GROBINSCIE UST





Simple, Functional IPM — it's *Bio-Logical*

Growers face rising demand for perfect stewardship practices while producing a flawless crop. Biological solutions, such as beneficial nematodes, biopesticides and other tools of our trade, harness natural enemies to complement the other elements of integrated pest management (IPM).

By blending biological, conventional and other functional tools, growers can reinforce IPM to help protect their crop quality and meet customers' expectations about responsible plant protection and nontarget preservation practices.

Rotation Made Easy

Good IPM programs are unique to the operation and the crop in production, and great ones are dynamic like the pressures they face.

Growers can create a simple, flexible IPM program by selecting from the Functional Groups, each representing options that target pests in distinctive ways to automatically create rotations across multiple modes of action (MOAs). Where possible and practical for the operation, choosing two to five options from the groups creates a robust program.

Functional Group	Target	BASF Solution
Biological Control Agents (BCAs)	Host-Specific	Nemasys® and Millenium® Beneficial Nematodes
Formulated Biologicals	Targeted	Velifer [®] Bioinsecticide / Miticide
Targeted Conventionals	Targeted	Sultan [®] Miticide Ventigra [®] Insecticide
Growth Regulators (IGRs/MGRs)	Targeted	Check labels and BCA compatibility with active ingredients: buprofezin, clofentazine, novaluron, pymetrozine, spiromesifen
Oils and Soaps	Broad-Spectrum Short-Lived	Ultra-Pure [®] Oil Horticultural Insecticide, Miticide and Fungicide
Broad-Spectrum Conventionals*	Broad-Spectrum Rescue	Pylon [®] Miticide-Insecticide Pylon TR Insecticide Pyrethrum [®] TR Insecticide

*Broad-spectrum and all product category choices are optional and may be used on an as-needed rescue basis, or not at all in your operation. Always read and follow label directions.

Why This Approach Works

- Strong, adaptable IPM: Multiple modes of action delay resistance and support healthier crops.
- Easy integration: Biological tools fit into existing programs without extra hassle.
- Sustainability in practice: Comprehensive integration including rotations allow for short and long-term solutions, advance planning for population changes, and focused prevention with rescue applications just in case.



Strengthen your IPM with *Bio-Logical* Solutions.

Scan the QR code to learn more.

Always read and follow label directions. Millenium, Nemasys, Pylon, Pyrethrum, Sultan, Ultra-Pure, Velifer and Ventigra are registered trademarks of BASF. © 2025 BASF Corporation. All rights reserved.





Table of Contents

In this issue

- 6 Editor's Note Bill Cakins
- 6 Further Reading
- 18 Bioinsecticides Efficacy Table
- 24 Biofungicides Efficacy Table
- 34 In Conclusion Paul Pilon



Features _

8 Making the Move

by Michael Brownbridge, BioWorks

What can you do to ease the transition to a more biologically based approach to pest and disease management?

14 It's NOT All or Nothing

by Jeremy Webber, Koppert

An argument for a hybrid approach to IPM in ornamentals.

20 The Impact of Logistics on BCA Product Quality

by Lowell Halvorson, Triadicon

Transportation of BCA products from insectary to farm has a large impact on product quality.

26 Assessing Your Biological Workforce

by Suzanne Wainwright-Evans, Buglady Consulting Step-by-step quality control tests you can perform in-house.

GROWERTALKS

editorial

EDITOR-IN-CHIEF Chris Beytes beytes@growertalks.com EDITOR Jennifer Zurko MANAGING EDITOR Jennifer Polanz SENIOR EDITOR/DIGITAL EDITOR Bill Calkins

PRODUCTION SPECIALIST Jackie Batson CREATIVE DIRECTOR Anissa Lobrillo VIDEO PRODUCER Osvaldo Cuevas COPY EDITOR Nathalie Dreifelds

sales 866.888.4237

PUBLISHER, SALES MANAGER Paul Black pblack@ballpublishing.com Account MANAGER Kim Brown kbrown@ballpublishing.com SALES ASSISTANT Adriana Heikkila aheikkila@ballpublishing.com PUBLISHING ASSISTANT Denielle Noe dnoe@ballpublishing.com



A Friend Remembered G. Victor Ball, Editor from 1949–1997

GrowerTalks's general offices are located at: P.O. Box 1660 West Chicago, Illinois 60186 U.S.A.

Tel. (630) 231-3675 Fax (630) 231-5254 Toll-Free 1 (888) 888-0013 www.growertalks.com

BALL <u>PUBLISHING</u>

GrowerTalks (ISSN 0276-9433) is published monthly by Ball Publishing, P.O. Box 1660, West Chicago, Illinois 60186, United States. Subscriptions are free to qualified readers in the US. Subscription price for non-qualified readers is \$50 per year US and Canada. All other foreign subscriptions must pay \$199/year to receive/continue to receive *GrowerTalks* and *Green Profit*. *GrowerTalks* is a U.S. registered trademark of Ball Horticultural Company. Periodicals postage paid at West Chicago, IL and at additional mailing offices. Postmaster: send address changes to *GrowerTalks* Magazine, P.O Box 1660, West Chicago, Illinois 60186, United States. ©2024 B.all Horticultural Company. All rights reserved. Posted under Canada publications mail agreement #40732015. Canada returns to be sent to International Delivery Solutions, P.O. Box 456, Niagara Falls, ON L2E 6V2, Canada. Printed in the USA.

GreenProfit Supplement Enclosed







WE ARE EXPERTS IN CROP PROTECTION SOLUTIONS WITH OUR BOTANICAL OIL-BASED BIOPESTICIDES



PathoCURB[®] ()RevoCURB[®]

RevoCURB



TetraCURB

MITICIDE-INSECTICIDE & REPELLENT



INSECTICIDE & REPELLENT



FUNGICIDE-BACTERICIDE **NEMATICIDE & PRE-PLANT** SOIL TREATMENT



@kemincroptechnologies

Inc., USA s product qualifier for exemption. from registration under s product qualifier for exemption for approval of the

in

Editor's Note

It's hard for me to believe we're three editions into this guide and how the biosolutions industry continues to evolve with the use of bio-based products becoming more and more critical in IPM programs! Whether you're interested in minimizing the impact of pesticides and fungicides on our environment, reducing the risk of resistance eliminating chemicals from your grower toolbox, keeping your workforce safe, or simply exploring pest and disease-control strategies with proven success - the movement towards biosolutions continues to be a major development in our industry.

At GrowerTalks, Green Profit and Inside Grower, we've been keeping a close eye on natural solutions and sustainable production for years, and doing our part to share this information with floriculture, garden center and CEA professionals. We work with leaders in research and product development, as well as growers to develop content across our multimedia platforms, and rarely does a month pass that we aren't covering biosolutions in one way or another. (Check out the QR codes below to get a taste of some recent content.) The 2025 *GrowerTalks* Biosolutions Guide continues a goal established when we launched this supplement in 2023 – to share bio/IPM products to help everyone grow and sell the best crops possible.

Our industry-leading content isn't possible without experts sharing knowledge and this guide is a prime example. Our favorite "Buglady," Suzanne Wainwright-Evans, provides step-by-step instructions for assessing how many beneficials are alive and ready to do their job upon arrival at your greenhouse on page 26. Frequent *GrowerTalks*' contributor Lowell Halvorson investigates four key logistics points that impact BCA viability, resulting in ways you can work to select and evaluate vendors (page 20).

BioWorks' Michael Brownbridge took an idea and ran with it in his article about how your production team can prepare in 2025 to pivot toward biocontrol in 2026 and beyond beginning on page 8. And reflecting the reality that 100% biobased is not always possible, I called on Koppert's Jeremy Webber to share his argument for a hybrid approach to IPM, which you'll find on page 14.



Hopefully, these articles inspire conversation at your greenhouse and continue to challenge us all to look forward and make positive changes that benefit plants, people and our environment while continuing to improve crop quality and minimize loss. I can't close this introduction without mentioning the charts found on pages 18 and 24. These elements can be tricky and change quickly when new products come to market, but as new technologies emerge and effectiveness is proven, your toolbox grows.

BILL CALKINS

Senior/Digital Editor – Ball Publishing Editor – Tech On Demand e-newsletter

Further Reading

Snap the QR codes below to read some past biosolutions articles and listen to podcasts. *GrowerTalks, Green Profit* and *Inside Grower* understand the importance of sharing bio-based solutions year-round!



Setting the Trap GrowerTalks 2024

Using "trap plants" as a tool against *Thrips parvispinus* in tropicals.



An Essential Part of Your Future Inside Grower 2024

In this article, the focus is on the use of biochemical and microbial biofungicides registered for management of foliar and soilborne diseases and their broader contribution to plant health and productivity.



Aphids: It's Go Time GrowerTalks 2025

If you're going the pesticide-free or reduced pesticide route with your battle plan, understanding a few key points about the main ones that you're likely to find will go a long way towards winning the war in spring.



A Biological Approach to Spring IPM Tech On Demand Podcast 2025

Heidi Doering joins host Bill Calkins to share strategies for spring pest control, integrated pest management and implementing biocontrol strategies that work.



