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GROWERTALKS

2027 Insecticide, Miticide & Fungicide Guide



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Rooted in Partnership, Growing with Purpose

Across the industry, success is driven by the people behind it—teams committed to producing healthy plants, improving each season and doing things the right way. That mindset continues to move our industry forward.

Today's environment brings real complexity. From shifting pest pressures to higher expectations across the value chain, growers are asked to do more with greater precision, and success relies on the right approach, supported by strong expertise, practical tools and trusted partners.

At BASF, we help bring those pieces together through crop protection solutions, technical insight and real-world experience, supporting growers with consistency, efficiency and plant quality from propagation through finish. Our portfolio combines trusted solutions with ongoing innovation and dedicated technical services. From the proven benefits of the **Intrinsic® brand fungicides** to newer chemistries like **Avelyo® fungicide** and targeted chemistries like **Ventigra® insecticide** and **Sultan® miticide**, we strive to provide growers with the building blocks for success.



Alex Henson
BASF Ornamentals
Product Manager

This year's Insecticide, Miticide & Fungicide Guide starts with a customer story that showcases Willoway Nursery's growing operation, highlighting how a collaborative plant health team advances its approach through experience, curiosity and a willingness to try new solutions. Their work reflects the industry's shift toward integrated strategies that blend targeted chemistries with biological tools to solve problems while balancing production demands.

The guide then moves into key production topics, including crop management considerations and emerging pest challenges that influence day-to-day decisions, and concludes with practical resources, including updated product use charts and rotation-focused tools that can simplify decisions and support resistance management.

Every season brings variables, but the goal remains the same: healthy plants and consistent results. We are proud to partner with growers and continue our sponsorship of this guide, providing resources to help you move forward with confidence.

On behalf of the BASF team, we hope this guide proves valuable throughout the season and wish you continued success in 2027.

—Alex Henson, BASF Ornamentals Product Manager

ON THE COVER: *Anthracnose on aglaonema.*

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Camryn Pierson, Mark Shelton and Will Mihalega are the dynamic trio of Plant Healthcare Specialists at Willoway Nurseries, Inc.



A Collaborative Approach to Plant Healthcare

When someone starts a conversation by enthusiastically saying, “I mean, the nematodes were a gamechanger,” you know you’re in for an interesting chat. And so it was with the plant healthcare team at Willoway Nurseries: Will Mihalega, Avon Plant Healthcare Supervisor; Mark Shelton, Huron Plant Healthcare Supervisor; and Camryn Pierson, Plant Healthcare Supervi-

sor in Training. Together, these three have 81.7 years of experience at the nursery.

Mark started at Willoway in 1987 and worked in shipping and sales. Will has him beat, arriving on scene in 1984 as an Ohio State University Agricultural Technical Institute (ATI) intern who stayed for 42 years. And Camryn, another ATI graduate started last summer.

“We all started working our way toward

the plant healthcare team because we had pesticide licenses,” Mark said. “And nobody wanted to work with the chemicals.”

Talking to Mark, Will and Camryn now, it’s clear that even though they each supervise different crops and manage separate parcels of Willoway’s 1,000-plus acres, they’re a collaborative and inquisitive team, leading the company’s IPM program through decades of change and innovation.

They’re quick to also give credit to the Demaline family, owners of Willoway, with Mark saying, “We couldn’t do what we get to do if the managers didn’t have an open mind. I’ve never been told ‘no’ when it comes to pursuing out-of-the-box solutions. They support our work with companies like BASF and others to get a foothold on problems before they blow up.”

Necessity is the mother of invention

Les and Marilyn Demaline founded Willoway in 1954, landscaping with a borrowed truck. They expanded the Ohio-based business to container production, then field production and greenhouses, largely because they and their colleagues couldn’t find the right type or volume of plant material for their landscaping business.

Today, the nursery ships millions of finished plants to 25 states in the eastern half of the U.S. and Canada.

“The Chicago area is one of our major markets,” said Mark. “But we also ship west to Nebraska, down to Texas and across the east coast.”

Today, Willoway’s focus is on containers from 1 qt. up to 45 gal. Woodies and perennials are their bread and butter, but annuals and a bit of BnB field production are also part of the mix. While they grow a few plants from seed or tissue culture, most of the propagation is done in-house via cuttings.

Willoway’s customer mix is around 40% garden centers, 30% landscapers and 30% re-wholesalers. With such a mix of

Willoway's Go-To Solutions

There isn't room to print every example the plant healthcare team shared, but they're particularly enthusiastic about these BASF solutions. Here's what they said:

- **FreeHand® herbicide:** a must-have to help achieve weed-free hydrangeas at the nursery
- **Millenium® beneficial nematodes:** used for flea beetles and anything with grubs
- **Ultra-Pure® Oil horticultural insecticide, miticide and fungicide:** amazingly effective on scale and really can be used year-round as long as the temperature is under 80F with humidity under 60%
- **Velifer® bioinsecticide/miticide:** a biological drench to control mites; a game changer for hydrangea tree production
- **Ventigra® insecticide:** it's excellent for aphids and scale

customers, every plant needs to reach peak salability in top condition. But how the plant goes from cutting to consumer has changed quite a bit over the past 40 years.

Innovation is the engine of growth

Those changes are the source of plant healthcare work for Mark and Will, with Will saying, "The job is a challenge that's always changing. I've sprayed all the old chemistries. And now I get to work with beneficials, new chemistries and, with the help of our BASF reps, come up with interesting, effective solutions."

Mark said, "If you had told me seven years ago that I'd be using nematodes, I wouldn't have believed you. But the **Millenium® beneficial nematodes** have absolutely turned the flea beetle problem around.

"The thing that has impressed me is the way BASF has worked to incorporate beneficials with their other products, cutting new paths."

Nerding out on nematodes

There's much, much more to Willoway's IPM program than the aforementioned nematodes, but understanding how they're incorporated into the program provides insight into Willoway's entire plant health strategy.

Mark explained, "Nematodes are a roundworm, not an insect. Therefore, you

can apply them with certain insecticides and fertilizers, and those don't touch the nematodes. BASF has a compatibility list they put together to help us combine the nematodes with other chemistries we use. For example, if I feel like I need to have a systemic in the plant, we can mix the nematodes with one." The entire program relies on this type of additive action.

"We like using **Sultan® miticide** because we can release beneficials within a couple of days of application."

Mark mentioned **Pageant® Intrinsic® brand fungicide** as another two-for-one product. "There's such a good bonus. We use it at the time of planting. Not only does it protect plants as they're establishing, but it also stimulates root growth."

Out with the old

"For years, when you'd find a bug, you'd freak out and spray everything. It's different now," said Mark. "Due to our protocols, we know the insects are there, how many there are, what stage the crop is in and then decide how to approach the problem. If the crop is saleable, we treat differently than at other stages of the plant's life."

Here's how they track pest population: There's a loose calendar for managing production. For example, "Depending on what the crop is, we might start with a month of beneficials in the spring, which buys us time from spraying. Then as pressure increases, we might shift," said Will.

Growers are assigned to individual sections. As they water, they scout for insect and disease issues, which they note on a crop action bulletin that goes to Will and Mark for review and any treatment decisions.

The labor day

They open up a conversation that every production nursery constantly has: how to manage labor. And the praise for the utility of nematodes continues.

"We like the nematodes because we can apply them during work hours and not disrupt operations," said Camryn.

"Spraying according to shipping times and working with shipping is one of the most difficult parts of our job," they said. Mechanized applicators and strategizing with BASF reps are two ways they've managed this issue.

"Our BASF reps, Kimberly Noffke, sales specialist, and Jen Browning (PCA) technical service, save us tons of time in other ways," said Mark. "I might be trying to calculate the liquid ratios for an application. I can call my rep and they'll have it back to me in two minutes."

