MAGAZINE • SINCE 1937

GROWERTALKS

2026 Insecticide, Miticide & Fungicide Guide

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Intrinsic® Brand Fungicides

The building blocks to better plants

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Pageant®
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Orkestra®
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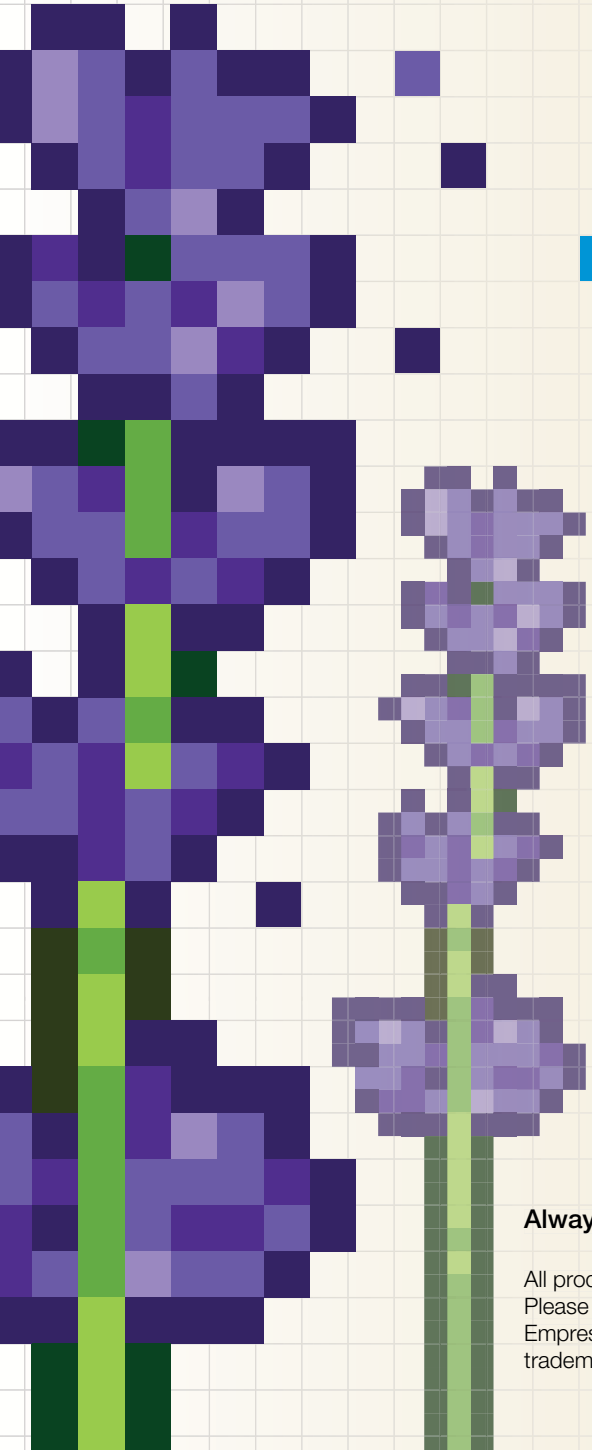
Intrinsic® Brand Fungicide



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GROWERTALKS®

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GreenProfit Supplement Enclosed

Cultivating Collaboration

There's something special about this industry. No matter where we go or who we meet, when it comes to describing a nursery or greenhouse operation, the word family often comes up. And just like many of us share pictures of our kids or pets, when talking to someone in our industry there's a sense of pride showing off perfectly nurtured plants.

At BASF, our sense of pride comes from bringing innovative products and technical expertise to the industry—whether it's with our Intrinsic® brand fungicides that provide proven plant health benefits, new molecules like the one found in Avelyo® fungicide that offers superior safety or our insecticides and miticides that get targeted control of key pests with little impact to beneficials.

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

Liz Dunbar
Product Manager, Greenhouse & Nursery, BASF

In this issue, you'll see why Tom Dodd Nurseries has a lot to be proud of. They built upon their strong foundation by expanding acreage and continuing to innovate. You'll also hear from plant scientists as they dig deep into disease control, growth efficiency and enhanced stress tolerance in plants. You'll see our research-based recommendations on utilizing fungicides to help grow stronger, more resilient plants, and also our newest solution to add to your rotation.

Our latest innovation, Pillar® SC Intrinsic brand fungicide, is a dependable, economical and easy-to-use fungicide that's part of the trusted Intrinsic family of products. This latest building block will:

- Provide broad-spectrum disease control
- Increase root development
- Improve stress tolerance
- Enhance plant quality

We're very proud to support this industry and our continued sponsorship of the Insecticide, Miticide & Fungicide Guide. On behalf of our entire team, we hope you find this edition valuable and wish you a successful year.

ON THE COVER:
Dragon's Breath Celosia in propagation.
Photo courtesy of BASF.