Factors That Can Influence Pesticide Resistance & Pesticide Applications GrowerTalks 2025

It's essential to know the biology and ecology of insect and/or mite pests to mitigate their populations from developing resistance.

Expert Technical Support for All

Ball Seed[®] Technical Services can help you grow all plant genetics and categories in the industry – not just ours! Contact our team of horticulture experts to help you troubleshoot challenges and identify solutions to keep you growing strong.

They have expert knowledge in:

- Crop culture
- Clean environment protocols
- Plant physiology and pathology
- Biological pest control agents, and more!



SEARCH OUR ADVANCED DIGITAL & ONLINE TOOLS

- Technical support videos
- Scheduling guides and culture info
- Podcasts
- Facebook groups

Connect with us at Ballseed.com/techsupport Ball Seed: 800 879-BALL • Ball ColorLink®: 800 686-7380

©2025 Ball Horticultural Company 25812884 [®] denotes a trademark of and [®] denotes a registered trademark of Ball Horticultural Company in the U.S., unless otherwise noted. They may also be registered in other countries.













Making the Move

By Michael Brownbridge

LIFE CYCLE OF WESTERN FLOWER THRIPS.

Several biocontrol agents can be used to manage different life stages of this pest:

1. Eggs – Laid in the leaf tissue, some control by dipping in oil products like SuffOil-X

2. First instar – Young larvae controlled by predatory mites such as *Neoseiulus cucumeris*

3. Second instar – Older, larger larvae consumed by Orius spp. and entomopathogenic fungi such as Beauveria bassiana and Metarhizium brunneum

4. Both the pro-pupal and pupal stages are soil-dwelling and can be managed using entomopathogenic nematodes such as Steinernema feltiae and predators such as Stratiolaelaps scimitus (Hypoaspis) and Dalotia coriaria (Atheta)

5. Adults - Entomopathogenic fungi



Figure credits: Skinner, M., B.L. Parker and J.S. Kim. 2014. Role of entomopathogenic fungi in integrated pest management, In Dharam P. Abrol (ed.) Integrated Pest Management: Current Concepts and Ecological Perspective, pp. 161-191. Academic Press. WHAT CAN YOU DO TO EASE THE TRANSITION TO A MORE BIOLOGICALLY BASED APPROACH TO PEST AND DISEASE MANAGEMENT?

What do we mean by "biologicals"? This is a catch-all phrase for biological pesticides (biopesticides – includes biochemical and microbial products) and macro-biological control agents (BCAs – insect and mite predators, and parasitoids).

"I've used chemicals to control pests and diseases throughout my career, but I get the sense they're not working as well as they used to and I'm tired of suiting up at the end of the day to spray. My workers don't like it either. What do I need to do so that I can start using biologicals? I may not want to give up chemistry entirely—is that possible? And I want to start next year."—A. Grower

> This type of request is not uncommon. It's easy to provide a response that focuses on the mechanics of using biologicals, while glossing over the groundwork that needs to be done to prepare for and facilitate the transition. While this piece may not uncover anything radically different from what's already out there, it's my hope that it may provide a checklist of sorts to make the journey less stressful and more successful. The starting point is this: What should a greenhouse owner or

manager and a production team do now to prepare for a move to biological control in 2026 and beyond?

One immediate step is to review current chemical usage. This has two purposes: First, have a target list of materials and know what each was being used for. The goal is to replace as many of these with biologicals, so this list will allow you to see what biological alternatives there are.

Second, to immediately remove some of these materials from your current year's program. Some chemicals have long residual activity (like Avid and Abermectin) and can impact biocontrol agents months after their use. Transitioning to a "low residue" program a year ahead of time makes the greenhouse a more welcoming place for natural enemies.

WHY SHOULD YOU CONSIDER USING BIOLOGICALS?

Resistance. Key pests (like thrips, spider mites and whiteflies) and diseases (including Botrytis, Fusarium and powdery mildew) have evolved resistance to multiple active ingredients. Use of biologicals in an integrated plant health management (IPHM) program helps preserve the active lifetime of synthetics that still work. That list is getting shorter and replacements don't come along very often.

Safety. Biologicals are safer for workers and our environment, and in the case of BCAs, there are no re-entry intervals (REIs) to worry about. Most biopesticides have REIs of four hours or less, making it easier to incorporate their use into a production program without disrupting other crop-management activities. Generally speaking (although there are exceptions), they're also softer on natural enemies



propagated in standard (top) and Trichodermaamended (bottom) media.



Sustainability. Greater integration of biologicals into an IPHM program helps reduce chemical inputs, contributing to sustainability goals and (for many producers) allows businesses to conform to sustainability guidelines issued by some of the major retailers around products that can or cannot be used, as well as acceptable residue levels on plants or vegetables.

DISPELLING SOME MYTHS

While biological products are increasingly used successfully in multiple indoor crops, adoption is still hampered by perceptions that they don't perform as well as conventional pesticides, that they're too complicated to use, and are unreliable, expensive and can only be used in organic systems.

Let's take a moment to dispel these myths. Used correctly, BCAs and biopesticides are highly effective and will deliver consistent results. Today's products and formulations are significantly better than those of even 10 years ago, making them easier to use in both organic and conventional systems, so it's not an either/or choice.

And let's put a stake in the heart of the statement, "You can't use biologicals with chemistry" once and for all. Biopesticides are compatible with many synthetic products, but it's essential to confirm their physical and biological compatibility before tank mixing or using together in a rotation. Chemical pesticides are typically more disruptive to BCAs, but some products are considered "softer" on beneficials and can be used to support a biocontrol program with minimal negative impact. Treatments can also be separated in time and space to avoid direct contact with the BCAs - applying a systemic insecticide by drenching rather than as a foliar spray, for example, avoids direct contact with beneficial species. We can continue to have pesticides in our back pocket if we need to use them, but biology allows us to maintain their efficacy so we can continue to use them effectively if needed.

And is it really more expensive? We're not advocating using biologicals as well as the same chemical inputs, but replacing chemistry with biology. Initially, costs - if you do a product-toproduct comparison – may be higher, but over time and with experience, costs inevitably come down and there are frequently other cost savings that accompany biological programs. Aside from the products, consider those costs associated with applying synthetics: equipment, equipment maintenance, time spent applying materials, having to shut down a greenhouse during the application and REI period, the additional labor expense of having a gualified applicator spray the crop, etc.

Furthermore, biological materials provide extended protection to a crop, which can further reduce labor costs or free up labor for other tasks. When you factor in all associated costs and the savings that can be realized, the argument can be made that using biocontrols can be a more economical proposition to the business. And, unlike chemistry, microbials can deliver many other crop benefits. Use opportunities lie in positioning biopesticides and BCAs in programs that support their success and allow us to get the most from the strengths and versatility that they can bring.

PLANNING TO MAKE THE MOVE

1. Mindset and commitment are key. To quote well-respected biological control expert Ron Valentin, "It's a mindset change. We need to stop thinking about biological control as a product you buy and instead see it as a system you cultivate."

Use of biologicals requires proactive action, preventing pest and disease problems versus the curative, reactive mindset we're used to when using chemistry. Taking action before you see a problem? Yes, that's the first hurdle. Many so-called failures are due to poor timing and improper application – using biologicals when there's nothing left in the chemical cabinet. Not the ideal time to use them.

Think proactively. This is where crop records can be extremely useful, as they provide insights into the what, when and where. What disease and pest issues have you dealt with in the past? When did they occur and in which crop(s)? The most successful bio programs start in propagation and there are several tools and strategies that have been proven to be critical to the season-long success of such programs. If growing a spring crop from vegetative cuttings, for example, consider the value of dipping those cuttings before sticking as a means of eliminating hitchhiking pests or promoting early root growth.

Commit. Becoming proficient in biocontrol is like learning any new skill. If you want to do it well, you have to be willing to invest your time and resources and that of any other dedicated staff. Ask the question up front: Do you have knowledgeable people with the right skill sets on staff to take this on? Having one person dedicated to the initiative to manage, coordinate and take ownership of it-creates accountability, focus and avoids duplication. Empower and support them, but don't neglect the rest of your staff. They're additional eyes that can monitor the health of the crop and ensure that crop-management decisions don't negatively impact the efficacy of the biologicals. Doing the job right necessitates time spent monitoring the crop to keep ahead of pest and disease problems, to ensure strategies are working, and to adjust as needed. Make sure that the person dedicated to this task isn't reassigned to assist in other areas of the greenhouse when things get busy. 🕨

Making the Move

2. Rome wasn't built in a day. You won't build the Colosseum on your first attempt. Build experience and confidence across your team first. Start small. Don't try to implement a program in a crop that faces multiple production challenges every year. Chose a crop you know well and biological strategies that have a track record of success.

Let's say western flower thrips are a recurrent problem on a crop that otherwise performs well. There are several complementary biological tools with documented "foolproof" methods associated with their use that can be considered in this case. Nematodes. for example, are often considered a "gateway biological," as they're easy to use and apply, and work well against soil-dwelling stages of western flower and other thrips species. They have a long history of successful use in affected crops, so you don't need to reinvent the proverbial wheel. (More on this example later...)