Ongoing partnerships

Getting a nearly spotless, healthy finished plant to the customer requires a dance between the plant healthcare team, the growers, the shipping departments, sales reps and outside vendors. All of whom might have competing interests. What the Willoway team has found is the strength that comes with collaboration and feedback from everyone involved, including their BASF team.

Mark said, "I mean, look, BASF is a chemical company and we're buying nematodes from them. Anything's possible!" ■

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High Root-Zone Temperatures: A Problem or an Opportunity?

By Jeremy Pickens, Ph.D. — Assistant Extension Professor, Auburn University

Consider this thought experiment: Take two 3-gal. azaleas, prune 95% of the shoots off one and 95% of the roots off the other. Which plant has the best chance of recovery?

So why do we pay so little attention to roots? Obviously, we can't see them. We rely on what we can see to tell us how the plant is doing, but often the shoots show us something is wrong long after root damage has occurred. In container production, one of the most overlooked root issues is temperature.

While plant shoots have had to adapt to all kinds of temperature extremes and fluctuations across the eons, roots have had it easy in cooler soil. The soil helps buffer large temperature swings and roots operate best in the 60s to mid-70s. When we grow plants in black containers exposed to direct sunlight, root-zone temperature (RZT) can exceed 130F near the outer edges of the root ball. Temperatures are cooler toward the center of the container, but even those areas are often above the optimum range. In summer, ambient air temperatures themselves are often above optimum root temperatures and can indirectly affect plant physiology. Black, spaced containers with limited canopy shading can extend these critical indirect-injury temperatures well into the night, resulting in limited recovery time.

Researchers have been demonstrating the impact of high RZT for more than 60 years. We've learned that cell damage can occur at temperatures as low as 104F. Occasionally, and under certain conditions, we see crop loss due to high root-zone temperatures, but it's far more common for less extreme, chronic conditions to reduce production.

A problem or an opportunity?

If you look across your nursery and see a near-perfect crop, it's hard to imagine that high RZT is a problem, and in many cases it isn't. Its impact can depend heavily on the season, species, spacing and container size. A different approach is to stop thinking about RZT only in relation to whether a crop is marketable and sold. Instead, ask yourself: What are we leaving on the table? If you can be successful under conditions that are less than optimal, what benefits might you see if you alleviated this stress?

Often, studies that compare cooler RZT using methods like white containers demonstrate shoot growth over conventional black, sometimes approaching 30%, but it's situational. From my experience, a benefit in shoot growth may or may not occur, however, it's much more common to see improved root growth earlier in the crop cycle.

Recent research has taken a new approach beyond simply showing that plants grow better in cooler pots. Scientists are now looking at additional benefits, such as labor savings, fertilizer savings, water-use efficiency and disease susceptibility.

One example is fertilizer savings. Controlled-release fertilizers can be significantly affected by heat and researchers have been interested if cooler containers would result in savings. In a recent trial, fertilizer in cooler, white containers retained 22% more nitrogen. We also observed comparable growth of plants grown in white containers at a low rate compared to black containers at a high rate.

Disease pressure has also been shown to be affected by root-zone temperature. Studies with *Phytophthora* have shown reduced disease incidence when comparing inoculated crops grown under moderate root-zone temperatures with crops exposed to high root-zone temperatures.

Ever noticed how the southwest corner of a spaced container is often void of roots? Eventually, as the canopy grows and provides shade, this area will fill in, but in the meantime, you paid for fertilizer, bark and water that aren't being used in that area.

How high RZT affects plants

When a black container sidewall is exposed to solar radiation, it absorbs energy that's then re-radiated into the substrate. The high heat capacity of the substrate, combined with a steady flow of energy, is akin to a battery charging. The result is RZT well above ambient temperature. The high heat capacity also causes the root zone to remain hot for several hours after sundown. It's important to understand that the issue isn't just how hot the roots get, but how long they're exposed to temperatures above a critical threshold.

Container color and container spacing impacts root growth. Left to right: Black jammed, black spaced, white jammed and white spaced.





Container color and fertilizer longevity types impact on root growth. Root growth in shorter longevity fertilizer was reduced potentially through less efficient use of fertilizer.

High temperatures affect roots in several ways. Direct injury to cell membranes can occur because membranes become more fluid as temperatures increase, resulting in compromised cell membranes. High temperatures also affect oxygen availability. The warmer the root solution becomes, the less dissolved oxygen it can hold. At the same time, respiration speeds up for root cells and other microorganisms in the root zone, increasing oxygen demand. Low oxygen concentrations, along with the resulting reduction in energy production, can trigger a cascade of effects on root function. These impaired functions include water and nutrient uptake and cellular integrity. Everything is connected and temperatures beyond the optimum can create a domino effect that reduces plant productivity.

Indirectly, high RZT can also affect disease pressure because materials leaking from damaged cells, along with low-oxygen conditions, can create favorable conditions

for pathogens such as Phytophthora. It's almost like ringing the dinner bell.

Obviously, this isn't always catastrophic because plants are relatively robust. Still, under conditions that favor high RZT, it's worth asking whether things could be better—for example, through reduced production time, increased quality or decreased disease incidence. Improving root-zone temperature may be worth investigating in crops that consistently struggle during warm periods.

How to reduce root-zone temperature

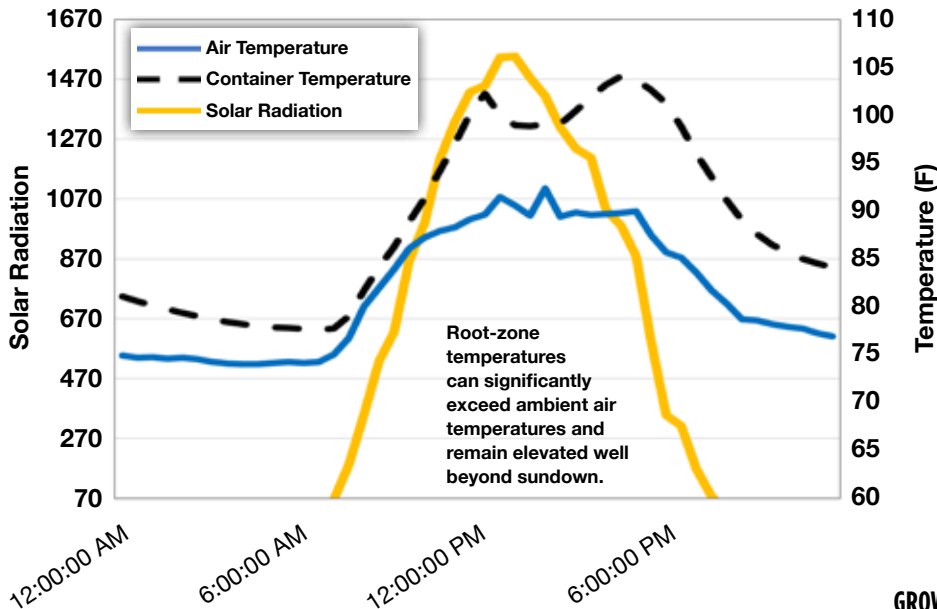
With more than 60 years of research, scientists and growers have developed several methods to reduce root-zone temperature. The primary mechanism is simple: block or shade sunlight from directly hitting the container.

Canopy closure and spacing (jammed

vs. spaced plants) is one method many growers employ unknowingly. Plants are commonly kept close together after potting to maximize space and, inadvertently, container sidewalls are shielded from the sun.

