This table will assist greenhouse growers in determining which life stage miticides are most effective on. For example, four miticides are active, as indicated on the label, on all the life stages (egg, larva, nymph, and adult) of twospotted spider mite: acequinocyl (Shuttle), bifenazate (Floramite), fenpyroximate (Akari), and pyridaben (Sanmite). Three of these miticides (Shuttle, Akari, and Sanmite) are classified as mitochondria electron transport inhibitors or METI's. Four miticides are not (or less) active on twospotted spider mite adults: clofentezine (Ovation), etoxazole (TetraSan), hexythiazox

TABLE 1. MITICIDES (ACTIVE INGREDIENT AND TRADE NAME) AND TWOSPOTTED SPIDER MITE LIFE STAGES MOST EFFECTIVE ON.

ACTIVE INGREDIENT	TRADE NAME	ACTIVITY TYPE	EGGS	LARVAE	NYMPHS	ADULTS
Abamectin	Avid	T and C		X	X	X
Acequinocyl	Shuttle	C	X	X	X	X
Bifenazate	Floramite	C	X	X	X	X
Chlorfenapyr	Pylon	T and C		X	X	X
Clofentezine	Ovation	C	X	X	X	
Etoxazole	TetraSan	T and C	X	X	X	
Fenbutatin-Oxide	ProMite	C		X	X	X
Fenpyroximate	Akari	C	X	X	X	X
Hexythiazox	Hexygon	C	X	X	X	
Pyridaben	Sanmite	C	X	X	X	X
Spiromesifen	Judo	T and C	X	X	X	

Activity Type Codes
C=Contact

T=Translaminar

Author: Raymond A. Cloyd

Updated: October 16, 2007

(Hexygon), and spiromesifen (Judo). Finally, four miticides have both contact and translaminar properties: abamectin (Avid), chlorfenapyr (Pylon), etoxazole (TetraSan), and spiromesifen (Judo).

In order to effectively manage twospotted spider mite (or any mite pest) it is important that greenhouse growers identify the life stages that are affected by the currently available miticides. This will also make it easier to develop tank mixtures that make sense.

Raymond A. Cloyd, Ph.D

Purdue Sustainability Research Needs your HELP!

Cliff Sadof and graduate student Katie England from the Purdue Department of Entomology are conducting a study on insect pest management. The study explores how the rush toward "sustainability" is influencing the capacity of growers to control pests in commercial greenhouses. We are looking for growers who have considered sustainable practices (including the use of biocontrol agents) and have either adopted or rejected such practices based upon benefits to the company. We are asking that those willing to talk about their pest management strategy and those willing to assist with an on-site pest study contact Katie England by phone (765) 496-2664 or email englandk@purdue.edu.

Cliff Sadof, PhD.

Interactions between Purdue University and the Industry

I would like to point out some of the ways we at Purdue are attempting to further establish and maintain a strong relationship with you in the industry. Indiana's green industry contributes approximately $1.3 billion to Indiana's economy and provides valuable services to its citizens. Numerous organizations exist to facilitate business interactions, develop a sense of professionalism, and provide educational opportunities for industry members. Those of us at Purdue who are involved in horticultural teaching, research, and industry engagement (new word for extension) are dedicated to helping the industry grow. This is only possible if we have a strong connection to the industry, which depends on continued dialogue. There are several initiatives underway that are designed to strengthen these relationships, as well as to provide forums for discussions of horticultural education and research that I would like to briefly highlight.

Green Industry Working Group (GIWG)

We recognize the growing financial and operational success of many green industry organizations, however, we also see the opportunity for increased growth of the industry with improved communication among these various organizations. For example, the continued relationship between the INLA and the Midwest Regional Turf Foundation (MRTF) is most noticeable by the success of the Indiana Green Expo the past two years. However, that relationship extends beyond that one event and has undoubtedly been an important relationship for members of both organizations. We at Purdue believe the entire industry would be strengthened by more of these types of interactions among organizations. To this end, we are developing a forum that will facilitate the identification of specific needs that can be addressed through research, educational programming, and paper and electronic media development. Furthermore, we need to explore how educational programming can be delivered so that it reaches both small and large communities.

The GIWG will be composed of representatives from all aspects of the industry and Purdue extension specialists and educators. Many Purdue extension educators and specialists enjoy a good working relationship with industry groups and are often called upon to contribute to the educational programming for meetings. One goal of the GIWG is to improve the quality of these programs so they can address a list of prioritized industry-wide needs. We hope that through constructive interactions the mission of this group will grow beyond the scope of education to help define the research needs that could be addressed by Purdue University researchers. The list of needs generated by the GIWG can be used to guide applied research to become more responsive to industry concerns.