Rather than going into a full bio program, consider incorporating a bioinsecticide or biofungicide into a spray or drench rotation as the first step on a biocontrol journey. Biopesticides are a good way to ease into a bioprogram, as the methods used to apply them are very similar to those employed for conventional pesticides. Biofungicides can be inserted into a fungicide resistance management program, replacing one or more chemical applications in that rotation. There are now many working examples of hybrid programs that work as well as (or better than) all-chemistry rotations and you get double the benefits chemical inputs are reduced and the likelihood that diseases will develop resistance are diminished.

3. Do your homework and educate

the team. Based on the target crop, do you and your team know what pest or disease issues you may have to deal with? Do you know when these occur, what they look like and what plant symptoms are indicative of an infection or infestation? Do they happen in the same crop and location year after year? This is when crop scouting records are invaluable, as they help define what your target crop will be, the pest(s) and disease(s) you're likely to encounter, and the biological options that are available. With this information, start to do your research to understand how the different biologicals work, the life stages of the pest they work against or times when they can be used to prevent disease and how they're best deployed.

Let's go back to the earlier example of managing western flower thrips: The life cycle and biology of thrips differ from species to species and the controls you select must be appropriate. Western flower thrips lay their eggs in plant tissue: first and second stage larvae are motile, feeding on the foliage and flowers, whereas pre-pupal and pupal stages are non-feeding stages in the soil. Adults feed on the foliage and flowers. Some biocontrol agents work on larvae, others on the pupal stages or adults. In a basic program, you could consider three complementary biologicals: predatory mites, like Neoseiulus cucumeris, which consume young thrips larvae on the foliage. Or combine their use with sprays of entomopathogenic fungi, which infect larvae and adults, and entomopathogenic nematodes for the soil-dwelling stages, and you have a program. Integration of different natural enemies to target all accessible life stages of the pest is inherently more effective and reliable.

Knowing which biologicals you can use is one thing, but it's equally important to understand when and how to use them. When is the best time to make a first release (early), a biofungicide treatment (propagation) or bioinsecticide application (early)? Which method of application should be used - for example, predatory mite sachets versus sprinkling a bran formulation over the crop? Does your choice remain static through the life of the crop or are some natural enemies better suited to cool or warm conditions? When should biofungicides be used and what's the best formulation to use based on your business infrastructure and capabilities, such as pre-incorporating a granular formulation into the growing medium versus the use of a biofungicide drench? Are there any other strategies that can enhance a program (I already mentioned dipping to mitigate incoming pests on cuttings)? What other pest control products can be safely used with them and what cannot?



Untreated Control





There are many resources available just a click away on manufacturers' websites or university extension sites. Ask your peers, some of whom may be seasoned practitioners. Consider retaining the services of a crop consultant or independent scouting service. This can take the load off employees and provide essential crop data (including a record of how well your biologicals are working) on a regular basis. Attend webinars, local or national meetings and ask guestions. Read and learn and bring the team along with you. A dedicated and well-educated team will be more attentive to detail if responsibilities and information are shared. Communication of the goals and content of the program across the team and the entire staff will also help prevent mistakes. How many times has a pesticide been applied by mistake in an area where biocontrol agents were being used?



WHEN YOU SPEND 20 YEARS IMPLEMENTING BEAUVERIA BASSIANA INTO GROWER PROGRAMS, YOU BECOME THE EXPERT.

INTRODUCING PRINCIPLE[™] WP

We developed PRINCIPLE WP because controlling thrips, aphids, whiteflies, and other damaging insects can be difficult. PRINCIPLE WP is a new, easy-to-use insecticide and miticide that puts all fears to rest. Based on decades of implementing Beauveria bassiana into grower IPM programs, this new formulation makes broad-spectrum insect control in ornamental, edible, and cannabis crop production easier.

- OMRI-certified
- Resistance-free
- Excellent compatibility with other chemical and biological control products
- Comparable performance to conventional pesticide programs



ABOVE AND BEYOND IS WHERE WE BEGIN





BIOWORKSINC.COM/PRINCIPLE

Making the Move

4. Don't forget the basics (and do them

well). Healthy crops are inherently less susceptible to pests and diseases and are more resilient in the face of environmental stress factors. IPHM relies on you growing the healthiest plants you can, as this provides the best foundation for any control strategy, and particularly one that includes biologicals. Document your sanitation practices, both before and during the growing cycle. A clean greenhouse with minimal crop waste, weeds, algae, etc. is the goal. Sanitize at the end of the growing season to reduce the likelihood of carryover of diseases or pests from one crop cycle or growing season to the next and remember to clean any drip lines to get rid of biofilms that can build up in them and harbor various plant pathogens.

Review water management and watering practices - how many crops are overwatered, which stresses plants and provides an ideal environment for infection and spread of water molds? If pulling water from an irrigation pond or river, test it periodically over a growing season to ensure it's free from pathogens and has the right pH. Review your fertilization practices over- or under-fertilization can stress plants and increase susceptibility to both pests and diseases. Over-fertilization with soluble nitrogen (N), for example, can induce rapid plant growth, but may render plants more vulnerable to both foliar and root pathogens. High levels of N in plant tissue can stimulate population growth in pests like aphids, spider mites and thrips. And understand what the ideal growing environment is for your plants. IPHM is multi-faceted. Pest management with biologicals will work best when all components work together.

5. Develop a plan and prepare for

contingencies. Once you've selected your crop, identify the bioprogram you want to implement and the personnel who will be involved. This is much easier than flying by the seat of your pants when things get crazy, as they inevitably do. Share the plan with those directly involved and seek feedback. Seek advice from biopesticide or biocontrol reps and technical specialists wherever possible.

Michael Brownbridge is Senior Technical Services Manager for BioWorks, Inc.

PLANNING CHECKLIST

When planning the move to a biobased approach, make sure you clearly define what your goals are and what success looks like so you can track and measure it. Prepare a well-laid-out plan that includes:

- Details of the crop and the biological treatment(s) you will use.
- Who will be involved.
- Information resources and where to find them.
- Information on the biologicals that will be used. Start by using proven biocontrol agents as your first line of defense, supported by biopesticides and synthetic pesticides; keep chemicals in your back pocket until (or if) you need them. Ensure you match the right natural enemy or biopesticide to the life stages of the pest that are susceptible and re-apply or re-treat as recommended. Pests can multiply quickly in the summer and it's easy to become complacent or skip a treatment when everything seems to be going well.
- Timelines decision points and methods – include information on where the biologicals are being sourced. If using predators or parasitoids, remember orders must be submitted about a week before you need them; many companies only deliver once per week, so you have to be organized. Know how to handle and check the quality of every shipment.
- Create a list of chemicals that may be used, either as part of the plan or as a contingency if you have to reset the program. This means looking at compatibility data for the

products ahead of time to select those that have the least impact on the BCA(s) or are known to be compatible with the selected biopesticides. Equally important: highlight those which should not be used.

- Review your methods of recording inputs (time and resources) and effectiveness based on observations taken in the crop through the growing season. This can include scouting data and shrink.
- Schedule regular check-in points with the team through the crop cycle so you maintain a dynamic record of pest and disease incidence. It's important to capture what was learned throughout the crop cycle – what went well and what did not. Repeat the good, learn from mistakes, adapt and adjust accordingly.
- Add a communication component to explain the plan to your team and other crop workers to ensure that everyone is on the same page and understands what you're doing - when and why. English may be the second language for many greenhouse workers, so provide this training in a language that everyone can understand. And accept the fact that biologicals may not eliminate all pests, but their use will significantly delay the need to use chemistry.

Use this plan as a starting point to build and expand the program as your confidence grows. The first year will have its ups and downs, but clarity of your goals and the actions you're taking will go a long way to achieving them.



Serving IPM since 1981











APHID GUARD™ Banker Plant



We supply...

Biological Control Agents for the control of Aphids, Fungus Gnats, Spider Mite, Thrips & Whiteflies

Early Start Sustainable Systems for Flowers, Vegetables & Cannabis

Banker Plant Systems

315-497-2063

www.ipmlabs.com

While an application of a feeding inhibitor like Rycar works great to prevent this level of infestation in a crop of ornamental lavender, sometimes they're grown in an edible herb program and the heavy lifting goes to the bio program. In this case, all inputs are firing and the aphids are having a very bad time.

First released by Koppert back in the 1950s, she's seen here mopping up the stragglers of a hot spot that was mostly decimated by a single application of Shuttle-O.

A great shot of the "OG beneficial"— *Phytoseiulus persimilis*.

It's NOT All or Nothing

AN ARGUMENT FOR A HYBRID APPROACH TO IPM IN ORNAMENTALS.

By Jeremy Webber

ost growers utilizing biocontrols use some form of "hybrid" or combined approach with bugs and sprays. Perhaps the industry doesn't discuss this enough. There are many resources at your disposal describing the biocontrol tools themselves - what they eat, how to store them (don't), when to use them, etc. The implication is that it's all or nothing. At the end of the day, though, bios are just another tool in your toolbox (along with a slew of newer pesticides), and it's important to discuss them both together and not as one or the other. They play well together, and in ornamentals especially, are synergistic when they're designed into a coordinated program.