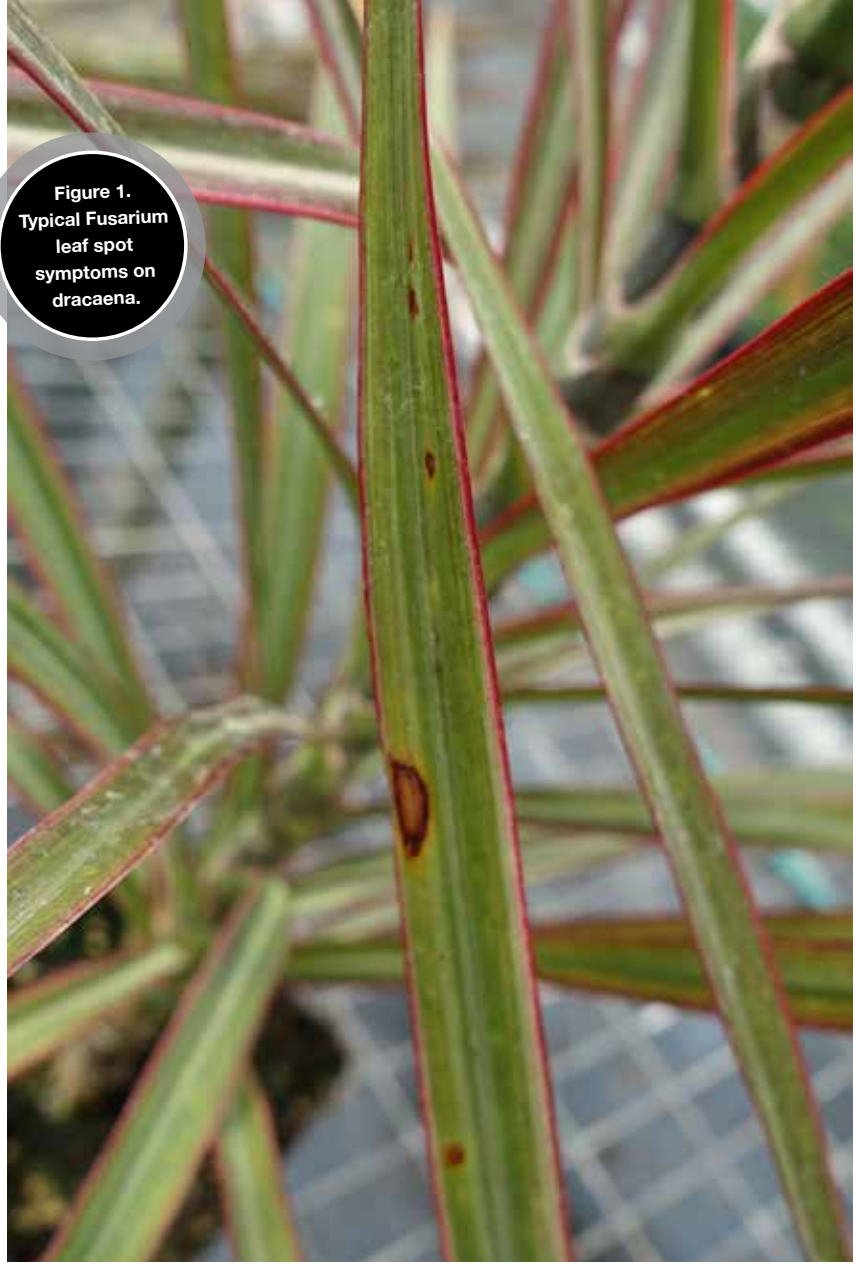

Figure 1. Typical Fusarium leaf spot symptoms on dracaena.

Guarding Against Fusarium

Best practices for growers.

By David James Norman, Ph.D.—
University of Florida Mid-Florida Research and Education Center

Growers are very familiar with the fungal pathogen Fusarium, however, they may not be aware of the many different diseases it can cause in various crops. Fusarium can produce diverse symptoms depending on the host, including leaf spots, root rot, crown rot, dry rots, vascular wilts and seedling damping off. Fusarium leaf spot symptoms can range from pinpoint spots to large spots over an inch in diameter. These leaf spots are frequently observed in holiday cactus and dracaena production. Dracaena plants often exhibit small leaf spots with a red halo, which is the most common symptom (Figure 1). Many propagative cuttings of dracaena are produced offshore and shipped to the United States. If the pathogen is present in the crop when cuttings are shipped, it can cause crown rot of the apical stem. Therefore, it's important to treat the cuttings before shipment to protect them during transit.

One of the hardest Fusarium diseases to control is Fusarium wilt of chrysanthemum. In chrysanthemums, Fusarium becomes systemic, breaking down tissue in stems and growing inside the vascular system, spreading upwards. This causes sectors of the foliage to wilt, die and turn dark brown (Figure 2).

Fusarium also causes root rot in infected plants and colonizes the soil. Early summer and spring symptoms of the wilt are generally not seen. Growers purchase cuttings, and after a few months of growth, plants are transplanted into finishing pots and often moved outdoors. In late summer, heat and rain favor Fusarium wilt development. Splashing rain and overhead irrigation help move spores between plants, leading to visible signs of infection as flowers bud. Growers should treat preventively for Fusarium wilt in late summer and fall when conditions favor the pathogen. Chrysanthemum breeders have been actively breeding for Fusarium wilt resistance, with yellow and orange chrysanthemums generally more resistant than exotic pink and purple cultivars.

Besides chrysanthemums, several other major flowering crops have been negatively impacted by Fusarium in both the United States and Europe. Two common examples are carnations and cyclamen. Extensive losses to Fusarium in these crops led to several nurseries going out of business in the late 1980s and early 1990s. These losses prompted productive changes in plant cultivation, benefiting current growers by encouraging practices such as rigorous sanitation, soil disinfestation, resistance breeding and the use of Fusarium-free cuttings or corms.

Bulb crops—such as gladiolus, iris and tulips—can also be negatively impacted by Fusarium. Over the years, various hot water treatments have been developed and recommended. Unfortunately, there ▶

Dependable. Economical. Easy to Use.

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The Newest Building Block To Better Plants.

Pillar® SC

Intrinsic® Brand Fungicide

- Broad Spectrum **Disease Control**
- Proven Plant **Health Benefits**
- Improved **Stress Tolerance**
- Improved **Root Development**

