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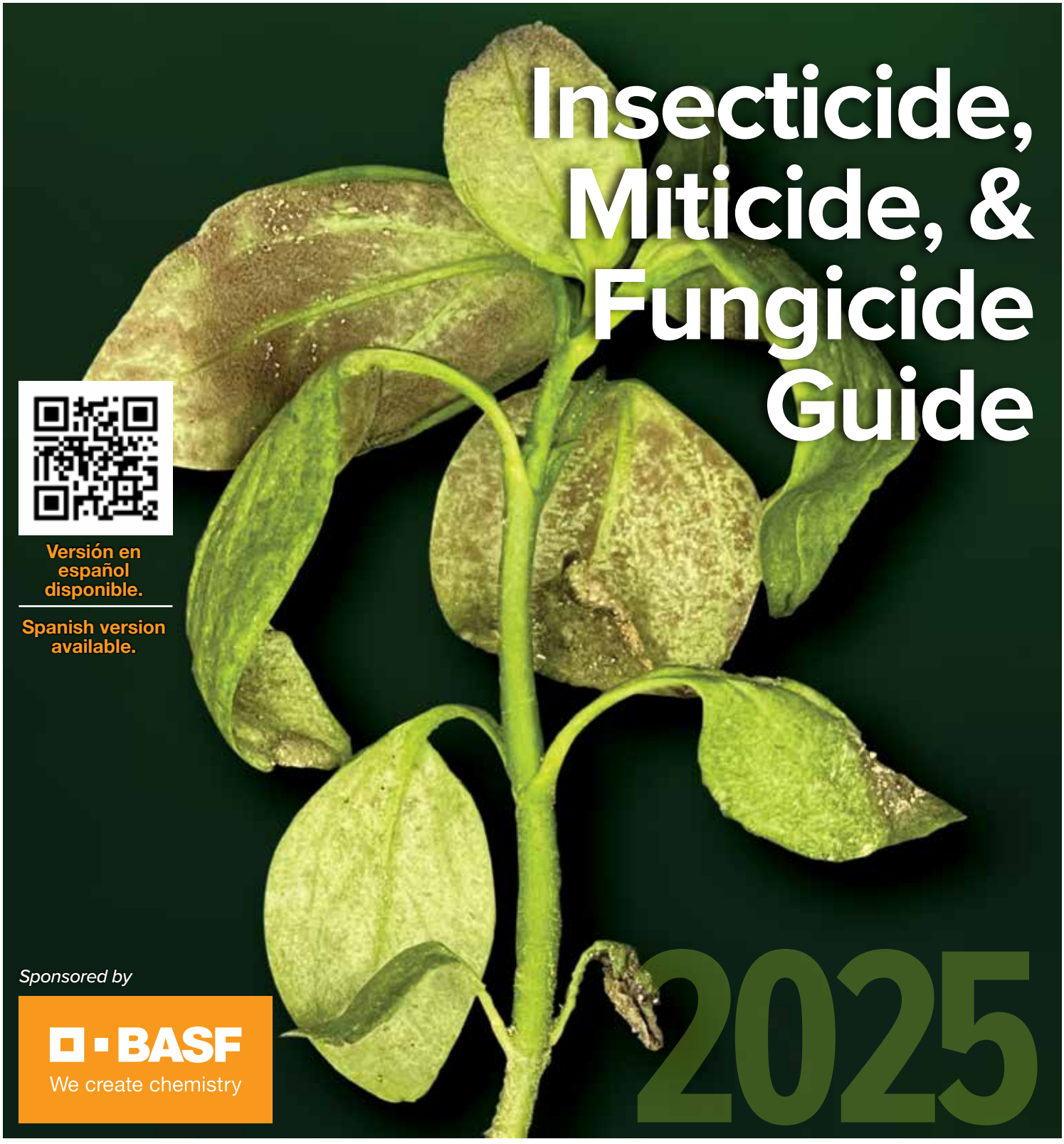

Insecticide, Miticide, & Fungicide Guide

Versión en español disponible.

Spanish version available.

2025

GROWERTALKS®

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GreenProfit Supplement Enclosed

Legacy, adaptability and fortitude— this industry continues to inspire despite the many challenges it faces. We've sponsored the Insecticide, Miticide & Fungicide Guide with *GrowerTalks* for over 10 years and during that time we've seen so much change in every aspect of the horticulture industry. Through a decade, one thing remains true—growers value industry resources that provide them with the latest information and techniques to improve the effectiveness of their crop protection in production horticulture.

Our dedication to this industry comes to life through our high standards in quality and reliability of our products, the consistency in which they perform, and our endless pursuit of innovation. Like our industry, our definition of innovation has continued to evolve over the last 10 years. We continue to innovate unique crop protection solutions like **Avelyo® fungicide** that complements our legacy of **Intrinsic® brand fungicides** as an excellent rotation partner to help you battle tough diseases like powdery mildew, leaf spots and soilborne pathogens.

We've seen growth and intention as it relates to sustainability throughout the horticulture value chain with increased focus on pollinator safety and utilization of BCAs in production practices. This focus has inspired us to innovate targeted chemistries with favorable safety profiles for beneficial insects like **Ventigra® insecticide** and **Sultan® miticide**. Additionally, we expanded our biological offering **Nemasys®** and **Millenium®** beneficial nematodes to include **Velifer® bioinsecticide/miticide**, giving growers an arsenal of tools to combat problem pests.

Caren A. Schmidt, Ph.D.
Regional Sales Manager
Greenhouse & Nursery
BASF

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Greenhouse & Nursery
BASF

It's with immense pride that we continue to be a collaborative resource for growers, helping them solve their toughest pest management challenges. In this year's edition of the Insecticide, Miticide & Fungicide Guide, you'll see tips, tricks and best practices from our sales and technical representatives that include the market's latest tools and resources. You'll also see a Spanish translated version of this guide, back by popular demand.

On behalf of our entire BASF greenhouse and nursery team, we wish you all success in your production for this 2025 growing season.

On the cover: Downy mildew on a snapdragon. Photo courtesy of Dr. Francesca Peduto Hand, The Ohio State University.

Disclaimer: These recommendations may not be appropriate for conditions in all states and may not comply with laws and regulations in every state. These recommendations were current as of July 2024. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage regulations and examine a current product label before purchasing or applying any chemical. For assistance, contact your county Cooperative Extension Agent or pest control advisor. The use of brand names and any mention or listing of commercial products or services in this publication does not imply endorsement by Ball Publishing.

Proven in Propagation

Program for Stronger Roots & Healthier Plants

By **Emma Lookabaugh, Ph.D.**—*Senior Technical Specialist Southeast - Turf and Ornamentals, BASF Professional and Specialty Solutions*

Propagation is stressful!

From cut to stick, plants go through a lot. Risk of physical injury is high with increased handling and losses associated with dry down can be common. Quality of stock plants and sources of propagative material can vary - don't forget cuttings, liners and even seeds sometimes come with pathogens for free. Always use reputable suppliers and inspect incoming plant material.

Open wounds and continuous leaf wetness while under mist create the perfect environment for pathogens like Botrytis, bacteria, Pythium and Rhizoctonia to infect and cause disease. Good sanitation practices and strong preventive fungicide programs go a long way to protect plant quality during propagation.

Grow a strong foundation

This propagation program is designed to begin at sticking and carry you through transplant. Products, rates and intervals shown below are recommended to control disease and stimulate plant health for longer, stronger roots – priming cuttings for root initiation.

Growers should observe faster callusing, greater numbers of root initials and better canopy branching. ■

Above left: Plants treated with thiophanate-methyl and Subdue Maxx®. Right: Plants treated with program of **Pageant® Intrinsic®** brand fungicide, Chipco® 26019 and **Empress® Intrinsic®** brand fungicide produced more roots and increased top growth.