Everyone who starts the journey towards producing crops with biologicals comes with different motivations. A common thread is some form of aversion to pesticide applications, though. This can range from "unfortunately, they're not working anymore" all the way over to "I don't have the labor to spray anymore." For most of the general ornamental plant growing populace, bios should just be a means to an end - clean crops, within your budget, resulting in happy customers. Another tool in the toolbox. Do they require some reworking of how you approach pest control? Possibly, depending on what you're used to, but maybe not. The reality is that there are a lot of ways to skin the proverbial "IPM cat" and pesticides should still stay on the table if staying within your budget concept is something you hold near and dear to your heart. Regardless, there are no one-size-fits-all solutions and your best approach will be something that's unique to you and your operation. Let's look at some examples of hybrid approaches to common areenhouse pests.







Superior Solutions for Superior Greenhouses.

The ultimate defense for healthier, resilient plants.



Improve Root Growth & Plant Health



Protect Plants From Soil-Borne Pathogens



Excellent For Propagation & Cuttings



Labeled For Ornamental & Vegetables



Scan For Results!



Always read and follow label directions. Obtego is a registered trademark of SePRO Corporation. © 2025 SePRO Corporation.





I like to think of californicus as the Honey Badger of the predatory mite world. They're mean and resilient, and they're the predatory species most tolerant to pesticide usage as well.

—Jeremy Webber

APHIDS (PLENTY OF BIOLOGICAL AND CHEMICAL OPTIONS ...)

The "hybrid approach toolbox" for aphids is a big one. We're still fortunate here in that there are number of active ingredients (A.I.s) that work against them, and most are relatively new and safe for us to be around. That said, you're here because you want or need to limit these applications. A solid approach for many growers is to use bios as a low-level preventative tool. These can range from parasitic wasps, gall midges (a personal favorite) to green lacewing predators or likely a combination.

Regardless of complexity, it's entirely possible to come up with something that most growers consider affordable. The back-up response - after scouting has determined when you've reached the end of this affordable level of prevention from your bioprogram - comes from a range of chemistry. Some favorites of the Koppert team are the Group 9 / 29 products - mainly Rycar, Aria and Endeavor. While they're in similar IRAC groups, they have nuanced advantages depending on time of year, application methodology and other pests controlled, based on labels. Keep in mind that there's some lag time to when you'll see control, ranging from three to seven days,

depending on climate. The trade off for the lag time is compatibility. There are relatively no issues with the main bios used in spring production when you bring these products into the equation.

Beyond the chemistries listed above are Mainspring, Pradia and Altus. These insecticides have significantly broader labels, but also have good safety with bioprograms and are frequently recommended by our team in hybrid approaches. It's not uncommon for growers to rely on Mainspring drenches in their aphid program for about eight weeks in spring, while we focus on other pests with bios simultaneously. Your mileage may vary with that approach, however, depending on pressure. It's more and more common to find some level of preventative bio program running concurrently with a drench application, especially earlier in the crop's life or later when the drench is starting to fade out.

SPIDER MITES (THERE ARE FEW COMPATIBLE PESTICIDE OPTIONS, BUT DO YOU REALLY NEED THEM?)

While certain areas of the U.S. see spider mites as their primary adversary, it's usually relegated to a background character in other regions. Regardless, there are several options depending on how big of an issue they play, and it's easy to mix both bios and chemistry. Bios are a fantastic option for spider mite control on their own. The pest doesn't fly, so it's just a numbers game of good guys to bad guys and application methodology to win this fight. You certainly want to be in a preventative mode to keep your budget in check, but really there isn't a population of spider mites that bios can't take down (assuming there aren't incompatible pesticide residues in the mix). The statement that "bios only work preventively" for spider mite is categorically false, however, it could be corrected as, "bios only work preventively if you have a budget."

Between the capabilities of *californicus* and *persimilis* mites, there's little out there that can't be solved with them alone, but money is always a limiting factor, and that's where a few good products help to keep things in line. Shuttle-O is an excellent, responsive product. The team When your weekly applications of Isaria for western flower thrips take out mealybugs as well, that's a win. Adult fungus gnats, leafhoppers, whiteflies and most other thrips species are all on the menu.

PODCAST EPISODE 171



Speaking of taking a hybrid approach to key greenhouse pests, Tech On I de 171 featured Koppert technical IPM expert Heidi Doering who discussed her role as a "greenhouse CSI" when walking into greenhouses and meeting with owners and growers, common spring pests and potential prevention and management strategies, education and planning as they relate to biological IPM, and the importance of relationships. Snap the QR code to hear the episode on Spotify.

has watched "good guys" moving around in foliage that was just clear of the REI with no impact. Floramite is another one (similarly safe on the rest of your program) and Sultan, as well. Sultan is newer to the scene, relatively, but works as a contact product, so good application technique is critical for good results. All three are fully compatible with most bioprograms and should be in your toolbox to keep costs in line.

WESTERN FLOWER THRIPS (WFT AND BIOSOLUTIONS ARE MADE FOR EACH OTHER)

Frankliniella occidentalis is the most common species most of you are dealing with, but a good bit of this applies to the latest bad guy, *Thrips parvispinus*, as well. The biocontrol options for this pest are numerous; multiple predatory mites, Orius and even green lacewing, depending on who you ask (and how many you introduce). Integrating regular chemical applications into the bio approach requires a bit of fine tuning, but generally, it shouldn't be necessary if the program is set up and executed correctly. Bios are ideal at controlling development from within the crop, but what about when a cloud of adults blows in through the roof vents? Masstrapping with yellow sticky material is your cheapest and most effective defense, but a foliar application of Mainspring or Altus works well (if necessary) and your beneficials shouldn't feel a thing.

One point that stands out with thrips (and whitefly and fungus gnats, as well), is the effectiveness of a good mycoinsecticide like Isaria (now renamed into the genus of Cordyceps).

Author's Note: I've mainly made my living working with predatory mites over the last two decades, but the effectiveness of Isaria continues to open my eyes for a few reasons. One is efficacy-it just works. This would have been the star of my spray regime when I was a grower and I wasn't sold on any of the other bio-insecticides that were available then. Almost every week, we share pics of dead, fuzzy insects in the Koppert team group chat. Seemingly, nothing is safe-from mealybugs to fungus gnats to thrips and even aphids. This is an aggressive organism that's easy to incorporate into systems you already have. The other reason is the need for resistance management. This product can be applied every week without complicated rotational plans. It should be tank-mixed with your IGR of choice (we're big fans of Azasol-a WP formulation of Azadirachtin) and applied as the foundation of your approach battling western flower thrips, whitefly, mealybug, fungus gnats or Thrips parvispinus. After that, the rest of your biocontrol program will have a significantly easier time keeping things subdued. Yes, it's a bio, but it's also an insecticide, so it's the very definition of the hybrid approach.

LET'S MIX IT UP

A good craftsperson knows how and when to use the correct tool for the job. Fortunately, you have an abundance of tools in your toolbox, both chemical and biological. There's no one correct method to put all of this together, but there's one that's ideal for you. There are a lot of moving parts to a hybrid approach, so work with a trusted partner to help you put the pieces together efficiently. We (the bio industry as a whole) can help you cut through years of expensive and frustrating trial and error to get things squared away quickly.

Jeremy Webber is the national Ornamental Consultant Team Leader for Koppert U.S.

Bioinsecticides Efficacy Table

Table 1. Examples of common bioinsecticides used in floriculture and nursery in the U.S. and their target pests. (+ indicates some activity, +++ indicates high activity).