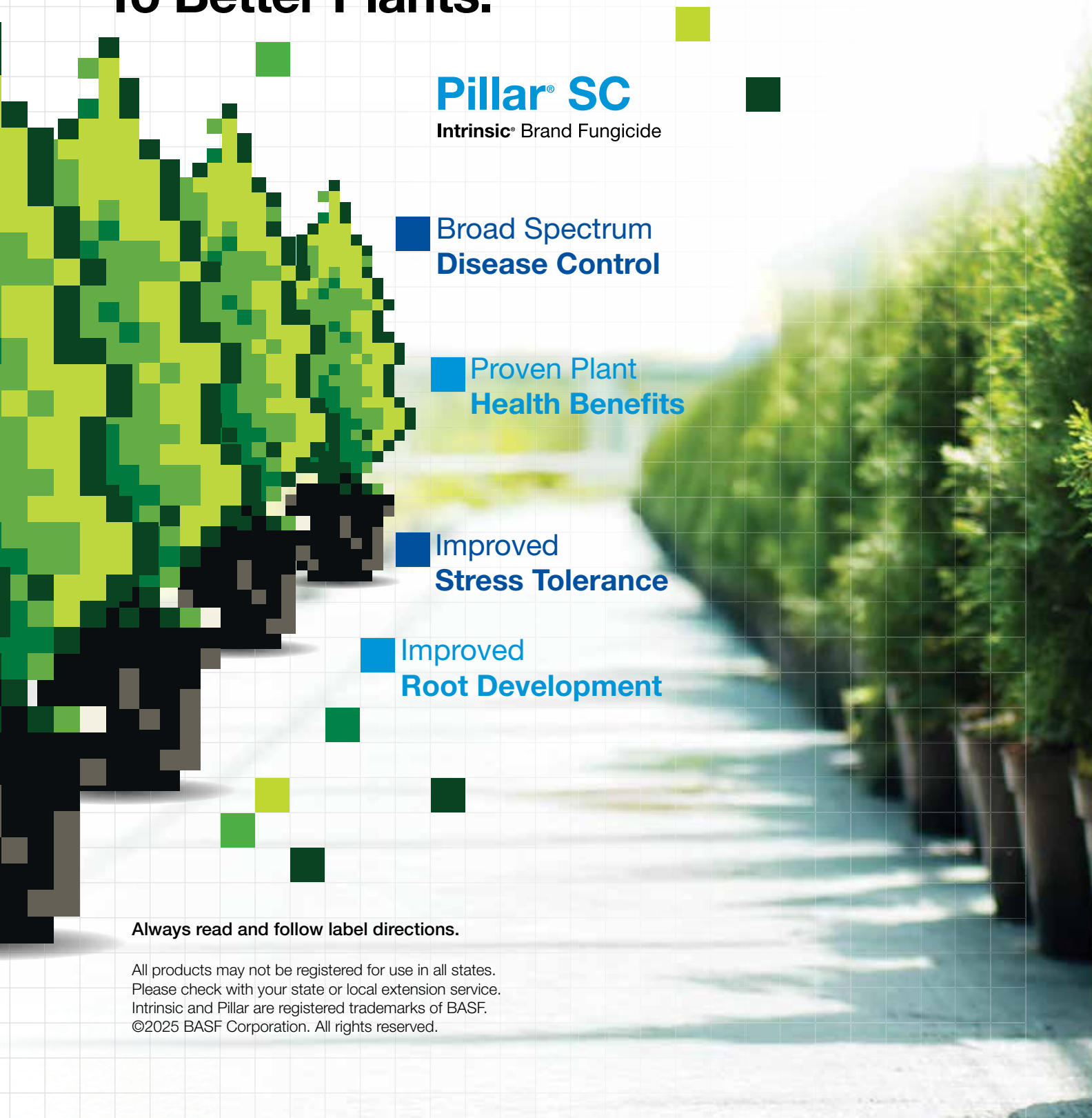

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Figure 2. Fusarium wilt of chrysanthemum causing sectors of the foliage to wilt, die and turn dark brown.

Figure 3. Fusarium rot of aglaonema.

are a limited number of fungicides labeled for bulb dips. Many of these bulb crops are grown in the field, presenting an interesting problem, as many soil fumigants have either been discontinued or aren't very effective. Because Fusarium can build up populations over time, it's sometimes recommended that crops be rotated at least every five years. Rotation offers the time-honored practice of eliminating the pathogen, but with the high cost of land this has become impractical.

In tropical foliage production, many different Fusarium-caused diseases affect common aroids such as pothos, philodendrons, alocasias, monsteras, ZZ plants, aglaonemas, syngonium and colocasias. Early symptoms usually occur with wounding and can be seen in damaged leaf axils, where the tissue turns brown and sometimes has a red halo. If plants are stressed, a dry soft rot of tissue can occur (Figure 3), differing from the mushy, fishy-smelling Erwinia bacterial soft rot.

Fusarium biology basics

There are many species of Fusarium, some of which are plant pathogens, while others live on decaying plant matter. Pathogenic Fusarium species are often subdivided into "formae speciales" with restricted host ranges. These species can also live without a host, complicating disease diagnosis.

Fusarium can rapidly overgrow other plant pathogens during isolation, sometimes leading to misdiagnosis. For example, in English ivy production, Fusarium is a common secondary pathogen to Phytophthora root rot. Fusarium is easier to isolate than Phytophthora, leading to incorrect fungicide recommendations that only treat Fusarium.

Saprophytic survival

Fusarium species can produce asexual spores (chlamydospores) or mycelium, and some produce ascospores, allowing survival in adverse conditions. Fusarium can survive in soil, crop residue, seed, greenhouse structures, tools and machinery for many years. It can gain access to facilities through infected plant propagules, media, seed, wind and water. Damage is often limited if plants are well cared for, but stress can trigger disease symptoms.

Preventative horticulture

Growers should follow these basic rules to manage Fusarium in production:

1. Know your plant propagule supplier. Change suppliers if Fusarium is a continual problem.
2. Use synthetic media mixes in greenhouses to eliminate casual introduction via infested soil.
3. Use light soil mixes to reduce Fusarium advantage. Water-soaked media stresses plants and promotes Fusarium colonization.
4. Sanitation is crucial; remove all dead plant material to prevent Fusarium growth and survival.
5. Choose resistant cultivars to make cultivation easier.

Apply fungicides preventatively when growing plants under warm, wet conditions conducive to Fusarium.

Disease Management—Fungicides

Fungicide resistance in Fusarium species is a growing concern worldwide. Fusarium species have developed resistance to various fungicide classes, and this resistance has been observed in different regions and crops. Resistance can occur due to genetic mutations or overexpression of certain chemical pathways in Fusarium, making fungicides less effective. Growers must understand fungicide usage patterns and rotate between active ingredients. While switching fungicides is a common method to combat resistance, the limited variety of antifungal products makes it challenging.

Some Fusarium strains are notorious for their resistance to multiple fungicides. For example, thiophanate-methyl products have been used successfully for many years to control Fusarium on various crops. However, without proper rotation, resistance has developed in a number of crops. Growers must always develop a rotation plan between fungicides containing different active ingredient classes. ■

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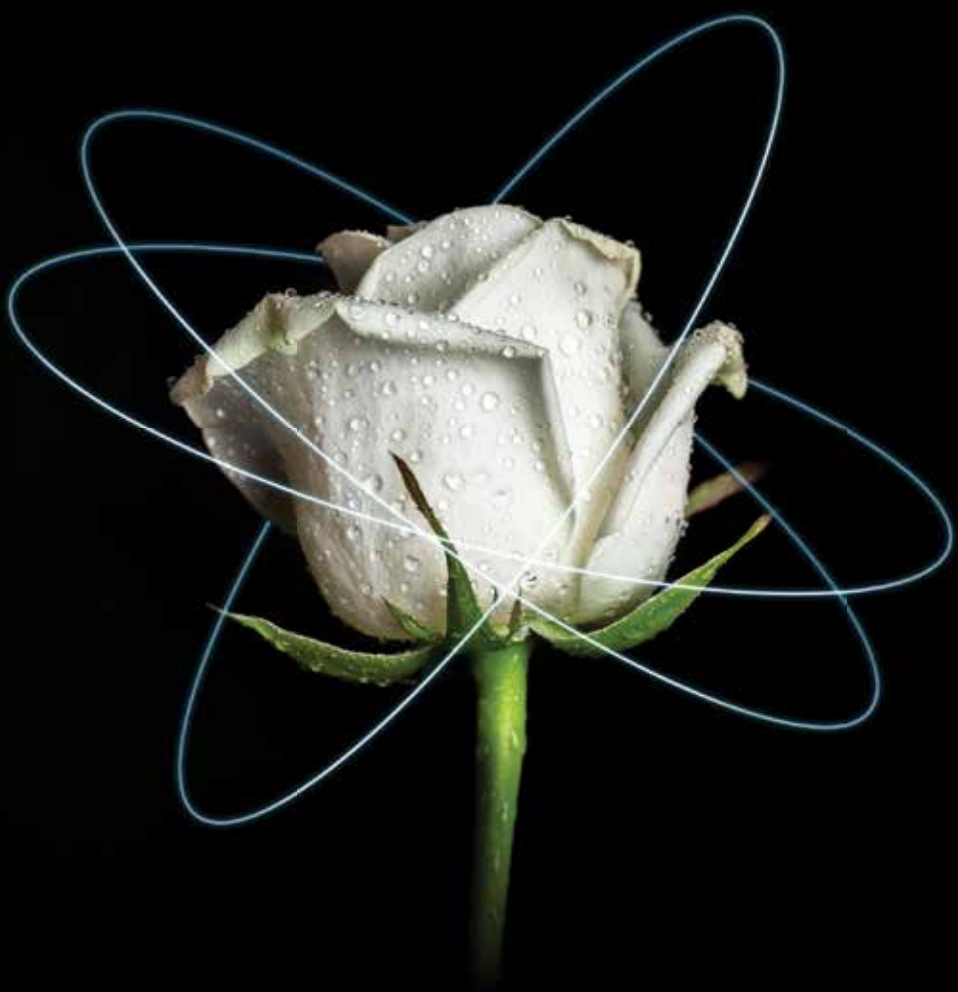
Avelyo®
Fungicide

