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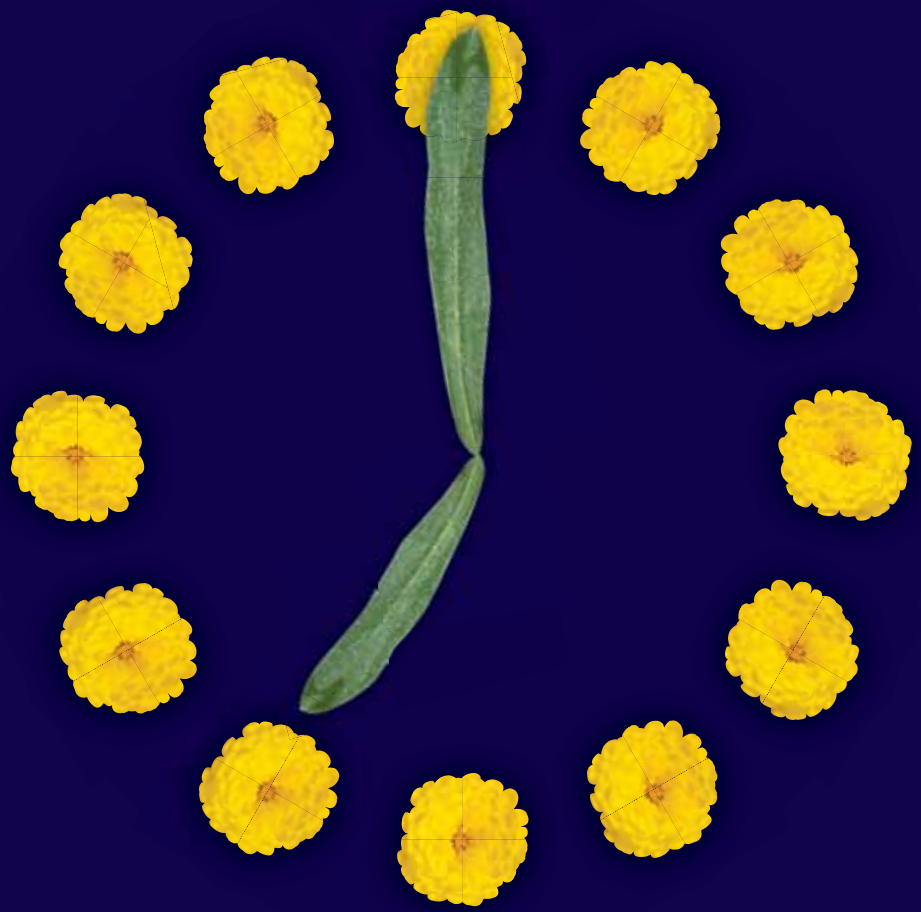
GROWERTALKS

Sponsored by Syngenta Plant Protection

Insecticide & Fungicide Guide

2014–15



IT ONLY TAKES A MINUTE

In that time, growers can turn on the lights and begin their day. But growers aren't the only ones working hard. It only takes a minute for pests like ***leafminers****,* ***lepidoptera*** *or* ***thrips*** *to invade your operation and start causing unsightly damage to your plants.*

In a new chemistry class, ***Mainspring***™ *insecticide is the perfect partner for integrated crop management programs. It quickly stops pests from feeding and prevents further plant damage. So while life is measured one minute at a time, it takes less than that to realize Mainspring is a great choice.*

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Mainspring™ Insecticide

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EDITORIAL
EDITOR Chris Beytes
beytes@growertalks.com
MANAGING EDITOR Jennifer Zurko
RETAIL EDITOR Jennifer Polanz
CONTRIBUTING EDITOR Ellen C. Wells
CONTRIBUTING EDITOR Jennifer D. White
INTERNATIONAL EDITOR Ron Van der Ploeg

COLUMNISTS
John Friel Kerry Herndon
Judy Sharpton Bill McCurry

CONTRIBUTING WRITERS
Bill Swanekamp Paul Westervelt
Gary Mangum Albert Grimm
Anne-Marie Hardie Abe Van Wingerden
Chris Fifo Gerry Raker
Charlie Hall Roger McGaughey
Doug Cole

PRODUCTION MANAGER Kathy Wootton
CREATIVE DIRECTOR Chris Truesdale
PHOTOGRAPHER Mark Widhalm
COPY EDITOR Sue Olsen

SALES 866.888.4237

PUBLISHER | SALES MANAGER Paul Black
pblack@ballpublishing.com
ACCOUNT MANAGER Kim Brown
kbrown@ballpublishing.com
SALES ASSISTANT Adriana Heikkila
aheikkila@ballpublishing.com
CUSTOMER SERVICE Allison Klicek
aklicek@ballpublishing.com
CLASSIFIED ADVERTISING classifieds@ballpublishing.com

BALL PUBLISHING

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G. Victor Ball, Editor from 1949–1997

GrowerTalks general offices are located at:
PO BOX 1660, West Chicago, Illinois 60186 U.S.A.
ph: 630.231.3675 | fax: 630.231.5254 | Toll-Free: 1-888-888-0013
www.growertalks.com

Welcome!

Insects. Diseases. No matter how sophisticated we in horticulture get, we'll never completely eliminate those two banes of our existence.

Thankfully, there are smart scientists in the pest management industry, such as our sponsor, Syngenta Plant Protection, working 24/7 to develop new products—both chemical and biological—that are more effective, more targeted, safer and easier to use than ever before. Additionally, there are researchers in academia and the private sector who dedicate their careers to finding methods for maximizing all the tools at our disposal to control those aforementioned pests.

Hence, the purpose of *GrowerTalks*' biannual Insect & Fungicide Guide: to bring you the most current listings of available pest management products and the newest methods for using them.

For instance, on page 4, Dr. Steve Frank of North Carolina State University shares up-to-date details on thrips control, including tips for breaking the thrips population cycle, which he thinks "accounts for 90% of calls to Extension and industry personnel."

Turning to the disease portion of this guide on page 12, Plant Pathologist Ann Chase of Chase Horticultural Research lays out the differences between using pre-mixed fungicides versus tank-mixing your own combinations (hint: there's no wrong answer).

On page 16, Nancy Rechcigl, a Technical Service Representative with Syngenta, offers best practices for sound disease management. She quotes Ben Franklin's famous line, "An ounce of prevention is worth a pound of cure," which could have been written specifically about greenhouse disease management.

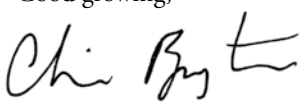
And since everyone involved in this guide is invested in offering broad-based alternatives for your insect and disease management program, on page 20, Suzanne Wainwright-Evans (the Buglady) outlines the basics of biological control in production—including when and how to use pesticide sprays.

Finally, all of the above will be much more effective if utilized within the framework of a proper ICM—integrated crop management—program. On page 23, Marla Faver covers the eight elements of a successful ICM program, including the most important one: scouting, which she says is "the only way for a grower to have an intimate knowledge of his crop and potential disease and pest pressures."

Of course, it's the charts that make this a handy year-round reference: the Insecticide Guide begins on page 5, the chemical class chart on page 14 and the Fungicide Guide on page 17.

A special thanks to our sponsor, Syngenta (whose products are in bold in the charts), and to all of our contributors.

Good growing,



Chris Beytes, Editor
GrowerTalks/Green Profit

How Thrips Evade Insecticides

By Steve Frank

If greenhouse growers have a worst pest, it's Western flower thrips. They've been called "the most damaging greenhouse pest in the world" for good reason. They reproduce quickly, feed on most crops and evade insecticides in at least three different ways. Western flower thrips damage most bedding plants, cut flowers, foliage plants and perennials, and can cause double damage to ornamental plants by feeding on leaves and flowers. They scrape plant tissue then suck the juices that are released. This causes abraded patches of tissue on leaves that eventually become silvery or brown. On flowers, the damage may appear as white or brown streaks on petals. Thrips also leave small black fecal pellets at feeding sites. When thrips feed on young leaves or buds, the leaves become distorted as they grow.

In this article, we'll explore the ways to circumvent thrips' trickery and optimize insecticide efficacy. We'll also clear up some common misconceptions about why insecticides sometimes appear to fail. Understanding some basic biology combined with monitoring and application techniques, you can improve thrips management and crop protection.

Biology

Western flower thrips feed on hundreds of plant species. This means almost any flower, vegetable or herb you grow is susceptible to thrips feeding and damage. It also means that any weeds growing in or around your greenhouse can also support thrips. This adaptive biology has helped Western flower thrips spread around the world. It can certainly help them set up shop in your greenhouse and stay there. This affects insecticide efficacy because thrips can easily move from sprayed to unsprayed plants. If you spot-treat one section of a house, thrips will just move to the next crop down. If you spray the benches but have weeds growing in corners or below the benches, thrips will just flit over to the weeds. Thus, if thrips are present, it's generally best to treat the entire greenhouse or compartment rather than just the most infested crops. Needless to say, if you have weeds, get rid of them. Weeds can also harbor many other arthropod pests and diseases.

Western flower thrips' life cycle also helps them evade insecticides. They lay eggs in leaf tissue. Larvae hatch a couple days later and feed on leaves and flowers for about a week. Thrips pupate in the soil then emerge as adults that can fly from plant to plant laying eggs and feeding for weeks. Eggs embedded in leaves aren't killed by insecticide applications. Neither are pupae; they're snug in the soil. This leaves just half of thrips' life stages, larvae and adults that are susceptible to insecticide applications. Thus, even if you had a magical insecticide that killed every thrips adult and larvae (you don't, by the way), the next day, new larvae will hatch from eggs and new adults will emerge from pupae in the soil.

