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GROWERTALKS

Insecticide, Miticide, & Fungicide Guide

2020

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GROWERTALKS

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GreenProfit Supplement Enclosed

Welcome to the 2020 edition of the Insecticide, Miticide & Fungicide (IMF) Guide! One of the most exciting things about my role as a Product Manager is launching new and innovative products into the commercial greenhouse and nursery market.

Newly introduced in 2019, the latest BASF offerings are complementary insecticide solutions—**Ventigra®** insecticide and **Velifer®** fungal contact insecticide/miticide—targeting the range of the most important piercing-sucking insects and mite pests. They now join the ranks of **Sultan®** miticide, and **Nemasys®** and **Millenium®** beneficial nematodes that readily integrate into grower IPM programs, while allowing beneficial insects and pollinators to thrive.

We're building on our commitment to be the leading manufacturer with an outstanding team to support the industry. The articles and content in this edition of the IMF Guide touch on those ideas: integration of controls and best practices alongside optimization of growing conditions.

In 2019, BASF is celebrating its 10th anniversary of the introduction of **Intrinsic®** brand fungicides, delivering a decade of outstanding, broad-spectrum disease control and a foundation for effective resistance management programs. **Pageant® Intrinsic** brand fungicide, **Empress® Intrinsic** brand fungicide and **Orkestra® Intrinsic** brand fungicide comprise the original EPA-registered fungicide brands to demonstrate specific plant health benefits. Over the past decade, growers have come to learn, understand and experience firsthand the results gained from greater stress tolerance and increased growth efficiency—producing stronger, denser roots and leading to more consistent, higher-quality plants.

The future is bright. BASF is continuing to invest in the development of more innovative ornamental crop protection tools, combining the best of conventional and biological pest management approaches. Altogether, BASF is delivering comprehensive resistance management solutions for maximum grower confidence, superior horticultural crops, and compatibility with pollinators and beneficials.

We wish you success in the coming 2020 season.

Joe Lara
Sr. Product Manager
Greenhouse & Nursery Production
BASF—Professional & Specialty Solutions

On the cover: A silverleaf whitefly *(Bemisia tabaci)* being infected with Velifer® fungal contact insecticide/miticide.

Plant Protection: How to Use Pesticides Appropriately

Raymond A. Cloyd, Kansas State University

Plant protection (formerly integrated pest management or IPM) is designed to alleviate or manage insect and mite pest populations of greenhouse and nursery-grown horticultural crops by using a variety of strategies, including scouting, cultural, physical, pesticidal and biological.

The primary means of managing insect and mite pest populations is still the use of pesticides, in this case, insecticides and miticides. Pesticide applications are conducted to suppress existing insect and mite pest populations in order to prevent or reduce plant damage. Therefore, it's important to exercise proper stewardship when using pesticides.

This article provides information on the factors that must be considered when selecting and applying insecticides and miticides to manage pest populations.

1. **Correctly identify insect and mite pests.** Proper identification of insect and mite pests is essential in selecting the appropriate pesticide because many selective pesticides have a narrow range of activity on specific insect and mite pests. There are a number of commercially available pesticides that are only labeled for use on one pest group (e.g. mites), whereas other pesticides have activity on two different insect types (e.g. aphids and thrips) or insects and mites (e.g., thrips and mites). Always have several reference publications available that contain clear images or pictures of the actual insect and mite pest, and plant damage that will help you to correctly identify the pest problem.

2. **Thoroughly cover all plant parts with spray solutions.** When using contact pesticides, it's important to thoroughly cover all plant parts, including leaves, flowers, stems, and fruits (Figure 1). The life stages (egg, larva, nymph, pupa or adult) of almost all insect and mite pests are located on the leaf underside to avoid desiccation (loss of moisture) from ultra-violet light. Therefore, coverage of leaf undersides is important in contacting and killing insect and mite pests.

When plants are small, it's easier to cover all plant parts, resulting in higher mortality of insect and mite pests. However, when the plant architecture (number of leaves and branches) is more complex (Figure 2) insects such as thrips and mealybugs can escape exposure from insecticide sprays because there are more hiding places. In addition, it's more difficult to cover the surface area of the entire plant. Therefore, more time must be spent spraying each plant to ensure thorough coverage. The use of a surfactant may be required to enhance coverage. A surfactant reduces the surface tension of spray droplets, allowing for better coverage of the leaf surface.

3. **Time pesticide applications accordingly.** Insecticides and miticides (pesticides) should be applied when the most susceptible life stage of a given insect or mite pest is present. The most susceptible life stages to many pesticides, in general, are the larva, nymph and adult. The egg and pupa are less susceptible to pesticides. Also, pesticide applications should be conducted in the early morning or late afternoon when most insect and mite pests are active.

Moreover, information obtained from scouting will help time applications because scouting determines population dynamics (the change of insect and mite pest populations over time based on environmental factors) and when the most susceptible life stages are present. This information will ensure high mortality levels of

Figure 1. When using contact pesticides, it's important to thoroughly cover all plant parts, including leaves, flowers, stems, and fruits.

insect and mite pest populations following applications, which will help prevent outbreaks from occurring.

4. Monitor water quality. Water quality is very important in enhancing plant growth and development, however, water quality—especially pH and hardness—may also influence the effectiveness of insecticides and miticides.

For example, when the pH of a spray solution is >7.0, certain insecticides (and miticides) are susceptible to alkaline hydrolysis. Alkaline hydrolysis is a degradation process in which insecticide molecules are fragmented when the water pH is >7.0. Insecticides in the chemical class organophosphate (e.g., acephate and chlorpyrifos) are very sensitive to alkaline hydrolysis. A spray solution water pH between 5.8 and 7.0 should be maintained to avoid alkaline hydrolysis. Always read the product label for information associated with appropriate spray solution pH.

Figure 2. When the plant architecture is more complex insects such as thrips and mealybugs can escape exposure from insecticide sprays because there are more hiding places.

5. Rotate pesticides with different modes of action. Rotating pesticides with different modes of action will reduce the potential for resistance developing in insect or mite pest populations. Mode of action refers to how a pesticide negatively affects the metabolic or physiological processes of insect and mite pests. In general, use the same mode of action within a pest generation and then switch to another pesticide with a different mode of action in the next generation.

The rotation of pesticides can vary depending on the season with more frequent rotations occurring from mid-spring through late fall (in most locations) compared to winter through early-spring. This is due to the effects of temperature on insect and mite pests, and the presence of host plants. The pesticide label should contain the Insecticide Resistance Action Committee (IRAC) mode of action designation (number or combination of number and letter) associated with the active ingredient. For example, the IRAC designation for spinosad (Conserve) is 5 and 7C for pyriproxyfen (Distance/Fulcrum). For more information on the IRAC mode of action designations consult the following website: www.irac-online.org

6. Apply pesticides frequently enough. Most commercially available pesticides used in greenhouse production systems only kill the young (larva and nymph) and adult life stage of insect and mite pests with minimal direct effects on the egg and pupal life stages. Therefore, repeat or multiple pesticide applications are required to kill life stages that were initially not affected by previous pesticide applications such as larva and nymph that were in the egg stage, and adults that were in the pupal stage. Furthermore, more frequent applications are needed when simultaneously dealing with multiple age structures or over-lapping generations.

Application frequency depends on the residual activity (persistence) of a given pesticide and temperature, as insect and mite pest development (life cycle: egg to adult) increases under higher temperatures, consequently requiring more frequent applications. However, more frequent applications can result in placing undue selection pressure on insect and/or mite pest populations, thus increasing the potential for insect and mite pest populations to develop pesticide resistance.

7. Use the proper label rate. Always read the pesticide label and follow specific rates accordingly to enhance pesticide effectiveness. In general, avoid consistently exposing pest populations to the highest label rate to mitigate the potential for insect and/or mite pest populations from developing pesticide resistance. The lowest label rate—especially early on in the crop production cycle—may be just as effective as the highest label rate. This may be due to insect or mite pests present early during crop production not being exposed to extensive use of pesticides, which may result in higher initial mortality levels.

In conclusion, pesticide applications will be more effective in suppressing insect and mite pest populations by following the seven points discussed in this article, including: 1) correctly identifying insect and mite pests; 2) thoroughly cover all plant parts with spray solutions; 3) time pesticide applications accordingly; 4) monitor water quality; 5) rotate pesticides with different modes of action; 6) apply pesticides frequently enough; and 7) use the proper label rate.

These Guys Suck!

Juang Horng "JC" Chong, Clemson University

Many sap-sucking insect pests, such as aphids and whiteflies, plague ornamental plant production. Members of this group share a unique characteristic: they all have a modified mouthpart that functions like a hypodermic needle. This modified mouth helps them pierce through plant tissues and suck up vascular sap or cell contents.

It also makes sucking insects good vectors of plant viruses, although viral transmission by sucking insects is a minor concern in greenhouse floriculture. The major damages by sucking insects are honeydew, sooty mold, reduced plant growth and objectionable presence.

Accurate identification of insect or mite pest species is crucial to developing an effective management program, particularly a biological control program, because different species can vary in their susceptibility to pesticides or biological control agents. "Insects and Related Pests of Flowers and Foliage Plants" (https://content.ces.ncsu.edu/insect-and-related-pests-of-flowers-and-foliage-plants) and "Insect and Mite Pests of Floriculture Crops: Identification Guide" (http://e-gro.org/books.php) from North Carolina State University are two of the many resources that can assist you in identifying your pest species.