Active Ingredient or Organsim	Product	Use Rates	Application Methods	Use Sites
Azadiractin	Aza-Direct, Azatin O, Molt-X	4-16 fl. oz./100 gal.	S, D, F	GH, N, L
Azadiractin + Fats and Glyceridic Oils Margosa	DeBug Turbo	16-104 fl. oz./100 gal.	S, D	GH, L
<i>Bacillus thuringiensis</i> , subsp. <i>israelensis</i> Strain AM 65-52	Gnatrol WDG	3.2-26 oz./100 gal.	D	GH
Bacillus thuringiensis, subsp. kurstaki Strain ABTS-351	DiPel DF	4-16 oz./100 gal.	s	GH, N
Beauveria bassiana Strain ANT-3	BioCeres WP	1.5-3.0 lb./100 gal.	S, D	GH, N
Beauveria bassiana Strain GHA	BotaniGard 22WP, BotaniGard ES, Mycotrol WPO, Mycotrol ESO	0.5-2.0 lb./100 gal.	S, D, F	GH, N, L
Beauveria bassiana Strain PPRI 5339	Velifer	3-13 fl. oz./100 gal.	S	GH
Burkholderia spp. Strain A396	Venerate CG	2-4 qt./100 gal.	S, D, F	GH, N
<i>Capsicum oleoresin</i> Extract, Garlic Oil, Soybean Oil	Captiva Prime	1-2 pints/100 gal.	s	GH, N
Chromobacterium subtsugae Strain PRAA4-1	Grandevo CG	1-3 lb./100 gal.	S, F	GH, N
Garlic Oil + Castor Oil	Allicurb Max	16-64 oz./100 gal.	S	GH, N, L
GS-omega/kappa-Hxtx-Hv1a	Spear-T	1-3 gal./100 gal.	S	GH, N
Horticultural Oils	Suffoil-X, TriTek, Ultra-Pure	1-2 gal./100 gal.	S	GH, N
Isaria fumosorosea Strain FE 9901	Isarid, NoFly	16 oz./100 gal.	S, D	GH, N, L
<i>Isaria fumosorosea</i> Apopka Strain 97	Ancora	14-28 oz./100 gal.	S, D, F	GH, N, L
Metarhizium brunneum Strain F52	Lalguard 52 OD	8-32 fl. oz./100 gal.	S, D, F	GH, N
Neem Oil (extract)	Triact 70	0.5-2 gal./100 gal.	S	GH, N, L
Peppermint Oil, Clove Oil and Sodium Lauryl Sulfate	EpiShield	9-12 fl. oz./100 gal.	s	GH, N, L
Pyrethrins	Evergreen Pro 60-6	2-12.6 fl. oz./acre	S, D	GH, L
Pyrethrins	PyGanic 5.0	16-32 fl. oz./100 gal.	S, D, F	GH, N
Pyrethrins	Pyrethrum TR	2 oz. can/ 1,500-3,000 sq. ft.	А	GH
Pyrethrins + Canola Oil	Pycana	1-2 gal./100 gal.	S, F	GH, N
Rosemary Oil + Clove Oil + Peppermint Oil	TetraCURB MAX	32-256 fl. oz./100 gal.	S	GH, N, L
Saccharopolyspora Spinosad	Conserve, Entrust	6-22 fl. oz./100 gal.	S, D, F	GH, N, L

Application Methods

- S = Spray
- D = Drench
- F = Fog
- A = Aerosol

Use Sites

GH = Greenhouse N = Nursery Production (Outside) L = Landscape

+ some ++ good

+++ very good



Aphids	Broad Mites	Caterpillars	Fungus Gnats	Mealybugs	Spider Mites	Thrips	Whiteflies
++		+++	++	+		+++	+++
+		++			++	++	++
			Larvae ++				
		++					
++			++	++		++	++
++		+	++	++	+	++	++
+				+	++	++	++
+		+++		+	+	+	+
		+			+	+	+
++	+	++			++	+	++
+	++	++			++	+	++
+	++				++	+	+
++				+	++	+	+
+		+	Larvae +++	+	Eggs	Pupa ++	Nymph +++
+		+	Larvae +++	+	Eggs	Pupa ++	Nymph +++
 +			++		+	++	+
++	+	++	++	++	+++	++	++
++	++			+	++	+	+
+++		++	++	++		++	++
+++		++	++	++		++	++
++		++	++	++		++	++
+++	+	++	Adults ++	++	++	+++	++
+++	+++			+++	+++	+++	+++
		+++			++	+++	

Information as of June 2025.

The exclusion of trade names other than those listed in the table above is not intentional and does not imply that products not listed are ineffective.

Aphidius wasps parasitized these aphids and left behind their mummies. Quality inputs and quality handling of the inputs heavily influence the week-over-week reliability of these.

The Impact of Logistics on BCA Product Quality

By Lowell Halvorson

TRANSPORTATION OF BCA PRODUCTS FROM INSECTARY TO FARM HAS A LARGE IMPACT ON PRODUCT QUALITY. rom the moment the vendor fills the bottle with beneficials to the moment the IPM manager uncorks the bottle at deployment, there's a chain of trust between vendor and customer, and overlap exists. To puzzle out issues of viability, vigor and efficacy it helps to understand how subtle glitches along the way impact pest control programs.

It's a game of darts, really. Landing the dart high by running up a big budget doesn't necessarily win the game, but hitting the board low by buying on the cheap doesn't mean effective pest control, either. Predictability is the bullseye – achieve results once and you're lucky; achieve results again and again and you're a champ.

Because some factors are vendordriven, choosing products becomes an exercise in picking a vendor. Although mix-and-match strategies do exist, beneficials aren't manufactured like nuts and bolts. These products are living organisms, so they're perishable; they pose many of the same logistical challenges as grapes and strawberries, for example.

Following are four key logistics points that affect the quality of any given BCA product inbound with examples. Questions for potential vendors are included to help buyers navigate some of the trickier logistics situations.

IS IT ALIVE?

Shrinkage (loss of inventory) occurs every day after the bottle is sealed. A little sliver of mortality slips away as the bottle loads into the crate and onto the

Left: A field consultant reviews a gerbera crop for the establishment of leaf minor parasitic wasps, one of the trickier BCAs to establish and work with. Vendors who deploy high-caliber knowledge in the greenhouse can solve problems that phone calls or chat messages cannot.

Below: Nematodes are often raised in large industrial tanks, similarly to how beer is fermented and brewed (with a similar smell, as well). High volume drives the cost per application down while driving up reliable delivery schedules and repeatable QC results.



because the more they test, the more they'll know and the better grip they'll

IS IT GOOD?

have on quality.

Ask about the sex ratio of the bottle fill – the answers are interesting. Males control pests for one short generation, then die. Females and their eggs control pests for several generations. Bottles dominated by females last longer than male-heavy bottles at the same price.

Bottle quality is nuance-y that way. Vigor, viability and efficacy goes beyond just boy bug/girl bug issues. Fecundity (how many they can lay in a day), vigor of the strain (how long a mite will live), shipping temperatures (how well they're paused for transportation), life stage shipped and many other details shape the caliber of the deployed BCA.

A vendor with a history of making good decisions out of sight is a vendor that

tends to ship dependable products, so ask a lot of questions. If solid details come back, this is a vendor that delivers a quality product and communicates key information, as well. Both are necessary.

IS IT RELIABLE?

Reliability extends into the client workflow as well, so the ability to share knowledge is important. Look for literature or training for standard procedures. For obscure and difficult areas, technical support is crucial to keeping integrated pest management (IPM) programs on track. On-site visits are especially useful for trapping and tracing unexpected results. A lot of information can be gathered at a glance, in person, that a phone call or email just cannot capture.

Some businesses have so much money at risk in crops they truly need testing and measurements extended inside **>**

dock, travels by plane or truck, shifts to common carrier, and drops in front of the door. Different steps have different mortality rates, but they're never zero.

Every change in handling causes a change in the mortality rate. A dramatic, tangible example is the leaf blower used for BCA deployment. Its appeal is in the power to deploy product at great distances. Its drawback is fearsome mortality. The shock of the muzzle velocity often rips the legs off the mites. Remember, this device is designed to clear plant debris, fast. Gentle is not in its nature. If 50% of the product is DOA upon landing, then staff needs to blow twice as much product to compensate.

An alternative is the blower gun designed for insect deployment. It uses a much lower muzzle velocity, akin to a stiff breeze, as it coats the tops of plants in a thin frosting of beneficials with a very low mortality rate of 5% to 8%. This change in handling results in maximum effect using minimal product.

Ask the vendor about handling and its impact on mortality, but especially ask about measurements. Do they measure products at the facility, at the dock, at the trans-shipment hub and at the common carrier? Do they test run shipments between their own locations? Acting as their own customer unveils issues. Do they test winter versus summer? These answers are important

Left: Inspection of microbiological inputs in a Brazilian QA/QC laboratory. A broad product range provides coverage over a range of solutions, but the development of future solutions is even better.

Below: A data logger is one of several measurement tools to reveal the truth underneath the logistics. This device travels with the shipment and records temperature and relative humidity over time, much like a black box on an airplane. Back in the lab, the QC team, shipping department or the support people can look for weakness in the cold chain – the dock, the plane, the truck, the last mile driver or the drop off.



IS IT FRESH?

Freshness sounds like a local supplier versus remote supplier question, but it's really about speed. The strawberries in the supermarket are fresh because they got there fast, not because they came from nearby. Think next-day grapes from Europe, next-day fish from Ecuador, next-day kiwis from New Zealand. Bugs work the same way. Sometimes local can be faster, but it's because they're good shippers, not because they're local shippers.

After top-notch shipping comes the scale of the operation. Size sheds details on the vendor's ability to buffer the delays of production, weather and orders. For example, if it rains in California, no one deploys BCAs

because it's wet. For a local supplier that ships only to California, this causes production to double up on the second week because the previous week didn't ship. To compensate, everyone gets a mix of old and new bugs – not so fresh.

A global supplier in Spain that feeds California among others will ship their production to Japan or Austria or places where the sun is shining. The next week, that Spanish facility will see twice as many California orders. All those shipments are fresh bugs because it's raining elsewhere. Whatever doesn't ship is disposed of because it's cheaper than storage. Everybody gets fresh all the time.

The key point is that the larger the business is the larger the volume and the easier logistics problems can be resolved.

A question to ask a vendor regarding this problem is the number of days in a week they routinely ship. Most growers only need one drop a week until a problem inevitably arises. Having those alternative ship days without scrambling is a great safety net. Only sizeable beneficial vendors can do this.