White containers are an effective option for smaller container sizes (up to 3- and 5-gal). It's important that the white container be lined with a black interior. White containers have been shown to significantly reduce the time spent above critical temperatures. For larger containers, where white containers may not be available, reflective or white pot sleeves or wraps can help reflect solar radiation. Pot-in-pot can drastically reduce root-zone temperature. Additionally, above-ground pot-in-pot systems can reduce root-zone temperatures when a smaller container is placed inside a larger one with an air gap between them. For some species and production systems, growing under shade can also be effective.

Effect of Time of Day on Root Zone Temperature in Container Center (n=10)



Root-zone temperatures can significantly exceed ambient air temperatures and remain elevated well beyond sundown.

Reducing root-zone temperature isn't a one-size-fits-all solution, but it's worth considering for crops that routinely have production issues. Try reducing root-zone

temperature on a small scale and evaluate the results for yourself. If you see a benefit, expand the practice to additional crops. The risk is relatively low and the potential upside may be substantial. ■

McBrayer, R.H.; Pickens, J.M.; Witcher, A.L.; Wells, D.E.; Sibley, J.L. Effects of Nursery Container Color and Spacing on Root Zone Temperatures of 'Soft Touch' Holly. Agriculture 2022, 12, 2165. <https://doi.org/10.3390/agriculture12122165>

Greenhouse Mealybug Management Guide for Growers

By Muhammad “Zee” Ahmed, Ph.D., Peilin Tan and Powlomee Mondal — Turf & Ornamental Entomology Lab at Clemson University’s PeeDee Research & Education Center

Mealybugs infiltrate greenhouses as first instar crawlers, easily hitchhiking on plant material, tools, carts, pots and worker clothing. Their biology makes eradication nearly impossible: No single strategy eliminates mealybugs. Effective management requires species identification, timing, rotation and integrated IPM practices

The most common greenhouse mealybug species

Most common in U.S. greenhouses:

- Citrus mealybug (*Planococcus citri*)
- Madeira mealybug (*Phenacoccus madeirensis*)
- Longtailed mealybug (*Pseudococcus longispinus*)
- Striped mealybug (*Ferrisia virgata*)
- Root mealybugs (*Rhizoecus* spp., *Ripsiella hibisci*)

Figure 1. Mealybugs among scale insects.

Scale Insects

→ Mealybugs

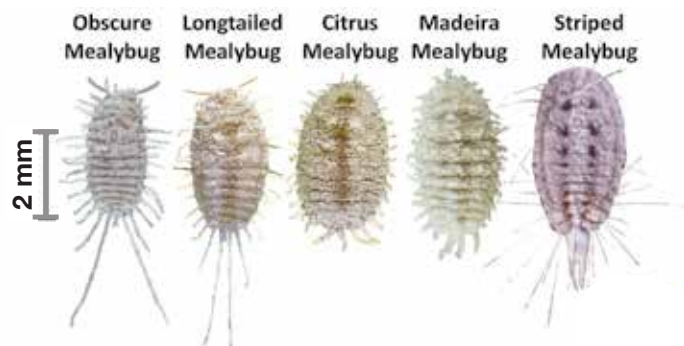


Species differ in:

- Wax production
- Feeding behavior
- Susceptibility to insecticides
- Life cycle duration
- Response to systemics

Accurate species identification is essential.

Figure 2. Most common mealybug species in greenhouses.

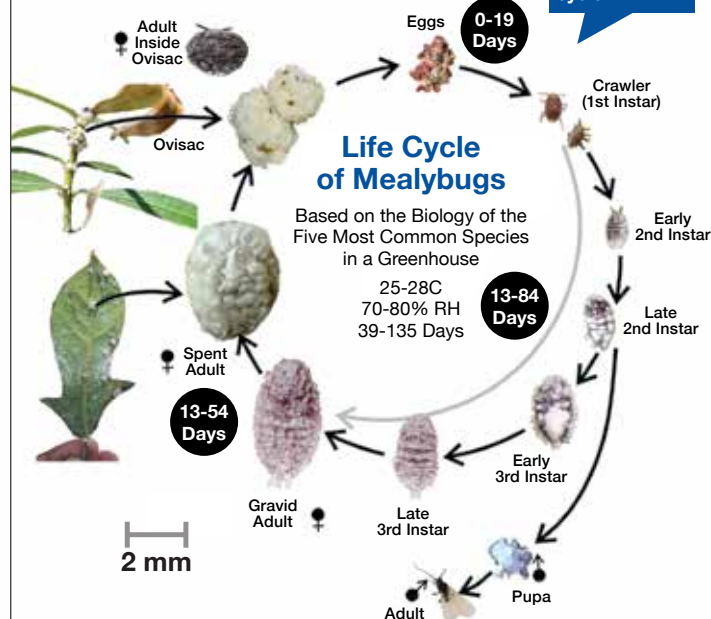


Biology that affects control

- Egg stage: 0 to 19 days
- Immature stage: 13 to 84 days
- Adult longevity: 13 to 54 days
- Generations per year: 4 to 10

Crawlers are the only reliably vulnerable stage. Adults are heavily waxed and difficult to kill.

Figure 3. Mealybug life cycle.



Why chemical control alone fails

Mealybugs are difficult to manage using pesticides alone because:

- They hide in protected places on plants.
- Their waxy covering protects them from insecticides.
- Foliar applications don't reach all areas.
- Drenching doesn't control them 100%.
- They don't feed enough to ingest lethal doses.

- Dense colonies create layers; the top layer doesn't feed.
- All life stages are present at the same time.
- Eggs hatch continuously and are unaffected by insecticides.
- Systemics aren't reliably effective on citrus mealybug in greenhouses.

Chemical control

Table 1. Comparison of insecticide performance across mealybug species, organized by IRAC mode of action based on IR 4 2023 Ornamental Horticulture Program data (as shown in Mondal et al. 2025).

IRAC	Active Ingredient	Citrus	Madeira	Mexican	Phormium	Striped	Root
1B	Acephate	HIGH	HIGH	HIGH	LOW to MODERATE	—	LOW to MODERATE
4A	Dinotefuran	HIGH	HIGH	HIGH	HIGH	—	HIGH
4A	Thiamethoxam	HIGH	—	HIGH	HIGH	—	—
4D	Flupyradifurone	LOW	LOW	—	—	—	—
7C	Pyriproxyfen	MODERATE	MODERATE	—	—	MODERATE	—
9B	Pyrifluquinazon	HIGH	MODERATE	—	—	—	—
9D	Afidopyropen	MODERATE	HIGH	—	—	MODERATE	—
16	Buprofezin	—	HIGH	—	—	—	—
21A	Tolfenpyrad	—	HIGH	—	—	—	—
23	Spirotetramat	LOW	HIGH	—	—	—	HIGH
28+29	Cyclaniliprole + Flonicamid	—	HIGH	—	—	—	—
29	Flonicamid	MODERATE	—	HIGH	—	—	HIGH
UN	Azadirachtin	LOW	LOW	—	—	—	—
UN	Oils	LOW	MODERATE	—	—	—	—

HIGH ≥ 90%; MODERATE 75–89%; LOW < 75%. Data from IR 4 (2023). Rotate IRAC groups to prevent resistance.

Updated rotation strategy (based on efficacy categories)

Primary rotation (broadest coverage):

1. Dinotefuran (4A)
2. Acephate (1B)
3. Flonicamid (29)
4. Pyriproxyfen (7C)
5. Afidopyropen (9D)

Species specific adjustments:

- Citrus: Pyrifluquinazon (9B), Acephate (1B), Dinotefuran (4A), Flonicamid (29), Afidopyropen (9D)
- Madeira: Tolfenpyrad (21A), Acephate (1B), Cyclaniliprole + Flonicamid (28+29), Afidopyropen (9D), Dinotefuran (4A)
- Mexican: Flonicamid (29), Dinotefuran (4A), Acephate (1B), Thiamethoxam (4A)
- Root: Dinotefuran (4A), Spirotetramat (23) drenches

A rigorous rotation alternates 4A → 1B → 29 → 7C → 9D, then layers in species specific top performers such as 9B for Citrus, 21A for Madeira and 23 drenches for Root.