Aphids are perhaps the most common pests in greenhouse floriculture. Wingless aphids composed the majority of the population and winged aphids (alates) are produced when the population is large. Melon aphid (AKA cotton aphid) and green peach aphid are the most common aphid species. Foxglove aphid (AKA glasshouse potato aphid) is becoming increasingly common in the northeastern United States. Potato aphid is also becoming more problematic, particularly in greenhouse vegetable production. Growers may encounter aphid species that specialized on certain crops, such as chrysanthemum aphid and rose aphid.

Sweetpotato whitefly (AKA silverleaf whitefly) is the most commonly encountered whitefly species, whereas the greenhouse whitefly and banded winged whitefly are found occasionally. The Q- or Mediterranean biotype of sweetpotato whitefly is known to be resistant to several neonicotinoids and insect growth regulators. The B- and Q-biotypes can only be distinguished using genetic analysis.

A large population of chrysanthemum aphids can cause a large amount of sooty mold.

Many scale insect and mealybug species can feed on ornamental plants. Brown soft scale and hemispherical scale are found occasionally. Citrus mealybug is the most common mealybug species, whereas the Madeira mealybug is commonly found in the southern U.S. Longtailed mealybug is a common pest of foliage plants. The ground or root mealybugs (*Rhizoecus* spp.) feed on the roots and are often detected only when the pots are removed.

The key to successful biological and chemical management of sucking insects is finding the infestation early. All sucking insects produce a large number of offspring; as a result, the population builds up very quickly. Catching and treating the population in its early stage of build-up ensures better treatment efficacy and reduces damage and cost.

Whitefly and winged aphid adults dispersing from the surrounding fields into the greenhouse can be monitored with yellow sticky cards deployed near doors, vents and side panels. Yellow sticky cards deployed just above the canopy within the crop can also detect individuals that are moving in or becoming active in the crop below. Scout the greenhouse regularly and look for signs of infestation, such as honeydew, sooty mold and shed skins. Randomly selected plants or those that have signs of infestation should be examined carefully for insects and mites. Treatment should begin as soon as an infestation is found.

Whiteflies.

Biological control practices, such as releasing whitefly parasitoids and deploying aphid bank plants, can be very effective in reducing pest populations, damage and treatment costs—particularly on crops that are consistently attacked by sucking insects. These biological control practices are especially effective when they're used against small pest populations. A large number of biological control agent species are available against whiteflies and aphids, however, the options for mealybugs and scale insects are limited.

Entomopathogens or entomopathogen-derived products—such as *Beauveria bassiana* (Botanigard, Velifer), *Isaria fumosorosea* (Ancora), *Chromobacterium subtsugae* (Grandevo) and heat-killed *Burkholderia* spp. (Venerate)—are available for sucking insect management and can be applied in the same method as conventional insecticides. Pre-plant dips of unrooted cuttings in a solution of 0.1% horticultural oil or a combination of 0.5% insecticidal soap and Botanigard have been demonstrated as an effective way of reducing whitefly populations on the cuttings and maintaining low whitefly populations for eight weeks.

Insecticides registered for managing sucking insects and other insect and mite pests are listed in this pest management guide. The options available can be overwhelming. Regardless of the products selected, everyone should remember three general practices in managing sucking insects.

First, because sucking insects generally feed under the leaves or deep within the canopy, full spray coverage must be achieved. Trials after trials have suggested that efficacy of insecticide spray can be improved by adding a spreader-sticker, particularly when used against insects with more wax deposits, such as whiteflies and mealybugs. And, lastly, because of the sucking insects' short developmental time and high reproductive capacity, we must rotate among products of different modes of action or IRAC groups.

Traditionally, sucking insects on highly susceptible crops have been effectively and economically controlled for an entire growing cycle with medium drench of systemic neonicotinoids (IRAC Group Number 4A), such as dinotefuran (Safari), imidacloprid (Marathon and others) and thiamethoxam (Flagship). In operations where the use of neonicotinoids is either limited or disallowed, medium drench with flupyradifurone (Altus; 4D), spirotetramat (Kontos; 23) and cyantraniliprole (Mainspring; 28) are effective alternatives to neonicotinoids and can provide protection for up to six to eight weeks.

Sucking insect populations can also be effectively managed with foliar application of many products listed in this guide. One of the newest introductions is Ventigra (afidopyropen; 9D) by BASF, which is a chordotonal organ TRPV channel modulator.

In my studies, aphid and whitefly populations on plants treated with Ventigra began to decline within one day of treatment and the aphid population was essentially eliminated and whitefly population significantly reduced within a week of treatment. One application provided 21 to 28 days of protection to the treated plants.

FAQs About Ventigra Insecticide

Jen Browning, BASF Technical Specialist

We launched Ventigra insecticide this spring in a great (or should we say awful?) aphid year. These sucking pests showed up early and often, with large populations on plants from propagation to finish. The timing was perfect and Ventigra was used in greenhouses, retail settings, landscapes and outdoor nurseries with excellent results. It might surprise you to hear that we learn about best practices from you, the grower, once a product is out in the wild and facing real world pest pressure.

I wanted to share some of those conversations with you in the form of questions that are commonly asked and the best practices that we've discovered and developed along the way.

■ **Is knockdown of aphids as fast as in the videos*?** In the video, you see the aphids stop feeding almost immediately and fall off the substrate in 10 minutes. This happens when aphids come into direct contact with the material, including ingesting it, which is the way we set up lab studies. Real world aphids aren't nearly as cooperative as lab aphids, so it can take longer for the material to move to where the pests are and knock down individuals, and especially larger populations. Afidopyropen, the active ingredient in Ventigra insecticide, moves into and through leaf tissue to come in contact with pests in the most common place they live: on the underside of leaves. Under high humidity and with large populations, it can take two to four days to achieve the best results. Thorough spray coverage and adjuvants speed up this process.

**You can see Ventigra insecticide in action in a time-lapse video at: www.betterplants.basf.us/products/ventigra-insecticide.html.*

■ **Can I drench Ventigra?** One of the strengths of this insecticide is that you don't have to! You won't need to wait up to a week for the active ingredient to move into the plant canopy like we do with drenched materials. In fact, we saw the same level and length of control on green peach aphid as we did with Safari insecticide. This doesn't mean you kick drench materials out of your program, but it does mean you can get those same excellent results with a little less labor and waiting time.

■ **Does Ventigra work on thrips?** Ventigra was developed for precision: piercing and sucking pests. The tradeoff with being a sharp shooter is that you miss some other common pests, like thrips, but that same precision allows for compatibility with non-targets, like pollinators and beneficial insects. Targeted chemistry is the way of the future, so we create programs with multiple tools to manage all the key horticultural pests you're dealing with.

■ **What about psyllids and glassy-winged sharpshooters?** The closer a pest is related to piercing and sucking insects like aphids, whiteflies, mealybugs and scale insects, the more likely we'll be able to add those pests to the label in the future. We're running trials now to evaluate additional pests for the label. Stay tuned!

■ **Does Ventigra control whitefly eggs?** We see the best control with Ventigra applications targeted to adults, eggs and first instar crawlers of whitefly. Treated eggs do hatch, but nymphs will quickly die after coming out of the egg. Young mobile whitefly nymphs are also susceptible. If older nymphs are present at application, they'll develop to maturity, but then be affected as adults and die. We call the effect on these stages "dead before they know it."

■ **How can I get better results for mealybug and scale?** For these difficult-to-control pests, Ventigra controls some species and life stages and suppresses others. We've seen the highest levels of control come from program approaches that include tank mixing adjuvants and alternating applications with Ultra-Pure Oil. Oils suffocate all the life stages of pests and they're a key part of our program recommendations for these and other pests.

Don't be afraid of oils! Ultra-Pure Oil is not your grandma's horticultural oil; modern oils are refined and cleaner, resulting in less phytotoxicity and worries about plant safety. See our Ventigra Insecticide Rotation guide for more information.

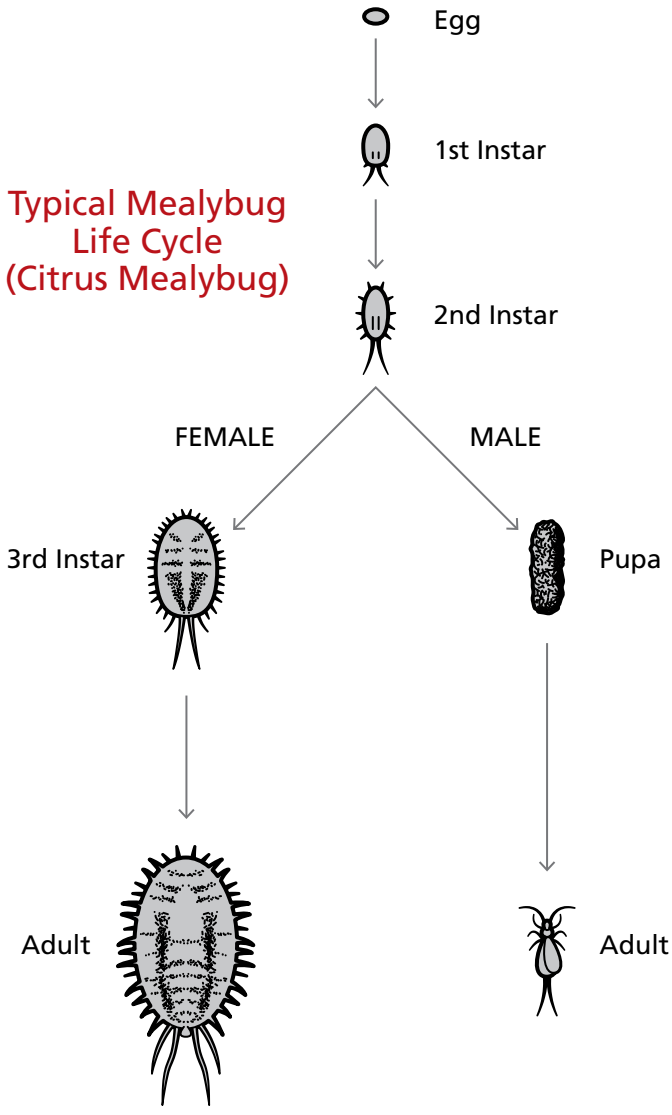
■ **If Ventigra is so great, why do I need a program?** The folks who develop insecticides are horticulturists like you. We want to see new active ingredients work well for as long as possible, so we steward the products to protect them from resistance developing in the field. We do this with Integrated Pest Management (IPM) programs. These are guides that feature our best solutions and also the "best in show" from trials and operations around the country. This is why our programs don't just recommend BASF products; they spell out solutions to deliver the best results for each crop, all year long.