DROP IN FOR A VISIT

COPPERT

A broad product range implies a commitment by senior management. To go deep means the company has resources and commits those resources. After you build a working IPM program, you don't want the vendor backing out anytime soon. The broad range also implies a deep well of knowledge that can be tapped if new challenges appear.

Once all the vendor questions have been answered, it's also a good idea to request a tour of the facility. This may answer questions that were not even on the radar. Every piece of knowledge gleaned helps keep an IPM program right on target.

Lowell Halvorson is a consultant and writer in Fairfield, Connecticut, for retail and wholesale horticulture, specializing in business development. He also covers the breeding community for GrowerTalks magazine.









FOR MORE INFORMATION CONTACT GOWAN TURF AND ORNAMENTAL SALES KHESTER@GOWANCO.COM



Aza-Direct*, Badge* and M-Pede* are registered trademarks of Gowan Company, L.L.C. Captiva* and Eco ing" are registered trademarks used under license by Gowan Company, 1.1.C. Always read and follow label directions

Biofungicides Efficacy Table

Table 2: Examples of common biofungicides used in floriculture and nursery in the U.S. and their target diseases. (+ indicates some activity, +++ indicates high activity).

Active Ingredient or Organsim	Product	Use Rates	Application Methods	Use Sites	Alternaria	Bacteria	Botrytis	Cercospora
Streptomyces lydicus WYEC 108	Actinovate SP	3-12 oz./100 gal.	S, D	GH, N, L	+	+	+	
<i>Bacillus amyloliquefaciens</i> Strain MBI 600	Bacilirid	35 oz./100 gal.	S, D	GH			++	
Copper (Hydroxide/Oxychloride)	Badge X2	1.5-5 lbs./A	s	GH, N, L	+	+++		++
Ulocladium oudemansii Strain U3	BotryStop	2-4 lb./acre	s	GH, N		++	+++	
Bacillus subtilis Strain QST 713	Cease	2-8 qt./100 gal.	S, D	GH, N	+	++	+++	+++
Bacillus amyloliquefaciens ENV503 (Bacillus subtilis Strain GB03)	Companion	16-64 oz./100 gal.	S, D	GH, N, L		+		
Copper (Hydroxide)	CuPRO 5000	1.5-5.0 lb./acre	S	GH, N, L	++	+++	++	++
Swinglea glutinosa (extract)	EcoSwing	1.5-2 pt./100 gal.	S	GH, N, L	+		++	
Copper (Octanoate)	Grotto, Camelot O	0.5-2.0 gal./100 gal.	S	GH, N	+++	+++	++	++
Bacillus mycoides isolate J	LifeGard WG	4.5 oz./100 gal.	S	GH, N	+	+	++	++
Potassium salts of fatty acids	M-Pede	1% to 2% V/V Solution	S	GH, N, L				
Potassium Bicarbonate	MilStop SP	1.25-5.0 lb./100 gal.	S	GH, N, L	+	+	+++	+++
Streptomyces Strain K61	MycoStop	40 g/100 gal.	S, D	GH, N				
<i>Trichoderma asperellum</i> Strain ICC 012 <i>Trichoderma gamsii</i> Strain ICC 080	Obtego	2.5-7.5 oz./100 gal.	D	GH, N				
Thyme Oil	PathoCURB	64-128 fl.oz./gal.	s	GH, N, L		++	+++	
Gliocladium catenulatum Strain J1446	PreStop	0.1% to 1%	S, D	GH, N			++	
Reynoutria sachakinensis (extract)	Regalia CG	32-128 fl. oz./100 gal.	S, D	GH, N	+	++		+
<i>Trichoderma rifai</i> Strain T-22 <i>Trichoderma virens</i> Strain G-41	RootShield Plus WP	3-8 oz./100 gal.	D	GH, N, L			+	
Bacillus amyloiliquefaciens Strain F727	Stargus	0.5-4.0 qt./100 gal.	S, D	GH, N	++	++	++	+
Bacillus amyloiliquefaciens Strain FZB24	Taegro ECO	2.6-5.2 oz./100 gal.	S, D			+		
Extract of Neem Oil	Triact 70	0.5-2.0 gal./100 gal.	S	GH, N, L	+		++	+
Trichoderma harzianum Rifai strain T-22	Trianum P	8-16 oz./100 gal.	D	GH, N, L				
Bacillus amyloiliquefaciens Strain D747	Triathlon BA	0.5-6.0 qt./100 gal.	S, D	GH, N, L	++	+++	+++	++

Application Methods

- S = Spray
- D = Drench

F = Fog

A = Aerosol

GH = Greenhouse

Use Sites

- N = Nursery Production (Outside) L = Landscape
- + some

++ good +++ very good



Colletotrichum	Cylindrocladium	Downy Mildew	Fusarium	Phytophthora	Powdery Mildew	Pythium	Rhizoctonia	Rust	Sclerotinia	Sclerotium	Thielaviopsis
+	+	+	++	++	+	++	++	+			
++					++	++	++				
+		++						+			
									++		
+		+	+	+	++		+				
						+					
+	++				+		+				
+					+++			+++			
++	+	++						+			
		+				++			+		
					++						
+		+++			+++			++			
			+++	++		+++	+++				+
			+	++		+	++		+	+	+
		++			+++				+		
++					++						
		+			++						
	++		++	+++	+	+++	+++				
			+	+++		+	++		++		
			+		+++						
+					+++			+++			
	++					++	++		++	++	++
	+++	+	+		++	+	++	++		+	

Information as of June 2025.

The exclusion of trade names other than those listed in the table above is not intentional and does not imply that products not listed are ineffective.

Assessing Your Biological Workforce

STEP-BY-STEP BCA QUALITY CONTROL TESTS YOU CAN PERFORM IN-HOUSE.

aving worked in biological control for decades, certain questions seem to come up time and again. One of the most frequent – and important – is this: How do insectaries count the beneficials that go into the packages? Whether we're talking about insects, mites or even nematodes, how can a grower know that what's printed on the label is actually in the package when it arrives?

To some extent, we rely on trust – just as growers have long trusted the concentration of active ingredients listed on pesticide labels. But there's far more than blind faith involved. A surprising amount of research and trial and error goes into ensuring that not only the correct number of beneficials are shipped, but also that they're alive and viable upon arrival.

Insectaries have invested for decades refining these processes. Everything from packaging size to the size of ventilation holes to the moisture content of carrier materials is carefully studied and controlled. All of it is aimed at one goal: Making sure that beneficial organisms reach growers in top condition and in the quantities promised.

Author's Note: Of course, much of what happens inside insectaries is proprietary and understandably so. But through conversations with producers, especially Beneficial Insectary, I've been able to learn about some of the quality testing methods used behind the scenes. Coupled with resources like the "Grower Guide: Quality Assurance of Biocontrol Products" and the "IOBC Quality Control Guidelines for Natural Enemies," I've compiled some simplified, growerfriendly methods for checking counts and assessing the basic quality of commonly used beneficials. After all, trust is goodbut a little verification never hurts.

Before you begin quality control testing, it's essential to have both the right tools and the right environment. While many tools are easy to source online, chances are your facility already has some of what you need. A well-lit, no air movement, distraction-free workspace is essential. This type of work requires patience, attention to detail and a steady hand. Don't worry if things don't go perfectly the first time. Counting and assessing beneficials is a skill that takes practice to master. It's not for everyone – hyperfocus and visual acuity are key. That's why identifying employees with the right temperament and skill set can make all the difference.

Once you've completed your quality control tests, contact your supplier immediately if you have concerns about low emergence or unexpected counts. Suppliers should be able to provide expected emergence percentages specific to the beneficial species in question. For predatory mites, the actual number present should closely match what's stated on the packaging.

It's not necessary to test every shipment. However, you may want to perform spot checks under certain conditions – such as when a biological control program isn't performing as expected, when shipments are delayed, or when products arrive and the temperature in the package is too hot or cold.

These organisms are your biological workforce, and like any good manager, you want to ensure your team shows up, is in good shape and is ready to get to work. These tests can help with that process. While not all commercially available beneficials are covered here, the ones included are among the most used. If you're interested in testing methods for other beneficials, ask your supplier.

After all, biological control isn't just about releasing bugs – it's about managing a living, dynamic system. And that starts with learning, asking questions and sometimes doing a little counting of your own. By Suzanne Wainwright-Evans



Tip for counting *Phytoseiulus persimilis*: Place sample in a folded sheet of paper to create a valley. The mites will naturally run uphill, allowing you to count them as they exit. A mechanical tally counter (silver item on the left) helps keep track.

ASSESSING PREDATORY MITES (SUCH AS PHYTOSEIULUS PERSIMILIS AND AMBLYSEIUS SWIRSKII)

Predatory mites are among the most widely used beneficials in commercial greenhouse and field production with around 10 species currently available in the U.S. market. While diverse in habitat and prey preference, the basic counting methods for these mites are quite similar.