At sticking	+14 days	+14 days under mist	Prior to transplant
Pageant® Intrinsic® brand fungicide	**Pageant® Intrinsic®** brand fungicide	**Avelyo®** fungicide or Daconil fungicide or Chipco 26019 fungicide	**Empress® Intrinsic®** brand fungicide + Segway O fungicide
12 fl oz	12 fl oz	SLR (Standard Label Rate)	3 fl oz drench + 1.5 fl oz

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Building Better Fungicide Programs

Balanced Plant Protection Solutions

BASF
We create chemistry

BOTRYTIS BLIGHT

Orkestra® Intrinsic® brand fungicide (Group 7 + 11)
Decree® + Daconil® (Groups 17 + M5)
Palladium® (Groups 12 + 9)
Affirm™ or Astun® SC (Group 19 or 7)

LEAF SPOTS

(Alternaria, Cercospora, Colletotrichum, Diplocarpon [black spot], Entomosporium, Myrothecium, Septoria)

Orkestra Intrinsic brand fungicide (Group 7 + 11) or **Pageant® Intrinsic** brand fungicide (Group 7 + 11)
Avelyo® fungicide (Group 3)
Protect™ DF or Daconil (Group M3 or M5)
Palladium (Groups 12 + 9)

DOWNY MILDEW

Adorn® + Subdue Maxx® (Groups 43 + 4)
Stature® fungicide (Group 40) or **Orvego®** fungicide (Group 40 + 45)
Orkestra Intrinsic brand fungicide (Group 7 + 11) + Protect DF (Group M3)
Segovis® (Group 49)

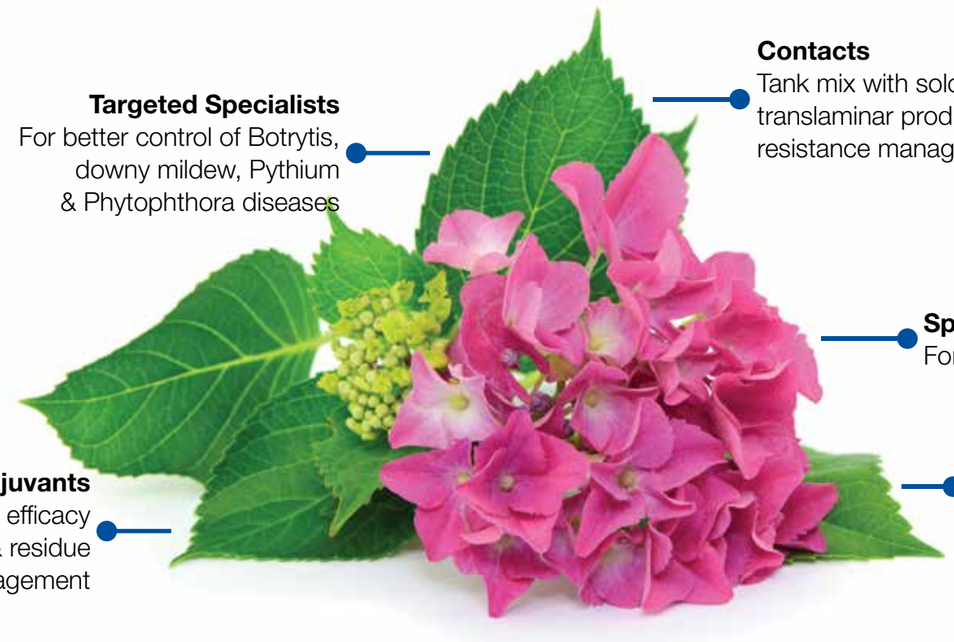
POWDERY MILDEW AND RUST

Orkestra Intrinsic brand fungicide (Group 7 + 11) or **Pageant Intrinsic** brand fungicide (Group 7 + 11)
Avelyo fungicide (Group 3)
Protect DF or Daconil (Group M3 or M5)
Palladium (Groups 12 + 9)

Foundational Combinations
Broad-Spectrum Systemics & Penetrants
Pick your favorite Group 7 + 11

Targeted Specialists
For better control of Botrytis, downy mildew, Pythium & Phytophthora diseases

Contacts
Tank mix with solo systemics/ translaminar products for resistance management



Spray
For foliar diseases

Drench
For root/crown diseases

Adjuvants
For efficacy boosts & residue management

Proper Diagnosis

ROOT AND CROWN ROTS (NON-OOMYCETE)

(Fusarium, Rhizoctonia, Cylindrocladium, Thielaviopsis = Berkeleyomyces)

Empress® Intrinsic brand fungicide + **Avelyo** fungicide (Group 11 + 3)
Medallion® or OHP® 6672 (Group 12 or 1)
Orkestra Intrinsic brand fungicide (Group 7 + 11) or **Pageant Intrinsic** brand fungicide (Group 7 + 11)

PYTHIUM ROOT ROT

Empress Intrinsic brand fungicide + Segway® O (Group 11 + 21)
Terrazole® (Group 14)
Aliette® [or Areca™] + Subdue Maxx (Group P 07 + 4)

PHYTOPHTHORA DISEASES

Orvego fungicide (Group 40 + 45) or **Stature** fungicide (Group 40)
Empress Intrinsic brand fungicide + Segway® O (Group 11 + 21)
Aliette [or Areca] + Subdue Maxx (Group P 07 + 4)
Segovis (Group 49)

BACTERIAL DISEASES

Phyton® 27, Camelot® O or Grotto™ (M1)
Triathlon® BA (Group BM 02)
Junction® (Group M1 + M3)

Always read and follow label directions.

From roots through bloom to finish
prevent diseases before they start

EMMA LOOKABAUGH, PH.D.
BASF Senior Technical Specialist

Chemical Class Chart for Greenhouse Nursery Fungicides

FRAC Group	Chemical Group	Active Ingredient Common Name	Trade Name
1	MBC - fungicides (MethylBenzimidazole Carbamates)	thiophanate-methyl	Banrot*, 3336, OHP 6672, Spectro 90*, 26/36*
2	dicarboximides	iprodione	OHP Chipco 26019
3	DMI-fungicides (DeMethylation Inhibitors)	Difenoconazole	Postiva*
		mefentrifluconazole	**Avelyo**
		metconazole	Tourney
		myclobutanil	Eagle 20EW
		propiconazole	Banner MAXX, Concert II*, Strider
		tebuconazole	Torque
		triadimefon	Bayleton
		triflumizole	Terraguard
		triticonazole	**Trinity, Trinity TR**
4	PA – fungicides (PhenylAmides)	mefenoxam	Subdue GR, Subdue MAXX
5	amines ("morpholines")	piperalin	Pipron
7	SDHI (Succinate dehydrogenase inhibitors)	benzovindiflupyr	Mural*
		boscalid	**Pageant Intrinsic***
		fluropyram	Broadform*
		flutolanil	ProStar
		fluxapyroxad	**Orkestra Intrinsic ***
		isofetamid	Astun
		Pydiflumetofen	Postiva*
9	AP - fungicides (AnilinoPyrimidines)	cyprodinil	Palladium*
11	QoI-fungicides (Quinone outside Inhibitors)	azoxystrobin	Heritage, Mural*
		fluoxastrobin	Fame SC
		pyraclostrobin	**Empress Intrinsic, Orkestra Intrinsic*, Pageant Intrinsic***
		trifloxystrobin	Compass
		fenamidone	FenStop
12	PP-fungicides (PhenylPyrroles)	fludioxonil	Medallion, Palladium*, Spirato GHN
14	AH-fungicides (AromaticHydrocarbons) (chlorophenyls, nitroanilines)	pentachloronitrobenzene (PCNB)	Terraclor
	heteroaromatics	etridiazole	Banrot*, Terrazole, Terrazole CA, Truban
17	KRI fungicides (KetoReductase Inhibitors)	fenhexamid	Decree
19	polyoxins	polyoxin - D	Affirm WDG
21	Qil - fungicides (Quinone inside Inhibitors)	cyazofamid	Segway O