Breaking the cycle

I believe this aspect of thrips biology accounts for 90% of calls to Extension and industry personnel that go something like, "I sprayed X insecticide last week and it didn't work" or "I have resistant thrips because I sprayed X insecticide and still have thrips." In some cases, insecticides don't work (wrong product, old product, low or high pH, poor mixing) and, yes, thrips can develop insecticide resistance. In most cases though, especially when trying to subdue an outbreak, one application is just not enough. To break the thrips population cycle, you need two to three applications five to seven days apart. This will hopefully kill larvae that hatch after the first application before they reproduce and kill adults that emerge from pupae before they lay too many eggs. By the third application, the goal would be to have very few new eggs present and even fewer adults.

The efficacy of this plan depends on killing as many of the susceptible larvae and adults as possible with each application. Another way thrips evade insecticides is just by hiding. Thrips feed in concealed places. The most accessible place thrips feed is the underside of leaves. Less accessible places include in flowers and between layers of petals, in buds and under unexpanded leaves, and all the other nooks and crannies of plants. These concealed feeding sites are hard to cover with insecticides. To make matters worse, leaves that expand the day after you apply a contact insecticide doesn't have insecticide residue. Flowers are the same way. Thrips love flowers and flowers that open after an application don't have residue. In addition, systemic insecticides aren't transported well to flower petals, which are favored feeding sites and critical to plants' aesthetic value. Part of the lesson here is that you cannot rely on insecticides to protect plants from thrips feeding when thrips abundance is high. The goal should be to keep thrips abundance low enough that very little feeding occurs in the first place.

Photo: A. Ernst, NCSU.

Western flower thrips larva.

Another misconception is that there aren't many insecticides available for thrips. In fact, there are many good insecticides, but you need to give them a fighting chance. For the reasons outlined, even the best insecticides will only kill some percentage of the thrips in your greenhouse. Therefore, it's better to stay ahead and keep thrips abundance low rather than try to catch-up. To stay ahead,

it's important to monitor thrips abundance with sticky cards. This will alert you to gradual population changes as thrips reproduce within your house and will also alert you to sudden changes due to external factors.

For example, if your neighbor mows his hay field, you could get a sudden influx of homeless thrips that would require immediate action. You wouldn't know this until several days—and much feeding and egg laying—had passed without sticky cards. Yellow sticky cards hung just above the crop canopy will catch adult thrips. Records of when and where you catch thrips throughout the year may help you identify seasonal or spatial patterns that help you predict thrips abundance and improve management. In most cases, even a few thrips caught on sticky cards is cause for action.

Thrips have a lot of tricks that help them evade insecticide applications. We can't change thrips biology, but we can improve control by monitoring, targeting small populations and making multiple applications when necessary to interrupt their population cycle. Knowing your enemy will help you knock them down. **GT**

Photo: S.D. Frank, NCSU.

Fresh feeding and feces from thrips feeding on ornamental pepper leaves.

Steve Frank is Associate Professor and Extension Specialist in the Entomology Department at North Carolina State University. You can reach him at sdfrank@ncsu.edu or visit his website http://ecoipm.com.

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 Classification)
APHID	Methiocarb	Mesurol	24 hours	Acetylcholine Esterase Inhibitor (1A)
	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Malathion	Gown Malathion 8F	12 hours	Acetylcholine Esterase Inhibitor (1B)
	Acephate	Orthene	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Bifenthrin	Attain/Talstar	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
	Lambda-cyhalothrin	**Scimitar GS**	**24 hours**	**Sodium Channel Blocker (3)**
	Fenpropathrin	Tame	24 hours	Sodium Channel Blocker (3)
	Pyrethrins	N/A	12 hours	Sodium Channel Blocker (3)
	Thiamethoxam	**Flagship**	**12 hours**	**Nicotinic Acetylcholine Receptor Disruptor (4A)**
	Imidacloprid	Marathon	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Abamectin	**Avid**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Kinoprene	Enstar II	4 hours	Juvenile Hormone Mimic (7A)
	Fenoxycarb	Preclude	12 hours	Juvenile Hormone Mimic (7B)
	Pymetrozine	**Endeavor**	**12 hours**	**Selective Feeding Blocker (9B)**
	Flonicamid	Aria	12 hours	Selective Feeding Blocker (9C)
▼	Azadirachtin	Azatin, Molt X, Azatrol/Ornazin	4/12 hours	Ecdysone Antagonist (18B)

(Pest Control Material in **bold typeface** are from Syngenta.)

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 Classification)
APHID continued	Tolfenpyrad	Hachi-Hachi	12 hours	Mitochodria Electron Transport Inhibitors (21A)
	Spirotetramat	Kontos	24 hours	Lipid Biosynthesis Inhibitor (23)
	Cyantraniliprole	**Mainspring**	**4 hours**	**Ryanodine Receptor Modulator (28)**
	Potassium Salts of Fatty Acids	Insecticidal Soap/M-Pede	12 hours	Desiccation or Membrane Disruptor
	Petroleum Oil	PureSpray Green/SufOil X/Saf-T-Side	4 hours	Suffocation or Membrane Disruptor
	Clarified Hydrophobic Extract of Neem Oil	Triact	4 hours	Suffocation or Membrane Disruptor
	Paraffinic Oil	Ultra-Fine Oil	4 hours	Suffocation or Membrane Disruptor
	Beauveria bassiana	BotaniGard/Naturalis	4 hours	Unclassified by IRAC
	Isaria fumosorosea Apopka Strain 97	Preferal	4 hours	Unclassified by IRAC
BROAD MITE	**Abamectin**	**Avid**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Chlorfenapyr	Pylon	12 hours	Oxidative Phosphorylation Uncoupler (13)
	Fenpyroximate	Akari	12 hours	Mitochondria Electron Transport Inhibitor (21)
	Pyridaben	Sanmite	12 hours	Mitochondria Electron Transport Inhibitor (21)
	Spiromesifen	Judo	12 hours	Lipid Biosynthesis Inhibitor (23)
CATERPILLAR	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Permethrin	Ambush/Astro	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
	Bifenthrin	Talstar	12 hours	Sodium Channel Blocker (3)
	Fenpropathrin	Tame	24 hours	Sodium Channel Blocker (3)
	Lambda-cyhalothrin	**Scimitar GS**	**24 hours**	**Sodium Channel Blocker (3)**
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Spinosad	Conserve	4 hours	Nicotinic Acetylcholine Receptor Agonist and GABA Chloride Channel Activator (5)
	Emamectin benzoate	**Enfold**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Fenoxycarb	Preclude	12 hours	Juvenile Hormone Mimic (7B)
	Bacillus thuringiensis spp. kurstaki	Dipel	4 hours	Midgut Membrane Disruptor (11B2)
	Chlorfenapyr	Pylon	12 hours	Oxidative Phosphorylation Uncoupler (13)
	Diflubenzuron	Adept/Dimilin	12 hours	Chitin Synthesis Inhibitor (15)
	Novaluron	Pedestal	12 hours	Chitin Synthesis Inhibitor (15)
	Azadirachtin	Azatin, Molt X, Azatrol/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Tolfenpyrad	Hachi-Hachi	12 hours	Mitochodria Electron Transport Inhibitors (21)
	Cyantraniliprole	**Mainspring**	**4 hours**	**Ryanodine Receptor Modulator (28)**
	Potassium Salts of Fatty Acids	Insecticidal Soap	12 hours	Desiccation or Membrane Disruptor
	Beauveria bassiana	BotaniGard	4 hours	Unclassified by IRAC
	Pyridalyl	Overture	12 hours	Unclassified by IRAC
CYCLAMEN MITE	**Abamectin**	**Avid**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Chlorfenapyr	Pylon	12 hours	Oxidative Phosphorylation Uncoupler (13)
	Fenpyroximate	Akari	12 hours	Mitochondria Electron Transport Inhibitor (21)
	Spiromesifen	Judo	12 hours	Lipid Biosynthesis Inhibitor (23)

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 Classification)
FUNGUS GNAT LARVAE	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Imidacloprid	Marathon	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Thiamethoxam	**Flagship**	**12 hours**	**Nicotinic Acetylcholine Receptor Disruptor (4A)**
	Kinoprene	Enstar II	4 hours	Juvenile Hormone Mimic (7A)
	Pyriproxyfen	Distance	12 hours	Juvenile Hormone Mimic (7C)
	Bacillus thuringiensis spp. israelensis	Gnatrol	4 hours	Midgut Membrane Disruptor (11A1)
	Chlorfenapyr	Pylon	12 hours	Oxidative Phosphorylation Uncoupler (13)
	Diflubenzuron	Adept	12 hours	Chitin Synthesis Inhibitor (15)
	Cyromazine	**Citation**	**12 hours**	**Chitin Synthesis Inhibitor (17)**
	Azadirachtin	Azatin, Molt X, Azatrol/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Steinernema feltiae	**Exhibitline sf**	**—**	**Unclassified by IRAC**
FUNGUS GNAT ADULTS	Bifenthrin	Attain/Talstar	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
	Fenpropathrin	Tame	24 hours	Sodium Channel Blocker (3)
	Potassium Salts of Fatty Acids	Insecticidal Soap	12 hours	Desiccation or Membrane Disruptor
	Petroleum Oil	PureSpray Green/Suf0il X/Saf-T-Side	4 hours	Suffocation or Membrane Disruptor
	Clarified Hydrophobic Extract of Neem Oil	Triact	4 hours	Suffocation or Membrane Disruptor
	Paraffinic Oil	Ultra-Fine Oil	4 hours	Suffocation or Membrane Disruptor
LEAFHOPPER	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Acephate	Orthene	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Bifenthrin	Attain/Talstar	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Fenpropathrin	Tame	24 hours	Sodium Channel Blocker (3)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
	Lambda-cyhalothrin	**Scimitar GS**	**24 hours**	**Sodium Channel Blocker (3)**
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Buprofezin	Talus	12 hours	Chitin Synthesis Inhibitor (16)
	Azadirachtin	Azatin, Molt X, Azatrol/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Spirotetramat	Kontos	24 hours	Lipid Biosynthesis Inhibitor (23)
	Beauveria bassiana	BotaniGard/Naturalis	4 hours	Unclassified by IRAC
LEAFMINER	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Acephate	Orthene	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
	Lambda-cyhalothrin	**Scimitar GS**	**24 hours**	**Sodium Channel Blocker (3)**
	Thiamethoxam	**Flagship**	**12 hours**	**Nicotinic Acetylcholine Receptor Disruptor (4A)**
▼	Imidacloprid	Marathon	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)

(Pest Control Material in **bold typeface** are from Syngenta.)