MAKE YOUR ROTATION REVOLVE AROUND PLANT SAFETY

Discover a brand new DMI fungicide that delivers long-lasting disease control with exceptional plant safety. Introducing Avelyo® fungicide, designed to keep plants healthy from every angle. It's a dynamic addition to your rotation that is safe to apply at any stage in production.



DYNAMIC ROTATION PARTNER

Discover Avelyo fungicide

Building better fungicide programs

Balanced plant protection solutions

BOTRYTIS BLIGHT

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

LEAF SPOTS, POWDERY MILDEW AND RUST

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

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

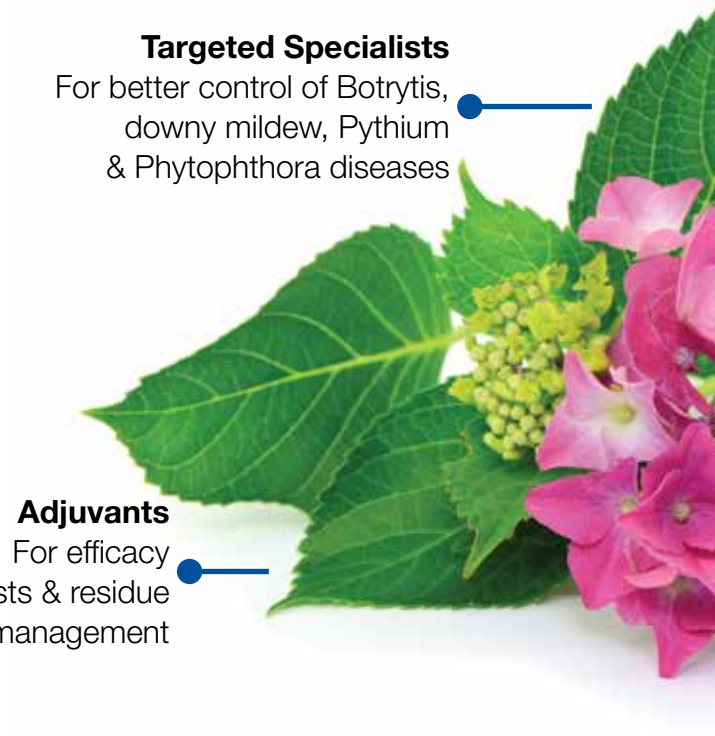
DOWNY MILDEW

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

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

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

Adjuvants
For efficacy boosts & residue management



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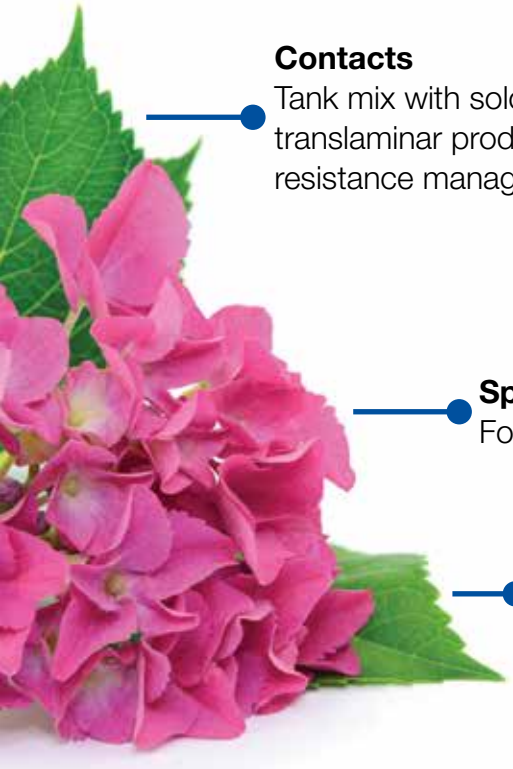


Contacts
Tank mix with solo systemics/ translaminar products for resistance management

Spray
For foliar diseases

Drench
For root/crown diseases

Proper Diagnosis

ROOT AND CROWN ROTS (NON-OOMYCETE)

(Fusarium, Rhizoctonia, Cylindrocladium, Thielaviopsis = Berkeleyomyces)

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

From roots through bloom to finish
prevent diseases before they start

EMMA LOOKABAUGH, PH.D.
BASF Senior Technical Specialist

Dedication, Passion & Innovation

What drives Casey Marshall and Tom Dodd Nurseries.

Casey Marshall, Chemical & Pest Manager at Tom Dodd Nurseries.

Casey Marshall's career began far from the tranquil nursery he now calls home. For 12 years, he worked offshore, loading and unloading 65,000 barrels of unleaded gasoline along the eastern seaboard, from Nova Scotia down to North Carolina.

"Having a son changed everything. He was 4 years old, you know, starting football and baseball and all that stuff," Casey recalled. The life of a barge tankerman was demanding, with three weeks on and three weeks off, flying between Alabama and New York."

As his son grew older, Casey yearned for a life closer to home, one where he could coach football and baseball and be present for his family.

Taking the plunge

In 1999, Casey made a bold move. He walked into a nursery and accepted a minimum-wage job pulling hoses and spraying plants. It was a big shift from his life at sea, but one that allowed him to be with his son and start a new chapter in his career. Six years later, Casey was managing the pesticide program.

A new beginning at Tom Dodd

In 2011, Casey joined Tom Dodd Nurseries, an historic enterprise founded in 1920 in the heart of Alabama's nursery capital near Mobile. Casey is part of a 150-member team, each playing an important role in daily operations.

"John Williams bought Tom Dodd in 2006 and I came over in 2011. He's a real good businessman and he put a good team together and we've been growing ever since," Casey explained.

Tom Dodd Nurseries is well known for its exceptional plant quality and customer service. Casey said it's the willingness to go above and beyond for customers that sets them apart in the industry.