Chemical Class Chart for Greenhouse Nursery Fungicides

FRAC Group	Chemical Group	Active Ingredient Common Name	Trade Name
28	Carbamates	propamocarb	Banol
40	CAA-fungicides (Carboxylic Acid Amides)	dimethomorph	**Stature SC, Orvego***
		mandipropamid	Micora
43	benzamides	fluopicolide	Adorn
45	QoSI fungicides (Quinone outside Inhibitor, stigmatellin binding type)	ametoctradin	**Orvego***
49	OSBPI oxysterol binding protein homologue inhibition	oxathiapiprolin	Segovis
50	aryl-phenyl-ketones	pyriofenone	Seido
P 05	plant extract	extract from *Reynoutria sachalinensis*	Regalia
P 07	Phosphonates	fosetyl-Al	Aliette, Areca
		phosphorous acid, potassium phosphite	Alude, Fosphite, Phostrol
M1	inorganic (electrophiles)	copper salts	Camelot O, CuPro 5000, Cuproxat FL, Junction*, Kalmor, Phyton 27, Phyton 35, Grotto
M3	dithiocarbamates and relatives (electrophiles)	mancozeb	Dithane, Fore, Junction*, Protect DF
M5	chloronitriles (phthalonitriles) (unspecified mechanism)	chlorothalonil	Daconil Ultrex, Daconil Weatherstik, Spectro 90*
BM 01	plant extract	extract from *Swinglea glutinosa*	Ecoswing
BM 02	microbial	*Bacillus amyloliquifaciens* (strain D747)	Triathlon BA
		Bacillus amyloliquifaciens (strain QST 713)	Cease
		Bacillus amyloliquefaciens (strain F727)	Stargus
		Pseudomonas chlororaphis (strain AFS009)	Zio
		Streptomyces griseoviridis	Mycostop
		Streptomyces lydicus (strain WYEC 108)	Actinovate SP
		Trichoderma harzianum (strain T-22)	Rootshield
		Trichoderma harzianum (strain T-22), *Trichoderma virens* (strain G-41)	Rootshield Plus*
		Trichoderma asperellum (strain ICC 012), *Trichoderma gamsii* (strain ICC 080)	Obtego*
		Gliocladium virens (strain GL021)	SoilGard
		Ulocladium oudemansii (strain U3)	BotryStop
Not Classified	inorganic protectants	botanical extract	Neem Oil, Triact 70
		hydrogen dioxide	Zerotol
		oil	**Ultra-Pure Oil**, SuffOil-X
		potassium bicarbonate	MilStop
		quaternary ammonums	KleenGrow

*** Indicates a product that contains more than one active ingredient in a pre-pack mixture.**
Consult label for specific use site where the product will be used on ornamentals since not all products are registered for both production greenhouses and outdoor nurseries or for use in landscapes.

Downy Mil-dos & Don'ts

By **Francesca Peduto Hand, Ph.D.**—*Department of Plant Pathology, The Ohio State University*

Downy mildews are some of the most destructive diseases of ornamental plants in both commercial production and landscapes. Contrary to powdery mildews, which are caused by true fungi, downy mildews are caused by a distinct group of organisms called oomycetes. Members of this group also include other well-known pathogens to ornamental growers, such as Pythium, Globisporangium, Phytophthora and Phytopythium. The two most common genera of downy mildew pathogens infecting ornamental plants are Peronospora and Plasmopara.

Greenhouse crops commonly affected by downy mildews include impatiens, coleus, pansy, snapdragon, salvia, primula and verbena. Among cut flower crops are scabiosa, stock, sunflower and rose. Severe outbreaks of downy mildew have been documented on impatiens and coleus in recent years. In both cases, they were linked to the presence of infected, but not-yet-symptomatic plants in the ornamental plant trade. This highlights the main take-home message for downy mildews: detect early!

Host range matters

Most downy mildews have a fairly limited host range being able to infect only a small group of plants. An example of this is *Plasmopara obducens*, which causes downy mildew on *Impatiens walleriana* (garden impatiens), *Impatiens balsamina* (garden balsam) and a few other native impatiens species, but doesn't affect *Impatiens hawkerii* (New Guinea impatiens).

Some others, however, have a broader host range, infecting across members of a plant family. An example of this is *Plasmopara halstedii*, which causes downy mildew on *Helianthus annuus* (sunflower), along with more than 30 other genera in the *Asteraceae* family. If a diseased sample is submitted to a laboratory for diagnosis, diagnosticians can use morphological traits and increasingly faster molecular tools to identify the downy mildew pathogen to the species level, which can help identify other hosts grown in the same environment that may be at risk of getting the disease. Molecular diagnostics can also provide information on fungicide sensitivity of a particular strain of the pathogen.

Know what to look for

Downy mildew symptoms can vary greatly depending on the host where they develop. Early symptoms are often subtle and may pass unobserved. Small, water-soaked, chlorotic spots form on the upper side of leaves, eventually enlarging to more extensive lesions of variable color (bronze to brown). These lesions are often angular in shape because they're delimited by veins. As the disease progresses, lesions enlarge and leaves drop.

Severe infections by highly virulent strains of the pathogen can lead to quick plant death. Beneath the upper leaf lesions, a white to gray to black (depending on species) downy-like growth will occur when high relative humidity conditions are met. Some downy mildew symptoms and signs can be confused with those of powdery mildew, a common fungal disease of ornamental crops. Although the names are similar and both pathogens produce white-gray sporulation on infected leaves, downy mildew sporulation is only found on the underside of the leaf, while powdery mildew sporulation primarily develops on the upper side of the leaf.

Pathogen biology basics

Downy mildew pathogens are biotrophic, obligate organisms, meaning that they require a living host tissue to grow and reproduce. These pathogens reproduce through structures called sporangia that form on the underside of infected leaves. After they're dislodged from diseased leaves by air currents or splashing water, they land onto healthy plants and initiate new infections. Moisture prompts the sporangia to release zoospores, which are able to swim through free moisture on the leaf surface due to the presence of motile appendages called flagella. Zoospores swim toward the leaf stomata, which they then penetrate to infect the host cells. Some downy mildews produce long-lasting survival spores, called oospores, which can persist in the soil for many years and serve as source of inoculum for new plants. Some downy mildew can infect the plant systemically, spreading throughout the plant beyond the initial site of infection and even persisting in dormant plants.

Downy mildew infections are favored by cool temperatures (50 to 75F/10 to 23C), high relative humidity (85% or above) and long periods of leaf wetness. The entire disease cycle—from initial infection of a healthy plant to production of new spores on infected tissue—is seven to 10 days, but it can be much shorter in optimal environmental conditions, especially highly humid and wet conditions.

Sporulation of an impatiens leaf showing Impatiens Downy Mildew.

Downy mildew on a rose leaf.

Downy mildew on a snapdragon.

Downy mildew on stock.

All photos courtesy of Francesca Hand.

Disease management toolbox

Downy mildews are very difficult to control once established, so every effort should be made to prevent the disease and its introduction into an environment, whether it's a greenhouse, nursery or landscape. Inspect plants regularly for signs and symptoms of disease and remove suspected plants immediately to prevent pathogen spread. Infected plants, plant debris and substrate should be removed by placing them into closed containers then burned. Reducing the spread of downy mildew decreases the likelihood of sexual recombination events that may lead to development of more virulent downy mildew populations.

Keep relative humidity below 85% by venting and heating in order to stop germination of spores and decrease the sporulation rate on infected plants. Reduce leaf wetness with proper plant spacing that ensures air circulation. In the landscape, pruning and thinning can both increase air circulation and light penetration, which can influence relative humidity around and within plants. Because sporangia are disseminated via water splash and spores need water to germinate, it's important to adopt practices that reduce the amount of moisture on the leaves, such as using drip as opposed to overhead irrigation.