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 Classification)
LEAFMINER continued	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Spinosad	Conserve	4 hours	Nicotinic Acetylcholine Receptor Agonist and GABA Chloride Channel Activator (5)
	Abamectin	**Avid**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Emamectin benzoate	**Enfold**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Novaluron	Pedestal	12 hours	Chitin Synthesis Inhibitor (15)
	Cyromazine	Citation	12 hours	Chitin Synthesis Inhibitor (17)
	Azadirachtin	Azatin, Molt X, Azatrol/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Cyantraniliprole	**Mainspring**	**4 hours**	**Ryanodine Receptor Modulator (28)**
	Potassium Salts of Fatty Acids	Insecticidal Soap	12 hours	Desiccation or Membrane Disruptor
	Isaria fumosorosea Apopka Strain 97	Preferal	4 hours	Unclassified by IRAC
MEALYBUG	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Acephate	Orthene/Precise	24/12 hours	Acetylcholine Esterase Inhibitor (1B)
	Bifenthrin	Attain/Talstar	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Lambda-cyhalothrin	**Scimitar GS**	**24 hours**	**Sodium Channel Blocker (3)**
	Fenpropathrin	Tame	24 hours	Sodium Channel Blocker (3)
	Thiamethoxam	**Flagship**	**12 hours**	**Nicotinic Acetylcholine Receptor Disruptor (4A)**
	Imidacloprid	Marathon	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Spinosad	Conserve	4 hours	Nicotinic Acetylcholine Receptor Agonist and GABA Chloride Channel Activator (5)
	Kinoprene	Enstar II	4 hours	Juvenile Hormone Mimic (7A)
	Fenoxycarb	Preclude	12 hours	Juvenile Hormone Mimic (7B)
	Pyriproxyfen	Distance	12 hours	Juvenile Hormone Mimic (7C)
	Flonicamid	Aria	12 hours	Selective Feeding Blocker (9C)
	Novaluron	Pedestal	12 hours	Chitin Synthesis Inhibitor (15)
	Buprofezin	Talus	12 hours	Chitin Synthesis Inhibitor (16)
	Azadirachtin	Azatin, Molt X, Azatrol/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Spirotetramat	Kontos	24 hours	Lipid Biosynthesis Inhibitor (23)
	Petroleum Oil	PureSpray Green/SufOil X/Saf-T-Side	4 hours	Suffocation or Membrane Disruptor
	Paraffinic Oil	Ultra-Fine Oil	4 hours	Suffocation or Membrane Disruptor
	Isaria fumosorosea Apopka Strain 97	Preferal	4 hours	Unclassified by IRAC
PLANT BUG/ LYGUS BUG	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Acephate	Orthene	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Bifenthrin	Attain/Talstar	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
▶	**Lambda-cyhalothrin**	**Scimitar GS**	**24 hours**	**Sodium Channel Blocker (3)**

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 Classification)
PLANT BUG/ LYGUS BUG continued	Fenpropathrin	Tame	24 hours	Sodium Channel Blocker (3)
	Thiamethoxam	**Flagship**	**12 hours**	**Nicotinic Acetylcholine Receptor Disruptor (4A)**
	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Buprofezin	Talus	12 hours	Chitin Synthesis Inhibitor (16)
	Azadirachtin	Azatin, Molt X, Azatrol/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Potassium Salts of Fatty Acids	Insecticidal Soap	12 hours	Desiccation or Membrane Disruptor
	Petroleum Oil	PureSpray Green/SufOil X/Saf-T-Side	4 hours	Suffocation or Membrane Disruptor
	Paraffinic Oil	Ultra-Fine Oil	4 hours	Suffocation or Membrane Disruptor
	Beauveria bassiana	BotaniGard/Naturalis	4 hours	Unclassified by IRAC
	Isaria fumosorosea Apopka Strain 97	Preferal	4 hours	Unclassified by IRAC
SCALES (HARD AND SOFT)	Acephate	Orthene/Precise	24/12 hours	Acetylcholine Esterase Inhibitor (1B)
	Bifenthrin	Attain/Talstar	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Kinoprene	Enstar II	4 hours	Juvenile Hormone Mimic (7A)
	Fenoxycarb	Preclude	12 hours	Juvenile Hormone Mimic (7B)
	Pyriproxyfen	Distance	12 hours	Juvenile Hormone Mimic (7C)
	Buprofezin	Talus	12 hours	Chitin Synthesis Inhibitor (16)
	Azadirachtin	Azatin/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Petroleum Oil	PureSpray Green	4 hours	Suffocation or Membrane Disruptor
	Clarified Hydrophobic Extract of Neem Oil	Triact	4 hours	Suffocation or Membrane Disruptor
	Paraffinic Oil	Ultra-Fine Oil	4 hours	Suffocation or Membrane Disruptor
SHORE FLY	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Thiamethoxam	**Flagship**	**12 hours**	**Nicotinic Acetylcholine Receptor Disruptor (4A)**
	Pyriproxyfen	Distance	12 hours	Juvenile Hormone Mimic (7C)
	Diflubenzuron	Adept	12 hours	Chitin Synthesis Inhibitor (15)
	Cyromazine	**Citation**	**12 hours**	**Chitin Synthesis Inhibitor (17)**
	Azadirachtin	Azatin/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Potassium Salts of Fatty Acids	Insecticidal Soap	12 hours	Desiccation or Membrane Disruptor
SLUG AND SNAIL	Methiocarb	Mesurol	24 hours	Acetylcholine Esterase Inhibitor (1A)
	Metaldehyde	Deadline/Metarex	24 hours	Unclassified by IRAC
	Iron Phosphate	Sluggo	0 hours	Unclassified by IRAC
TWOSPOTTED SPIDER MITE ▼	**Abamectin**	**Avid**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Emamectin benzoate	**Enfold**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Hexythiazox	Hexygon	12 hours	Growth and Embryogenesis Inhibitor (10A)

(Pest Control Material in **bold typeface** are from Syngenta.)

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 Classification)
TWOSPOTTED SPIDER MITE continued	Clofentezine	Ovation	12 hours	Growth and Embryogenesis Inhibitor (10A)
	Etoxazole	TetraSan	12 hours	Chitin Synthesis Inhibitor (10B)
	Fenbutatin-oxide (Hexakis)	ProMite	48 hours	Oxidative Phosphorylation Inhibitor (12B)
	Chlorfenapyr	Pylon	12 hours	Oxidative Phosphorylation Uncoupler (13)
	Acequinocyl	Shuttle O	12 hours	Mitochondria Electron Transport Inhibitor (20B)
	Fenpyroximate	Akari	12 hours	Mitochondria Electron Transport Inhibitor (21)
	Fenazaquin	Magus	12 hours	Mitochondria Electron Transport Inhibitor (21)
	Pyridaben	Sanmite	12 hours	Mitochondria Electron Transport Inhibitor (21)
	Spiromesifen	Judo	12 hours	Lipid Biosynthesis Inhibitor (23)
	Spirotetramat	Kontos	24 hours	Lipid Biosynthesis Inhibitor (23)
	Bifenazate	Floramite	4 hours	GABA-Gated Antagonist (25)
	Bifenazate+abamectin	Sirocco	12 hours	GABA-Gated Antagonist (25) GABA Chloride Channel Activator (6)
	Cyflumetofen	Sultan	12 hours	Mitochrondrial complex II electron transport inhibitor (25)
	Potassium Salts of Fatty Acids	Insecticidal Soap	12 hours	Desiccation or Membrane Disruptor
	Petroleum Oil	PureSpray Green/SufOil X/Saf-T-Side	4 hours	Suffocation or Membrane Disruptor
	Clarified Hydrophobic Extract of Neem Oil	Triact	4 hours	Suffocation or Membrane Disruptor
	Paraffinic Oil	Ultra-Fine Oil	4 hours	Suffocation or Membrane Disruptor
	Isaria fumosorosea Apopka Strain 97	Preferal	4 hours	Unclassified by IRAC
THRIPS	Methiocarb	Mesurol	24 hours	Acetylcholine Esterase Inhibitor (1A)
	Chlorpyrifos	DuraGuard	24 hours	Acetylcholine Esterase Inhibitor (1B)
	Acephate	Orthene/Precise	24/12 hours	Acetylcholine Esterase Inhibitor (1B)
	Bifenthrin	Attain/Talstar	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
	Lambda-cyhalothrin	**Scimitar GS**	**24 hours**	**Sodium Channel Blocker (3)**
	Thiamethoxam	**Flagship**	**12 hours**	**Nicotinic Acetylcholine Receptor Disruptor (4A)**
	Imidacloprid	Marathon	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Pyridalyl	Overture	12 hours	Unclassified by IRAC
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Spinosad	Conserve	4 hours	Nicotinic Acetylcholine Receptor Agonist and GABA Chloride Channel Activator (5)
	Abamectin	**Avid**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Kinoprene	Enstar II	4 hours	Juvenile Hormone Mimic (7A)
	Fenoxycarb	Preclude	12 hours	Juvenile Hormone Mimic (7B)
	Flonicamid	Aria	12 hours	Selective Feeding Blocker (9C)
	Chlorfenapyr	Pylon	12 hours	Oxidative Phosphorylation Uncoupler (13)
	Azadirachtin	Azatin, Molt X/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
▶	Tolfenpyrad	Hachi-Hachi	12 hours	Mitochondria Electron Transport Inhibitor (21)