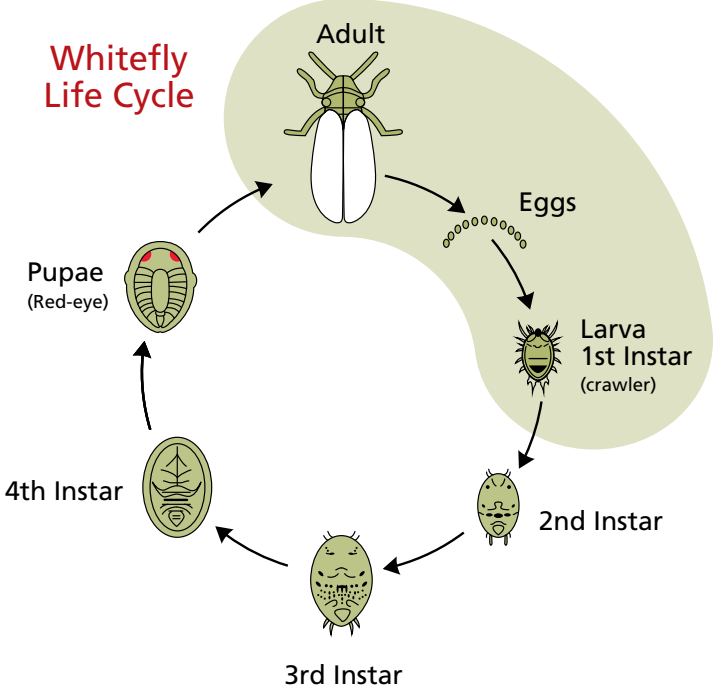
Dilution Rate Conversion for Ventigra

Use Rate (fl oz product/100 gal)	Spray Volume (mL product/2 gal)	Spray Volume (mL product/5 gal)	Spray Volume (mL product/10 gal)	Spray Volume (mL product/25 gal)	Spray Volume (mL product/50 gal)
1.4	0.8	2	4	10	20
4.8	2.8	7	14	35	70
6	3.6	9	18	45	90
7	4.2	10.5	21	52.5	105

■ **Where can I find the beneficials compatibility list for Ventigra?** Go to our Ventigra insecticide landing page at www.betterplants.basf.us/products/ventigra-insecticide.html and click on "Technical Information Brochure." You can learn more about this active ingredient and mode of action, see some of the data I've mentioned in this article and find the tested beneficials list on page 4. Is there a beneficial (BCA) you'd like to see added to our list? Let us know which BCAs are important to you.

■ **Can I use Ventigra in smaller spaces, like interiorscapes or small greenhouses?** Yes. We have rate and mixing information for small volume applications, as well as large. Ventigra is a very low-use-rate insecticide, so if you only need a small amount, you'll need to measure carefully.





How do I know which life stages to target with Ventigra applications?

We've made it easy to target the most susceptible life stage of each pest to get the best results. Here are the pests and application rates:
Whiteflies & Mealybugs: 4.8 to 7.0 fl. oz./100 gal.

Plant Health Sets Pyraclostrobin Fungicides Ahead of the Rest

Paul Pilon, Perennial Solutions

Most growers are very familiar with and routinely use fungicides containing strobilurins as reliable tools in their disease management programs. All strobilurins belong to the FRAC Mode of Action (MOA) Group 11. Even though there are several highly effective fungicides containing strobilurins on the market, they shouldn't be rotated with one another.

There are some differences in the diseases differing strobilurin fungicides control and the efficacy of these products, however, only those fungicides containing pyraclostrobin (Empress Intrinsic, Orkestra Intrinsic and Pageant Intrinsic) provide "plant health benefits." To differentiate the fungicides that offer plant health benefits, BASF markets them as Intrinsic fungicides.

Before I explain what plant health benefits pyraclostrobin-based fungicides offer, it's important to note that fungicides containing pyraclostrobin from BASF are the only strobilurin fungicides that have received EPA approval to list "plant health" on their product labels. This means that BASF has extensive research and data to back these claims and it was approved by the EPA.

How are plant health benefits obtained?

The active ingredient pyraclostrobin in several highly effective fungicides has been found to affect many plant processes on a cellular level. It would take a dissertation to fully explain what occurs on a physiological level, but in layman's terms, pyraclostrobin affects many cellular processes that collectively improve the plant's ability to navigate through or overcome various types of plant stresses.

Plants treated with pyraclostrobin have a reduced respiration rate, which results in more available energy for necessary plant processes. This extra energy combined with improved physiological activity increases a plant's tolerance to various stresses and allows them to develop better root systems in many instances.

It's more complicated than how I've explained it here, but I like simplicity and I think the manner I've presented how the plant health benefits are obtained provides a practical and easy-to-understand explanation most growers can relate to. The bottom line for growers is fungicides containing pyraclostrobin aren't only excellent tools for controlling a wide variety of plant pathogens, they can also be used in certain situations to help decrease the consequence of various stresses.

What are the plant health benefits?

For over the past decade, I've been involved in a number of replicated and demonstrational trials exploring the potential uses for pyraclostrobin fungicides. I've also been fortunate enough to work with several of my consulting clients to identify areas where pyraclostrobin could be used to overcome plant stresses.

Up to now, I've been fairly vague as to what the plant health benefits are or what types of stresses pyraclostrobin fungicides can help overcome. Some of the most favorable results were obtained when looking at cold, heat, propagation, shipping and transplant stresses. Let's look at a few situations where pyraclostrobin could be used to obtain these plant health benefits.

- **Cold stress**—We looked at the potential for using pyraclostrobin on plants just prior to frost events. In some cases, the results were amazing, but please approach this application with an open and realistic mind. Cold is cold and treating a plant with pyraclostrobin doesn't work like you injected it with antifreeze. If it gets cold enough for long enough, freeze injury is still likely to occur.

Using pyraclostrobin for improving cold tolerance is also not a given as no two cold events are identical in magnitude or duration. However, I've seen treated plants shrug off cold events like they didn't even happen, or if some injury did occur, they resumed growing significantly faster than the untreated plants following the cold event.

Some of the practical applications include applying pyraclostrobin to crops prior to moving them from a greenhouse structure to an outside environment in the early spring, making applications prior to anticipated frost events and applying to plugs and liners just prior to boxing and shipping

One of the main "plant health benefits" commonly observed is a better root system, as seen on the Cimicifuga James Compton shown above right. This plant was treated with Pageant after transplanting, whereas the plant on the left was not treated.

to prevent cold injury in the box during the winter months.

BASF nor I will guarantee cold protection, rather consider pyraclostrobin as a cost-effective insurance policy. It's not catastrophe insurance, but it's more like AFLAC and will help the plants get back on their feet following a cold event.

■ **Heat stress**—Going to the other end of the spectrum, I've seen pyraclostrobin be used to help the plants navigate through short-term heat stresses. One potential application is to help the plants get through a few days of unusually hot conditions that may arise from time to time. Think short-term exposure to heat rather than for extended periods.

Another great application is to apply pyraclostrobin to plugs and liners prior to shipping them in the summer. I've seen heat-sensitive varieties that typically melt in the box during summer shipping no longer have issues when they're treated prior to being shipped.

■ **Drought stress**—I'm not referring to using pyraclostrobin during extended periods of dry growing conditions or as a replacement for watering plants on weekends, but I've seen great results whenever I've examined drought events on treated plants. Essentially, treated plants take longer to show signs of water stress, but more impressive to me is their ability to recover from slight-to-moderate wilting. Similar to my comments on cold, drought is drought and plants need water—pyraclostrobin isn't a substitute for water, and under severe conditions, the lack of water can still cause plant injury.

Poinsettia Advent Red: Untreated (left), Pageant at 4 oz. per 100 gals (right). The treatment was applied the day the cuttings were stuck.

Vegetative propagation benefits

For me, this is the most exciting area growers should consider using pyraclostrobin fungicides (in this case, I'd stick with Pageant Intrinsic) to obtain plant health benefits. Time and time again, I've seen slightly faster rooting and more root mass on treated cuttings versus untreated cuttings.