Several fungicides are available to control the disease and should be applied preventively for maximum efficacy. Keep in mind that if sporulation is observed on the leaf underside, control will be difficult to impossible. Many fungicides that provide excellent control when applied preventively will not work curatively! Although not a comprehensive list, some examples of fungicide active ingredients include mefenoxam (FRAC 4), azoxystrobin (FRAC 11), oxathiapiprolin (FRAC U15), phosphorous acid salts (FRAC 33), and ametoctradin + dimethomorph (FRAC 40+45). To avoid development of resistance to any fungicide by the pathogen, make sure to rotate among FRAC codes or tank mix if indicated as safe. Begin a fungicide program to prevent disease development and then maintain a regular schedule as prompted by the fungicide label. ■

Getting the Jump on Foliar Disease Problems

By **Tom Creswell, Ph.D. & John Bonkowski, D.P.M.**—*Plant and Pest Diagnostic Laboratory, Purdue University*

Spotting an unmarketable plant may be easy, but figuring out the "why" can be challenging. Knowing the range of problems that can affect even a single species of plants, like geraniums, can be a daunting task, let alone diagnosing the issue on the spot.

An accurate diagnosis, whether in the field or from a lab, is critical for implementing appropriate and cost-effective management strategies. Here, we'll focus on leaf problems—including leaf spots, blights, necrosis and discoloration—and a step-wise approach for diagnosing plant disease issues.

Biotic or abiotic

After a problem is spotted, the next question turns on whether a disease is involved. We separate plant problems into two broad categories: biotic and abiotic. A biotic problem is caused by a living organism, whether it be an insect or microbe (fungi, bacteria, viruses). An abiotic problem is caused by a non-living factor, such as environmental stress, nutrient imbalance, handling injuries or pesticide applications.

Abiotic problems can be much more challenging to diagnose because conclusions must be based on crop history, application records, weather records and other observations rather than the presence of a fungus or bacterium. To separate biotic from abiotic problems, and to begin to narrow the range of possible causes, we consider several factors:

- Symptom distribution
- Symptom appearance
- Speed of symptom development
- Site history

Figure 1. Acidovorax bacterial leaf spot appearing randomly on verbena plugs.

Symptom distribution

Location of the damage is a key piece of information in separating biotic from abiotic problems. Disease and insect issues tend to be scattered or randomly distributed in the growing area (Figure 1). Not every plant is affected, but there might be hot spots where a number of plants are showing severe symptoms compared to the surrounding plants. Insects and mites often prefer to feed on new growth, so you may see deformation or damage on the newest leaves. Leaf spots often develop lower in the plant canopy where there's higher humidity and some shade. Botrytis is more likely to show up when humidity is high and air circulation is poor, so plants growing pot to pot may be attacked more than those spaced out.

By contrast, abiotic problems typically develop in a uniform pattern, i.e. all of the plants near a walkway treated with a cleaner or late spring freeze damage (Figure 2).

Plants injured by spray applications may show symptoms that are irregular in shape or follow the path of liquids on the foliage, including traveling along leaf veins or concentrating on the tips. Leaves may partially cover other leaves, protecting them, which may later show up as damage that ends abruptly on half the leaf, something that would not happen with a disease. Injuries caused by a single event may affect a certain age of leaves in mid-canopy with older and newer leaves remaining normal (Figure 3).

Questions of distribution may be complicated by susceptibility of individual species. Some pesticides are not recommended for specific plants, so when you see damage limited to a single type of plant it may pay to check application records and pesticide labels.

Figure 2. Frost damage on new growth of yew showing a uniform pattern.

Figure 3. Butterfly bush showing spray damage limited to mid-canopy.

Photo: Eric Bilner, Indiana Department of Natural Resources.

Symptom appearance

Much of the difficulty in diagnosing a plant problem hangs on the fact there only so many ways an individual plant may show symptoms due to disease or stress. Wilt symptoms may look the same, whether the cause is an excess or lack of water, root damage or root rot disease. However, plants are at their most expressive when they "speak" by producing leaf symptoms of spots, blights, necrosis and discoloration.

Bacterial leaf spots are usually dark brown to black in color, water soaked or greasy in appearance, and will frequently have a yellow margin or "halo" around the spot. On dicot plants, bacterial lesions are usually limited by major leaf veins, so they appear angular or boxy in shape, like the viburnum shown in Figure 4. In plants with parallel veins, bacterial lesions are usually elongated, following the pattern of the leaves as shown in Figure 5.

Fungal leaf spots tend to be brown, dry and frequently are circular or irregular in shape, as they're less likely to be limited by leaf veins. There are some exceptions, such as Pseudocercospora leaf spot on Japanese tree lilac. Spots or blighting may even develop zone lines or concentric circles as the fungus expands in the leaf as shown in Figure 6.

Brown, purple or red borders (Figure 7) around a leaf spot are also a clue that you may be dealing with a fungal pathogen. Keep in mind that abiotic problems like nutrient deficiencies or spray damage can sometimes mimic a disease.

Viral diseases often result in unexpected coloration and patterns on the leaves, including mottling, angular mosaic patterns and vein discoloration. Some viruses like Impatiens Necrotic Spot Virus or Tomato Spotted Wilt Virus, which are transmitted by thrips, produce chlorotic or necrotic ringspots (Figure 8).

Speed of symptom development

Disease takes time. While some diseases may spread very rapidly (think Botrytis blight or downy mildew), most diseases require a few days to weeks to develop and spread throughout the growing area, even if it seems like disease shows up everywhere all at once. If symptoms appear to crop up seemingly overnight on a large proportion of the planting (50%-plus) then look for an injury or stress caused by an abiotic factor.

Site history

What are the conditions prior to symptom development? Is the crop monitored and are there any pests? Records of observations or dates of various practices could prove crucial in determining a timeline of symptom development and narrowing down potential causes for damage. Often, issues are found when changes to standard practices occur, including changes in irrigation quantity and frequency, chemical applications (fertilizer type/amount, individual pesticide products or changes in tank mixes), or recent location changes. ▶

Figure 4. Bacterial leaf spot on viburnum showing angular leaf spots with yellow margins.

Photo: NC State Plant Disease & Insect Clinic.

Figure 5. Bacterial leaf blight on canna showing elongated lesions following the veins.

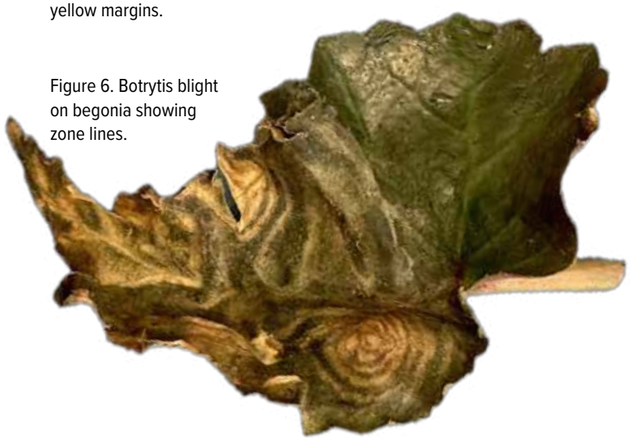


Figure 6. Botrytis blight on begonia showing zone lines.

Figure 7. Cercospora leaf spot on holly.

Figure 8. Impatiens Necrotic Spot Virus symptoms on coleus.

It's okay to ask for help

Laboratory diagnosticians are fond of saying "pathogens don't read the books," meaning even known pathogens may cause unusual symptoms and information in reference material may not cover all situations. For diagnostic assistance, we recommend submitting a sample to a diagnostic lab with membership in the National Plant Diagnostic Network (NPDN).