"We'll bend over backwards for a customer, so I'd say customer service is a big part of why we grew," he said. Whether it's accommodating last-minute add-ons to orders or ensuring top-notch plant quality, the nursery's commitment to customer satisfaction is unwavering.

Tom Dodd Nurseries operates off of 400 acres of production in Semmes, Alabama.

Tom Dodd Nurseries specializes in producing high-quality woody ornamentals, perennials, grasses and groundcovers, offering products ranging from liners to 30-gallon containers. They serve growers, re-wholesalers, distribution centers and retail garden centers across the South, Central and Eastern United States. The wholesale nursery is based in Semmes, Alabama, and are licensed growers for well-known brands, including Encore® Azaleas, Endless Summer® Hydrangeas, First Editions® Shrubs and Trees, Garden Debut®, Gardener's Confidence®, Southern Living® Plant Collection, and Proven Winners®. They also produce the popular Star® Knock Out® and Drift® Roses.

Innovation, technology & experience

In recent years, Tom Dodd Nurseries has embraced technology and innovation with their openness to test new types of sprayers, including drones. This forward-thinking approach is part of the nursery's culture, which values both customer service and innovation. The team at Tom Dodd—including Flint Johnson, the general manager, and Wayne Howell, Senior Grower—have a wealth of experience and knowledge.

"We have a really good team. Flint has been in the nursery business for 40-plus years. He's an awesome general manager. This family-like atmosphere

Tom Dodd Nurseries grows a wide range of products, from liners to 30-gallon containers of trees and shrubs.

Nursery Fast Facts

- 150-member team
- 400 acres
- 573 greenhouse structures
- 161 acres of outside bed space
- 5,540 gallons of water used per minute capability
- 194 acres of irrigation

contributes to the nursery's success and low turnover rate.

Staying ahead of disease

Managing a nursery comes with its share of challenges, from pests to diseases. Casey's expertise in pest control is evident, as he discusses the various issues they face, such as leaf spots, bugs and diseases like southern blight and Fusarium wilt.

"We deal with a lot of Phyllostica, Cercospora and Entomosporium leaf spot, southern blight, Anthracnose, Fusarium rust—we pretty much get all of it. I'm all about getting ahead of things and trying to forecast what's about to happen," Casey explained.

Preventive measures are key and Casey's proactive approach ensures that problems are addressed before they escalate.

One of the nursery's standout practices is the use of a unique spray applicator, which provides better coverage and reduces chemical usage.

"It's not so much a sprayer as it is a wand. Most people use the JT9 pistol with their sprayers. They'll pull it out there and it's like a pistol, reaching mainly the tops of plants. Well, you don't get really good coverage like that," Casey said.

The wand method, developed by Casey, has been in use for about three years and has proven effective in maintaining plant health by surrounding the plants instead of being shot at.

The importance of relationships

Casey also highlights the importance of relationships in the industry. He speaks highly of his BASF representative Mindy Money, who provides invaluable support and expertise.

"Mindy's great. If I have a problem, I call her and we'll try to figure out what's going on. That's not something you get with generics," said Casey.

The nursery's collaboration with Metrolina—a large customer that supplies plants to major retailers like Lowe's, Home Depot and Walmart—further underscores the significance of strong partnerships. The commitment to growing and maintaining strong relationships with customers, by meeting their needs and exceeding expectations, is part of the Tom Dodd culture.

A legacy of quality

Tom Dodd Nurseries' reputation for quality is well deserved. Their primary customers include re-wholesalers and growers, with a focus on independent garden centers. Holly plants, a staple of the nursery, have been grown there for over 105 years.

"They're an oldie, but a goodie. We sell a ton of hollies," Casey said.

The nursery recently expanded by adding 100 acres, bringing their total to 400 acres with room to grow. This expansion involved significant effort, including clearing land and re-irrigating. BASF products play a crucial role in the operations at Tom Dodd Nursery.

"I love Intrinsic, part of the Orkestra and Empress and Pageant. I use those three quite a lot," Casey shared. "These products help in managing pests and diseases effectively, ensuring the health and quality of the plants."

Intrinsic® Brand Fungicides, including Orkestra® and Empress®, are known for their broad-spectrum disease control and plant health benefits.

"When we applied the Orkestra, it was like I was painting the nursery green after I'd spray a crop and move onto the next one. A day or two later, that crop was just … boom! It just like jump-started the plant," Casey said.

The fungicides not only prevent diseases, but also promote root growth and overall plant health.

Casey highlighted the importance of using high-quality products.

"I used to jump all over the generics thinking I'm saving money but it's not always the same thing. I know I'm paying for the research and development and all the things that you guys do for new chemicals," Casey said.

The consistency and reliability of BASF products have made a significant difference in the nursery's operations.

Looking ahead

As Casey reflects on his journey, it's clear he loves what he does. The nursery's family atmosphere and the satisfaction of seeing healthy, thriving plants make his job rewarding.

"I do love what I do and it's a challenge every day, trying to stay ahead of everything. Getting the preventative sprays out. It's a challenge, but I enjoy it. In the end, we're more than co-workers, we're family and each of us takes pride in our work," he said. ■

Chemical Class Chart for Greenhouse Nursery Fungicides

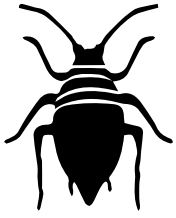
FRAC Group	Chemical Group	Active Ingredient Common Name	Trade Name
1	MBC - fungicides (MethylBenzimidazole Carbamates)	thiophanate-methyl	Banrot*, 3336, OHP 6672, Spectro 90*, 26/36*
2	dicarboximides	iprodione	OHP Chipco 26019
3	DMI-fungicides (DeMethylation Inhibitors)	Difenoconazole	Postiva*
		mefentrifluconazole	**Avelyo**
		metconazole	Tourney
		myclobutanil	Eagle 20EW
		propiconazole	Banner MAXX, Concert II*, Strider
		tebuconazole	Torque
		triadimefon	Bayleton
		triflumizole	Terraguard
		triticonazole	**Pillar SC Intrinsic***
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	Qol-fungicides (Quinone outside Inhibitors)	azoxystrobin	Heritage, Mural*
		fluoxastrobin	Fame SC
		pyraclostrobin	**Empress Intrinsic, Orkestra Intrinsic*, Pageant Intrinsic*, Pillar SC 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

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.