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 Classification)
THRIPS continued	**Cyantraniliprole**	**Mainspring**	**4 hours**	**Ryanodine Receptor Modulator (28)**
	Petroleum Oil	PureSpray Green/SufOil X/Saf-T-Side	4 hours	Suffocation or Membrane Disruptor
	Paraffinic Oil	Ultra-Fine Oil	4 hours	Suffocation or Membrane Disruptor
	Beauveria bassiana	Botanigard	4 hours	Unclassified by IRAC
	Isaria fumosorosea Apopka Strain 97	Preferal	4 hours	Unclassified by IRAC
	Pyridalyl	Overture	12 hours	Unclassified by IRAC
WHITEFLY	Acephate	Orthene/Precise	24/12 hours	Acetylcholine Esterase Inhibitor (1B)
	Bifenthrin	Attain/Talstar	12 hours	Sodium Channel Blocker (3)
	Cyfluthrin	Decathlon	12 hours	Sodium Channel Blocker (3)
	Fluvalinate	Mavrik	12 hours	Sodium Channel Blocker (3)
	Fenpropathrin	Tame	24 hours	Sodium Channel Blocker (3)
	Pyrethrins	N/A	12 hours	Sodium Channel Blocker (3)
	Thiamethoxam	**Flagship**	**12 hours**	**Nicotinic Acetylcholine Receptor Disruptor (4A)**
	Imidacloprid	Marathon	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Dinotefuran	Safari	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Acetamiprid	TriStar	12 hours	Nicotinic Acetylcholine Receptor Disruptor (4A)
	Spinosad	Conserve	4 hours	Nicotinic Acetylcholine Receptor Agonist and GABA Chloride Channel Activator (5)
	Abamectin	**Avid**	**12 hours**	**GABA Chloride Channel Activator (6)**
	Kinoprene	Enstar II	4 hours	Juvenile Hormone Mimic (7A)
	Fenoxycarb	Preclude	12 hours	Juvenile Hormone Mimic (7B)
	Pyriproxyfen	Distance	12 hours	Juvenile Hormone Mimic (7C)
	Pymetrozine	**Endeavor**	**12 hours**	**Selective Feeding Blocker (9B)**
	Flonicamid	Aria	12 hours	Selective Feeding Blocker (9C)
	Diflubenzuron	Adept	12 hours	Chitin Synthesis Inhibitor (15)
	Novaluron	Pedestal	12 hours	Chitin Synthesis Inhibitor (15)
	Buprofezin	Talus	12 hours	Chitin Synthesis Inhibitor (16)
	Azadirachtin	Azatin/Ornazin	4/12 hours	Ecdysone Antagonist (18B)
	Pyridaben	Sanmite	12 hours	Mitochondria Electron Transport Inhibitor (21)
	Spiromesifen	Judo	12 hours	Lipid Biosynthesis Inhibitor (23)
	Spirotetramat	Kontos	24 hours	Lipid Biosynthesis Inhibitor (23)
	Cyantraniliprole	**Mainspring**	**4 hours**	**Ryanodine Receptor Modulator (28)**
	Potassium Salts of Fatty Acids	Insecticidal Soap	12 hours	Desiccation or Membrane Disruptor
	Petroleum Oil	PureSpray Green	4 hours	Suffocation or Membrane Disruptor
	Clarified Hydrophobic Extract of Neem Oil	Triact	4 hours	Suffocation or Membrane Disruptor
	Paraffinic Oil	Ultra-Fine Oil	4 hours	Suffocation or Membrane Disruptor
	Beauveria bassiana	Botanigard/Naturalis/Mycotrol	4 hours	Unclassified by IRAC
	Isaria fumosorosea Apopka Strain 97	Preferal	4 hours	Unclassified by IRAC

(Pest Control Material in **bold typeface** are from Syngenta.)

Pre-mix Fungicides vs. Tank Mixing

By A. R. Chase

Combining products for an application has been and will be common in ornamental production. It can be a mixture of diverse products from fertilizer and minor elements to adjuvants to insecticides, miticides, fungicides and bactericides. For disease prevention and control, the choice of using premixes versus creating your own through tank mixing is a critical decision.

Pre-mixes

Use of pre-mix fungicides can be driven by a variety of goals, including resistance management, ease of use, cost effectiveness and breadth of activity. Using a pre-mix will give you the security of knowing that the two products are chemically suited to work together and, in some cases, both are effective on the target disease. The following table shows some of the premixes available to ornamental producers. I've included the FRAC groups to demonstrate why some pre-mixes are additive and others aide in resistance management.

Pre-mixes have both positive and negative aspects. Some of the positive aspects include: 1) diagnosis is less critical; 2) mixed infections are covered; 3) plant safety is known; 4) resistance management; 5) improved efficacy; 6) fewer products on the shelf; and 7) can be more cost effective. If you don't have time for a lab diagnosis of a problem, use of a pre-mix that covers the most common disease possibilities would allow more timely control. It's always better to obtain a diagnosis since not all problems are due to bacteria or fungi. Viruses, phytotoxicity, nutritional imbalance and temperature extremes won't be cured by a fungicide whether it's a pre-mix or not. In the same vein, there are often mixed infections of two or more fungi causing a disease. This is especially common in root diseases, but sometimes leaf damage is caused by more than one fungus or bacterium. If you apply a pre-mix with the right combination of active ingredients, you'll control both problems with a single application.

Since application of more than one fungicide at a time is common, using a pre-mix will give you the security of knowing that the two products are chemically suited to work together. Making your own mixtures has the drawback of possible phytotoxicity and only your experience can determine safety of the mixture under your conditions.

One of the most important aspects of pre-mixes is that if the correct partners are chosen, they're excellent for resistance management. The only requirement is that both active ingredients target the pathogen. For instance, both copper and mancozeb in the pre-mix Junction work on bacteria like Pseudomonas and Xanthomonas. Botrytis resistance can be delayed with Palladium since both cyprodinil and fludioxonil target Botrytis.

Finally, stocking pre-mixes is an attractive solution to the confusion that can occur by having every fungicide and bactericide that's labeled on ornamentals. It will, obviously, also be much more cost effective, especially for the smaller producer who might not use large quantities of these products.

Table 1. Some premix fungicides for ornamentals.

Fungicide	Manufacturer	Components (FRAC group)	Nature of pre-mix	Key targets
Banrot 40WP	Scotts Company	Thiophanate methyl (1)/ etridiazole (14)	additive	soil-borne pathogens
Concert II	**Syngenta**	**Chlorothalonil (M5)/propiconazole (3)**	**additive/resistance management**	**foliar diseases (except downy mildew)**
Hurricane WDG	**Syngenta**	**Fludioxonil (12)/mefenoxam (4)**	**additive**	**soil-borne pathogens**
Junction	SePRO	Copper hydroxide (M1)/mancozeb (M3)	resistance management	foliar diseases
Orvego	BASF Corp.	Dimethomorph (40)/ ametoctradin (45)	resistance management	downy mildew, Phytophthora
Pageant	BASF Corp.	Pyraclostrobin (11)/ boscalid (7)	additive/resistance management	foliar and crown diseases
Palladium	**Syngenta**	**Fludioxonil (12) /cyprodinil (4)**	**additive/resistance management**	**foliar diseases (except downy mildew)**
RootShield Plus	BioWorks	Trichoderma harzianum T-22/T. virens G41	additive	soil-borne pathogens
Spectro 90WDG	Cleary Chemical Company	Chlorothalonil (M5)/ thiophanate methyl (1)	additive/resistance management	foliar diseases
Strike Plus	OHP	Trifloxystrobin (11)/ triadimefon (3)	additive/resistance management	foliar and crown diseases

(Pest Control Material in **bold typeface** are from Syngenta.)

Some possible negative aspects of pre-mixes are that the specific ratios of the two active ingredients may not be ideal for all diseases and that using a pre-mix may give you a false sense of security. They think they've covered all of the possible bases and, unfortunately, there's always a new disease that escapes the broad-spectrum treatment. These growers usually wait until it's too late to notice that something is amiss and then the crop is ready for the dumpster. Pre-mixes aren't insurance policies—they're conveniences.

Tank mixes

Tank mixing can be a better solution in a number of situations. It gives the user ultimate control of the rates and specific products utilized. Certainly, there's not a pre-mix for all situations and thus you may need to do your own customized tank-mix.

Sometimes, tank mixing is mandated by the product label. This is the case with Adorn, which must be tank-mixed with another fungicide from a different FRAC group for any use. Subdue Maxx must be tank-mixed (also with a fungicide from another FRAC group) if it's used as a foliar spray for downy mildew. These restrictions are specifically designed for resistance management (delaying resistance development).

One of the biggest drawbacks of tank mixing is the practice of decreasing the rates of the two (or more) products mixed. It's not recommended in any case to reduce rates even when they're combined. This is actually exactly what a scientist would do to create resistance in a population of a pathogen to that particular active ingredient or FRAC group.

Conclusions

Pre-mixes save time and allow the user to be less involved in your disease management. Tank mixes are by nature customized and allow you to be more involved in your disease management. In the case of pre-mixes, you're making use of outside expertise and, in the case of tank mixing, you're becoming the expert. Both are valid and effective ways to approach disease management in ornamental production. **GT**

A poinsettia starting with bad roots.

A mixed infection of Alternaria and Xanthomonas leaf spots on zinnia.

Ann Chase is a plant pathologist and president of Chase Horticultural Research, Inc., Mt. Aukum, California; www.chasehorticulturalresearch.com.