The NPDN (npdn.org) is a consortium of diagnostic labs in all U.S. states and territories protecting national plant health with a distributed ability to provide timely quality diagnostics of plant pests and pathogens. A diagnostic lab can perform routine diagnostic procedures, including isolating for pathogens, but can also perform specialized tests to detect specific pathogens, such as viruses, and provide management recommendations or connect you with an expert who can provide assistance. When submitting a sample to a diagnostic lab, we recommend visiting the lab's website to determine fees, services offered and get information on the best way to send samples. ■

2025 Insecticides and Miticides for Managing Insect and Mite Pests of Greenhouse-Grown Horticultural Crops

Raymond A. Cloyd
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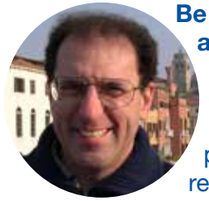
Kansas State University



Be sure to rotate insecticides and miticides with different modes of action within generations to avoid the potential for insect and mite pest populations to develop resistance. *—Raymond Cloyd*

Greenhouse pest management/plant protection involves using a multitude of strategies in order to minimize the prospect of dealing with insect and mite pest populations. The use of pest control materials (insecticides and miticides) is one component of a pest management/plant protection program, which also includes pest identification and monitoring along with cultural, physical, and biological control. Proper stewardship of pest control materials involves resistance management by rotating products with different modes of action. The Insecticide Resistance Action Committee (IRAC) has developed a grouping, based on mode of action, to facilitate the implementation of appropriate rotation programs. Pest control materials have been assigned a designated number (sometimes number and letter combinations) associated with their mode of action. For more information, consult the IRAC website (www.irac.online.org). **The information presented in this chart is not a substitute for the label. Always read and understand all information presented on the label before using any pest control material.** Also, be sure to check county and state regulations to determine if there are any local restrictions associated with the use of specific pest control materials listed in this chart.

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
APHIDS	Abamectin	Avid	12 hours	**6:** GABA[1] chloride channel activator
	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Afidopyropen	**Ventigra**	12 hours	**9D:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	Cycaniliprole	Sarisa	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole + Flonicamid	Pradia	12 hours	**28 + 29:** Selective activation of ryanodine receptors + Selective feeding blocker/chordotonal organ modulator
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
▼	Flupyradifurone	Altus	4 hours	**4D:** Nicotinic acetylcholine receptor modulator
APHIDS *continued*	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Cordyceps (=Isaria) fumosorosea Apopka Strain 97	Ancora	4 hours	
	Cordyceps (=Isaria) fumosorosea Strain FE 9901	NOFLY WP	12 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pymetrozine	Endeavor	12 hours	**9B:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Pyrifluquinazon	Rycar	12 hours	**9B:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Spinetoram + Sulfoxaflor	XXpire	12 hours	**5 + 4C:** Nicotinic acetylcholine receptor disruptor/agonist and GABA chloride channel activator + nicotinic acetylcholine receptor modulator
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
BROAD MITE	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Fenpyroximate	Akari	12 hours	**21A:** Mitochondria electron transport inhibitor
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Pyridaben	Sanmite	12 hours	**21A:** Mitochondria electron transport inhibitor
	Spiromesifen	Savate	12 hours	**23:** Lipid biosynthesis inhibitor
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
CATERPILLARS	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Bacillus thuringiensis subsp. *kurstaki*	Dipel	4 hours	**11:** Midgut membrane disruptor
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
▼	Cyclaniliprole	Sarisa	4 hours	**28:** Selective activation of ryanodine receptors

(Pest control materials in **bold typeface** are from BASF.)

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
CATERPILLARS *continued*	Cyclaniliprole + Flonicamid	Pradia	12 hours	**28 + 29:** Selective activation of ryanodine receptors + Selective feeding blocker/chordotonal organ modulator
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Pyridalyl	Overture	12 hours	Unknown mode of action
	Methoxyfenozide	Intrepid	4 hours	**18:** Ecdysone agonist: mimics action of molting hormone
	Novaluron	Pedestal	12 hours	**15:** Chitin synthesis inhibitor
	Spinetoram + Sulfoxaflor	XXpire	12 hours	**5 + 4C:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator + nicotinic acetylcholine receptor modulator
	Spinosad	Conserve	4 hours	**5:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
CYCLAMEN MITE	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Fenpyroximate	Akari	12 hours	**21A:** Mitochondria electron transport inhibitor
	Spiromesifen	Savate	12 hours	**23:** Lipid biosynthesis inhibitor
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
FUNGUS GNAT LARVAE	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Bacillus thuringiensis subsp. *israelensis*	Gnatrol	4 hours	**11:** Midgut membrane disruptor
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Cyromazine	Citation	12 hours	**17:** Chitin synthesis inhibitor
	Diflubenzuron	Adept	12 hours	**15:** Chitin synthesis inhibitor
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
▼	Pyriproxyfen	Distance/Fulcrum	12 hours	**7C:** Juvenile hormone mimic

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
FUNGUS GNAT LARVAE *continued*	*Steinernema feltiae*	**Nemasys**		
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
FUNGUS GNAT ADULTS	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
LEAFHOPPERS	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Buprofezin	Talus	12 hours	**16:** Chitin synthesis inhibitor
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
	Flupyradifurone	Altus	12 hours	**4D:** Nicotinic acetylcholine receptor modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Cordyceps (=Isaria) fumosorosea Strain FE 9901	NOFLY WP	12 hours	
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
LEAFMINERS	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
▼	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator

(Pest control materials in **bold typeface** are from BASF.)

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
LEAFMINERS *continued*	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole	Sarisa	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole + Flonicamid	Pradia	12 hours	**28 + 29:** Selective activation of ryanodine receptors + Selective feeding blocker/chordotonal organ modulator
	Cyfluthrin + Imidacloprid	Discus	4 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Cyromazine	Citation	12 hours	**17:** Chitin synthesis inhibitor
	Diflubenzuron	Adept	12 hours	**15:** Chitin synthesis inhibitor
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Cordyceps (=Isaria) fumosorosea Apopka Strain 97	Ancora	4 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Novaluron	Pedestal	12 hours	**15:** Chitin synthesis inhibitor
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Spinosad	Conserve	4 hours	**5:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
MEALYBUGS	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Afidopyropen	**Ventigra**	12 hours	**9D:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Buprofezin	Talus	12 hours	**16:** Chitin synthesis inhibitor
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Cyclaniliprole + Flonicamid	Pradia	12 hours	**28 + 29:** Selective activation of ryanodine receptors + Selective feeding blocker/chordotonal organ modulator
▼	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
MEALYBUGS *continued*	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
	Flupyradifurone	Altus	4 hours	**4D:** Nicotinic acetylcholine receptor modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	Nicotinic acetylcholine receptor modulator (4A)
	Cordyceps (=Isaria) fumosorosea Apopka Strain 97	Ancora	4 hours	
	Cordyceps (=Isaria) fumosorosea Strain FE 9901	NOFLY WP	12 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Pyrifluquinazon	Rycar	12 hours	**9B:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Spineotram + Sulfoxaflor	XXpire	12 hours	**5 + 4C:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator + nicotinic acetylcholine receptor modulator
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
PLANT BUGS	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Cyclaniliprole + Flonicamid	Pradia	12 hours	**28 + 29:** Selective activation of ryanodine receptors + Selective feeding blocker/chordotonal organ modulator
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Flupyradifurone	Altus	4 hours	**4D:** Nicotinic acetylcholine receptor modulator
	Cordyceps (=Isaria) fumosorosea Apopka Strain 97	Ancora	4 hours	
	Cordyceps (=Isaria) fumosorosea Strain FE 9901	NOFLY WP	12 hours	
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
SCALES (HARD AND SOFT)[a]	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
▼	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone

(Pest control materials in **bold typeface** are from BASF.)