Resistance rule: Never apply more than two sequential sprays from the same IRAC group.

Biological control (Commercial availability varies by supplier)

Parasitoids:

- *Anagyrus pseudococci*
- *Leptomastix dactylopii*
- *Leptomastidea abnormis* †

Predators:

- *Cryptolaemus montrouzieri* *
- *Chrysoperla* spp.*
- *Hippodamia convergens* †

Microbial:

- *Beauveria bassiana* *
- *Isaria fumosorosea* *

* Commonly available
† Not mass produced; limited availability

Cultural control (fully expanded and rigorous)

Sanitation:

- Remove crop debris immediately
- Keep greenhouse and perimeter weed free
- Disinfest recycled pots thoroughly
- Use high pressure water sprays to clean benches and tables (one to two times weekly)
- Disinfest growing areas after removing infested consignments

- Disinfest clothing, gloves and tools after working in infested zones
- Avoid staff movement from infested to clean areas

Plant material management:

- Only propagate from clean mother stock
- Avoid moving infested plants within the facility
- Remove heavily infested plants entirely
- Prune infested branches when localized
- Squash individual mealybugs and egg masses on lightly infested plants

Environmental management:

- Maintain optimal temperature, humidity, irrigation and fertility
- Avoid excessive nitrogen
- Ensure adequate plant spacing
- Monitor environmental conditions weekly

Ant management:

- Control ants aggressively—they spread crawlers and protect mealybugs
- Trace and eliminate ant trails and colonies

Inspection:

- Conduct weekly, rigorous inspections
- Pay special attention to mother stock and incoming shipments

Mechanical control:

- Clean plants after treatments to remove wax and residues
- Use high pressure water sprays to dislodge crawlers and adults
- Remove and destroy heavily infested plants or plant parts
- Avoid moving tools, carts and hoses from infested to clean zones
- Sticky cards help detect crawlers, but don't control them

Key takeaways for growers

1. Mealybugs cannot be eliminated with a single spray.
2. Species identification is essential.
3. Crawlers are the only reliably vulnerable stage.
4. Dinotefuran (4A) is the strongest broad spectrum option for mealybugs.
5. Acephate (1B) and thiamethoxam (4A) are strong alternatives.
6. Systemics are weak on citrus mealybug.
7. Rotate IRAC groups to prevent resistance.
8. Combine systemic + contact materials.
9. Integrate chemical, biological, cultural and mechanical tools.
10. Maintain strict sanitation and prevent spread. ■



Figure 1. Crapemyrtle bark scale settled crawlers in branch crotch and male pupae on stem.



Figure 2. Hot pink crapemyrtle bark scale eggs and adult female with ovisac removed.

Crapemyrtle Bark Scale: A Nursery & Landscape Pest

By Kevin D. Chase, Ph.D. — Bartlett Tree Research Laboratory

Few ornamental pests frustrate growers more than those that evade detection until plant quality is already compromised—crapemyrtle bark scale fits that description perfectly. Crapemyrtle bark scale (CMBS) is a familiar and increasingly important pest among growers and plant health care specialists that manage this pest in the nursery and in the ornamental landscape.

While tree mortality is typically not associated with this pest, CMBS can reduce flowering and produce abundant honeydew that leads to sooty mold growth. For nursery growers working with crapemyrtles, CMBS is no longer a regional issue. Since its first detection in Texas in 2004, it has spread rapidly across the southeast, into the Mid-Atlantic and most recently found on Long Island, New York.

CMBS can colonize all woody sections of a plant and is commonly found in branch crotches during initial establishment. Among scale insects, CMBS is thankfully one of the easier ones to identify. The eggs and crawler stage are hot pink (like 1980s hot pink!), and the cottony ovisacs (where eggs are housed) and male pupal cases are bright white.

One reason CMBS is so hard to control

is because it has multiple generations that can overlap and persist deep into the growing year. At the Bartlett Tree Research Laboratory and Arboretum in Charlotte, North Carolina, we observed crawlers emerging well into December during warmer years.

Another reason management is so challenging is because a very low number of females can result in massive population spikes—and quickly. While conducting a masters project at Mississippi State, researcher Erika Wright found that a single CMBS ovisac placed on potted crapemyrtles resulted in population establishment 92% of the time! This makes managing CMBS extremely difficult because if 100% mortality isn't achieved (and when is it ever?), the likelihood of a population resurgence is extremely high. This also means that any plants placed in the landscape with even one ovisac will likely result in a population explosion. From a production standpoint, this means that even low-level infestations shouldn't be tolerated, as populations can rebound rapidly following incomplete control.

Thankfully, some native predators have learned that CMBS is food. *Hyperaspis* lady beetles (of which there are several species native to North America) have

been found in large numbers feeding on CMBS. The larvae of *Hyperaspis* lady beetles are “wolves in sheep's clothing,” as they look like female ovisacs. In practice, the presence of abundant *Hyperaspis* beetles should trigger a pause in insecticide applications to preserve natural control. The commercially available lady beetle *Rhyzobius lophanthae* feeds on both ovisacs and crawlers, and can reduce populations in field conditions. While commercially available lacewings have been found to feed on eggs and crawlers in lab settings, they haven't been found to be an effective management tool in field conditions.

When considering pesticide applications for CMBS, there are many options. Systemic products should only be considered for very young plants that aren't producing flowers yet. Topical applications should only be made when crawlers are present (which are much easier to identify than most scale species). Rotating between insect growth regulators (IGRs), horticultural oils and soaps, and more traditional topical applications in different IRAC groups is key to successful CMBS management.

Management takeaways:

- Dormant applications of horticultural oil or insecticidal soap are critical because crawlers can still be active late into the growing year.
- CMBS population explosions can happen quickly and from even a single female ovisac.
- When large numbers of *Hyperaspis* lady beetles are present, don't make any applications.
- Rotate IRAC groups. ■

Rotate & Re-Apply

Preemergent Herbicides for Nursery Weed Control

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

Active Ingredient	Example Trade Names	WSSA Herbicide Group*	Weeds Controlled*
Dithiopyr	Dimension EW	3	Grasses and some broadleaves
Oryzalin	Surflan AS	3	
Pendimethalin	Pendulum AquaCap/G	3	
Prodiamine	Barricade L, RegalKade G	3	
Trifluralin	Treflan G	3	
Flumioxazin	Broadstar G, SureGuard SC	14	Broadleaves and some grasses
Oxadiazon	Ronstar G	14	
Oxyfluorfen	Goal XL	14	
Dimethenamid-P	Tower EC	15	Grasses, broadleaves, sedge suppression
s-Metolachlor	Pennant Magnum EC	15	Grasses, some broadleaves, sedge suppression
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	
Oxyfluorfen + Prodiamine	Biathlon G	14+3	
Oxyfluorfen + 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.