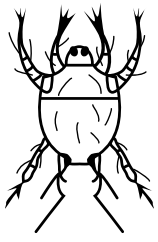
Building Better Insecticide Programs

Basic Rotations + Functional Glow Ups



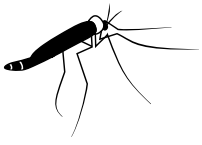
APHIDS

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)



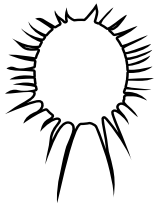
BROAD MITES

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)



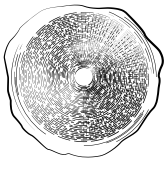
FUNGUS GNAT LARVAE

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

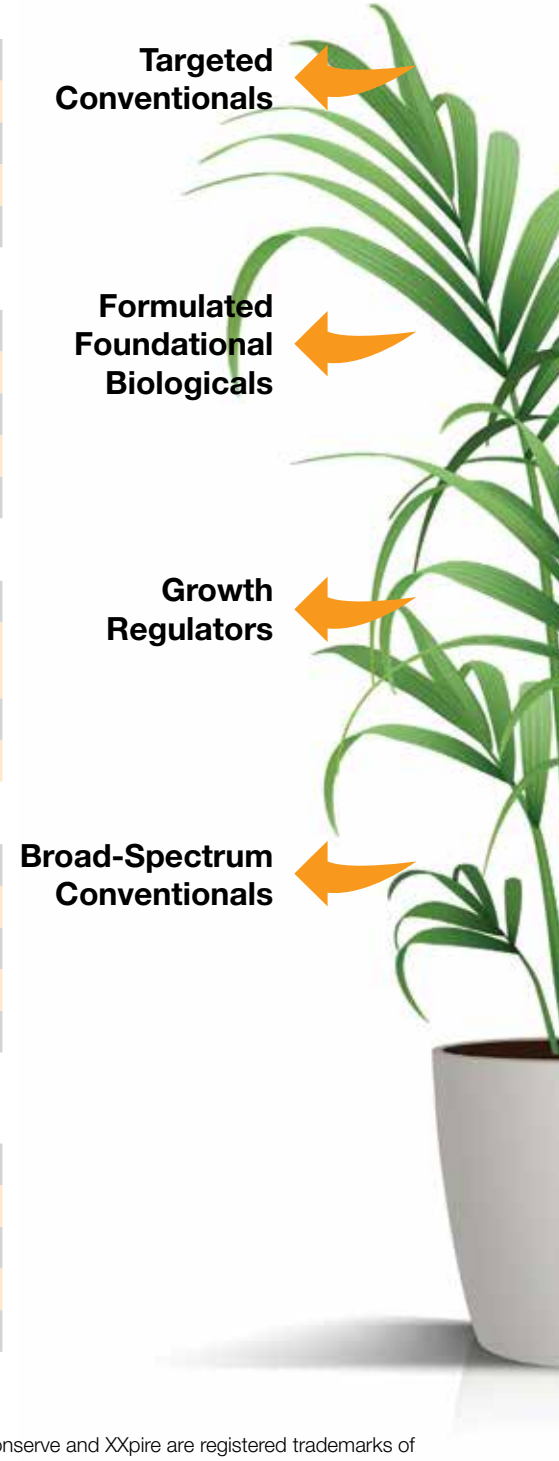
Ventigra insecticide (Group 9D)
Ultra-Pure Oil insecticide, miticide, fungicide (Group NC)
Safari insecticide (Group 4A)
Pradia insecticide (Groups 28+29)
IGR: Fulcrum insect growth regulator (Group 7C)

Targeted Conventionals

Formulated Foundational Biologicals

Growth Regulators

Broad-Spectrum Conventionals



Always read and follow label directions.

BASF
We create chemistry

the IPM decision tree

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

Beneficials & Predators

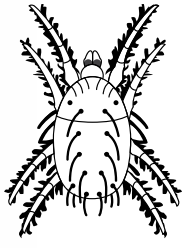
Oils & Soaps

Cultural & Mechanical Controls

Scouting & Record-Keeping

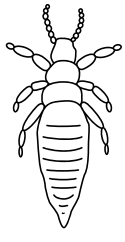
SHORE FLIES

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)



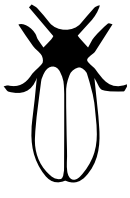
SPIDER MITES

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)

We make suggestions, you make the decisions

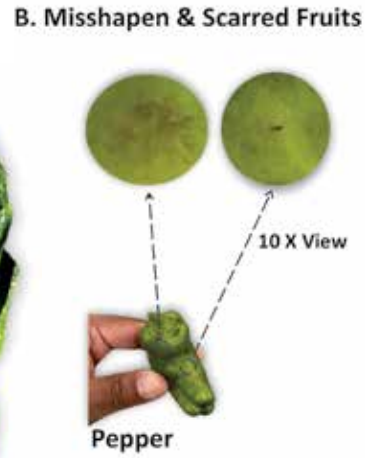
JEN BROWNING, PCA
BASF Senior Technical Specialist

A focus on *Thrips parvispinus*

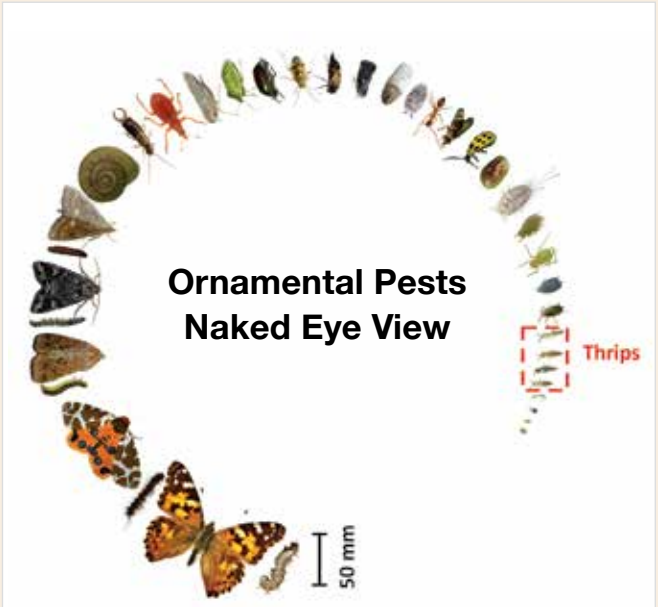
By Zee Ahmed, Ph.D.—*Clemson University*