Since this is a stress-management tool, I find it very beneficial to apply pyraclostrobin to cuttings as soon as possible after they're stuck and placed into the greenhouse. If it were me, I'd always apply pyraclostrobin by the end of the day (if not sooner) on the day of sticking or the following morning at the latest. The closer it's applied to the stress event (putting them in the greenhouse is a tremendous stress), the more potential plant health (stress management) benefits you'll likely receive.

Transplant benefits

Similar to the results obtained in the propagation trials, I've seen plants treated with pyraclostrobin just prior to or just after transplanting establish faster and with more root mass compared to untreated plants. Earlier rooting and quicker establishment equals stronger plants.

Only pyraclostrobin has plant health

As I previously mentioned, there are many strobilurin fungicides on the market and they're all great and effective fungicides. Pageant Intrinsic was the first fungicide to contain active ingredients from MOA Groups 7 and 11.

They say imitation is the truest form of flattery—now there are several MOA Groups 7 and 11 fungicides available and they all offer great disease control. However, when looking at which standalone strobulurin (MOA 11) or MOA Group 7 and 11 fungicide to use, it's in my professional experience that the products containing pyraclostrobin are the best to demonstrate and support the claims of plant health benefits coupled with outstanding disease control. GT

The Petunia Pink Frost were treated with the grower's standard practice of Segway at 3 oz./100 gals (left) and Empress at 3 oz./100 gals (right) the day the plugs were planted into the cell packs. The rooting benefit from the pyraclostrobin was very evident at eight days following the application.

Using Intrinsic Brand Based Fungicides With Your Propagation Practices

Kathie E. Kalmowitz, Ph.D., Technical Specialist, BASF Turf and Ornamentals

We've heard from a plantsman—Paul Pilon—the benefits he's seen from the BASF Intrinsic brand based fungicides in many grower operations. I'll review the key to using Pageant Intrinsic brand fungicide on unrooted cuttings and use of Empress Intrinsic brand fungicide when working with plugs and transplants. BASF has evolved our recommendations following several years of work through research trials, as well as directly with growers to help customers be more successful.

7-Step Program Approach to Rooting and Disease Control with Intrinsic brand fungicides

1. Research has shown that two applications of Pageant Intrinsic brand fungicide made seven to 14 days apart have resulted in accelerating callusing, root initials and then overall root development when starting with an unrooted cutting.

2. Not all cuttings respond at the same—this makes sense when you consider the diversity of plant material, both herbaceous and woody, that is grown. Therefore, the two applications of Pageant Intrinsic brand fungicide have resulted in the greatest overall root stimulation. Pageant Intrinsic brand fungicide is applied at 4 to 6 fl. oz./100 gal.

3. Some URT cuttings respond when the first application of Pageant Intrinsic brand fungicide is applied at sticking, then 14 days later. With some plant material, it's better to wait seven to 14 days to make the first application and follow within the month with the second. Some of this variation depends on how quickly the species develops callus tissue and how long the cutting has to remain in the rooting bed.

4. Following the second Pageant application, *rotate to a non-Group 7 or 11 fungicide* in your propagation bed when the cuttings are to remain for greater than four weeks.

5. Woody ornamental cuttings can take months to successfully set roots. The use of Pageant Intrinsic brand fungicide during the initial two months can result in better callus development and rooting percentage resulting in less culls and a better developed root system for the rooted liner. Pageant Intrinsic brand fungicide is applied to woody ornamental cuttings at 6 to 8 fl. oz./100 gal. rate.

6. Empress Intrinsic brand fungicide is best used for plug development and at transplanting of rooted cuttings. Best application rate has been 3 fl. oz./100 gal. Make no more than two applications and rotate to a non-strobilurin (Group 11) fungicide.

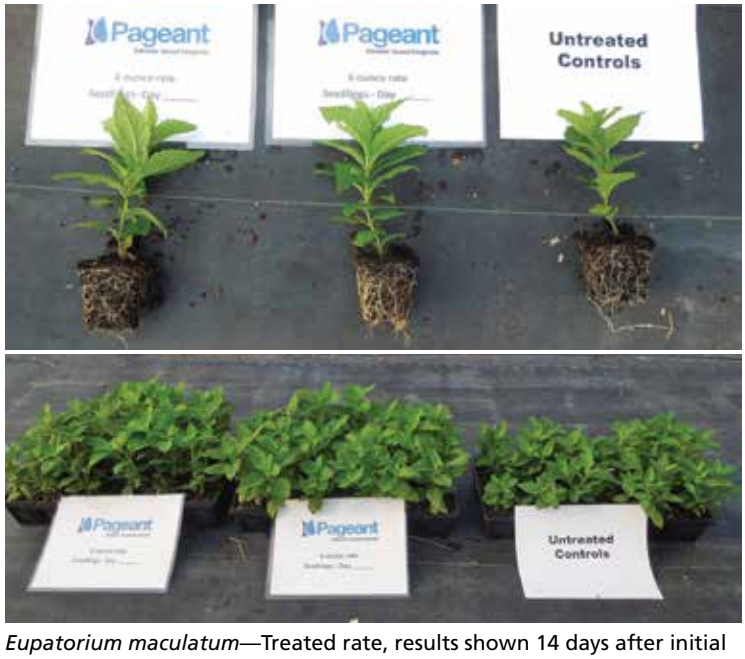
7. Based on 10 years of research in propagation, Intrinsic brand fungicides always provide disease control and are labeled for plant health responses.

a. The best use of Pageant Intrinsic brand fungicide on unrooted cuttings is two applications approximately 14 days apart.

b. The best application timing is at sticking and 14 days later. (Depending on your operation and the degree of difficulty in rooting, the first application can be applied at sticking or you can wait seven to 14 days then apply.)

c. The best use of Empress Intrinsic brand fungicide is to plugs and rooted liners at transplanting to protect developing rootballs from damping-off pathogens Fusarium, Pythium and Rhizoctonia, along with Phytophthora. GT

At 22 days following treating cuttings at 6 fl. oz./100 gal. application (top) vs. the untreated cuttings (bottom). All cuttings were pretreated with rooting hormone by grower.

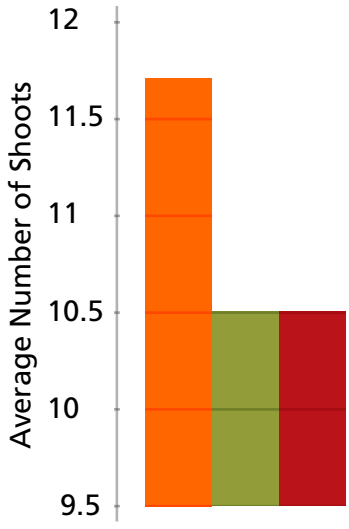


Eupatorium maculatum—Treated rate, results shown 14 days after initial treatment. Greater root volume, stem branching, leaf size, stem caliber all showed growth greater than the untreated.

Picture and trial courtesy of Dr. R. Oetting, University of Georgia Professor Emeritus from a commercial operation in Georgia.

Cuttings in the trays (untreated, left and Pageant Intrinsic treated, right). Observed the greener leaves, slightly larger leaves.

Photo courtesy of Dr. R. Oetting, Professor Emeritus, University of Georgia at a commercial operation in Georgia.



Treatment Comparison of Average Number of New Guinea Shoots Per Plant 28DAT-Trial 1

Greater, more consistent rooting with Empress Intrinsic brand fungicide.

- Reducing the time it takes to root a plant into its finished container helps to cut finishing time.
- Reduction in production cost realized when all plants are more consistent in size and quality, resulting in less culls.

Empress
UTC
Heritage

S. Ronyak, BASF Corp., Research Triangle Park, NC Greenhouses replicated studies.

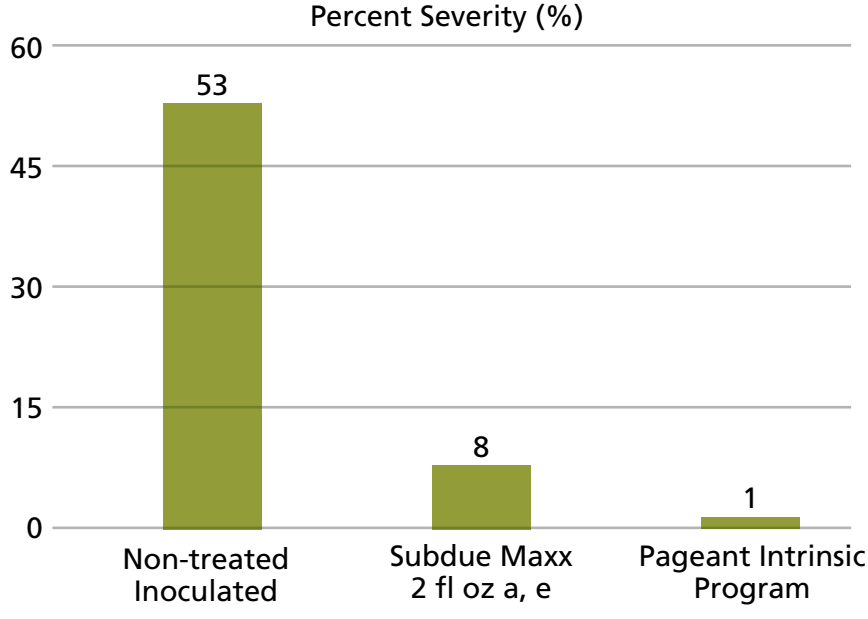
Evaluation of Fungicides for Control of Phytophthora Root Rot of Boxwood Cuttings

Pageant Intrinsic fungicide-Rooting Program (/100 gal)

a Nov 7 Pageant Intrinsic 6 fl oz
b-Nov 21 Pageant Intrinsic 6 fl oz
c-Dec 12 Chipco 26019 2 fl oz
d-Jan 2 Empress Intrinsic 3 fl oz

Subdue Maxx applied Nov 7, 2018 , Jan 9, 2019

F. Baysal-Gurel and T. Simmons, Tennessee State University, McMinnville, TN 2018 – 2019; All treated plants are inoculated.