Chemical Class Chart for Ornamental Fungicides

FRAC group	Chemical Class	Active Ingredient common name	Trade Name
1	Methyl Benzimidazole Carbamates (Thiophantes)	thiophanate-methyl	AllBan Flo, Banrot*, 3336, ConSyst*, OHP 6672, Spectro*, SysTec 1998, T-Storm, TM 4.5, TM/C*, 26/36*, Zyban*
2	Dicarboximides	iprodione	Chipco 26019, Lesco 18 Plus, OHP 26GT-O, 26/36*
3	Demethylation Inhibitors (imidazole, pyrimidine, triazole)	fenarimol	Rubigan
		imazalil	Fungaflor TR
		metconazole	Tourney (not registered for use in CA)
		myclobutanil	Clevis*, Eagle, MANhandle*, Systhane
		propiconazole	**Banner Maxx, Concert II***
		triadimefon	Strike 50
		triflumizole	Terraguard
		triticonazole	Trinity
4	Phenylamides	mefenoxam	**Hurricane WDG*, Subdue GR, Subdue Maxx**
5	Amines "Morpholines" (Piperadines)	piperalin	Pipron
7	Succinate dehydrogenase inhibitors - SDHI (Pyridine carboxamides, phenyl-benzamides)	boscalid	Pageant*
		flutolanil	Contrast, Prostar
9	Anilinopyrimidines	cyprodinil	**Palladium***
11	QoI-fungicides (strobilurins)	azoxystrobin	**Heritage**
		fluoxastrobin	Disarm 0
		kresoxim-methyl	Cygnus
		pyraclostrobin	Insignia, Pageant*, Empress
		trifloxystrobin	Compass 0
	Imidazolinone	fenamidone	Fenstop
12	Phenylpyrroles	fludioxonil	**Hurricane WDG*, Medallion WDG, Palladium***, Mozart™ TR
14	Aromatic Hydrocarbons (chlorophenyl)	dicloran	Botran
		pentochloronitrobenzene (PCNB)	Terraclor
	Thiadiazole	etridiazole	Banrot*, Terrazole, Terrazole CA, Truban
17	Hydroxyanalide	fenhexamide	Decree
19	Polyoxins	polyoxin - D	Endorse, Affirm WDG, Veranda 0
21	Quinone inside inhibitors (Cyano-imidazole)	cyazofamid	Segway 0
28	Carbamate	propamocarb	Banol
33	Phosphonates	fosetyl-Al	Aliette
		phosphorous acid, potassium phosphite	Alude, Biophos, Fosphite, Reliant, Vital
40	Carboxylic Acid Amines (cinnamic acid amides, mandelic acid amides)	dimethomorph	Stature DM, Orvego*
		mandipropamid	**Micora**
43	Benzamides (Pyridinemethyl-benzamides)	fluopicolide	Adorn
44	Microbials	Bacillus subtilis (QST 713)	Cease, Companion
		Bacillus subtilis (MBI600)	Subtilex NG
45	Quinone x Inhibitor	ametoctradin	Orvego*
M1 (multi-site)	Inorganics	copper salts	Camelot 0, Champion, Copper-Count N, CuPro 5000, Cuproxat, Junction*, Nordox, Nu-Cop, Phyton 27, Phyton 35
M3 (multi-site)	Dithiocarbamate	mancozeb	Clevis*, Dithane, Fore, Junction*, Pentathlon, Protect, Zyban*
M5 (multi-site)	Chloronitriles	chlorothalonil	Clevis*, ConSyst*, **Concert II*, Daconil Ultrex, Daconil Weatherstik**, Echo, Exotherm Termil, Manicure 6FL, Spectro 90*, TM/C*
Not Classified	Micorbial/Biopesticides	Streptomyces griseoviridis	Mycostop
		Streptomyces lydicus (strain WYEC 108)	Actinovate SP
		Trichoderma harzianum Rifai strain	Rootshield
		Trichoderma harzianum T22, Trichoderma virens G41	RootShield Plus*
Not Classified	Inorganic Protectants	botanical extract	Neem Oil, Regalia
		hydrogen dioxide	Zerotol
		hydrogen peroxide	X3, Zeroton
		potassium bicarbonate	Armicarb 100, Kaligreen, Milstop
		quaternary ammoniums	KleenGrow

* Indicates a product that contains more than one active ingredient in a pre-pack mixture.

(Pest Control Material in **bold typeface** are from Syngenta.)

IT TAKES TWO

During pansy production season in the Midwest, a grower noticed signs of botrytis and myrothecium leaf spot. Faced with two disease problems, he consulted with his Syngenta representative who reviewed the Chase/Syngenta fungicide chart with him and realized there was one product to fix both disease issues.

The solution was Palladium® fungicide which features two active ingredients, one of which is in a unique chemistry class, as his source of protection against botrytis as well as myrothecium. Palladium and its dual modes of action was applied and served as his double agent to keep his pansies out of trouble.

EVERY FLOWER TELLS A STORY™

Palladium® Fungicide

syngenta.

™

Protecting Your Crops With Sound Disease Management

By Nancy Rechcigl

The wise and industrious Ben Franklin once said, "An ounce of prevention is worth a pound of cure." In short, if we take steps to prevent a problem, it'll save us a great deal more in time, effort and expense than it would if we have to correct or repair the problem later. While this phrase can apply to many aspects of our life, it also certainly applies to the production of ornamental crops. The expense of inputs (plants, seed, soil, pots, water, fertilizer, energy and labor) is an investment that needs to be protected. To ensure plant quality and future sales, an effective disease management strategy is important and should include a preventive fungicide rotation partnered with proper cultural practices to reduce the risk of disease.

While there are many different fungicide products on the market, they differ in their mode of action and spectrum of activity. Fungicides are classified as having protectant or curative activity. Those that work through contact with the pathogen are considered protectants and work by preventing infection. Fungicides with curative activity have systemic or partially systemic activity and can move within the plant tissue or from the site of application to other areas of the plant. Systemic fungicides tend to have longer residual activity than those that work through contact and can be effective after an infection has occurred. A fungicide strategy that contains both contact and systemic products tends to provide the best results.

Designing a disease management strategy

Before making any selection of fungicides, it's important to have an understanding of the parameters that can affect your crop. Important questions to ask include:

- What diseases can affect the crops you're growing?
- When is the crop susceptible? That is, what stage of plant growth, time of year or environmental conditions are favorable to the disease?
- How does the disease spread (air movement, contact, insects, splashing water/overhead irrigation)?
- Is the disease host-specific or can it spread to surrounding plant material?
- What cultural changes can you implement to minimize risk?

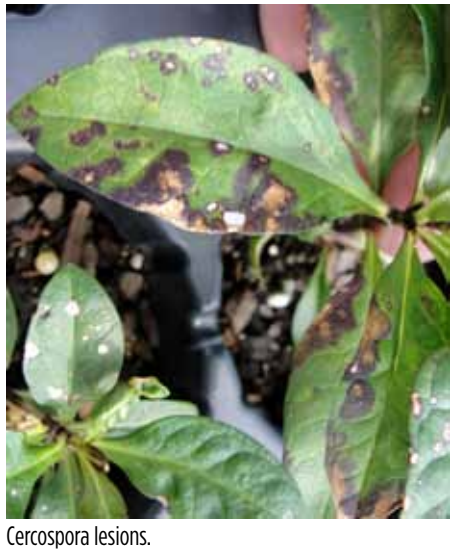
Many disease problems can be reduced or eliminated with proper watering practices, adjustments in relative humidity and avoiding excessive soluble salts. Important cultural tips to integrate in your disease management program include:

- Clean growing area/greenhouse and benches of all debris and sanitize between crops.
- Irrigate early in the day to allow time for the foliage to dry before evening.
- Provide good spacing of plants and flats to allow for good air circulation and spray coverage.
- Scout and rogue crop weekly for insect and disease problems.

An effective disease management program should include a built-in fungicide resistance management strategy. After identifying the primary disease problem that can affect each crop in production, select three to four fungicide products with *different modes of action* that have proven activity on each potential disease. You may notice some fungicides have activity across different diseases and utility across multiple crops. This can help make your product selection easier and help manage inventory in your chemical shed.

Certain disease problems may be more of a problem during different times of production. Adjust your plan accordingly and rotate among the products based upon the label recommendations. Modify your treatment interval based on disease pressure and current environmental conditions. Many of the newer fungicides have broad application intervals. Keep in mind that when making fungicide applications in a preventive manner, you can extend the treatment interval based upon the label recommendations.

A close up of powdery mildew.



Cercospora lesions.

Stem rot on dianthus.

This can help save resources without sacrificing quality. However, when disease is already present in the crop, the shortest application interval listed on the label should be used. Remember to keep good records; this will help provide a framework for your strategy with future crops. **GT**

Nancy Rechcigl is a Technical Service Representative for Syngenta.