Field Guide for Two-spot Cotton Leafhopper

Amrasca biguttula (Ishida) (Typhlocybae: Hemiptera)

By Muhammad "Zee" Ahmed, Ph.D., Peilin Tan & Nisha Yadav, — Turf & Ornamental
Entomology Lab at Clemson University's PeeDee Research & Education Center



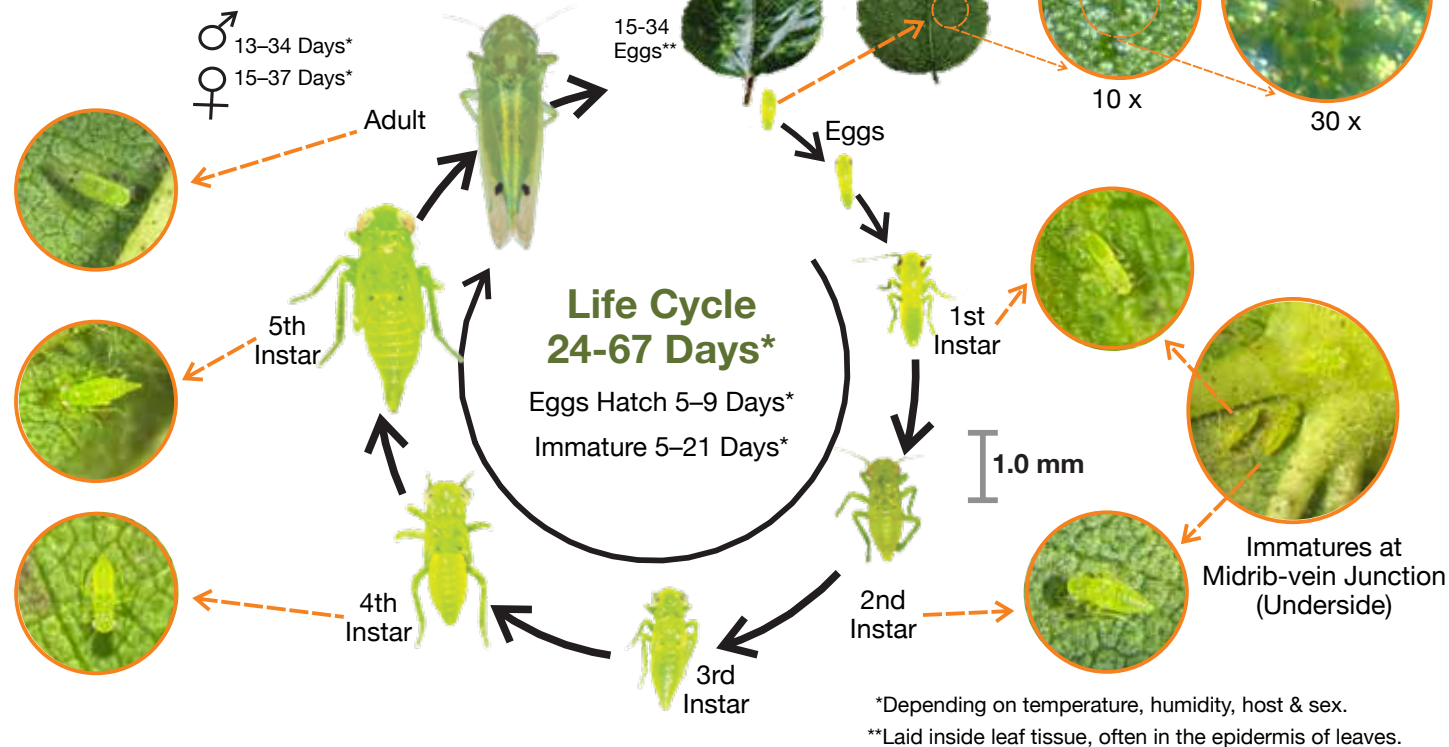
I. Understanding Size



II. Understanding Life Cycle

Location: Feeds on the underside of leaves.

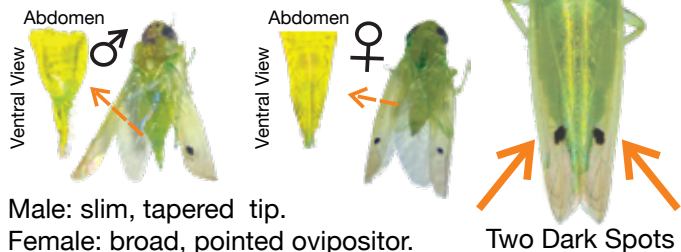
Feeding Habit: Sucks out leaf cell contents, causing visible damage.



III. Look for Two Spots and Signs of Damage

A. Two Spots:

- Tiny green body
- Two dark spots on wings



B. Symptoms: (also known as hopperburn)

- Leaves turn yellow, then red, then brown
- Leaves may wilt & curl

I. Yellowing



II. Curling & Wilting



III. Hopperburn



IV. Look for Host Plants

Malvaceae: Cotton, Okra, Roselle, Hibiscus
Solanaceae: Eggplant, Tomato, Potato
Asteraceae: Sunflower, Marigold
Vitaceae: Grapevine
Fabaceae: Cowpea, Green gram, Pigeon pea
Cucurbitaceae: Cucumber, Pumpkin
Pedaliaceae: Sesame

V. Look for Scouting Options

Visual Inspection: Underside of young leaves; note hopperburn (yellowing, curling, bronzing).
Sweep Net: Sweeps plants; count adult/immature.
Beat Sampling: Tap plants over white tray; count nymphs/adults.
Sticky Traps: Yellow cards at canopy height; monitor adult migration. Thresholds: 2 nymphs/leaf (cotton, okra); 2–3 adults/sweep; hopperburn on ~10–15% plants.

VI. Look for Control Options

A. Cultural/Mechanical Control

1. Start Clean

- Inspect all incoming stocks
- Isolate infested

2. Weed & Sanitize

- Remove alternate hosts
- Destroy infested debris

3. Space & Airflow

Maintain plant spacing to enhance airflow, reduce pest buildup and improve spray coverage

4. Barrier Netting

Use insect-proof netting or screen houses in high-value blocks

5. Scout Weekly

Flip leaves and inspect undersides for nymphs; check yellow sticky traps for adults

6. Prune & Remove

Clip off heavily infested plant parts & destroy them to prevent reinfestation

7. Plant Health

Balance fertilization & irrigation to maintain healthy plant growth

8. Trap Crops

Use cotton, okra or roselle as pull crops to attract this species away, as they are preferred

B. Chemical Control

1A (Carbamates)

Carbaryl (Sevin SL)
Nursery

1B (Organophosphates)

Acephate (Orthene T&O)
Nursery, Greenhouse

3A (Pyrethroids)

Bifenthrin (OnyxPro, Talstar);
Cyfluthrin (Lambda-cyhalothrin (Scimitar GC);
Fenpropathrin (Tame 2.4EC;
Tau-fluvalinate (Mavrik Aquaflow;
Permethrin (Perm-Up 3.2EC);
Pyrethrins (Pyganic, Pyrethrum TR)
Nursery, Greenhouse

3A + UC

Pyrethrins + Canola oil (Pycana)
Nursery, Greenhouse

4A (Neonicotinoids)

Acetamiprid (TriStar 8.5SL);
Dinotefuran (Safari 20SG);
Imidacloprid (Marathon);
Thiamethoxam (Flagship 25WG)
Nursery, Greenhouse

4D (Butenolide)

Flupyradifurone (Altus)
Nursery, Greenhouse

9D Afidopyropen (Ventigra)

Nursery, Greenhouse

16 (IGR)

Buprofezin (Talus 70DF)
Nursery, Greenhouse

21A (METI insecticides)

Fenpyroximate (Akari 5SC);
Pyridaben (Sanmite SC);
Tolfenpyrad (Hachi-Hachi SC)
Nursery, Greenhouse

23 (Tetramic acid derivative)

Spirotetramat (Kontos)
Nursery, Greenhouse

28 + 4A (Diamide + Neonic)

Cyantraniliprole + Thiamethoxam (Mainspring Xtra)
Nursery, Greenhouse

29 (Feeding blocker)

Flonicamid (Aria)
Nursery, Greenhouse

Botanicals / Biopesticides

Azadirachtin (AzaGuard);
Neem oil (Triact 70);
Beauveria bassiana (BotaniGard);
Horticultural oils (SuffOil-X, Sunspray);
Capsicum + garlic + canola oil (Captiva Prime)
Nursery, Greenhouse

The insecticides listed are those currently registered for use against leafhoppers in general. Their inclusion here does not indicate that each product has been specifically tested or proven effective against TSCL. Mention of trade names or products is for informational purposes only and does not constitute endorsement. Always follow the product label and local regulations when making management decisions. For resistance management, rotate across different IRAC numbers (switch colors), not sub-letters.