Evaluation of Fungicides for Best Rooting of Boxwood Cuttings

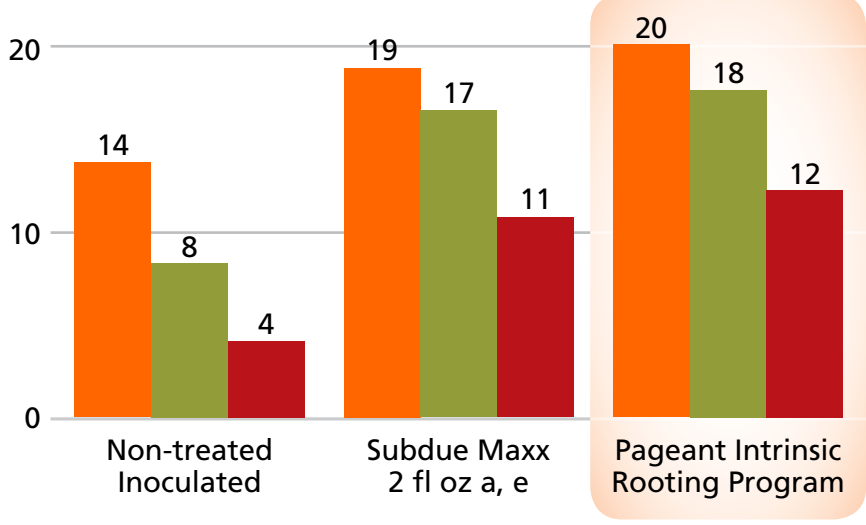
Pageant Intrinsic fungicide Rooting Program (/100gal)

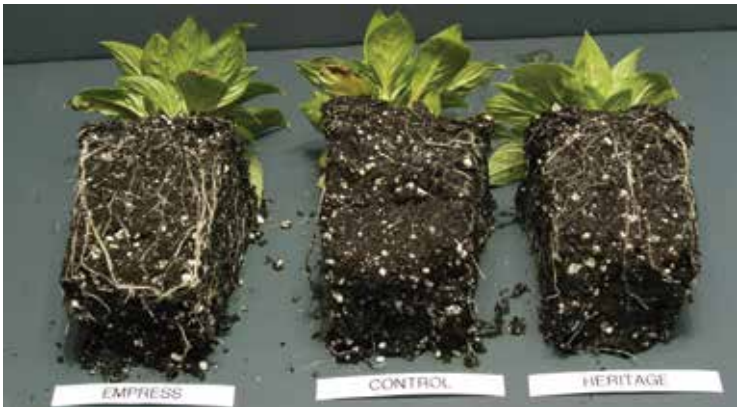
a Nov 7 Pageant Intrinsic 6 fl oz
b-Nov 21 Pageant Intrinsic 6 fl oz
c-Dec 12 Chipco 26019 2 fl oz
d-Jan 2 Empress Intrinsic 3 fl oz

Subdue Maxx applied Nov 7, 2018 and Jan 9, 2019

Plant Height (cm)
Total Fresh Weight (g)
Root Weight (g)

F. Baysal-Gurel and T. Simmons, Tennessee State University, McMinnville, TN 2018 – 2019, All treated plants are inoculated.

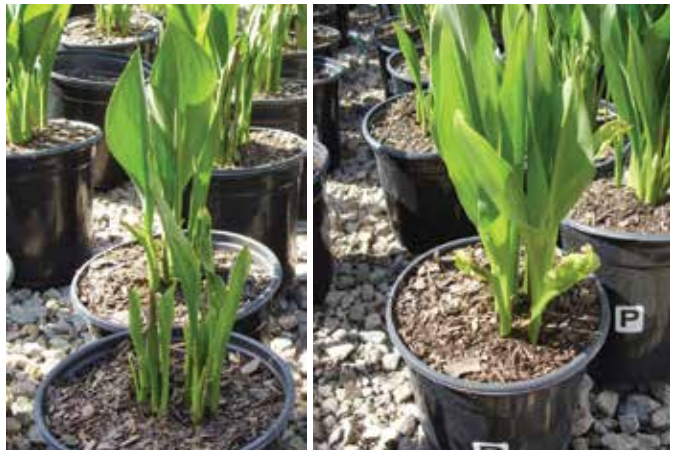




8 days after treatment drench—Left, Empress Intrinsic brand fungicide at 3 fl. oz.; center, untreated; right Heritage fungicide at 0.7 oz.


Use of Pageant Intrinsic brand fungicide in calla production.


40% of calla crop lost to early spring cool temperatures due to poor growth and inconsistent emergence.


Heritage fungicide (left); Pageant Intrinsic brand fungicide (right). BASF conducted nursery trial with grower at commercial operation in South Carolina. Statement about loss prior to trial was from grower based on crop experience.

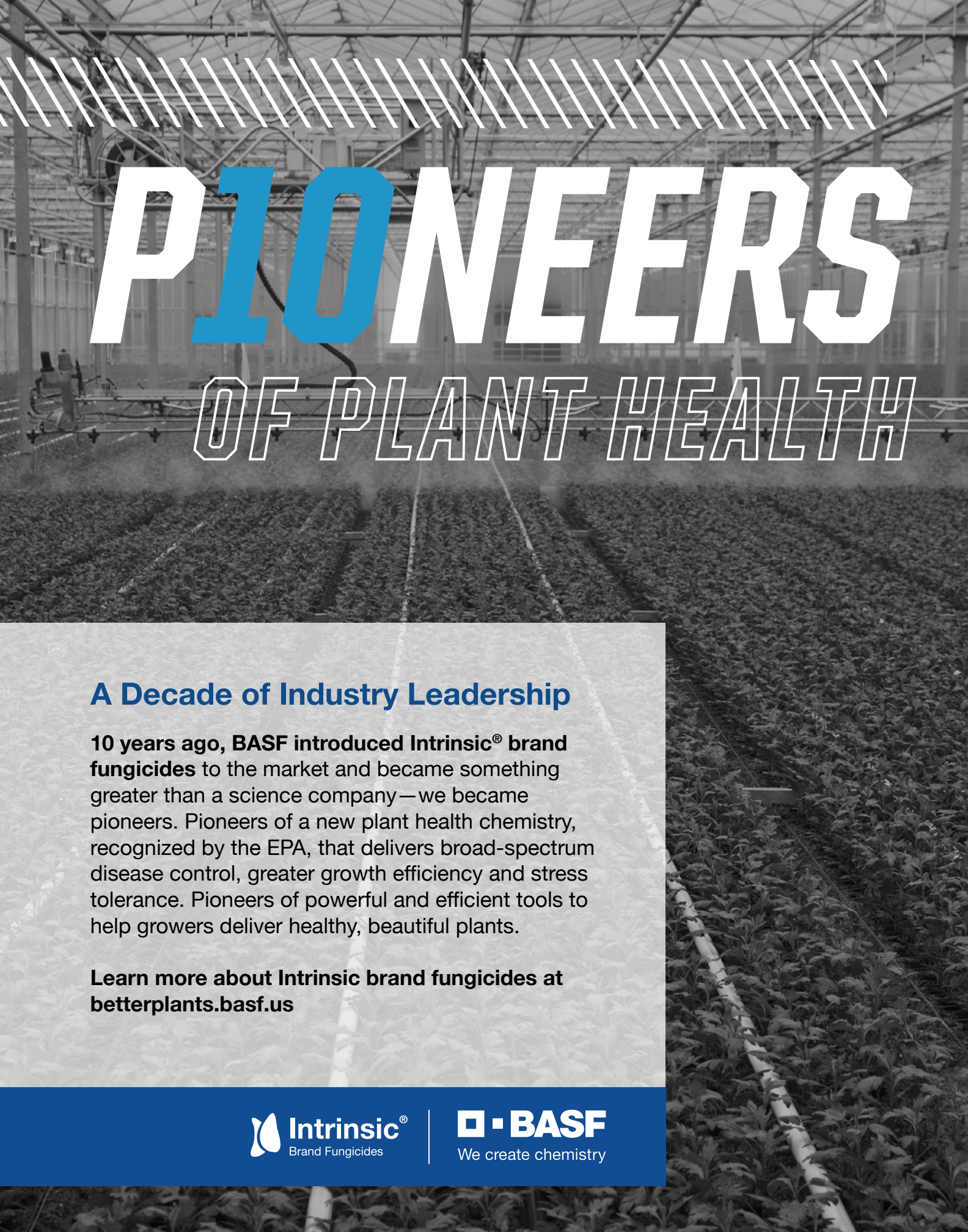
PAGEANT® INTRINSIC® brand fungicide UNROOTED CUTTINGS ROOTING PROGRAM
6-7 Weeks of Coverage to Transplant

At sticking	+ 14 days	+ 14 days under mist	Prior to transplant
Pageant Intrinsic brand fungicide	Pageant Intrinsic brand fungicide	Chipco 26019 or Daconil or Medallion	Empress® Intrinsic brand fungicide
6 oz foliar	6 oz foliar	SLR (Standard Label Rate)	3 fl oz drench