Know the diseases to which your crop is prone	Recognize disease symptoms	Know the conditions that cause diseases to develop	Understand disease management
ROOT AND CROWN ROT DISEASES			
Pythium Root Rot	Damping off; attacks root tips; lower leaves yellow and wilt; poor growth; nutrient deficiencies; brown, limp roots—outer cortex sloughs off; plant may die. Plant wilts during warm, sunny days even with adequate moisture. Uneven height or coloration within a crop.	Generally cool, wet substrate but depends on Pythium species present. *P. aphanidermatum* can be found at high temps; over fertilization may predispose plants to infection. Produce survival structures. Can be spread by irrigation water.	Pathogen-free potting substrate; sterilized flats; plant when soil and air temps are favorable for rapid emergence; good drainage; careful irrigation; sanitation. Make sure flat cells are filled evenly. Preventative fungicide applications if a history of disease. **Geranium, chrysanthemum, calibrachoa**
Phytophthora Root and Crown Rot	Infects roots and may move into crown and stems; stunting of leaves and plant; leaves turn yellow, wilt and may drop prematurely; plant may die; roots turn dark and rot—outer cortex sloughs off; may also be present with *Pythium.*	High substrate moisture more than 70%; generally cool temps (59 to 74F); wet substrate; over fertilization generally predisposes plants. Wide host range. Produce survival structures. Can be spread by irrigation water.	Good drainage and water management; use pathogen-free potting substrate, plants, water and equipment. Preventative fungicide applications if a history of disease. **Gerbera, poinsettia, pansy, African violet, lavender, annual vinca**
Thielaviopsis Root Rot (Black Root Rot)	Yellowing, stunted growth; signs of nutritional deficiencies; root decay; wilting; roots develop black lesions along root and root tips.	Moist, cooler (55 to 61F) substrates favor disease; weakened/stressed plants are more susceptible; Wide host range. Can be spread by fungus gnats.	Sterilize containers, grow plant at pH most favorable for the crop, good sanitation; discard infected plants. Use preventative fungicide applications for highly susceptible crops. Avoid stressing crop. **Calibrachoa, pansy, petunia, annual vinca**
Rhizoctonia Crown Rot	Damping off; infection starts at crown and moves up stem; constriction of stem; stem becomes soft; plant may wilt; rotted crown (shredded, dry-appearance); roots sometimes affected. Brown, irregular-shaped spots can develop on leaves and stems. Aerial web blight can develop when the fungus grows from the potting medium surface into the plant canopy. Fungus grows in a radial pattern, so that infected areas look like a circle or semi-circle of dead plants. Web-like strands of the fungus can be seen when humidity is high.	Drier substrate, but still wet (~40% water-holding capacity); humid and warmer conditions. Wide host range. Survives in plant debris and soil on benches, floors, pots, etc.	Discard infected plants (all plants in a flat). Apply fungicides to protect visibly healthy plants. Avoid placing plants directly on the ground. Irrigate plants only when plants will dry quickly; increase air circulation to reduce humidity. Clean pots and production facility surfaces of dirt and crop debris, followed by application of a disinfectant on all surfaces. Use pathogen-free potting substrate; good drainage; careful irrigation. **Chrysanthemum, celosia, garden and New Guinea impatiens, poinsettia**
Fusarium Wilt	Lower leaves yellow and dry; can be followed by rapid wilting of the entire plant or one side of the plant in the case of chrysanthemums. Infected plants wilt under moisture stress. On some hosts, if stems cut open, the vascular system appears reddish-brown. Yellowing and stunting of older plants. Symptoms often expressed at time of flowering. Damping off of seedlings.	High air and substrate temperatures (75 to 86F); infected plants may appear symptomless at soil temperatures less than 68F: can be spread by infected but healthy-looking cuttings; fungus may be present on seed coats. Drought or flowering stress can result in rapid and severe symptoms. Can be spread by fungus gnats. Spores and fungal fragments move via irrigation water. Produces survival structures.	Infected plants nearly always die. Remove crop debris and disinfest between crops. Avoid reusing trays and pots; use fungicides preventatively. **Chrysanthemum, cyclamen, gerbera, lisianthus, pansy, annual vinca**
Myrothecium Leaf Spot and Crown Rot	Petioles rot at the soil line, leaf collapses. Leaf spots initially appear water-soaked, and eventually turn brown or light tan in color. Diagnostic symptom is the presence of raised, dark green-to-black masses of spores surrounded by a fringe of white fungal tissue. Spores typically produced in a circular pattern on the leaf tissue.	Warm, moist, humid conditions favor infection and disease development. Wounds are quickly colonized by this soilborne fungus.	Remove and discard infected plants. Highly susceptible crops should be carefully scouted or fungicides applied on a preventative basis. Remove plant debris between crops and disinfect benches. **New Guinea impatiens, pansy, syngonium**

(Susceptible plants in **bold**)

Know the diseases to which your crop is prone	Recognize disease symptoms	Know the conditions that cause diseases to develop	Understand disease management
Bacterial Soft Rot (Pectobacterium=Erwinia)	Watery decay of plant tissue at the soil line; foul odor; collapse of plant (meltdown).	Requires high humidity to infect. Bacterium is ubiquitous in environment. Increased irrigation increases severity of the disease. Excessive nitrogen increases disease on calla lily.	Immediately discard infected plants. Porous substrates have been reported to decrease disease on calla lily. Copper dips are effective for about 6 weeks. **Calla lily, cyclamen, primrose, bulb crops**
Sclerotinia Blight (White Mold)	Water-soaked spots on the stems or leaves become covered in a white cottony mass of fungal mycelium. Plant becomes soft and slimy. Hard black structures (sclerotia) develop within the fungal mass. May also cause dry lesions that girdle the stem; sclerotia form within the stem.	Spread is primarily by airborne ascospores. High soil moisture, high humidity and cool temperatures (50 to 75F) favor disease development.	Difficult, if not impossible, to control once infection has occurred. **Lobelia, marigold, petunia, zinnia**
FOLIAR AND STEM DISEASES			
Anthracnose	Anthracnose is a catch-all term for leaf spot or stem canker symptoms caused by several different fungal species. Affected tissue dies. Colletotrichum forms masses of pinkish-orange spores within the lesions or stem cankers.	Warm, moist conditions with high humidity favor disease development.	Minimize duration of leaf wetness through environmental modification and cultural practices, such as irrigation and plant spacing. Preventative fungicide applications may help to reduce new infections and spread. Pathogen populations of Colletotrichum species resistant to thiophanate-methyl have been found. **Begonia, cyclamen, osteospermum, pansy**
Botrytis Leaf Blight (gray mold)	Symptoms vary with host and tissue invaded; leaf spots; bud rot; flower blight; cutting rot; stem canker, stem and crown rot; proliferation of fluffy, brown/gray fungal mycelium containing spores; damping-off.	High humidity more than 85%; poor air circulation; 70 to 77F optimum temp for spore germination; spores must have free moisture to germinate; old flowers and decaying vegetation source of spores; rapidly colonizes wounded tissue.	Keep relative humidity below 85%; do not allow leaves to stay wet for more than 6 hours; provide good air circulation around plants; remove infected plants; strict sanitation to remove spent flowers and old leaves; fungicides alone will not control Botrytis. **Cyclamen, geranium, poinsettia, rose**
Powdery Mildew	Fluffy white patches on upper leaf surface, turning gray with age. Can also infect stems and flower petals when severe.	Favored by warm days and cool, damp nights; free water inhibits spore germination. This fungus can infect at low relative humidity.	Must be detected early, as this disease can spread quickly. Susceptible crops should be treated with a fungicide prior to development of powdery mildew. Increase air movement, reduce humidity. **Gerbera, petunia, rosemary, rose, verbena**
Downy Mildew	White/purple/gray fuzz (spores) on undersides of leaves. Yellowish or pale green mottling on upper leaf surface. On garden impatiens, foliage appears to have yellow stippling similar to spider mite injury. Downward curling of leaves. Emerging leaves may be small or discolored. Can become systemic in plants, resulting in stunting or distorted new growth.	Favored by high humidity, long durations of leaf wetness and cool weather (60 to 74F daytime). Can survive in plant debris in soil. Spores are spread by splashing water and air currents. Increasingly detected during warm months and in warmer regions.	Immediately discard infected plants and adjacent plants. All remaining plants on premises should be treated with a fungicide. Fungicides are used to prevent spread to non-infected plants and to new growth when symptoms first appear (apply frequently with good coverage). Fungicides will not cure an already infected plant. Keep relative humidity below 80 to 85%. Do not reuse pots from diseased plants. **Bracteantha, coleus, garden impatiens, snapdragon, veronica**

Know the diseases to which your crop is prone	Recognize disease symptoms	Know the conditions that cause diseases to develop	Understand disease management
Fungal leafspot diseases (Alternaria, Cercospora, Septoria, Phyllosticta)	Round to irregular leaf spots; often with a border (red/purple/brown). Center of lesions becomes tan with age; size of lesion increases over time. Fruiting bodies may be present within lesion.	Prolonged leaf wetness, high humidity and warm temperatures favor most fungal leafspot diseases.	Minimize leaf wetness. Scout frequently. Fungicide applications. **Geranium, impatiens, pansy, zinnia, many perennials**
Rust	Yellow, orange or brown spore masses or pustules form on the underside of the leaf and erupt through the leaf tissue. On geranium and snapdragon, the pustules are formed in a target pattern.	Infect under mild, moist conditions. Spores easily spread in air currents.	Minimize the time foliage stays wet. Discard infected plants as soon as they're detected. Provide good air circulation and don't crowd plants. Fungicides applied at the first sign of infection can help prevent serious damage. **Aster, fuchsia, geranium, snapdragon**
Bacterial Leaf Spot *(Pseudomonas sp., Xanthomonas)*	Small, round, water-soaked lesions sometimes surrounded by a purple or yellow halo on leaves. Lesions often vein-delimited. Lesions initially yellow or light green, quickly progressing to dark brown or black (lesions may turn tan with age). Lesions may rapidly enlarge and entire leaf will rot. Infection may follow the petiole down to the crown.	High humidity, wet leaf surfaces. Splashing water moves bacteria and allows infection of new leaves. Reducing nitrogen may reduce disease caused by Pseudomonas. Insects (fungus gnats, shore flies, leaf miners) and pruning may spread bacteria.	Discard infected plants and leaves showing symptoms. Surface-disinfect clipping shears, tools and benches between plantings. Monitor humidity; reduce free moisture on leaves; bactericides may help reduce spread, but are generally not very effective; preventative applications may mask symptoms and still not control disease. Irrigate when leaves will dry quickly. Drip irrigation or ebb & flow will help to control some leaf spot diseases. **Reiger begonia, English ivy, geranium, gerbera, poinsettia, zinnia**
Viruses: INSV (Impatiens necrotic spot virus) TSWV (Tomato spotted wilt virus)	Symptoms vary with host; yellow or necrotic spots on stems or leaves; leaf mosaic; black leaf spots; black ring spots; line patterns, overall yellowing; stunting.	Transmission from infected to healthy plants via thrips; introduction into the greenhouse via infected plants or insect vector.	Careful monitoring and management of thrips population; inspection and isolation of new plant materials; purchase material certified virus free; weed management; avoid carrying over stock plants unless tested free of viruses. **Many ornamental hosts**
Viruses: HVX (Hosta Virus X)	Symptoms highly variable depending on cultivar. Major leaf veins may take on a feathered appearance at the edges, resulting in a "bleeding" appearance. Extreme symptoms include severe necrosis and death of leaves.	No evidence this virus is transmitted by insects. Vegetative propagation most important means of spread.	Some reported differences in cultivar susceptibility. Tiara series, Blue Cadet and Honeybells are highly susceptible. Purchase plants from a reputable source. Sanitize tools often and avoid mixing lots from different sources. **Hosta**
Foliar Nematodes	Pattern of damage is dictated by the pattern of major leaf veins (i.e., stripes, patchwork). Nematodes enter leaf cells through wounds or natural openings. Plant tissue initially turns yellow and eventually brown and necrotic. Symptoms often not visible until nematode population becomes quite large.	Spread by vegetative propagation, splashing water, plant-to-plant contact, worker movement and tools.	Exclusion is the most effective method of management. Inspect plant materials before introduction. Separate dormant materials until new growth has emerged and can be inspected for symptoms. Plants confirmed with foliar nematodes should be promptly discarded. Chemical control is highly variable, with limited effectiveness. **Many herbaceous and woody perennials**