Disclaimer: This field guide provides tentative support for field identification and management.
Photo Credits: Nisha Yadav, Peilin Tan, Zee Ahmed

Building Blocks to 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)

**Add a plant-safe adjuvant to boost
efficacy and manage residue.**

From roots through bloom to finish prevent diseases before they start



EMMA LOOKABAUGH, PH.D.
BASF Senior Technical Specialist

ROOT AND CROWN ROT (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 (Group 11)

Aliette [or Areca] + Subdue Maxx (Group P 07 + 4)

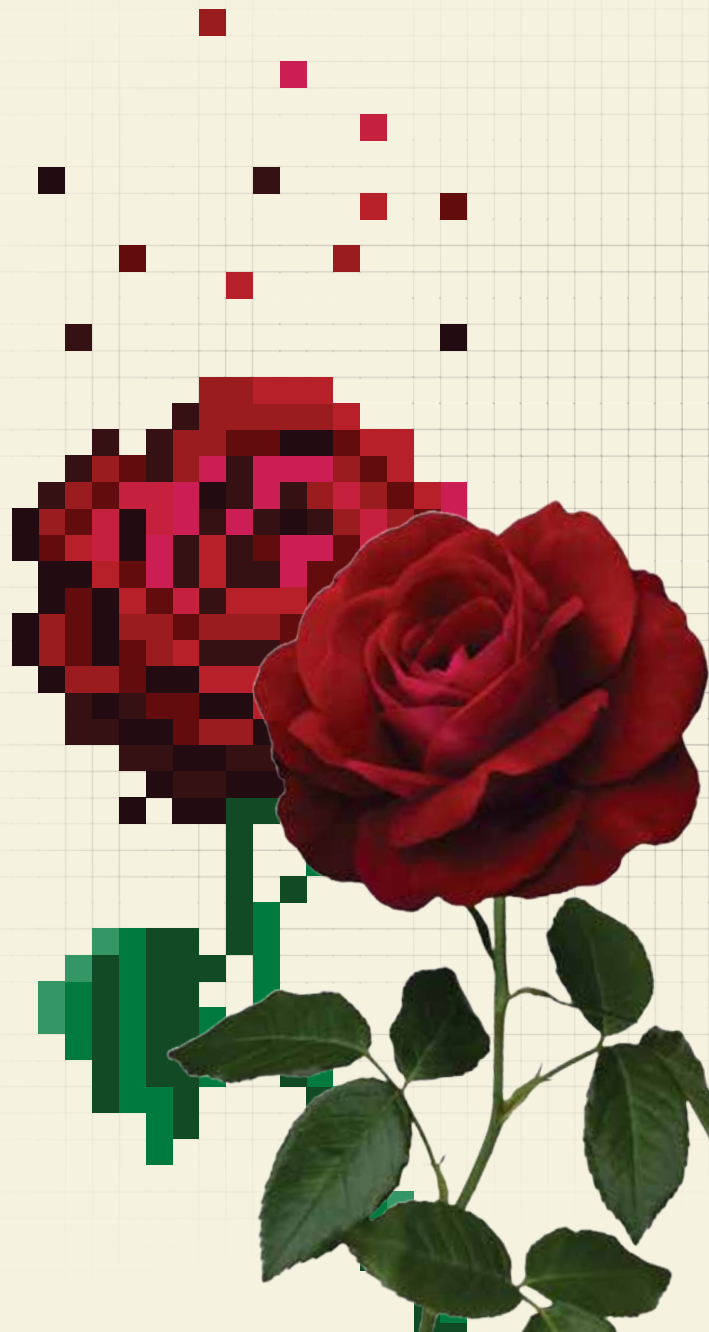
Segovis (Group 49)

BACTERIAL DISEASES

Phyton® 27, Camelot® O or Grotto™ (M1)

Triathlon® BA (Group BM 02)

Junction® (Group M1 + M3)



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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*
		flupyrim	Broadform*
		flutolanil	ProStar
		fluxapyroxad	Orkestra Intrinsic *
		isofetamid	Astun
		Pydiflumetofen	Postiva*
9	AP - fungicides (AnilinoPyrimidines)	cyprodinil	Palladium*
11	QoI-fungicides (Quinone outside Inhibitors)	azoxystrobin	Heritage, Mural*
		fluoxastrobin	Fame SC
		pyraclostrobin	Empress Intrinsic, Orkestra Intrinsic*, Pageant Intrinsic*, 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 <i>Reynoutria sachalinensis</i>	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, Phytan 27, Phytan 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 <i>Swinglea glutinosa</i>	Ecoswing
BM 02	microbial	<i>Bacillus amyloliquefaciens</i> (strains D747, QST 713, F727, MBI-600)	Triathlon BA, Cease, Stargus, Bacilirid
		<i>Pseudomonas chlororaphis</i> (strain AFS009)	Zio
		<i>Streptomyces griseoviridis</i>	Mycostop
		<i>Streptomyces lydicus</i> (strain WYEC 108)	Actinovate SP
		<i>Trichoderma harzianum</i> (strain T-22)	Rootshield
		<i>Trichoderma harzianum</i> (strain T-22), <i>Trichoderma virens</i> (strain G-41)	Rootshield Plus*, Triatum-P
		<i>Trichoderma asperellum</i> (strain ICC 012), <i>Trichoderma gamsii</i> (strain ICC 080)	Obtego*
		<i>Gliocladium virens</i> (strain GL021)	SoilGard
		<i>Ulocladium oudemansii</i> (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 ammoniums	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 Blocks to 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)



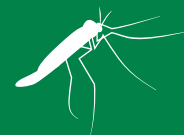
BROAD MITES

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)



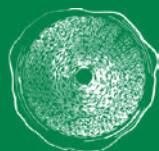
We make suggestions,
you make the decisions.

JEN BROWNING, PCA

BASF Senior Technical Specialist



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)

SHORE FLIES



Millenium® beneficial nematodes (Group NC)

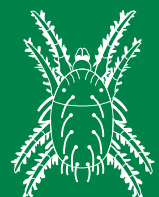
Azatin O biological insecticide (Group UN)

Citation insecticide (Group 17)

Conserve® SC Insecticide (Group 5)

IGR: Fulcrum insect growth regulator (Group 7C)

SPIDER MITES



Sultan® miticide (Group 25)

Pylon miticide-insecticide or **Pylon TR** miticide-insecticide (Group 13)

Velifer bioinsecticide/miticide (Group NC)

Savate® miticide/insecticide (Group 23)

IGR: TetraSan® miticide/ovicide

THRIPS



Pylon miticide-insecticide (Group 13)

Velifer bioinsecticide/miticide (Group NC)

Mainspring (Group 28)

XXpire (Group 5 + 4C)

IGR: Pedestal® insect growth regulator (Group 15)

WHITEFLIES



Ventigra insecticide (Group 9D)

Velifer bioinsecticide/miticide (Group NC)

Aria insecticide (Group 29)