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
SCALES (HARD AND SOFT)[a] *continued*	Bifenthrin	**Attain TR**/Talstar	12 hours	**4A:** Prolong opening of sodium channels
	Buprofezin	Talus	12 hours	**16:** Chitin synthesis inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole	Sarisa	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole + Flonicamid	Pradia	12 hours	**28 + 29:** Selective activation of ryanodine receptors + Selective feeding blocker/chordotonal organ modulator
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Pyriproxyfen	Distance/Fulcrum	12 hours	**7C:** Juvenile hormone mimic
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
SHORE FLY LARVAE	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyromazine	Citation	12 hours	**17:** Chitin synthesis inhibitor
	Diflubenzuron	Adept	12 hours	**15:** Chitin synthesis inhibitor
	Pyriproxyfen	Distance/Fulcrum	12 hours	**7C:** Juvenile hormone mimic
	Spinosad	Conserve	4 hours	**5:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator
	Steinernema carpocapsae	**Millenium**		
SLUG AND SNAIL	Iron phosphate	Sluggo	0 hours	Inhibits calcium metabolism
	Metaldehyde	Deadline	Refer to Label	Central nervous system toxin
SPIDER MITE (TWOSPOTTED)	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Acequinocyl	Shuttle	12 hours	**20B:** Mitochondria electron transport inhibitor
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenazate	Floramite	12 hours	**20D:** Mitochondria electron transport inhibitor
▼	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
SPIDER MITE (TWOSPOTTED) *continued*	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Clofentezine	Novato	12 hours	**10A:** Growth and embryogenesis inhibitor
	Cyflumetofen	**Sultan**	12 hours	**25:** Mitochondria electron transport inhibitor
	Etoxazole	TetraSan/Beethoven	12/24 hours	**10B:** Chitin synthesis inhibitor
	Fenazaquin	Magus	12 hours	**21A:** Mitochondria electron transport inhibitor
	Fenpyroximate	Akari	12 hours	**21A:** Mitochondria electron transport inhibitor
	Hexythiazox	Hexygon	12 hours	**10A:** Growth and embryogenesis inhibitor
	Cordyceps (=Isaria) fumosorosea Apopka Strain 97	Ancora	4 hours	
	Metarhizium brunneum Strain F52	Met52	4 hours	
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyridaben	Sanmite	12 hours	**21A:** Mitochondria electron transport inhibitor
	Spiromesifen	Savate	12 hours	**23:** Lipid biosynthesis inhibitor
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
THRIPS	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole	Sarisa	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole + Flonicamid	Pradia	12 hours	**28 + 29:** Selective activation of ryanodine receptors + Selective feeding blocker/chordotonal organ modulator
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
▼	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator

(Pest control materials in **bold typeface** are from BASF.)

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
THRIPS *continued*	*Cordyceps (=Isaria) fumosorosea* Strain FE 9901	NOFLY WP	12 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Metarhizium brunneum Strain F52	Met52	4 hours	
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Novaluron	Pedestal	12 hours	**15:** Chitin synthesis inhibitor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Pyridalyl	Overture	12 hours	Unknown mode of action
	Spinetoram + Sulfoxaflor	XXpire	12 hours	**5 + 4C:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator + nicotinic acetylcholine receptor modulator
	Spinosad	Conserve	4 hours	**5:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Steinernema feltiae	**Nemasys**		
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
WHITEFLIES	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Afidopyropen	**Ventigra**	12 hours	**9D:** Selective feeding blocker/chordotonal organ TRPV modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Buprofezin	Talus	12 hours	**16:** Chitin synthesis inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole	Sarisa	4 hours	**28:** Selective activation of ryanodine receptors
	Cyclaniliprole + Flonicamid	Pradia	12 hours	**28 + 29:** Selective activation of ryanodine receptors + Selective feeding blocker/chordotonal organ modulator
▼	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
WHITEFLIES *continued*	Cyfluthrin + Imidaclorpid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Diflubenzuron	Adept	12 hours	**15:** Chitin synthesis inhibitor
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenazaquin	Magus	12 hours	**21A:** Mitochondria electron transport inhibitor
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
	Flupyradifurone	Altus	4 hours	**4D:** Nicotinic acetylcholine receptor modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Cordyceps (=Isaria) fumosorosea Apopka Strain 97	Ancora	4 hours	
	Cordyceps (=Isaria) fumosorosea Strain FE 9901	NOFLY WP	12 hours	
	Metarhizium brunneum Strain F52	Met52	4 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Novaluron	Pedestal	12 hours	**15:** Chitin synthesis inhibitor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pymetrozine	Endeavor	12 hours	**9B:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	Pyrethrins + Canola Oil	Pycana	12 hours	**3 + suffocation (oil on board):** Sodium channel modulators
	Pyridaben	Sanmite	12 hours	**21A:** Mitochondria electron transport inhibitor
	Pyrifluquinazon	Rycar	12 hours	**9B:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Pyriproxyfen	Distance/Fulcrum	12 hours	**7C:** Juvenile hormone mimic
	Spinetoram + Sulfoxaflor	XXpire	12 hours	**5 + 4C:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator + nicotinic acetylcholine receptor modulator
	Spiromesifen	Savate	12 hours	**23:** Lipid biosynthesis inhibitor
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor

[a] Refer to label for specific scale species.

[1] GABA=Gamma-aminobutyric acid.

[2] Additional azadirachtin products include the following: AzaGuard, Aza-Direct, and AzaSol.

(Pest control materials in **bold typeface** are from BASF.)

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July, 2024

Bell Nursery: Sowing the Seeds of Sustainability in their Production Practices

Bell Nursery's Morven, North Carolina facility that covers a little more than 60 acres of container grown perennials.

Bell Nursery got its start in the late 1920s with a greenhouse behind the Langley Park, Maryland, home of Rose and Grafton Mangum. From those beginnings grew a family business that developed into an organization with 350 acres of fields and 75 acres of greenhouses. Bell Nursery is a single-source supplier to The Home Depot, providing around 100 million annuals and perennials to stores in seven states and Washington, D.C.

Care for the environment has always been part of the Bell Nursery culture. In 2014, Bell Nursery became the country's first large-scale grower to eliminate neonicotinoids from its pest management toolbox, due to the impact to bees and pollinators. Leading the way, Bell has inspired other growing operations throughout the industry to follow their example. Bringing this culture to life starts with the people of Bell Nursery.

Always playing in the dirt

Brandon Christopher, head grower at Bell Nursery's North Carolina facilities, has a love of plants that has spanned his lifetime.

"My grandparents always grew big gardens," Brandon recalls. "And we grew tobacco, so I was always playing in the dirt somewhere as a kid."

His passion for plants was taken further in adolescence by getting involved in the 4H program in Buncombe County and judging horticulture competitions on district, state and national levels. Brandon continued his education at Haywood Community College, earning his AAS in Horticultural Science, while acquiring professional certifications in the horticultural field.

Brandon now balances his time between the two Bell Nursery facilities located in Monroe and Morven, North Carolina.

"I hired on here as a head grower at the Morven facility covering a little more than 60 acres under production," he said. "I also serve as head grower in Monroe and farm manager in Morven, overseeing day-to-day operations."

The North Carolina facilities grow perennials, groundcovers and garden mums in pots 1 to 3 gallons in size.

Brandon and Bell Nursery seem like an ideal combination. Both have an intense interest in the ecological impact of their work. And both have an appetite for trying new tools and approaches to pest management.

With Brandon, watching out for the land is just part of the process.

"In Sandy Mush, North Carolina, where I grew up, we didn't have a lot of chemicals, so they used a lot of IPM practices," Brandon explained. "They taught me a lot of the companion plantings—like tomatoes and carrots, you plant those together [for mutual benefits like weed suppression and nutrient sharing]—and the symbiotic relationships like ladybugs eating aphids. I learned that stuff at a young age, but the industry moved away from those techniques since chemicals were so easy and so quick."