(Susceptible plants in **bold**)

Biological Control in Production

By Suzanne Wainwright-Evans

Bugs eating bugs has been going on since the beginning of time. Until recent years, this hasn't been something that commercial growers have really relied on as a weapon in their arsenal, but with the many concerns facing our industry today, growers are looking to use biological control as a way to combat their pests.

Why are growers choosing to incorporate biological control agents (BCA) into their pest management program? One driving factor has been managing pesticide resistance. This could be growers encountering pests that were resistant to pesticides (and not being able to control them) or using the BCAs to proactively help prevent developing pesticide resistance. Other reasons BCAs are gaining popularity are environmental concerns, worker safety, the convenience of zero re-entry intervals, and in some cases, simple economics. Recently though, a new factor has been prompting more commercial growers to look at biocontrol—social pressures. The use of neonicotinoids has been coming under scrutiny and some growers are under pressure to reduce the use of this class of pesticides. The result is that some companies are looking for alternatives to this class of chemistry. One viable alternative is to use BCAs.

Neonicotinoids are a class of neuro-active insecticides chemically similar to nicotine. They're found in several commercial pesticides today.

Know your enemy

When starting with a biological control program it's critical that you properly identify your pests before you start. Don't guess, or assume—you *MUST* have *POSITIVE ID*! Biological control often is going to require a more specific level of identification than traditional spray programs may require. With traditional chemical applications, often just knowing what type of insect you have is enough. For instance, you might have only had to know that your pest was a whitefly, aphid or thrips, but that may not be enough for a successful biocontrol program. In order to select the right control agent for your situation, one may often need to know the specific species of aphid or specific species of whitefly you have. Assuming that an aphid is an aphid is not enough. Don't worry—you don't have to go back to school to get an advanced degree in entomology in order to get positive identification. There are many resources out there that can help you with positive ID and you can always ask your local extension office.

Why is accurate identification of your pest so important for biological control? Because some beneficials are host-specific to their pests (this is more true for parasites than predators). Take for example the cotton/melon aphid, *Aphis gossypii*. If you find this pest in your greenhouse and want to treat using biological control agents, you could use the parasitic wasp *Aphidius colemani*.

But let's say instead you have the potato aphid, *Macrosiphum euphorbiae*. You (or the biocontrol company you're dealing with) will need to know that *Aphidius colemani* won't work that well on that particular aphid species. You would want to get *Aphidius ervi* or even *Aphelinus abdominalis*; these parasites prefer the potato aphid. There are increasing numbers of different aphid parasites commercially available, so it's important to match the correct beneficial with your pest. This information can be supplied by your biological control supplier.

Using beneficials

Once you know exactly what your target pests are, you'll need to check the spray records for the specific crop over the last three months. This may mean asking for spray records from your liner or plug supplier. Some pesticides, such as synthetic pyrethroids, have extremely long persistence periods. From the date of the application of the pyrethroid, you'll need to wait eight to 12 weeks before your first BCA release. What can you do in the meantime? Your supplier or crop consultant can help put together a spray program of products that have shorter persistence times, getting you ready for your first release.

Once you get your beneficials out there working for you, don't think that you cannot use pesticides at all. It's simply not true. While pesticides can be a compatible option, it's not as if you can just spray any product on your beneficials before doing your homework. There are definitely some products that can cause problems. Thankfully, many of the newer products on the market today are softer on most beneficials, and if used intelligently, they can be successfully incorporated as a tool in your pest management program alongside the beneficials.

To figure out the chemical compatibility information, you'll need to know the active ingredient in the product you're considering applying, as well as how you'll be applying it (drench, spray, etc.). You'll also need to know the scientific name of the BCA you're using. This information can be plugged into tables provided by the biological control companies or by asking your supplier. Don't make an assumption that just because one product is compatible with one specific BCA that it'll be compatible with all others. Always check for each beneficial and active ingredient before treating. This will include not only insecticides, but fungicides as well. Details are important here.

When to use pesticides

When are pesticide sprays needed in a biocontrol program? Sometimes it's right when you're getting started. Remember, biological control is not a curative; it's a preventative program. BCAs need to be released when pest levels are low or sometimes when the pests aren't even present yet. I say "yet" because they do come every year—the thrips, aphids, whiteflies and so on. If you can get the beneficials out first, then sprays may not be necessary. If you do need to spray, try to select products, such as soaps or oils, where beneficials can be released once the sprays dry. The last thing you want to do when starting a bio program is shoot yourself in the foot by using a pesticide with a long spray residual that might kill the beneficials you're releasing.

Sometimes even if you do everything right, the pest population can climb beyond the control of the BCAs. If this happens, a cleanup or spot spray may be needed (using a compatible product) to help reduce the pest population.

Another time a pesticide spray may be needed is if a new pest pops up for which there's not a predator or parasite commercially available. Sometimes this can

happen when applications of broad-spectrum pesticides aren't being used anymore. First, as always, make sure to accurately identify the newcomer, making sure it's not a beneficial. It's not uncommon for growers to make every effort to kill a new insect, when in fact it may be a volunteer predator. Once you have a positive identification, select a product that you can apply with minimum impact of your ongoing beneficial program (your biological supplier can help you with this).

Biological control in commercial production greenhouses is still a new emerging science. I don't think anyone will deny that the advancements in just the last 10 years have been great ones. Many growers are running successful programs controlling Western flower thrips, spider mites, aphids and other pests of economic importance. When getting started, growers just need to realize they'll have to learn a lot, but it'll pay off in the end. **GT**

Suzanne Wainwright-Evans is an Ornamental Entomologist specializing in integrated pest management and owner of Buglady Consulting.

An *Orius insidiosus* release box.

Aphid Biological Control Agents

	Aphidius matricariae (parasite, wasp)	*Aphidius colemani* (parasite, wasp)	*Aphidius ervi* (parasite, wasp)	*Aphelinus abdominalis* (parasite, wasp)	*Aphidoletes aphidimyza* (predator, midge)	*Chrysoperla sp.* (predator, lacewing)
Green peach *Myzus persicae*	yes	yes	somewhat	somewhat	Attacks over 60 species of aphids.	Attacks most species of aphids that live on the foliage.
Cotton/ Melon *Aphis gossypii*	no	yes	somewhat	no		
Potato *Macrosiphum euphorbiae*	no	no	yes	yes		
Foxglove *Aulacorthum solani*		no	yes	yes		
Tobacco *Myzus nicotianae*		yes	yes			
Rose *Macrosiphum rosae*	yes		yes			

Western Flower Thrips (WFT) Biological Control Agents

	Amblyseius cucumeris (predator, mite)	*Amblyseius swirskii* (predator, mite)	*Amblydromalus limonicus* (predator, mite)	*Hypoaspis miles (Stratiolaelaps scimitus)* (predator, mite)	*Orius insidiosus* (predator, insect)	*Atheta coriaria* (predator, insect)	*Steinernema feltiae* (parasite, nematode)
Western Flower Thrips (WFT) *Frankliniella occidentalis*	Early instars on plant	Early instars on plant	Early instars on plant	Pupa in soil	Immatures and adults on plant	Pupa in soil	Pupa in soil

Fly Biological Control Agents

	Steinernema feltiae (parasite, nematode)	*Steinernema carpocapsae* (parasite, nematode)	*Hypoaspis miles (Stratiolaelaps scimitus)* (predator, mite)	*Atheta coriaria* (predator, insect)
Fungus gnats *Bradysia sp*	yes		yes	yes
Shore Flies *Scatella sp.*		yes		

Whitefly Biological Control Agents

	Encarsia formosa (parasite, insect)	*Eretmocerus eremicus* (parasite, insect)	*Eretmocerus mundus* (parasite, insect)	*Delphastus catalinae* (predator, insect)	*Amblyseius swirskii* (predator, mite)	*Amblydromalus limonicus* (predator, mite)	*Chrysoperla sp.* (predator, insect)
Greenhouse Whitefly *Trialeurodes vaporariorum*	yes	yes		yes	yes	yes	Will feed but not control
Sweet Potato / Tobacco *Bemisia tabaci*		yes	yes	yes	yes	yes	Will feed but not control