Unfortunately, assessing true product quality is challenging for growers beyond some basic checks upon arrival – such as observing activity. In many cases, quality issues only become apparent after application, often when a biocontrol program doesn't perform as expected.

However, it's important not to jump to conclusions. A failed biological control program is not always a result of poor-quality beneficials. In fact, the leading cause of failure in biocontrol programs is pesticide residues – particularly those with sublethal repellence quality or those that effect egg laying of the beneficials.

No Matter the Crop or Situation Dramm has You Covered

Apply Biopesticides, Insecticides, Fungicides, Disinfectants. Spray, Foam, Fog, Drench.



Over 50 ways to spray and a team of experts to help you make the most of your pesticide and biopesticide applications.

Call Dramm to help improve your pest management program.

DRAMM Integrated Plant Health

information@dramm.com www.dramm.com 920.684.0227



Want help? Download our Whitepaper.

PREDATORY MITES (BOTTLE OR BAG)

As with most things in life, there's more than one way to count predatory mites. The two most common methods are:

- By volume counting the number of mites in a known volume of carrier
- By weight counting the number of mites in a known weight of carrier

The volume method tends to be simpler. Scoop out a measured amount (like 1 mL), spread it onto a white tray and count the mites using a hand lens. However, accuracy can be compromised if the carrier has settled or become "fluffed up" during remixing meaning your 1-mL scoop might not be consistent from one sample to the next.

In contrast, using weight can offer greater consistency. By weighing your sample, you reduce variability caused by carrier density. Of course this method requires a precision scale and a bit more setup, but the results are more reliable especially if you're trying to compare batches or track trends over time.



Using a bright light improves visibility for counting mites, and if the lamp gives off warmth, it can encourage mites to move out of the sample, making them easier to spot. To keep track of which mites you've already counted, simply squish each one with a pencil eraser after counting.

SUPPLY LIST:

- 1 mL measuring spoon (or known volume small spoon)
- 5L container (or bigger) or 5-gallon bucket
- □ Tally counter
- White plastic tray (optionally ringed with soap to prevent escape)
- Stereoscope or magnifying visor
- Precision scale
- Desk lamp for heat/ light stimulus (optional)

METHOD—STEP BY STEP:

- 1. Note date on product and batch/lot number.
- 2. Weigh the full container using a precision scale to establish the total weight of the product. Be sure to tare the weight of the packaging so you're just weighing the carrier and beneficials.
- 3. Thoroughly mix the product to distribute mites evenly.
 - a. Pour into a 5-gallon bucket to gently rotate.
 - b. Alternatively, pour the product back and forth between two containers at least 10 times.
- 4. Immediately take a sample.
 - a. Weigh the sample before counting to ensure consistency across replicates. (Do not include weight of measuring spoon.)
- 5. Transfer the sample to a white tray.
 - a. Optionally, use a thin ring of dish soap along the tray's inner edge to prevent mites from escaping.
 - b. Shining a lamp down on the tray may encourage mites to move, making them easier to spot.
- **6.** As mites walk out, squash and count each individual using a tally counter. Wearing a magnifying visor can be very useful.
- **7.** Repeat the process three times, taking and counting a total of three separate samples.
- 8. Enter numbers into formula (below).
- 9. Repeat the test three times per package.

FORMULA 1:

Total Live Mites in Package =

Total Weight of Product Weight of Sample

x Live Mites Counted

PREDATORY MITES (SACHETS)

Tracking mite emergence from sachets helps verify product quality and lifespan. Use this simple method to count how many mites are released and know when it's time to replace them. For the most accurate results, test at least three sachets.

SUPPLY LIST:

- Sachets (unopened or altered)
- Binder clips
- Yellow sticky cards
- □ Stereoscope or magnifying visor

METHOD—STEP BY STEP:

- 1. Note date on product and batch/lot number.
- **2.** Mounting for monitoring.
 - a. Date yellow sticky card.
 - Place sticky cards in binder clip, then stick flat part of clip to middle of the sticky card.
 - c. Position the sachet vertically so mites can walk out naturally onto the card.
- **3.** Place the sachet/sticky card assembly in a shady location within the greenhouse that closely matches the crop's microclimate where sachets would be used. Note: Do not test in air-conditioned offices.
- **4.** Monitor mite emergence.
 - a. Once per week remove binder clip with sachet from card. Use a stereoscope or magnifying visor to count and record the number of emerged predatory mites and feeder mites (if applicable) stuck to the card.
 - b. Predatory mites that come in slowrelease sachets are typically creamy, with a shiny appearance and a distinct teardrop-shaped body. In contrast, feeder mites (such as *Tyrophagus spp.* or bran mites) are more translucent

or off-white, have dense body hairs (setae) and darker, more prominent mouthparts.

- 5. Repeat weekly.
 - a. Get new sticky cards, date and attach the same sachet to the new card.
 - Repeat this weekly until no new mites are observed emerging from the sachet.

By counting the number of predatory mites captured on the sticky card each week and totaling them, you can determine how many mites emerged over the lifespan of the sachet. In the first week, you'll notice a low number of predatory mites emerging from the slowrelease sachets. However, each consecutive week will see an increase in the number of mites, followed by a decline as the release slows down. The mites emerge following a characteristic release curve.

This test will let you know when mite emergence has stopped, allowing you to gauge how frequently sachets need to be replaced under your specific environmental conditions. While most sachets typically last four to six weeks, their longevity can vary depending on the brand and factors like temperature and humidity.



Here is a sample log for the sticky card test:

Sachet Mite Emergence Log

Sachet ID	Date Deployed	Week #	Date of Count	# Predatory Mites	# Feeder Mites	CommentsObservations
		1				
		2				
		3				
		4				
		5				
		Final				

Pictured left: To test mite emergence from the sachets, place them on sticky cards and count the mites weekly.

ASSESSING PARASITOIDS SUCH AS APHIDIUS SPP., ENCARSIA FORMOSA AND ERETMOCERUS EREMICUS

There are a few ways to assess parasitoid quality, but for simplicity, we'll focus on two key indicators: emergence success and flight capability. These factors are essential for ensuring your biological control agents are both alive and can fly.

It's important to note that this first is a destructive sampling method - the parasitoids used in the test will not survive. However, by sampling a small, representative amount, you can still gather meaningful data without significantly impacting your program.

(Note: Use three test containers for each lot.)

SUPPLY LIST:

- 1 mL measuring spoon (or known volume small spoon)
- 32 oz. ventilated sample container (Large Chinese takeout soup
- Yellow sticky cards

container)

- Tally counter
- Stereoscope
- Fluon (insect barrier coating)

METHOD—STEP BY STEP:

- 1. Make ventilated container.
 - a. Best if ringed with Fluon. This prevents the beneficials from walking up to the sticky card. We want to count flying parasitoids.
- 2. Label the container date and batch/lot number.
- 3. Tips for taking sample:
 - a. For loose product: Thoroughly mix bottle of beneficials by rolling (if in carrier, as different companies have different packaging). Use spoon and take out known volume and place in bottom of container.
 - b. For cards: Place card in bottom of container with parasitoids up.
- 4. Add sticky card.
 - a. See directions for making a ventilated container below.
- 5. Wait 14 days.
 - a. Maintain containers at room temperature with 70% to 90% humidity.
 - b. Keep samples undisturbed for at least 14 days to allow full emergence.
- 6. Count the number of wasps on the sticky card.
 - a. For assessing parasitoids on a card, you can ask your supplier the expected emergence rate and then compare it to the number of parasitoids that were collected.
 - b. With loose product, use the formula below to calculate percent emergence.

FORMULA	2:				
CARDS	Emergence (%) =		LOOSE	Total Parasitoids in Product	=
[Total Parasitoids Counted on Sticky Card Total Number Expected) x 100		Total Weight of Product Weight of Sample	x Parasitoids on Card



SUPPLY LIST: П

with lid Insect screening (fine mesh)

Approximately

32 oz. plastic

container

- Utility knife
- Hot glue or strong tape

How to make a ventilated container for parasotoid test.

- 1. Use a utility knife to cut large rectangular windows into the sides of the plastic container - one on each side. These will serve as ventilation points.
- Cut pieces of insect screening slightly larger than 2. each cut-out window.
- 3. Secure the screen over each window using glue or strong tape. Tape from the inside of the container to avoid edges where small insects might get trapped.
- 4. Trim a yellow sticky card to fit snugly inside the container lid. Peel the protective layer off one side only, so the sticky surface faces downward into the container. Use double sided sticky tape to secure it to the lid.

Beneficial Insectary

PROVIDING A NATURAL BALANCE IN PEST MANAGEMENT

BIOLOGICAL SOLUTIONS FOR:

- ✓ Mites
- Thrips
- Aphids
- Whiteflies
- Mealybugs

& More!



ABOUT US

- 🗸 Based in Redding, CA
- U.S. Production for 35 years
- Expert Technical Support
- Top-Rated Customer Support
- Same Week Shipping for Most
 Products

CONTACT US (530) 226-6300 | 1-800-477-3715 www.Insectary.com



Before applying beneficial nematodes. it's critical to verify that they've been stored properly-ideally around 41°F (5C). Exposure to fluctuating temperatures (especially warming followed by cooling) can significantly reduce viability.