He's happy to see that the industry, and an operation like Bell in particular, have embraced the importance of good stewardship.

Brandon Christopher and his Great Dane puppy Lily at the Morven, North Carolina, location of Bell Nursery.

Healthy roots treated with Pageant Intrinsic brand fungicide.

Lessons from a Legacy

Incorporating biological solutions into production can seem like a daunting task. Brandon shares his advice and approaches he keeps top of mind:

- ***Be open to trying new things.*** "I just keep my ear to the ground, hear what's coming out and just try it. That's all you can do. We're trying new chemicals, new [biological control agents [BCAs] and new application techniques to see what we can do to make these plants grow a little better."
- ***Leverage your industry resources.*** Whether its among his fellow growers or looking to industry experts, Brandon knows he's not alone when facing a challenge. Having resources to lean on when pest or disease pressures spike is critical to being successful.
- ***Don't be afraid to fail.*** Brandon has big plans for expanding the trial gardens at the Morven facility. "The trial gardens are my playground. I try new tools and approaches to see what works and what doesn't."

Brandon knows that with the right techniques, the right biologicals and the right partners, pests and diseases can be managed in a way that benefits the growers, the agriculture industry and the planet.

"I started out at a young age, just fell in love with it and just keep going. I've seen so many changes over the last 10 years and I can't wait to see where it goes from here."

Change is perennial

As an experienced manager who still gets his hands dirty, Brandon has a good view of where the industry has been and where it's going.

"It's always evolving, always changing," he said. "There's always something different out there—new techniques, new varieties, new chemicals—and you're always meeting new people.

"I try to make sure I'm as educated as I can be to make the right decisions because some people will just sell you stuff," he continued. "Staying educated and up to date is the biggest thing."

One area of focus and interest to Brandon is the use of biologicals as an integrated pest management (IPM) tool to help manage resistance.

At Bell Nursery, weekly calls help the growers across sites stay on the same page and share information about what's working and where there are challenges. This exchange of best practices and problem solving is critical as many crops are started in one location and shipped to another location to finish based on climate needs and timing. Locally, Brandon has built his team with fellow peers that share his passion.

"I've got a couple of young employees; they're always scouting and Googling everything they see in the field, then coming to me with something new. We need to keep the next generation involved and continue to improve our process." he said.

Whether it's a new conventional chemistry or a new way to apply biologicals like Nemasys beneficial nematodes, Brandon has built a team that endlessly pursues learning about new ideas and innovations to bring into production.

Brandon and his team are constantly trying new products and techniques as they navigate the challenges of two facilities. As he explained, "We've used Velifer [bioinsecticide/miticide], a lot of nematodes—including Nemasys [beneficial nematodes]."

Everything is a balance, and while research is important, urgency and action are critical too.

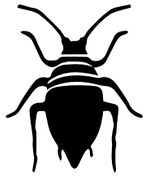
"A lot of people forget with biologicals, these are living organisms just like the plants. You have to have urgency to make sure these things survive—making sure the environment is correct, [for example] making sure you're not putting your nematodes out when it's 95 degrees," he said.

Brandon and his team have worked hard to build out their IPM practices, balancing both conventional chemistries and biological solutions. He notes, "It's been doing really well for me. I like to use a lot of the oils. And I'm a big fan of the Intrinsic [brand fungicides]. I am always excited to see new biological chemicals coming out like Velifer!"

Bell also incorporates targeted conventional chemistries like Sultan miticide and Ventigra insecticide as part of their IPM programs. ■

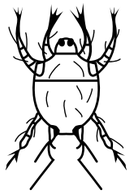
Building Better Insecticide Programs

Basic Rotations + Functional Glow Ups



APHIDS

- **Ventigra®** insecticide (Group 9D)
- **Velifer®** bioinsecticide/miticide (Group NC)
- Pradia® insecticide (Groups 28+29)
- XXpire® (Group 5 + 4C)
- IGR: Azatin® O biological insecticide (Group UN)

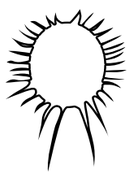


BROAD MITES

- **Pylon®** miticide or **Pylon TR** miticide (Group 13)
- **Velifer®** bioinsecticide/miticide (Group NC)
- **Ultra-Pure® Oil** insecticide, miticide, fungicide (Group NC)
- Sanmite® miticide/insecticide (21A)
- Sirocco® miticide/insecticide (6+20D)

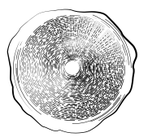
FUNGUS GNAT LARVAE

- **Nemasys®** beneficial nematodes (Group NC)
- **Pylon** miticide-insecticide or **Pylon TR** miticide-insecticide (Group 13)
- Citation® insecticide (Group 17)
- IGR: Fulcrum® insect growth regulator (Group 7C)



MEALYBUGS

- **Ventigra** insecticide (Group 9D)
- **Ultra-Pure Oil** insecticide, miticide, fungicide (Group NC)
- Safari® insecticide (Group 4A)
- Pradia insecticide (Groups 28+29)
- IGR: Talus® insect growth regulator (Group 16)

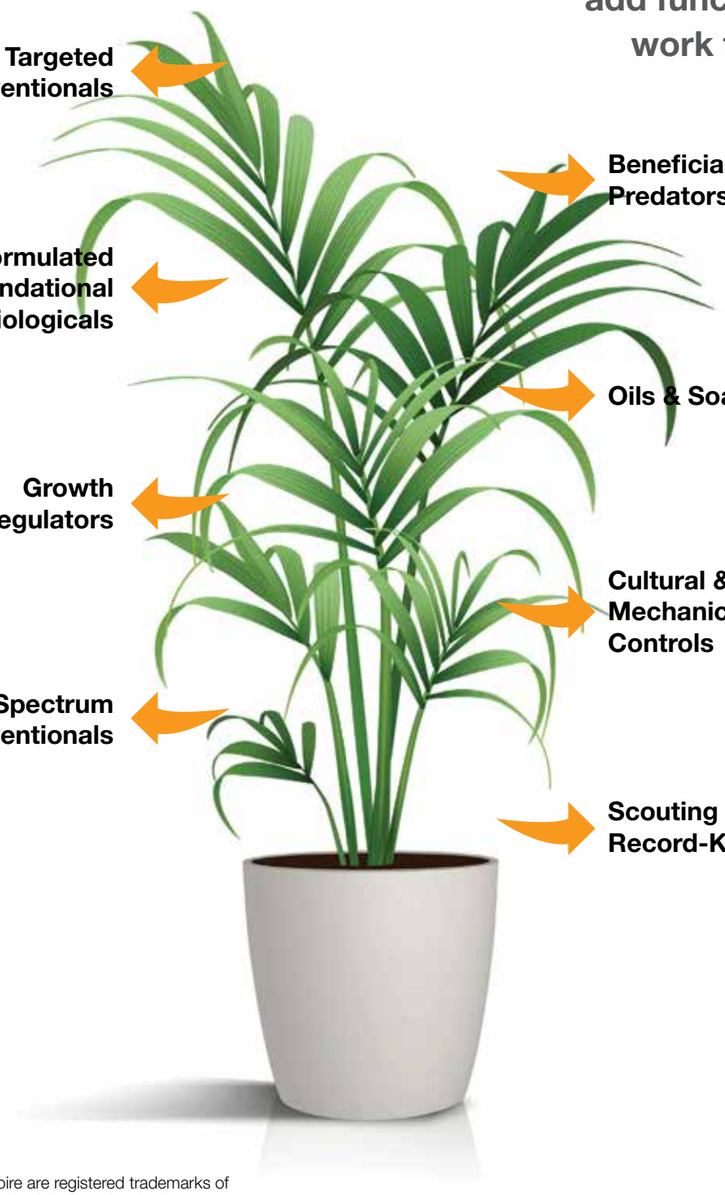


SCALE

- **Ventigra** insecticide (Group 9D)
- **Ultra-Pure Oil** insecticide, miticide, fungicide (Group NC)
- Safari insecticide (Group 4A)
- Pradia insecticide (Groups 28+29)
- IGR: Fulcrum insect growth regulator (Group 7C)