Industry Advisory Board

Dr. Bob Joly, head of the Department of Horticulture and Landscape Architecture (HLA), is in the process of creating an industry advisory board. The role of the board will be to provide better avenues of communication between the academic community in HLA and the industry throughout the state. We at Purdue recognize that while we work hard to provide our students with the tools necessary to embark on successful, productive careers in horticulture, we also depend upon the continuing insights of those who work directly in the industry to make sure that our educational programs are meeting the needs of a rapidly-changing horticultural business environment. The role of the advisory committee will be to serve as a sounding board to the department head and faculty on specific issues related to the learning, discovery and engagement missions of the department. We would seek advice on a broad range of issues including student curricula, recruitment, scholarships, fundraising objectives, and potential avenues for collaborative research. We hope that the open lines of communication will also increase the interaction between students and potential employers as well as between industry leaders and scientists at Purdue.

Industry-Related Research

It is an exciting time for applied research related to the production and marketing of

ornamental crops at Purdue. We have a core group of scientists who are dedicated to conducting research that can have a direct impact on the GREEN industry. We currently have projects on (to name just a few) evaluation of new landscape plants, nutrition of nursery stock, effects of growth regulators on greenhouse crop production, and identifying consumer and grower perceptions of sustainable production.

As scientists, we rely on people in the industry to make us more aware of research needs. Some research is designed to address short-term problems, while other research is more long-term in nature. A survey of consumer preference may provide information that is immediately implemented in retail garden centers, while research on water and nutrient use of nursery crops often requires several years of trials before conclusions can be made. In both cases, however, the people who will ultimately use the information play an important role in identifying the need in the first place, and suggesting ways in which the research outcomes can be implemented into commercial practices.

Research requires funding. This is a fact of life that researchers have to deal with. However, the industry can support research in more ways than simply donating money to the university. "In-kind" gifts such as plant material, fencing, mulch, etc, as well as allowing research to be conducted in nurseries and greenhouses, is an important contribution that allows applied research to be conducted.

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Upcoming 2008 Industry and University Events				
Date	**Event**	**Location**	**Speaker/Topic**	**Web site/E-mail**
July 12 - 15	OFA Short Course	Columbus, OH	Education and Trade Show	http://www.ofa.org/shortcourseinfo.aspx
July 22 - 24	PA Green Expo Trade Show	Harrisburg, PA	Trade Show	http://www.pagreenexpo.com/
July 25	NIFGA Bus Tour	West Chicago, IL	The Gardens at Ball Horticulture Co.	Contact Bernie at North Manchester Greenhouse: (800) 589-3478, bernie.greenhouse@gmail.com
Aug. 4 -15	Michigan Garden Plant Tour	Throughout MI	Display gardens	http://www.hrt.msu.edu/planttour/default.htm
Aug. 5	MSU Garden Plant Showcase	East Lansing, MI	Educational and garden tour	http://www.hrt.msu.edu/planttour/MSU_showcase.htm
Sept. 11	NWIFA Meeting	Windmill Acres, Beecher, IL	Roberto Lopez on Sustainability	http://faculty.pnc.edu/emaynard/nwifa/nwifa.html
Sept. 29 - Oct 1	Plug & Cutting Conference	Orlando, FL	Educational	http://www.ofa.org/education.aspx
Oct 8 - 9	IFGA Meeting	West Lafayette, IN	Golf, banquet, tour & educational sessions	http://hort2.agriculture.purdue.edu/flowers/
Oct 8 - 9	Canadian Greenhouse Conference	Toronto, Canada	Education and Trade Show	http://www.canadiangreenhouseconference.com/
Nov. 5 - 7	New England Greenhouse Conference	Worcester, MA	Education and Trade Show	http://www.negreenhouse.org/
Nov. 6	NWIFA Meeting	Kingma's Greenhouse, DeMotte, IN	Indiana Private Pesticide Applicator Recertification	http://faculty.pnc.edu/emaynard/nwifa/nwifa.html
Nov. 7 - 9	Sustainability Conference	Fresco, TX	Educational	http://www.ofa.org/education.aspx
Nov. 9 - 10	Retail Experience	Fresco, TX	Educational	http://www.ofa.org/education.aspx
Nov. 11 - 12	MI Greenhouse Growers Expo	Lansing, MI	Educational and Trade Shoe	http://www.hrt.msu.edu/floraoe/greenhouseexpo.htm
Dec. 4 Dec. 6 Dec. 9	NCSU Purdue UFL	Raleigh W. Lafayette Gainsville	National Poinsettia Cultivar Trials	http://flowers.hort.purdue.edu/PoinsettiaSite/default.html

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