Step 1. Look for Thrips Damage

Naked Eye View
Gardenia



Step 3. Understand Thrips Size



Step 4. Understand SpeciesThrips D

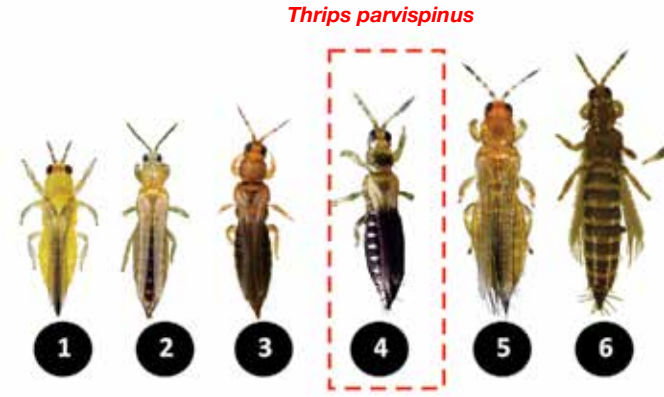
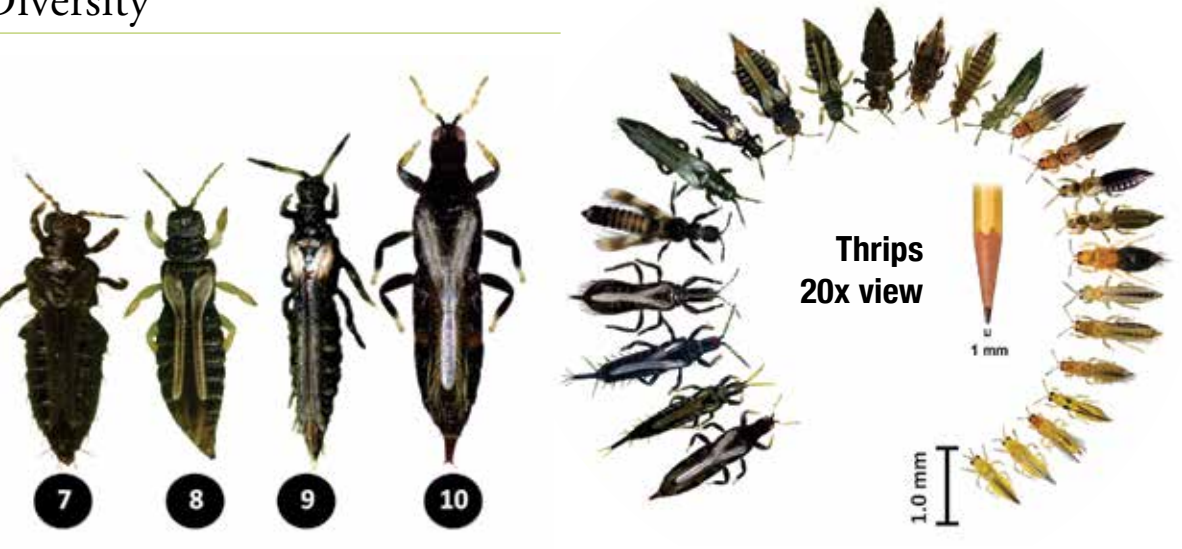


Photo credits go to Agrobaseapp; Babu Panthi, Ph.D., University of Florida; Carl Barrentine from Bug Gui
FDACS; iNaturalist; Lance Osborne, Ph.D., University of Florida; Lavender_gooms129 from Reddit; Lyle Buss
Clemson University. Disclaimer: This field guide provides tentative identification. Species, especially thos

s in Ornamentals:

Step 2. Look for Thrips

Diversity



1. Chilli thrips, *Scirtothrips dorsalis*
2. Onion thrips, *Thrips tabaci*
3. Hawaiian flower thrips, *Thrips hawaiiensis*
4. Pepper thrips, *Thrips parvispinus*
5. Western flower thrips, *Frankliniella occidentalis*
6. Common blossom thrips, *Frankliniella schultzei*
7. Redbanded thrips, *Selenothrips rubrocinctus*
8. Greenhouse thrips, *Heliothrips haemorrhoidalis*
9. Poinsettia thrips, *Echinothrips americanus*
10. Cuban laurel thrips, *Gynaikothrips ficorum*

de; Choi and Lee (2018); Dreamstime Images (204693333, 206675336, 232488730, 285200326, 338987666, 338987666, 338988018); Elijah Talamas, Ph.D., DPI-FDACS; Felipe Soto-Adames, Ph.D., DPI-, University of Florida; Shutterstock Images; Tony DiTerlizzi from BugGuide; Vivek Kumar from the University of Florida; Whitney Cranshaw, Ph.D., Colorado State University; and Zee Ahmed, Ph.D., e of regulatory concern, should be confirmed by a qualified taxonomist. Thrips size may vary based on age, host plant, and location. **Acknowledgment:** Dr. Felipe Soto-Adames (FDACS-DPI, Florida).

2026 Insecticides and Miticides for Managing Insect and Mite Pests of Greenhouse-Grown Horticultural Crops

By Raymond A. Cloyd, Ph.D. —*Department of Entomology, Kansas State University*

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

Rotate insecticides and miticides with different modes of action across generations to avoid insect and mite pest populations from developing resistance.

—Raymond A. Cloyd

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 *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
	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	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
	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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Use of Rice Hulls and Preemergence Herbicides for Improving Container Nursery Weed Control

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

Interest and use of rice hulls (and other types of mulch) has increased in recent years as a way of controlling weeds in chemically sensitive ornamentals. Many growers are using rice hulls successfully, but like other methods, they're not 100% effective, especially if rice hulls are added on top of pots that already contain a lot of weed seed.

In a Horticulture Research Institute-sponsored study at the University of Florida, we found weed control was excellent when weed seeds were added on top of rice hulls (e.g. pots mulched at potting), but while still providing a benefit over using nothing, there was a breakthrough when weed seeds were placed below a 0.5-in. layer of rice hulls (e.g. mulching weeks after potting, Figure 1).

Most commercially grown ornamental species can tolerate at least a few different preemergence herbicides, so we investigated if rice hulls and herbicides could be combined to improve weed control even further. In this study, we had nursery pots that either had rice hulls (0.5-in. depth) or no rice. Pots were then seeded with about 50 seeds of woodsorrel (oxalis) with seeds being placed either above or below rice hulls. To determine if there was any benefit to adding a preemergence herbicide, we then treated half the pots with Tower (dimethenamid-P) herbicide, applying it either above or below the rice hulls to separate sets of pots. Our objective was to determine if we would see any benefit of applying Tower to mulched containers, and if the placement of the herbicide or weed seeds would impact results. After seeding and the herbicide treatment, the weeds were allowed to grow for 10 weeks before the study was concluded.