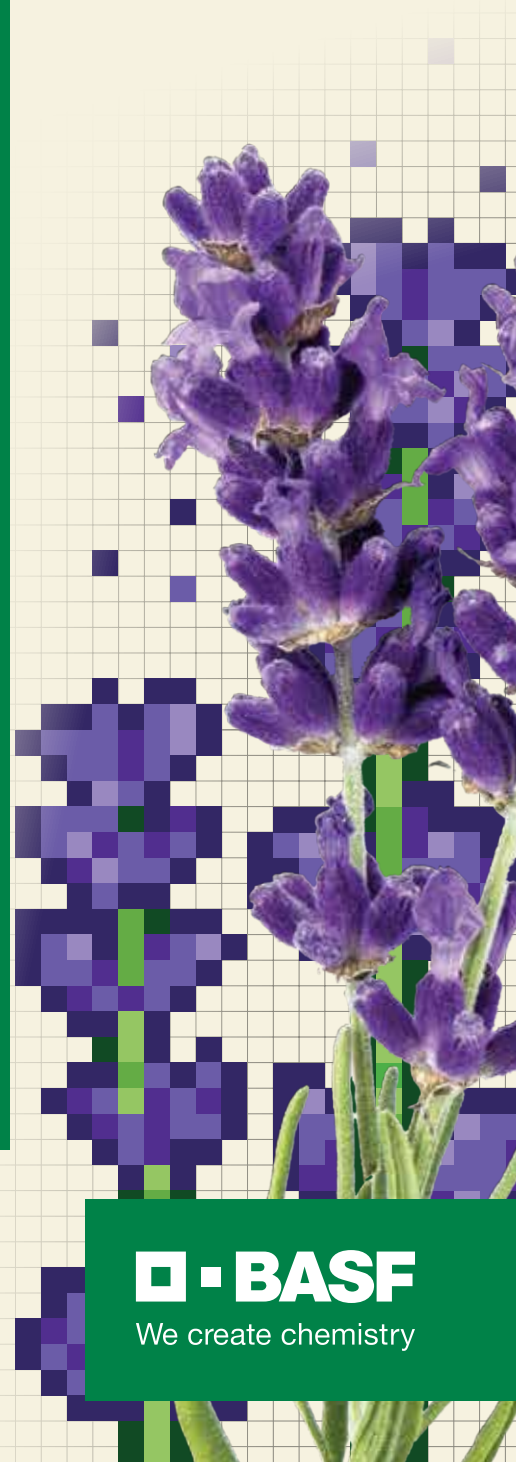
Savate® miticide/insecticide (Group 23)

IGR: Talus insect growth regulator (Group 16)

Always read and follow label directions.

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2027 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	UN: Ecdysone antagonist that inhibits action of the molting hormone
	<i>Beauveria bassiana</i> Strain GHA	BotaniGard	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	<i>Beauveria bassiana</i> Strain PPRI 5339	Velifer	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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	UNE: Suffocation or membrane disruptor
	<i>Cordyceps (=Isaria) fumosorosea</i> Apopka Strain 97	Ancora	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	<i>Cordyceps (=Isaria) fumosorosea</i> Strain FE 9901	NOFLY WP	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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





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 <i>continued</i>	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
	Kinoprene	Enstar	4 hours	7A: Juvenile hormone mimic
	Mineral oil	Ultra-Pure Oil/SuffOil-X	4 hours	UNM: Non-specific mechanical and physical disruptor
	Potassium salts of fatty acids	M-Pede/Kopa	12 hours	UNE: Desiccation or membrane disruptor
	Pymetrozine	Endeavor	12 hours	9B: Selective feeding blocker/chordotonal organ TRPV channel modulator
	Pyrethrins	Pyreth-Ilt/ Pyrethrum	12 hours	3A: Prolong opening of sodium channels
	Pyrethrins + Canola Oil	Pycana	12 hours	3 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	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
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator
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
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator
CATERPILLARS	Acetamiprid	TriStar	12 hours	4A: Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol ²	4/12/4/4 hours	UN: Ecdysone antagonist that inhibits action of the molting hormone
	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Dipel	4 hours	11: Midgut membrane disruptor

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 <i>continued</i>	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
	Cytraniliprole	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
	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	UNE: Desiccation or membrane disruptor
	Pyrethrins	Pyreth-I/Pyrethrum	12 hours	3A: Prolong opening of sodium channels
	Pyrethrins + Canola Oil	Pycana	12 hours	3 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	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
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator
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	UN: Ecdysone antagonist that inhibits action of the molting hormone
	<i>Bacillus thuringiensis</i> subsp. <i>israelensis</i>	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

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 <i>continued</i>	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
	<i>Steinernema feltiae</i>	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	UNE: 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	UN: Ecdysone antagonist that inhibits action of the molting hormone
	<i>Beauveria bassiana</i> Strain GHA	BotaniGard	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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	UNE: Suffocation or membrane disruptor
	<i>Cordyceps (=Isaria) fumosorosea</i> Strain FE 9901	NOFLY WP	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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
	Potassium salts of fatty acids	M-Pede/Kopa	12 hours	UNE: Desiccation or membrane disruptor
	Pyrethrins + Canola Oil	Pycana	12 hours	3 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	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

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)
LEAFHOPPERS <i>continued</i>	Thiamethoxam	Flagship	12 hours	4A: Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	21A: Mitochondria electron transport inhibitor
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator
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
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol ²	4/12/4/4 hours	UN: Ecdysone antagonist that inhibits action of the 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
	<i>Cordyceps (=Isaria) fumosorosea</i> Apopka Strain 97	Ancora	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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
	Kinoprene	Enstar	4 hours	7A: Juvenile hormone mimic
	Mineral oil	Ultra-Pure Oil/SuffOil-X	4 hours	UNM: Non-specific mechanical and physical disruptor
	Novaluron	Pedestal	12 hours	15: Chitin synthesis inhibitor
	Pyrethrins + Canola Oil	Pycana	12 hours	3 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	Spinosad	Conserve	4 hours	5: Nicotinic acetylcholine receptor disruptor/agonist and GABA chloride channel activator
	Thiamethoxam	Flagship	12 hours	4A: Nicotinic acetylcholine receptor modulator
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric 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	UN: Ecdysone antagonist that inhibits action of the molting hormone

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 <i>continued</i>	<i>Beauveria bassiana</i> Strain GHA	BotaniGard	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	<i>Beauveria bassiana</i> Strain PPRI 5339	Velifer	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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	UNE: Suffocation or membrane disruptor
	<i>Cordyceps (=Isaria) fumosorosea</i> Apopka Strain 97	Ancora	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	<i>Cordyceps (=Isaria) fumosorosea</i> Strain FE 9901	NOFLY WP	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	Nicotinic acetylcholine receptor modulator (4A)
	Kinoprene	Enstar	4 hours	7A: Juvenile hormone mimic
	Mineral oil	Ultra-Pure Oil /SuffOil-X	4 hours	UNM: Non-specific mechanical and physical disruptor
	Potassium salts of fatty acids	M-Pede/Kopa	12 hours	UNE: Desiccation or membrane disruptor
	Pyrethrins + Canola Oil	Pycana	12 hours	3 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	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
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator
PLANT BUGS	Acetamiprid	TriStar	12 hours	4A: Nicotinic acetylcholine receptor modulator
	<i>Cordyceps (=Isaria) fumosorosea</i> Apopka Strain 97	Ancora	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	<i>Cordyceps (=Isaria) fumosorosea</i> Strain FE 9901	NOFLY WP	12 hours	UNF: Fungal agent of unknown or uncertain mode of action

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)
PLANT BUGS <i>continued</i>	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
	Pyrethrins + Canola Oil	Pycana	12 hours	3 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	Tau-fluvalinate	Mavrik	12 hours	3A: Prolong opening of sodium channels
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator
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	UN: Ecdysone antagonist that inhibits action of the molting hormone
	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	UNE: 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	UNM: Non-specific mechanical and physical disruptor
	Potassium salts of fatty acids	M-Pede/Kopa	12 hours	UNE: Desiccation or membrane disruptor
	Pyrethrins + Canola Oil	Pycana	12 hours	3 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	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
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator

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)
SHORE FLY LARVAE	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol ²	4/12/4/4 hours	UN: Ecdysone antagonist that inhibits action of the 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
	<i>Steinernema carpocapsae</i>	Millenium		
SLUG AND SNAIL	Iron phosphate	Sluggo	0 hours	Inhibits calcium metabolism
	Metaldehyde	Deadline	Refer to Label	Central nervous system toxin
SPIDER MITE (TWO SPOTTED)	Abamectin	Avid	12 hours	6: GABA chloride channel activator
	Acequinocyl	Shuttle	12 hours	20B: Mitochondria electron transport inhibitor
	<i>Beauveria bassiana</i> Strain PPRI 5339	Velifer	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	Bifenazate	Floramite	12 hours	20D: Mitochondria electron transport inhibitor
	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
	Clarified hydrophobic extract of neem oil	Triact	4 hours	UNE: Suffocation or membrane disruptor
	Clofentezine	Notavo	12 hours	10A: Growth and embryogenesis inhibitor
	<i>Cordyceps (=Isaria) fumosorosea</i> Apopka Strain 97	Ancora	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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
	<i>Metarhizium brunneum</i> Strain F52	Met52	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	Mineral oil	Ultra-Pure Oil /SuffOil-X	4 hours	UNM: Non-specific mechanical and physical disruptor
	Potassium salts of fatty acids	M-Pede/Kopa	12 hours	UNE: 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
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator

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	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	UN: Ecdysone antagonist that inhibits action of the molting hormone
	<i>Beauveria bassiana</i> Strain GHA	BotaniGard	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	<i>Beauveria bassiana</i> Strain PPRI 5339	Velifer	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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
	<i>Cordyceps (=Isaria) fumosorosea</i> Strain FE 9901	NOFLY WP	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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
	Kinoprene	Enstar	4 hours	7A: Juvenile hormone mimic
	<i>Metarhizium brunneum</i> Strain F52	Met52	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	Mineral oil	Ultra-Pure Oil /SuffOil-X	4 hours	UNM: Non-specific mechanical and physical disruptor
	Novaluron	Pedestal	12 hours	15: Chitin synthesis inhibitor
	Potassium salts of fatty acids	M-Pede/Kopa	12 hours	UNE: Desiccation or membrane disruptor
	Pyrethrins	Pyreth-I/Pyrethrum	12 hours	3A: Prolong opening of sodium channels
	Pyrethrins + Canola Oil	Pycana	12 hours	3 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	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
	<i>Steinernema feltiae</i>	Nemasys		

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 <i>continued</i>	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
	Isocycloserum	Vykenda	12 hours	30: GABA gated chloride channel allosteric modulator
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	UN: Ecdysone antagonist that inhibits action of the molting hormone
	<i>Beauveria bassiana</i> Strain GHA	BotaniGard	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	<i>Beauveria bassiana</i> Strain PPRI 5339	Velifer	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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	UNE: Suffocation or membrane disruptor
	<i>Cordyceps (=Isaria) fumosorosea</i> Apopka Strain 97	Ancora	4 hours	UNF: Fungal agent of unknown or uncertain mode of action
	<i>Cordyceps (=Isaria) fumosorosea</i> Strain FE 9901	NOFLY WP	12 hours	UNF: Fungal agent of unknown or uncertain mode of action
	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
	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
	<i>Metarhizium brunneum</i> Strain F52	Met52	4 hours	UNF: Fungal agent of unknown or uncertain mode of action

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 <i>continued</i>	Kinoprene	Enstar	4 hours	7A: Juvenile hormone mimic
	Mineral oil	Ultra-Pure Oil /SuffOil-X	4 hours	UNM: Non-specific mechanical and physical disruptor
	Novaluron	Pedestal	12 hours	15: Chitin synthesis inhibitor
	Potassium salts of fatty acids	M-Pede/Kopa	12 hours	UNE: 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 + UNM: Sodium channel modulator + non-specific mechanical and physical disruptor
	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.

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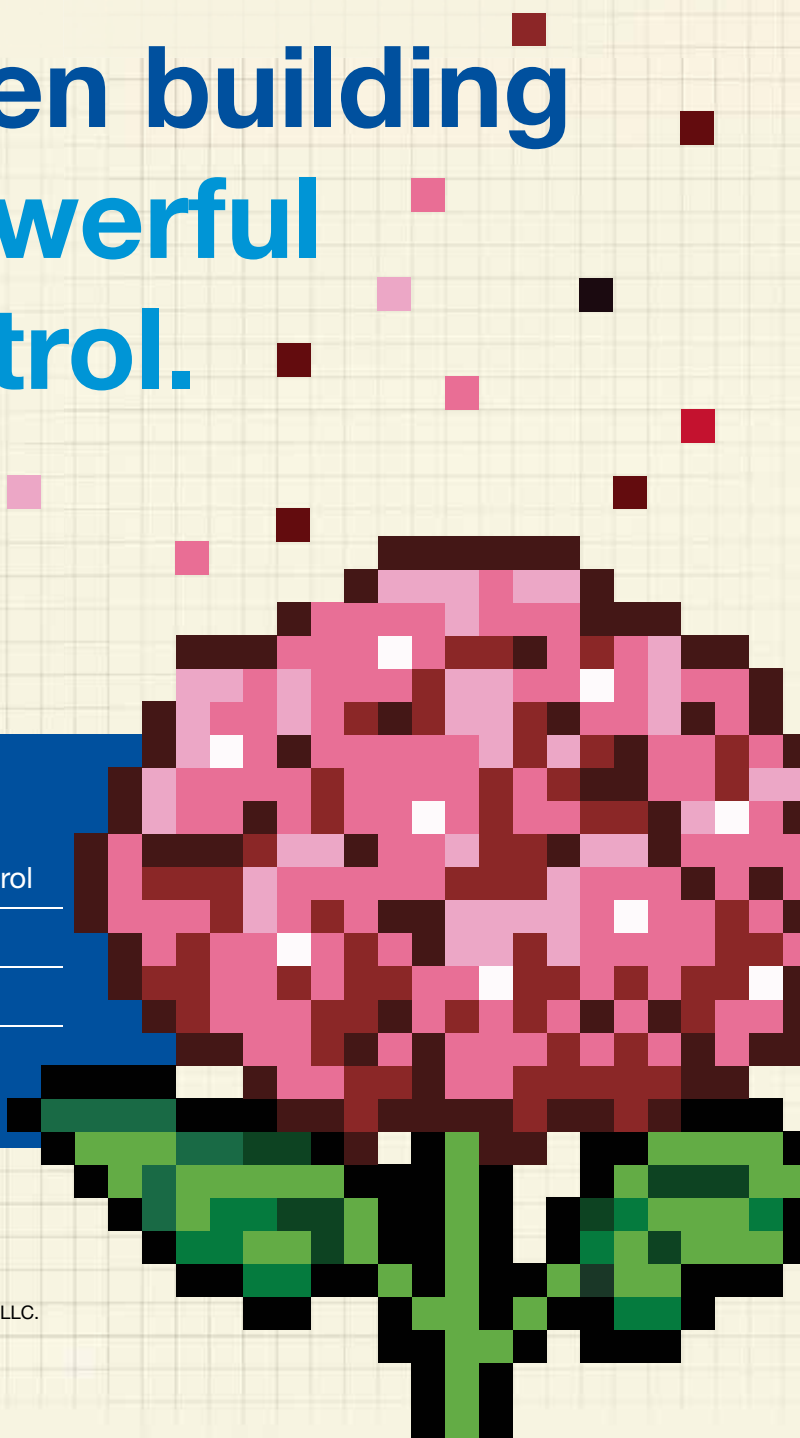
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