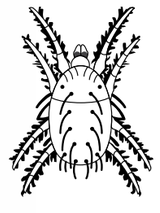
the IPM decision tree

basic rotations to build on
add functional groups that
work for your operation



SHORE FLIES

- **Millenium®** beneficial nematodes (Group NC)
- Azatin O biological insecticide (Group UN)
- Citation insecticide (Group 17)
- Conserve® SC Insecticide (Group 5)
- IGR: Fulcrum insect growth regulator (Group 7C)



SPIDER MITES

- **Sultan®** miticide (Group 25)
- **Pylon** miticide-insecticide or **Pylon TR** miticide-insecticide (Group 13)
- **Velifer** bioinsecticide/miticide (Group NC)
- Savate® miticide/insecticide (Group 23)
- IGR: TetraSan® miticide/ovicide

THRIPS

- **Pylon** miticide-insecticide (Group 13)
- **Velifer** bioinsecticide/miticide (Group NC)
- Mainspring (Group 28)
- XXpire (Group 5 + 4C)
- IGR: Pedestal® insect growth regulator (Group 15)

WHITEFLIES

- **Ventigra** insecticide (Group 9D)
- **Velifer** bioinsecticide/miticide (Group NC)
- Aria insecticide (Group 29)
- Savate® miticide/insecticide (Group 23)
- IGR: Talus insect growth regulator (Group 16)

Always read and follow label directions.

BASF
We create chemistry

We make suggestions,
you make the decisions

JEN BROWNING, PCA
BASF Senior Technical Specialist

Apply Preemergence Herbicides Accurately & Uniformly (Easier Said Than Done!)

By **Joseph C. Neal, Ph.D., Professor of Weed Science**—*Department of Horticultural Science, North Carolina State University*

Preemergence herbicides won't work well if they aren't applied uniformly. It sounds simple—apply the herbicides uniformly. BUT obtaining uniform applications of granular preemergence herbicides at the labeled dose is hard to do. We measured the uniformity of applications by nursery workers at multiple container nurseries in North Carolina. The results surprised even the most skeptical among us:

- Only one of six applications was within 20% of the target dose.
- Even on that site the dose the individual pots received varied from 0.5 to 2.5 times the target dose.

Is it any wonder that preemergence herbicides sometimes don't work as well as you hoped? Weed control is poor where the dose is too low, and occasionally we see random plants in the block that aren't growing well, perhaps because the herbicide dose was too high.

"But I used the calibration catch pan the salesperson gave me" is a phrase I often hear. Here's the unfortunate reality: Those calibration catch pans aren't very accurate. Granules bounce out … and they bounce in. We found that the most common catch pans captured only about 50% of the granules that hit the pan; the rest of the granules bounced out. Catch pans with taller walls captured between 60% and 70% of the granules. It turns out agricultural engineers have known about this problem for many years.

So how do you improve the uniformity and accuracy of granular herbicide applications in your nursery? Turns out the answer is actually pretty simple … but you're not going to like it.

Step 1. Calibrate your spreader to apply about half the target dose.

- Fill the spreader with herbicide, weigh the spreader, apply the herbicide on a known area, then weigh the spreader again.
- The difference in weight is the amount of herbicide applied.
- Divide by the square feet treated times 43,560—that is the dose (per acre) applied.

Variable granule distribution when the granular spreader is not used correctly.

All photos by Joe Neal.

Step 2. To make uniform applications with a hand-cranked, hand-held spreader, you must follow these guidelines.

- Maintain a consistent walking speed and handle cranking speed. Use a metronome.
- The size of the beds matters! Keep nursery beds between 6- and 8-ft. wide (for an 8- to 10-ft. swath width). No more, no less.
- Only use the center rudder position on the spreader and don't hold the spreader at an angle.
- Refill the hopper when the level drops to about 25% full. Don't wait until it runs out.
- Start walking and cranking before opening the hopper.
- Spread half the dose walking in one direction then reverse direction ON THE SAME PATH. Yes, that's right—two passes on each path (in opposite directions).
- If the wind is 5 mph or more, don't make the application. Wait for a calmer day.

What's new in nursery herbicide application? Aerial drones! Many nurseries in the U.S. are evaluating the use of aerial drones to apply granular herbicides. Besides reducing the time required to apply herbicides, these application systems may (and I emphasize *may*) be more accurate and precise.

In tests by researchers at Auburn University, the application uniformity of aerial drones was significantly better than that of hand-held spreaders. But readers are cautioned: There's much to be learned about the operational parameters that will produce uniform and accurate herbicide applications with aerial drones. Yet, I predict that within just a few years aerial drone applications of granular herbicides will be common in container nurseries. ■

Applying granular herbicides in container nurseries.

For more details and videos about granular herbicide applications in container nurseries, scan the QR code.

And for more information on weed management in nurseries and landscape plantings, visit Dr. Neal's website at weeds.ces.ncsu.edu.

Rotate & Re-Apply

Preemergent Herbicides for Nursery Weed Control

By **Chris Marble, Ph.D.**—*Associate Professor, University of Florida Mid-Florida Research and Education Center*

Active Ingredient	Example Trade Names	WSSA Herbicide Group*	Weeds Controlled*
Dithiopyr	Dimension EW	3	Grasses and some broadleaves
Oryzalin	Surflan AS	3	
Pendimethalin	Pendulum AquaCap/G	3	
Prodiamine	Barricade L, RegalKade G	3	
Trifluralin	Treflan G	3	
Flumioxazin	Broadstar G, SureGuard SC	14	Broadleaves and some grasses
Oxadiazon	Ronstar G	14	
Oxyfluorfen	Goal XL	14	
Dimethenamid-P	Tower EC	15	Grasses, broadleaves, sedge suppression
s-Metolachlor	Pennant Magnum EC	15	Grasses, some broadleaves, sedge suppression
Napropamide	Devrinol DF	15	Grasses and some broadleaves
Isoxaben	Gallery SC	21	Broadleaves
Indaziflam	Marengo SC, G	29	Broadleaves and grasses
Benefin + Oryzalin	XL 2G	3+3	Grasses and some broadleaves
Dimethenamid-P+ Pendimethalin	FreeHand 1.75G	15+3	Grasses and broadleaves
Isoxaben + Trifluralin	Snapshot G	21+3	
Isoxaben + Prodiamine	Gemini SC/G	21+3	
Isoxaben + Dithiopyr	Fortress G	21+3	
Flumioxazin + Prodiamine	Fuerte G	14+3	
Oxadiazon + Prodiamine	RegalStar G	14+3	
Oxyfluorfen + Oryzalin	Rout G	14+3	
Oxyfluorfen + Pendimethalin	OH2 G	14+3	
Oxyflourfen + Prodiamine	Biathlon G	14+3	
Oxyflourfen + Oxadiazon	Regal O-O G	14+14	

* Weed Science Society of America (WSSA) herbicide group numbers are based on herbicide mode of action (MOA) and represented by different color codes. MOA should be rotated to prevent/delay resistance development and improve weed control. Weeds control column lists general weed types controlled by each herbicide; user should consult individual product labels for a full list of weed species controlled.

PRECISION TARGETED

for piercing-sucking insects

We understand the threat of pests is constantly top of mind throughout production. You need precise, effective solutions that support your sustainable growing practices. Ventigra insecticide uses an innovative mode of action that delivers targeted control of piercing and sucking insects with minimal impact to beneficial insects including predatory mites.

Ventigra®
Insecticide

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Always read and follow label directions.

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