EMPRESS® INTRINSIC® brand fungicide PLUG AND TRANSPLANT ROOTING PROGRAM
6-7 Weeks of Coverage from Root Development to Transplant

Young Plant Development	Young Plant Development	Prior to transplant
Empress Intrinsic brand fungicide	Segway O or Medallion or Banrot	Empress Intrinsic brand fungicide
3 fl oz	SLR (Standard Label Rate)	3 fl oz

- All product rates shown are per 100 gallons.
- Product rates are based on preventive applications; adjust rates and intervals to conditions for disease development. Additional sprays may be necessary depending on disease spectrum. Rotate chemistries for best program performance.
- Refer to product labels and recommendations for additional instructions.
- For additional protection from *Pythium* spp., apply Segway O fungicide at 3 fl oz alternating with **Empress Intrinsic** brand fungicide, or tank mix 3 fl oz of **Empress Intrinsic** brand fungicide with 1.5 fl oz of Segway O.
- For Erwinia spp. or other bacterial diseases, use Junction or copper followed by a product such as Cease or Rhapsody, then return to rotation with **Pageant Intrinsic** brand fungicide or other products as recommended above.
- Use of **Empress Intrinsic** brand fungicide in this program is recommended when the cuttings have been completely rooted. This application will provide more root development while protecting the plant from soilborne diseases when transplanting to the next container size. When made in the original container prior to transplanting, this economical application saves time and labor by treating a smaller area and less media.



A Decade of Industry Leadership

10 years ago, BASF introduced Intrinsic® brand fungicides to the market and became something greater than a science company—we became pioneers. Pioneers of a new plant health chemistry, recognized by the EPA, that delivers broad-spectrum disease control, greater growth efficiency and stress tolerance. Pioneers of powerful and efficient tools to help growers deliver healthy, beautiful plants.

Learn more about Intrinsic brand fungicides at betterplants.basf.us

Intrinsic® Brand Fungicides | BASF We create chemistry

Managing, Identifying and Treating Bacterial Problems in Production

Dave Norman, University of Florida

Summer conditions, with warmer temperatures and high humidity, are prime for the establishment of bacterial pathogens within greenhouse production facilities. Bacterial outbreaks within production facilities account for extensive losses industry-wide each year. A grower's first priority is simple: pathogen exclusion.

One of the best ways to control pathogens is to acquire pathogen-free plant material, although this isn't always possible. Bacteria can thrive in plant material, inhabiting everything from seeds to cuttings. Bacteria are frequently introduced to production facilities from propagative cuttings taken from ground beds or from unsanitary facilities, as well as certain species that are known to be seed-born. Cuttings and plant plugs may also harbor bacterial pathogens without symptoms, especially if environmental conditions aren't conducive for symptom expression.

Bacteria can also be introduced into facilities via aerosols through their venting systems, although this isn't considered to be a major mode of introduction. Closely monitoring plant material and tracking growth of material from different suppliers is crucial for growers and can be especially helpful in determining the cleanliness of a product.

Once bacterial pathogens have gained access to a production facility, they're usually spread by one of two ways: water and workers. Splashing water is one of the primary ways plant pathogens spread throughout a nursery. Pathogens move even more readily when water, splashing on leaf surfaces or soil, produces aerosols. These mist-like small water droplets can carry both bacterial and fungal spores even longer distances than large splashing droplets.

The size of individual aerosol particles and air movement within the greenhouse determine how far water-borne pathogens can spread. With overhead irrigation, for example, the finer the droplets applied during watering, the less impact they have and the less potential there is for aerosol formation and potential pathogen movement. In addition, most major plant pathogenic bacteria, including Erwinia, Xanthomonas, Pseudomonas and Agrobacterium, have flagella (tails), which they can use to swim short distances on wet leaf surfaces.

Figure 1. Greasy water-soaked lesions on anthurium caused by Xanthomonas.

Besides movement with water, pathogens are frequently transported on contaminated farm tools or on workers' clothing. Teaching workers proper maintenance and sterilization procedures for equipment is paramount to controlling contamination within greenhouses. Cutting tools should always be dipped into a surface sterilant, such as bleach or quaternary ammonium compounds, between plants. Foot mats soaked with a surface sterilant should be placed at the entrance of each greenhouse. Employees must also be sure to wash their hands and arms with soapy water when moving between functions, such as rooting or pruning.

Identifying bacterial pests

While identifying specific bacterial symptoms varies with the plant host and specific pathogen, there are, however, key symptoms that help distinguish bacterial symptoms from those caused by fungi. Bacterial foliar leaf spot pathogens (Xanthomonas and Psuedomonas) usually produce greasy, water-soaked spots (Figure 1). These spots are formed when bacteria reach concentrations greater than 100 million cells per gram tissue and are often spread by through water or workers. As the plant tissue breaks down, these bacterial cells are released.

A number of the Xanthomonas species are also released from infected plants each morning in guttation droplets. These droplets easily adhere to clothing and are moved from plant to plant. Bacteria move across wet plant surfaces and enter the new host via wounds or into hydathodes on margins of leaves from which guttation droplets form. There are nitrogen-containing amino acids found within guttation droplets. These amino acids serve as both an attractant and food source for the bacteria, and higher concentrations of amino acids have been linked with over fertilization .

Agrobacterium, Erwinia *(Syn. Pectobacterium)* and Ralstonia produce galls, soft rot and plant wilt, respectively. These bacteria differ from the common leaf spots produced by Xanthomonas and Pseudomonas species. Agrobacterium are found in soils and primarily enter plants via wounds or during grafting. Once inside the plant, Agrobacterium transfers genetic material to the host, which in turn instructs the plant to produce food for the invading pathogen. During this process, a gall is formed (Figure 2). Agrobacteria galls are common in rose, ficus and some bedding plant species. Agrobacterium is most easily prevented by careful sanitizing clippers and tools.

Soft-rots caused by Erwinia are common during warm and humid weather. Under these prime conditions, the bacteria can produce both cellulolytic and pectolytic enzymes. This enables the bacteria to create their own entrance into the host. Erwinia cause extensive crop losses, primarily infecting

Figure 2. Agrobacteria galls are common in ficus production.

Figure 3. Phalaenopsis orchids are especially sensitive to bacterial soft rot (Erwinia, Syn. *Pectobacterium*).

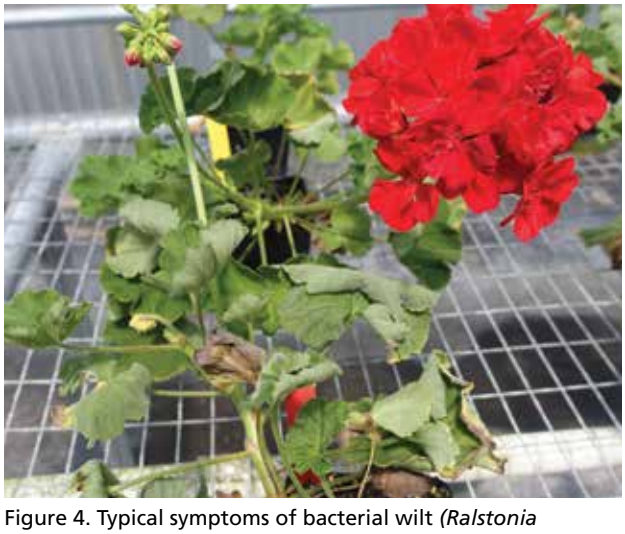


Figure 4. Typical symptoms of bacterial wilt *(Ralstonia solanacerum)* on geranium.

succulent plants, which have some parts that are thickened and fleshy. Phalaenopsis orchids are also especially sensitive to Erwinia soft rots (Figure 3). During hot and humid conditions, Phalaenopsis leaves can become mushy and rot within a 24-hour period. Erwinia is most recognizable from a distinctive, fishy smell associated with the active rotting of plant tissue.

Bacterial wilt caused by *Ralstonia solancerium* has a very broad host range. Extensive losses occur in agricultural commodities throughout the world on major vegetable and fruit crops, including potato, tomato, pepper and banana. Ornamentally, bacterial wilt can be found on geranium, mandevilla and pothos. This bacterium primarily moves in contaminated water and can infect plants through their root system or via wounds. Once it's invaded the xylem, the bacterium multiplies, clogging and prohibiting water movement, and causing the plant to wilt and die (Figure 4).

Cultural management

The establishment of pathogens, disease development and disease spread are all directly related to water management within a production facility. The following cultural recommendations will aid in disease control:

- **Plant exclusion.** The first line of defense is pathogen exclusion. As soon as symptoms appear, suspect plants should be immediately removed from the greenhouse. When propagating new material, use clean stock and follow proper sanitation procedures.
- **Low-impact sprinklers.** Limiting the formation of large splashing droplets and aerosols will slow pathogen dissemination within a nursery. Set sprinkler heads to produce as fine a mist as possible. The use of drip irrigation has proven to be even more successful, however, its use is usually limited by high initial installation cost.
- **Decrease surface water.** As previously mentioned, most plant pathogenic bacteria, along with some fungi, can swim in standing water and on wet plant surfaces. Keeping foliage as dry as possible will slow down pathogen spread within production facilities. Also be sure to manage greenhouse grounds for any standing water, especially under plant beds.
- **Minimize worker handling.** Growers should minimize the amount of workers handling plants, as well as the amount each plant is handled. Bacteria exuded onto leaves are easily moved between plants by workers, especially if plants are wet and improper sanitation procedures are followed.
- **Lower humidity.** High humilities promote bacterial infections. Ventilating a production structure or increasing plant spacing to lower humidity will greatly aid in slowing the infection process.
- **Light soil mixes.** Avoid heavy soil mixes, which contain limited pore spaces. Soils having small pore spaces easily become saturated and oxygen needed for root respiration is limited. Plants under this type of stress are more susceptible to bacterial wilt and leaf-spotting pathogens.