Spider Mite Biological Control Agents

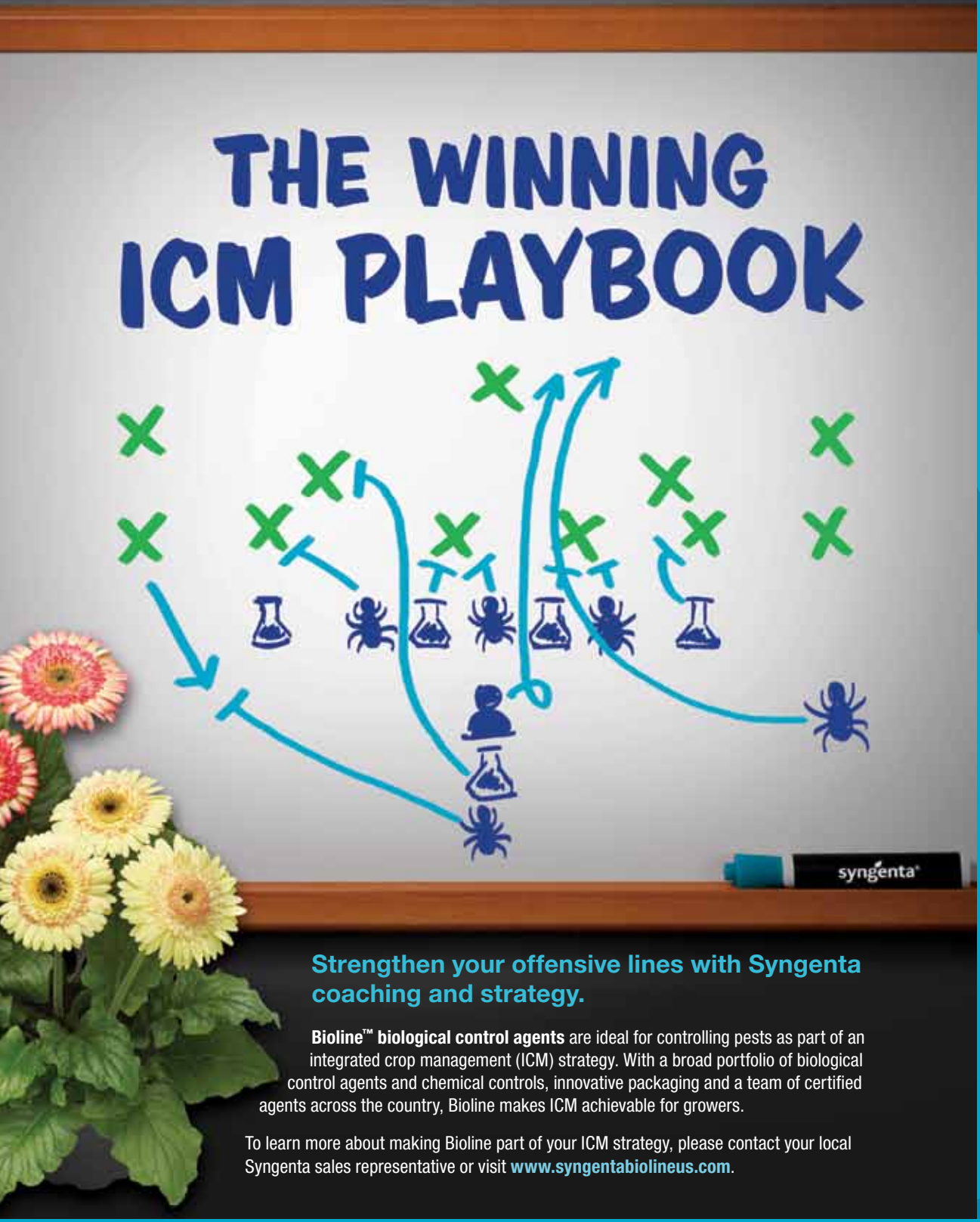
	Phytoseiulus persimilis (predator, mite)	*Amblyseius californicus* (predator, mite)	*Amblyseius fallacis* (predator, mite)	*Amblyseius andersoni* (predator, mite)	*Feltiella acarisuga* (predator, insect)	*Chrysoperla sp.* (predator, insect)
Spider mite species	yes	yes	yes	yes	yes	Will feed but not control

Leafminer Biological Control Agents

	Diglyphus isaea (ectoparasitic, insect)	*Dacnusa sibirica* (endoparasitoid, insect)
Leafminer species	yes	yes

TIPS

- When on a bio program, native beneficials often show up to work for free for you. Be sure not to kill them with sprays.
- Watch for pesticides that are incorporated into media. They can impact some of the BCAs.
- Beneficial nematodes do well under mist systems in propagation.
- Get your beneficials in early, before you have a pest problem.
- Scouting is critical. You must know what's going on in your crop!



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Scouting for Success with Integrated Crop Management

By Marla Faver

Integrated Crop Management (ICM) is the comprehensive and coordinated use of cultural, biological and chemical tactics to reduce pest populations to acceptable levels. Successful ICM programs are those that have been well thought-out then customized for individual needs. Gathering information before, during and after a program is essential to perfecting the strategy and achieving continued success, year after year.

To begin an ICM program, it's essential to evaluate cultural practices, gather information on crops, and scout and examine environmental conditions. Growers should compile historical data on pests, diseases and resistance issues, as well as chemicals, biological control agents (BCAs) and other treatments used in the growing area. All ICM programs, including BCAs, are best implemented preventively. Understanding your crop and potential pest pressure is imperative.

Elements of a successful ICM program

- Scouting
- Monitoring
- Good record keeping
- Realistic expectations
- Dedication
- Communication at all levels
- Flexibility
- Preventative cultural practices

Unfortunately, ornamental pest activity doesn't follow a calendar. *Scouting is the key to any successful ICM program.* The decision to implement a scouting program is one that can weigh heavily on the minds of growers. Production facilities that don't utilize a scouting program often rely on broad-spectrum calendar sprays and/or "curative" applications to gain control of established pest populations. Calendar spraying can result in unnecessary and costly pesticide applications and may accelerate the development of pesticide resistance. Last minute or curative applications are often not successful, resulting in multiple applications and/or an unsellable crop.

Scouting is the only way for a grower to have an intimate knowledge of his crop and potential disease and pest pressures.

For a scouting program to be successful, there must be people devoted to scouting regularly. Look at all crops weekly and on the same day each week to avoid missing significant outbreaks. Many pest life cycles during periods of higher temperatures may be completed within seven days or less. Scouting is an important job and cannot be done appropriately with a hit-or-miss approach. It'll be difficult to detect and identify pest problems early in the infestation cycle without a good scouting program in place.

Scouting methodology

The first important step in scouting is to thoroughly inspect all newly arriving plant material for any hitchhikers.

Utilize yellow sticky cards to monitor flying insect pests. For specific monitoring of thrips, blue sticky cards may be used. At a minimum, evaluate sticky cards weekly to monitor adult populations and determine appropriate application and timing of control options. One sticky card every 1,000 to 3,000 sq. ft. is usually sufficient. Sticky cards may also be used to monitor populations two to three days after a pesticide application to ensure proper control was achieved. Sticky cards are a very useful scouting tool, but take care not to rely solely on them for monitoring pest populations. Without careful incorporation of multiple scouting methods, instances of minor disease and insects/mites are often missed.

When scouting, look for obvious signs of plant damage, such as chlorotic, stunted or malformed growth, cast off skins, feeding damage, honeydew, sooty mold and the presence of ants. Using a hand lens, check undersides of leaves from the top to the bottom of the plant to detect infestations before they cause severe plant damage. Take hanging baskets down and inspect from sides and top to ensure devastating populations of spider mites, thrips or aphids don't go unchecked.

Just as a successful ICM program requires a good scouting program, scouting without proper record keeping will be ineffective. Growers who attempt to diagnose a problem without records are at a disadvantage and may overlook potential causes of the problem. Scouting data isn't very useful if the problem sites aren't clearly noted, showing where disease, mite and insect infestations are located in the growing area. A good way to organize the scouting data is to summarize the information for each growing area, according to the pests detected, the counts and any unusual circumstances discovered. Information generated by scouting can be used to determine if pests present are above or below action thresholds to make effective pest control decisions. As the season progresses, growers will observe pest trends developing within the scouting data, which will allow improved pest management decisions.

Scouting must continue after pesticide and/or BCA application to make sure pest management practices are successful. Choosing an insecticide or BCA that's effective for the pest life stage present and fits into a proper rotation is essential. Keeping detailed records of any pesticide application or BCA release is very helpful when comparing previous pest management practices and evaluating if fewer control applications are necessary or more efficacious chemical or biological controls should be substituted.

Implementing a scouting program takes time and patience. Adequate time must be invested into the production of a crop and detailed records must be kept. Over time, growers can determine their own economic threshold for any given insect, related pest or disease, allowing better decisions for pest control. Early detection by scouts will allow growers to substitute or incorporate a targeted insecticide or BCA application before pest populations reach unmanageable levels. This will also help decrease the likelihood that pests will develop resistance, which will allow the grower to maintain effective products in their arsenal against pests.

Results with any particular program will depend on many factors, including time of year, number of applications, environmental conditions and specific products used. Releases of BCAs and chemical applications should be based on particular scouting/monitoring programs. **GT**

Marla Faver specializes in technical service for ornamental production and can be reached at paintedskygsp@gmail.com.

EARN YOUR MEDALLION

A root disease began to invade on a grower's fall pansy crop. Before taking action, he consulted with his Syngenta technical representative who walked the grounds and discovered, not pythium, but actually Thielaviopsis. This somewhat rare and dangerous disease, for which most fungicides are not labeled to treat, threatened this year's profits.

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