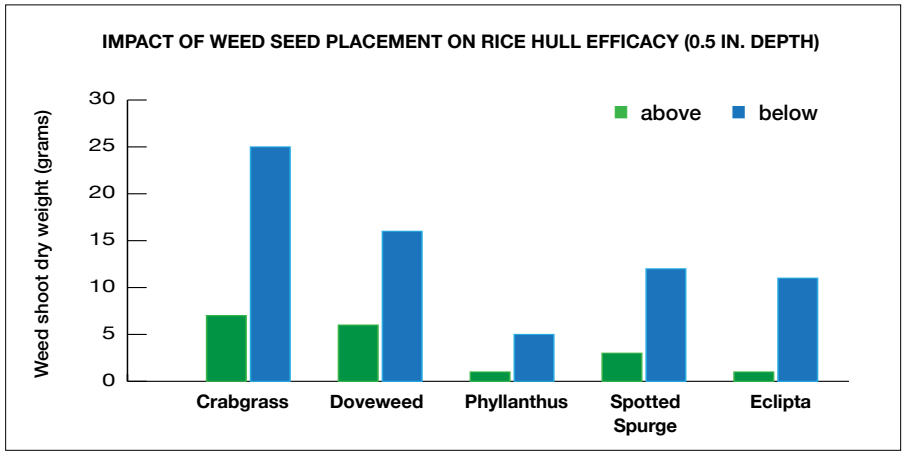

FIGURE 1. Growth of five container nursery weed species following seeding either above or below a 0.5-in. layer of rice hull mulch. Both treatments resulted in a significant reduction in growth compared with a non-mulched control (not pictured).

The results

Using rice hulls alone definitely provided a benefit and more so when weed seeds were placed on top of pots that were already mulched. Oxalis growth doubled when seeds were placed below the mulch layer compared to when seeds were placed on top. When looking at non-herbicide treated pots versus treated pots, Tower was more effective than rice hulls, as rice hulls reduced oxalis growth (shoot weight) by about 70% on average when it was used alone compared with a 93% decrease when Tower was used alone (Figure 2).

When comparing all of the Tower-treated pots, weed control was high overall and would have been considered excellent (>90% control) in both mulched and non-mulched pots. However, combining Tower with the rice hulls provided the best control, reducing woodsorrel growth by another 60% compared with using Tower alone (Figure 3). There was no meaningful difference based on Tower placement in relation to the mulch layer (above or below) and Tower was equally effective on seeds placed above and below the mulch layer.

Practical implications

While rice hulls work regardless of where the seeds are, they tend to work best when weed seeds land on top of the mulch because they dry so quickly after irrigation and don't provide a good environment for weed growth. Therefore, it would be important to apply rice hulls as soon as possible after potting to prevent weed growth and seed ▶


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FIGURE 2.

Oxalis (woodsorrel) control following treatment with Tower + rice hulls (0.5 in.), Tower alone, rice hulls alone and a non-treated control at eight weeks after seeding.

Tower + rice hulls

Tower alone

Rice hulls alone

Control

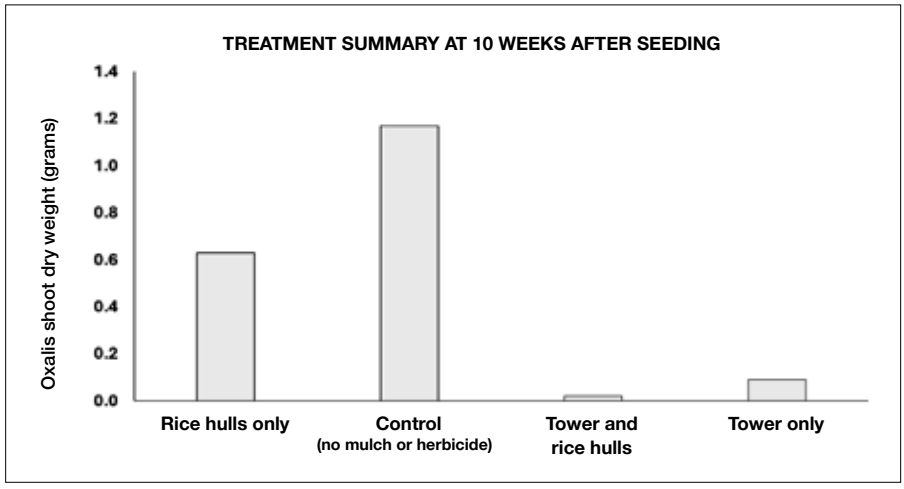

FIGURE 2. Oxalis (woodsorrel) growth following treatment with rice hulls (0.5 in.), no rice hulls or herbicide, Tower + rice hulls (0.5 in.), and Tower alone. Lower oxalis shoot weight indicates better weed control.

contamination. As the depth of rice hulls increases, they become more effective on seeds beneath the mulch layer.

In some cases, they can even suppress small weed seedlings that have already emerged. In one previous study, we saw a 100% reduction in oxalis and bittercress (Cardamine spp.) One inch of rice hulls were placed on top of small weed seedlings at the one to two leaf and two to four leaf growth stages (Figure 4).

placement had no impact on Tower efficacy. While results will vary depending on the herbicide and weed species, it can be concluded that even if rice hulls are used, there are further advantages when combining with herbicides where possible. Use of both a preemergence herbicide such as Tower and rice hulls could offer advantages in addition to just improving weed control, such as giving you some "insurance" if a herbicide application is delayed, controlling

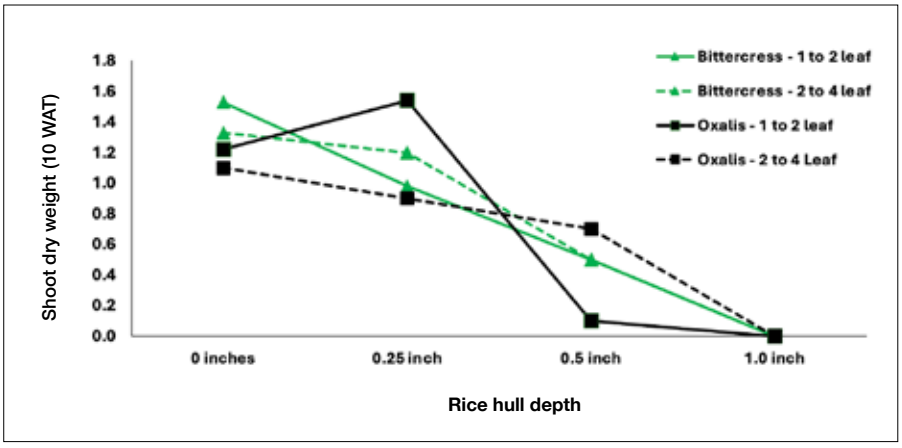

FIGURE 4. Example of the ability of rice hulls to suppress small weed seedlings. Rice hulls were added on top of five seedlings of oxalis or bittercress at the one to two leaf or two to four leaf growth stage at four different depths. Treatment averages at 10 weeks after mulch application are shown.

While rice hulls worked well, better control was achieved in this study with Tower. We also saw advantages when combining Tower and rice hulls over just the rice hulls alone and seed

different weed species or extending the time in between herbicide applications. Combining multiple methods of control based on your crops and unique situation is going to yield the best results. ■

Rotate & Re-Apply

Preemergent Herbicides for Nursery Weed Control

By Chris Marble, Ph.D.—
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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
Pethoxamid	Stricor EC	15	
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	
Flumioxazin + Pyroxasulfone	SureGuard Xtra SC	14 +15	

** 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.*

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