Chemical control

Bactericides can be used preventively and post-haste to help manage a bacterial outbreak. The most effective products contain copper compounds, mancozeb and/or *bacillus*. For proper disease prevention, all three product groups can be used in an effective rotation program. However, when managing an outbreak, these products are less effective and are able to lower disease impact and symptoms, but aren't curative. Plants with symptoms should be discarded and suspect plants should be rotated out of the nursery quickly as possible.

2020 Pest Control Materials for Managing Insect and Mite Pests of Greenhouse-grown Horticultural Crops

Raymond A. Cloyd
Department of Entomology
Kansas State University

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

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
APHIDS	Abamectin	Avid	12 hours	**6:** GABA[1] chloride channel activator
	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Afidopyropen	**Ventigra**	12 hours	**9D:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	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	**4A:** Nicotinic acetylcholine receptor modulator
	Isaria fumosorosea Apopka Strain 97	Ancora	4 hours	
	Isaria fumosoroseus Strain FE 9901	NoFly	4 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Methiocarb	Mesurol	24 hours	**1A:** Acetylcholine esterase inhibitor

Ventigra™ is registered in all states except NY and CA

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
APHIDS *continued*	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pymetrozine	Endeavor	12 hours	**9B:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	Pyrifluquinazon	Rycar	12 hours	**9B:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Spinetoram + Sulfoxaflor	XXpire	12 hours	**5 + 4C:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator + nicotinic acetylcholine receptor modulator
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
BROAD MITE	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Fenpyroximate	Akari	12 hours	**21A:** Mitochondria electron transport inhibitor
	Pyridaben	Sanmite	12 hours	**21A:** Mitochondria electron transport inhibitor
	Spiromesifen	Savate	12 hours	**23:** Lipid biosynthesis inhibitor
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
CATERPILLARS	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Bacillus thuringiensis subsp. *kurstaki*	Dipel	4 hours	**11:** Midgut membrane disruptor
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	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

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

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
CATERPILLARS *continued*	Spinosad	Conserve	4 hours	**5:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
CYCLAMEN MITE	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Fenpyroximate	Akari	12 hours	**21A:** Mitochondria electron transport inhibitor
	Spiromesifen	Savate	12 hours	**23:** Lipid biosynthesis inhibitor
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
FUNGUS GNAT LARVAE	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Bacillus thuringiensis subsp. *israelensis*	Gnatrol	4 hours	**11:** Midgut membrane disruptor
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Cyromazine	Citation	12 hours	**17:** Chitin synthesis inhibitor
	Diflubenzuron	Adept	12 hours	**15:** Chitin synthesis inhibitor
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Pyriproxyfen	Distance/Fulcrum	12 hours	**7C:** Juvenile hormone mimic
	Steinernema feltiae	**Nemasys**, NemaShield, Scanmask, and Entonem		
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
FUNGUS GNAT ADULTS	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
LEAFHOPPERS	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Buprofezin	Talus	12 hours	**16:** Chitin synthesis inhibitor

Ventigra™ is registered in all states except NY and CA

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 *continued*	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Cyfluthrin + Imidacloprid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
	Flupyradifurone	Altus	12 hours	**4D:** Nicotinic acetylcholine receptor modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Isaria fumosoroseus Strain FE 9901	NoFly	4 hours	
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
LEAFMINERS	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	Cyfluthrin + Imidacloprid	Discus	4 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Cyromazine	Citation	12 hours	**17:** Chitin synthesis inhibitor
	Diflubenzuron	Adept	12 hours	**15:** Chitin synthesis inhibitor
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Isaria fumosorosea Apopka Strain 97	Ancora	4 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
▼	Novaluron	Pedestal	12 hours	**15:** Chitin synthesis inhibitor

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

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
LEAFMINERS *continued*	Spinosad	Conserve	4 hours	**5:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
MEALYBUGS	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Afidopyropen	**Ventigra**	12 hours	**9D:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Buprofezin	Talus	12 hours	**16:** Chitin synthesis inhibitor
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	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)
	Isaria fumosorosea Apopka Strain 97	Ancora	4 hours	
	Isaria fumosoroseus Strain FE 9901	NoFly	4 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	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

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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	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor 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
	Isaria fumosorosea Apopka Strain 97	Ancora	4 hours	
	Isaria fumosoroseus Strain FE 9901	NoFly	4 hours	
	Tau-fluvalinate	Mavrik	12 hours	**3A:** Prolong opening of sodium channels
SCALES (HARD AND SOFT)[a]	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Bifenthrin	**Attain TR**/Talstar	12 hours	**4A:** Prolong opening of sodium channels
	Buprofezin	Talus	12 hours	**16:** Chitin synthesis inhibitor
	Clarified hydrophobic extract of neem oil	Triact	4 hours	Suffocation or membrane disruptor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors
	Cyfluthrin	Decathlon	12 hours	**3A:** Prolong opening of sodium channels
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyriproxyfen	Distance/Fulcrum	12 hours	**7C:** Juvenile hormone mimic
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
	Thiamethoxam	Flagship	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Tolfenpyrad	Hachi-Hachi	12 hours	**21A:** Mitochondria electron transport inhibitor
SHORE FLY LARVAE	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyromazine	Citation	12 hours	**17:** Chitin synthesis inhibitor
	Diflubenzuron	Adept	12 hours	**15:** Chitin synthesis inhibitor
	Pyriproxyfen	Distance/Fulcrum	12 hours	**7C:** Juvenile hormone mimic
	Spinosad	Conserve	4 hours	**5:** Nicotinic acetylcholine receptor disruptor/ agonist and GABA chloride channel activator
	Steinernema carpocapsae	**Millenium**	0 hours	

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

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
SLUG AND SNAIL	Iron phosphate	Sluggo	0 hours	Inhibits calcium metabolism
	Metaldehyde	Deadline	Refer to Label	Central nervous system toxin
	Methiocarb	Mesurol	24 hours	**1A:** Acetylcholine esterase inhibitor
SPIDER MITE (TWOSPOTTED)	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Acequinocyl	Shuttle	12 hours	**20B:** Mitochondria electron transport inhibitor
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenazate	Floramite	4 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	Suffocation or membrane disruptor
	Clofentezine	Novato	12 hours	**10A:** Growth and embryogenesis inhibitor
	Cyflumetofen	**Sultan**	12 hours	**25:** Mitochondria electron transport inhibitor
	Etoxazole	TetraSan/Beethoven	12/24 hours	**10B:** Chitin synthesis inhibitor
	Fenazaquin	Magus	12 hours	**21A:** Mitochondria electron transport inhibitor
	Fenpyroximate	Akari	12 hours	**21A:** Mitochondria electron transport inhibitor
	Hexythiazox	Hexygon	12 hours	**10A:** Growth and embryogenesis inhibitor
	Isaria fumosorosea Apopka Strain 97	Ancora	4 hours	
	Metarhizium brunneum Strain F52	Met52	4 hours	
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pyridaben	Sanmite	12 hours	**21A:** Mitochondria electron transport inhibitor
	Spiromesifen	Savate	12 hours	**23:** Lipid biosynthesis inhibitor
	Spirotetramat	Kontos	24 hours	**23:** Lipid biosynthesis inhibitor
THRIPS	Abamectin	Avid	12 hours	**6:** GABA chloride channel activator
	Acephate	**1300 Orthene TR**/Precise	24/12 hours	**1B:** Acetylcholine esterase inhibitor
	Acetamiprid	TriStar	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Azadirachtin	Azatin/Ornazin/Molt-X/Azatrol[2]	4/12/4/4 hours	Ecdysone antagonist: inhibits action of molting hormone
	Beauveria bassiana Strain GHA	BotaniGard	4 hours	
	Beauveria bassiana Strain PPRI 5339	**Velifer**	12 hours	
	Bifenazate + Abamectin	Sirocco	12 hours	**20D + 6:** Mitochondria electron transport inhibitor + GABA chloride channel activator
	Bifenthrin	**Attain TR**/Talstar	12 hours	**3A:** Prolong opening of sodium channels
	Chlorfenapyr	**Pylon**	12 hours	**13:** Oxidative phosphorylation uncoupler
	Chlorpyrifos	**DuraGuard ME**	24 hours	**1B:** Acetylcholine esterase inhibitor
	Cyantraniliprole	Mainspring	4 hours	**28:** Selective activation of ryanodine receptors