While counting the exact number of nematodes in a package is impractical for most growers, you can assess whether they're alive and active with a simple quality check. Repeat this test three times.

SUPPLY LIST:

- П Beneficial nematodes
- Clean, room-temperature wate
- Petri dish or small white tray
- П Hand lens (10x or greater) or dissecting microscope

METHOD—STEP BY STEP:

- 1. Note lot number and expiration date.
- 2. Remove nematodes from the refrigerator and allow them to gradually reach room temperature.
 - a. Tip: Sudden temperature shifts can shock nematodes let them acclimate slowly.
- 3. Take a small sample (about the size of a pen tip or grain of rice) and place it into a petri dish or shallow tray.
- 4. Add a few drops of room-temperature water to the sample. Wait two to three minutes for them to become active.
- 5. View the sample using a hand lens or dissecting microscope. If you're having trouble seeing them, use a black background.
- 6. Assess activity:
 - a. Live nematodes will display a slight bend or wriggle, moving in a characteristic "snake-like" motion.
 - b. Dead nematodes appear rigid and straight, often resembling tiny arrows.
- 7. Expect to see a few dead nematodes that's normal but the majority should be active. If most are immobile and straight, the batch may be compromised.

Even if your nematodes are confirmed viable before application, it's a good idea to verify they're surviving application equipment. One method is to clean and reuse the plastic shipping trays to catch some nematode spray from application in the greenhouse. Inspect the water in the tray using a hand lens or dissecting microscope – looking for live nematodes exhibiting characteristic "swimming" or serpentine motion.

BCA STORAGE CHART (* FOR EMERGENCY USE ONLY!)

This chart provides general guidelines for short-term storage of common beneficials. *THIS IS NOT RECOMMENDED AS STANDARD PRACTICE, THESE STORAGE INSTRUCTIONS ARE INTENDED ONLY FOR EMERGENCY - NOT ROUTINE HANDLING.

Beneficial	Ideal Storage	Notes
	Note: Try to keep humidity above 60%.	
Amblyseius swirskii	60-68F (15-20C)	Store bottles on side
Aphidius spp. (parasitoids)	42–50F (5-10C)	Can also be kept at room temperature if not hatching
Chrysoperla spp. (larvae & eggs)	42–50F (5-10C)	Larvae can be cannibalistic if not kept cool
Encarsia formosa	42–50F (5-10C)	Can also be kept at room temperature if not hatching
Eretmocerus eremicus	42–50F (5-10C)	Can also be kept at room temperature if not hatching
Dalotia coriaria	50–60F (10-15C)	Open shipping box upon arrival; Can be stored at room temperature
Neoseiulus californicus	44–50F (6-10C)	Store bottles on side
Neoseiulus cucumeris	44–50F (6-10C)	Store bottles on side
Phytoseiulus persimilis	42–50F (5-10C)	Very sensitive to cold; Apply ASAP; Store bottles on side
Orius insidiosus	42–50F (5-10C)	Release as soon as possible
Nematodes, beneficial	39–42F (3-5C)	Do not freeze
Stratiolaelaps scimitus	50–60F (10-15C)	Open shipping box upon arrival; Can be stored at room temperature
Sachets, predatory mites	Room temperature	Open box upon arrival; Store in shaded area in greenhouse; Do not keep in AC

Includes information from the BioWorks Biological Control Agents (BCAs): Optimum Temperatures table.



Mycorrhizae for Growers

MycoApply[®] Mycorrhizal Fungi are fascinating microbes that form a symbiotic relationship with plant roots. They seek out water, nutrients, and other resources that would otherwise be unavailable or difficult for the plant to access.

MycoApply[®] has many benefits for operations that grow or finish plants - from seed, cutting, plug, or bare root.



Improves nutrient-use efficiency



Increases transplant survival rates and establishment rates



Increases water absorption and drought resistance



Optimizes plant performance



Decreases susceptibility to transportation stress



Scan the QR code to search for your plant's mycorrhizal types



TREATED WITH MYCOAPPLY®

Learn more and find a distributor at www.mycorrhizae.com



MycoApply[®] is a registered trademark of Mycorrhizal Applications, LLC.

710 NW E Street, Grants Pass, OR 97526 (866) 476-7800 | mycorrhizae.com

In Conclusion

Rather than viewing this conclusion of the third edition of the *GrowerTalks* Biosolutions Guide as an ending, I view it more as a continuation of my biosolutions journey. Resources such as this one have proven invaluable to me as I've evolved my approaches with managing pests and diseases over the past three decades.

Like previous editions, the experts featured in this guide did an excellent job sharing perspectives and expertise in a meaningful manner – and I'm very appreciative our industry is blessed with passionate people who are willing to share their knowledge so others can benefit. With that, I'd like to thank each of the past and present Biosolutions Guide contributors, the Ball Publishing staff and, most importantly, I'd like to thank *you* (our loyal readers) for making this guide possible.

Each of you made it to this final page because of your interest in and/ or commitment to using biological control agents, bioinsecticides and biofungicides to better manage many of the pests and diseases you commonly face in your production systems. If you're anything like me, I suspect there were at least a couple of key take-home messages in each of the articles in this invaluable resource. Our biosolutions journeys differ and each of us will likely home in on slightly different details as we read and decipher the information these experts shared. Here's a few of the highlights I picked up on:

Suzanne Wainwright-Evans (Buglady Consulting) emphasized the importance of performing quality-control inspections prior to applying biological control agents (aka the good bugs). It really hit home to me when Suzanne said, "These organisms are your biological workforce, and like any good manager, you want to ensure your team shows up, is in good shape and is ready to get to work." She then continued with, "After all, biological control isn't just about releasing bugs – it's about managing a living, dynamic system. And that starts with learning, asking questions, and sometimes, doing a little counting of your own." I couldn't agree with her more.

I really appreciated Jeremy Webber's (Koppert) approach as he addressed how many growers are successfully using a hybrid approach when it comes to using beneficial insects combined with pesticides for controlling various pests. He emphasized, "There are no one-size-fits-all solution and your best approach will be something that's unique to you and your operation."

Michael Brownbridge (BioWorks, Inc.) really packed tons of useful information into his article focusing on how growers can transition to more biologically based approaches to manage pests and diseases. Michael spent some time dispelling myths surrounding the use of biological products, provided reasons growers should use them and gave useful information on how to develop a biological program, including a detailed planning checklist.

And last, but certainly not least, freelance contributor Lowell Halvorson discussed several considerations regarding the key logistical points that affect the quality of any given BCA product. Like the other experts, Lowell provided lots of great information in his article. I took home several useful nuggets of information, but the one that hit home with me the most is when he mentioned how leaf blowers are used for BCA deployment and the muzzle velocity of the blower often rips the legs off the beneficial mites. A tool many of us have used for years to effectively disperse BCAs may have been making these applications less effective.

I obviously can't summarize all the great content each of these experts shared in this guide on this final page, but the good news is you can easily flip back and reread them whenever you need to.



As you're likely already aware, there are a few nuances with using biological approaches, and as our contributors shared, there are many considerations regarding logistics, quality control, formulating management plans and developing hybrid approaches. I'd like to thank them for sharing some of their knowledge and ideas with us in this guide.

I'm hopeful you found this information useful and inspiring. Please return to this guide, as well as the first two editions, as you navigate through your biosolutions journey.

GrowerTalks is committed to being the leader when it comes to providing biosolutions content to the industry. To help them with these endeavors, I encourage subscribers to let them know what types of content you're looking for, and researchers and manufacturers to pass along efficacy data, research results and new products. Please share your comments and any information you'd like to share with Senior Editor Bill Calkins at bcalkins@ballhort.com.

Paul Pile

PAUL PILON Director of Growing – Opel Growers, Hudsonville, Michigan Editor-at-Large – Perennial Pulse e-newsletter





Gord 229 BotoniGord ES

0 II Y D

BotaniGard® Mycoinsecticide offers proven, broadspectrum control of a variety of pests in the GH, nursery, and CEA markets. Long recognized as the best-in-class mycoinsecticide in horticulture, BotaniGard is the latest addition to the OHP family of Solutions.

Ask for BotaniGard, the Natural Selection.





Hopper holds up to 3L of product

Rotates to keep product blended through the application

> Comfortable shoulder strap for long term use

Control blower speed and flow rate from the hopper

naturec

Wide grip for easy handling Mortality rates lower than 2%

Rechargable battery for up to two hours of use



Koppert

Natutec Airobreez from Koppert

next generation BCA blower gun

BUILT FOR THE JOB, the Natutec Airobreez delivers highly efficient distribution rates by fine-tuning the technology. BCAs are deployed with an easy-to-use blower gun.

Despite its strength, the Airobreez handles like a video game. Precise motor controls ensure delivery of beneficials to exactly where they are needed in volume or in detail.

Engineered to cut waste, the Airbreez delivers an even layer of predators right where it counts.

From loading to carrying to storage, the Airobreez has a tight focus on doing its job well.



Contact Koppert for more information on the Natutec Airobreez.