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

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

Insect or Mite Pest	Pest Control Material Common Name	Pest Control Material Trade Name(s)	Restricted Entry Interval (REI)	Mode of Action (IRAC Mode Of Action Group)
WHITEFLIES *continued*	Cyfluthrin + Imidaclorpid	Discus	12 hours	**3A + 4A:** Prolong opening of sodium channels + nicotinic acetylcholine receptor modulator
	Diflubenzuron	Adept	12 hours	**15:** Chitin synthesis inhibitor
	Dinotefuran	Safari	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Fenazaquin	Magus	12 hours	**21A:** Mitochondria electron transport inhibitor
	Fenoxycarb	Preclude	12 hours	**7B:** Juvenile hormone mimic
	Fenpropathrin	Tame	24 hours	**3A:** Prolong opening of sodium channels
	Flonicamid	Aria	12 hours	**29:** Selective feeding blocker/chordotonal organ modulator
	Flupyradifurone	Altus	4 hours	**4D:** Nicotinic acetylcholine receptor modulator
	Imidacloprid	Marathon/Benefit/Mantra	12 hours	**4A:** Nicotinic acetylcholine receptor modulator
	Isaria fumosorosea Apopka Strain 97	Ancora	4 hours	
	Isaria fumosoroseus Strain FE 9901	NoFly	4 hours	
	Metarhizium brunneum Strain F52	Met52	4 hours	
	Kinoprene	Enstar	4 hours	**7A:** Juvenile hormone mimic
	Mineral oil	**Ultra-Pure Oil**/SuffOil-X	4 hours	Suffocation or membrane disruptor
	Novaluron	Pedestal	12 hours	**15:** Chitin synthesis inhibitor
	Potassium salts of fatty acids	M-Pede	12 hours	Desiccation or membrane disruptor
	Pymetrozine	Endeavor	12 hours	**9B:** Selective feeding blocker/chordotonal organ TRPV channel modulator
	Pyrethrins	Pyreth-It/**Pyrethrum**	12 hours	**3A:** Prolong opening of sodium channels
	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.

For more information contact Dr. Raymond A. Cloyd, Professor and Extension Specialist in Horticultural Entomology/Plant Protection at Kansas State University, Department of Entomology, 123 Waters Hall, Manhattan, KS 66506-4004
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Updated: April 30, 2019

Suggested Rotations by Key Diseases and Rotations:

Note at least three different chemical groups are included for overall program to target the disease.

Disease Targets	Rotation 1	Rotation 2	Rotation 3
Anthracnose	Spectro 90 Group 1 + M5	**Pageant Intrinsic** Group 7 + 11	Palladium Group 9 + 12
Powdery Mildews and Rusts	**Pageant Intrinsic** Group 7 + 11	Phyton 27 or mancozeb Group M1	Terraguard Group 3
Flower and Stem Blights, Scab	**Pageant Intrinsic** Group 7 + 11	Palladium Group 9 + 12	Chipco 26019 Flo Group 2 Cleary's 3336, or 26/36 Group 1 or 1+ 2
Leaf spots Myrothecium, Diplocarpon (Black Spot) Alternaria, Cercospora, Entomosporium	**Pageant Intrinsic** Group 7 + 11	Cleary's 3336 Group 1 or Spectro 90 Group 1+ M5	Palladium Group 9 + 12
Fusarium, Rhizoctonia, Cylindrocladium	**Empress Intrinsic (drench)** Group 11 or **Pageant Intrinsic** Group 7+11	Medallion Group 12	Cleary's 3336 Group 1 or 26/36 Group 1 + 2 or Spectro 90 Group 1 + M5
Thielaviopsis	Banrot Group 1 + 14 or Cleary's 3336 Group 1	Terraguard Group 3	**Orkestra Intrinsic** Group 7 + 11
Downy Mildews	**Stature** Group 40	Segovis Group U15	Segway O Group 21 or Aliette Group 33
Pythiums	Segway O Group 21	Banol Group 28 or Terrazole/Truban Group 14	**Empress Intrinsic (drench)** Group 11
Phytophthoras	**Orvego** Group 40 + 45	Aliette Group 33 or Segway O Group 21 or Segovis Group U15	**Empress Intrinsic (drench)** Group 11
Bacterial diseases *see labels for specific pathogens*	Copper Kocide 2000 or copper based Phyton 27 or Camelot O Group M1	Cease or Rhapsody Biopesticide	Junction copper + mancozeb Group M1 + M3

INSECTICIDE ROTATIONS FOR H

PLANT PESTS

Aphids

Rotation 1 **Ventigra™** insecticide
Rotation 2 **Velifer®** fungal contact insecticide/miticide
Rotation 3 Altus® insecticide
Rotation 4 Mainspring® insecticide

Fungus Gnats

Rotation 1 **Nemasys®** beneficial nematodes
Rotation 2 **Nemasys®** beneficial nematodes
Rotation 3 Enstar® AQ insect growth regulator
Rotation 4 **Nemasys®** beneficial nematodes

Mealybugs

Rotation 1 **Ultra Pure Oil** horticultural insecticide, miticide and fungicide
Rotation 2 **Ventigra™** insecticide
Rotation 3 **Velifer®** fungal contact insecticide/miticide
Rotation 4 Altus® insecticide

Scale

Rotation 1 **Ultra-Pure Oil®** horticultural insecticide, miticide and fungicide
Rotation 2 **Ventigra™** insecticide
Rotation 3 Enstar® AQ insect growth regulator
Rotation 4 Hachi-Hachi® insecticide

Always read and follow label directions.
Product timing is a suggestion only; optimize application for local weather and field conditions. Confirm active status of product registration in your state before using; not all products are registered in all states. Contact your local rep for more information.

IEALTHY PLANTS

BASF
We create chemistry

Shore Flies

Rotation 1 **Millenium®** beneficial nematodes
Rotation 2 Azatin® O biological insecticide
Rotation 3 Distance® insect growth regulator or
Fulcrum® insect growth regulator
Rotation 4 **Millenium®** beneficial nematodes

Spider Mites

Rotation 1 **Sultan®** miticide
Rotation 2 TetraSan® 5 WDG miticide/ovicide
Rotation 3 **Sultan®** miticide
Rotation 4 Kontos® insecticide/miticide

Thrips

Rotation 1 **Velifer®** fungal contact insecticide/miticide
Rotation 2 Aria® insecticide
Rotation 3 **Pylon®** miticide-insecticide
Rotation 4 Conserve® SC insecticide

Whiteflies

Rotation 1 **Ventigra™** insecticide
Rotation 2 **Velifer®**fungal contact insecticide/miticide
Rotation 3 Savate® miticide/insecticide
Rotation 4 Altus® insecticide

Chemical Class Chart for Ornamental Fungicides

FRAC group	Chemical Class	Active Ingredient common name	Trade Name
1	Methyl Benzimidazole Carbamates (Thiophanates)	thiophanate-methyl	AllBan Flo, Banrot*, 3336, ConSyst*, OHP 6672, Spectro 90*, 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)	metconazole	Tourney
		myclobutanil	Clevis*, Eagle, MANhandle*
		propiconazole	Banner MAXX, Concert II*
		tebuconazole	Torque
		triadimefon	Bayleton, Trigo*
		triflumizole	Terraguard
		triticonazole	**Trinity**, **Trinity TR**
4	Phenylamides	mefenoxam	Subdue GR, Subdue MAXX, Hurricane*
5	Amines "Morpholines" (Piperadines)	piperalin	Pipron
7	Succinate dehydrogenase inhibitors - SDHI (Pyridine carboxamides, phenyl-benzamides, pyrazole-4-carboxamides)	benzovindiflupyr	Mural*
		boscalid	**Pageant Intrinsic***
		fluropyram	Broadform
		flutolanil	Contrast, ProStar
		fluxapyroxad	**Orkestra Intrinsic** *
9	Anilinopyrimidines	cyprodinil	Palladium*
11	Qol-fungicides (strobilurins)	azoxystrobin	Heritage, Mural*
		fluoxastrobin	Fame
		pyraclostrobin	**Pageant Intrinsic***, **Empress Intrinsic**, **Orkestra Intrinsic***
		trifloxystrobin	Compass, Broadform*
	Imidazolinone	fenamidone	Fenstop
12	Phenylpyrroles	fludioxonil	Medallion, Hurricane*, Palladium*
14	Aromatic Hydrocarbons (chlorophenyl)	dicloran	Botran
		pentachloronitrobenzene (PCNB)	Terraclor
	Thiadiazole	etridiazole	Banrot*, Terrazole, Terrazole CA, Truban
17	Hydroxyanalide	fenhexamide	Decree
19	Polyoxins	polyoxin - D	Affirm WDG
21	Quinone inside inhibitors (Cyano-imidazole)	cyazofamid	Segway O
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 SC**, **Orvego***
		mandipropamid	Micora
43	Benzamides (Pyridinemethyl-benzamides)	fluopicolide	Adorn
44	Microbials	Bacillus amyloliquifaciens (D747)	Triathlon BA
		Bacillus amyloliquifaciens (MBI600)	**Subtilex NG**
		Bacillus amyloliquifaciens (QST 713)	Cease, Companion
45	Quinone x Inhibitor	ametoctradin	**Orvego***
49	piperidinyl-thiazole-isoxazolines	oxathiapiprolin	Segovis

Chemical Class Chart for Ornamental Fungicides

FRAC group	Chemical Class	Active Ingredient common name	Trade Name
M1 (multi-site)	Inorganics	copper salts	Camelot O, 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*
P5	plant extract	complex mixture, ethanol extract	Regalia, Milsana
Not Classified	Microbial/Biopesticides	Gliocladium catenulatum (J1446)	PreStop
		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, Triact 70
		hydrogen dioxide	Zerotol
		hydrogen peroxide	X3, Xeroton
		oil	Ultra-Pure Oil, SuffOil-X
		potassium bicarbonate	Armicarb 100, Kaligreen, 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 landcapes.

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