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BIOCONTROLS SPECIAL REPORT

NEW APPROACHES TO BIOCONTROL

The Benefits of Biostimulants

p. 6

Bio-Brews: A
Grower Case Study p. 4

Managing Stink Bug,
SWD, and More p. 10

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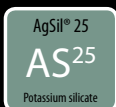
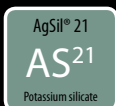
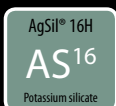
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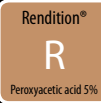


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Biocontrol has become a familiar crop protection tool. Today's growers are expanding their understanding of the ins and outs of using biopesticides, biochemicals, microbials, and beneficials in fruit, vegetable, and ornamental production. But new technologies, new applications, and even new crops to use them on are getting attention as we head into the 2017 season.

In this special report, we're taking a look at a few of these new biocontrol topics you should know, from the perspective of presenters at the upcoming **Biocontrols USA West 2017 Conference & Expo, March 2-3 in Reno, NV**. There is still time to register now at **BiocontrolsConference.com** for an in-depth education on these topics and many more that will deliver real-world biocontrol applications for your fields, orchards, vineyards, or greenhouses.

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Rethinking Biocontrol With Bio-Brews

Bio-brews can be applied topically to crops or injected into the irrigation water with a metering pump by flow on a constant basis.

With all the biocontrol tools for combatting pests and diseases at growers' disposal, sometimes the unconventional methods, like using bio-brews, get the best results.

Janeen Wright, Managing Editor, Greenhouse Grower

TOM Costamagna, Director of Growing at American Color, an ornamental crops producer in Orange, VA, is anything but orthodox in his approach to pest and disease control, yet he gets results. With more than a decade of experience with biocontrols and biopesticides to back him up, he prefers to complement what growers are already doing — spraying. He's just changing what they are applying.

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Costamagna focuses on microbials and entomopathogenic fungi. He uses bio-brews, which are mixtures of regenerative microorganisms (also known as efficient microorganisms or EM) that occur freely in nature.

A bio-brew is not a pesticide, but rather a biostimulant, which activates the natural processes of plants, benefiting nutrient use efficiency and/or tolerance to abiotic stress. Biostimulants are not fertilizers or pesticides, as they work regardless of nutrient content in products and do not have any direct actions against pests or diseases. Instead, they act on the plants' vigor, rounding out crop nutrition and crop protection by working in synergy with them.

INUNDATIVE CONTROL: A NEW APPROACH

New Approaches to Biocontrol

Table of Contents

3 Rethinking Biocontrol with Bio-Brews

6 Biostimulants are Quickly Gaining Traction

10 Key Pests: Bringing Biocontrol to Bear

14 Cannabis and Biocontrol Options



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Rethinking Biocontrol With Bio-Brews

With all the biocontrol tools for combatting pests and diseases at growers' disposal, sometimes the unconventional methods, like using bio-brews, get the best results.

By **Janeen Wright**, Managing Editor, *Greenhouse Grower*

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INUNDATIVE CONTROL: A NEW APPROACH

Costamagna prefers to think of using bio-brews as an inundative or full immersion approach, which he takes due to plant purchasers with little to no tolerance for the presence of pests and the damage they cause.

To achieve inundative control, Costamagna says he recommends cal-

New Approaches to Biocontrol

TABLE OF CONTENTS

- 3 Rethinking Biocontrol with Bio-Brews
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- 10 Key Pests: Bringing Biocontrol to Bear
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At American Color, growers use 30 sticky cards per acre in conjunction with pheromone lures (Alpha Scents for thrips) to monitor pest populations, and they rogue plants thoroughly for trapped pests.

endar spraying to provide ample CFUs (colony forming units) of biocontrol/biopesticide agents like nematodes and entomopathogenic fungi or bacteria. Regular applications of bio-brews must start at the plug and liner stage and continue through shipping to ensure pest populations are low to nonexistent.

Cost effective bio-brews work well for calendar spraying and have a longer shelf life than other beneficials. With the industry's zero-tolerance view toward pests, Costamagna says taking an inundative approach to prevent crop damage makes more economic sense than treating problems you don't have with expensive chemistries.

Costamagna got the chance to tackle just such an issue in his role as Director of Plant Quality with a previous employer, Mid-American Growers in Granville, IL, now part of Color Point.

Under Costamagna's direction, the operation's growers applied bio-brews topically to plants once a week and injected them into the irrigation water. They also made additional applications when needed based on scouting intel. This routine continued throughout the year, no matter what crops they were growing, because the bio-brews were safe enough to spray on full, open bracts without any phytotoxicity.

Costamagna jokes that it wasn't long before chemical companies were asking why Mid-American Growers wasn't doing as much business with them.

"The business didn't go anywhere, we just changed our prac-

PEST MONITORING SCOUTING SCALE

0	= PEST NOT DETECTABLE (effective control measures in place)
1	= VERY LOW POPULATION < Less than 5 (additional control measures may be required)
2	= LOW POPULATION < Less than 10 (formulate additional effective control measures)
3	= MEDIUM SIZE < Less than 20 (use EMERGENCY RESCUE LIST for effective control measures)
4	= HIGH POPULATION > Greater than 20 (effective control measures will require 2x/wk spray)
5	= VERY HIGH POPULATION = NOT TOLERATED (problems should'nt reach this magnitude)

NOTE: The scale is to be based on yellow sticky cards (YSC) placed in a crop and read no less than every 24 hours. Additionally, roguing plants, monitoring root health, etc. is required during routine monitoring.

tices," he says. "That year we saved thousands of dollars in chemicals because we were no longer taking an aspirin for a headache we didn't have."

SCOUTING INDISPENSABLE TO BIO-BREW SUCCESS

Costamagna has since implemented bio-brew applications, coupled with a strong scouting program, in his current role at American Color with the same positive results.

A scouting program is critical to the success of a bio-brew program, Costamagna says, because growers need to have a good idea of where pest populations are trending (detectable, increasing, or decreasing). In addition to bio-brews and other pest and disease control measures, there are times when they must make the shift to using conventional tools (e.g., synthetic pesticides).

"At the end of the day, we need to produce quality plants," Costamagna says. "When making this transition, we must choose wisely, assessing the risk and considering compatibility and that a knee-jerk reaction is not made qualitatively, but quantitatively,

HERE'S WHY YOU'LL WANT TO ATTEND TOM COSTAMAGNA'S PRESENTATION AT THE 2017 BIOCONTROLS CONFERENCE

Tom Costamagna, Director of Growing at American Color in Orange, VA, worked for 10 years in the Department of Entomology at University of California, Davis (UC Davis) with Dr. Michael Parrella, one of the key researchers early on studying the implementation of biocontrol and biopesticide use in floriculture. After graduating with a bachelor's degree in Environmental Horticulture and Landscape Architecture, Costamagna worked as Senior Superintendent of Agriculture for UC Davis, where he continued to run Dr. Parrella's research programs in developing applied pest control strategies in commercial greenhouse production to ultimately lead to a reduction in pesticide

use by the environmental horticulture industry.

After leaving UC Davis, Costamagna worked for a year at Aldershot Greenhouses in Las Cruces, NM, before taking a position as Director of Plant Quality for Mid-American Growers in Granville, IL, which is now part of Color Point. Here he developed a bio-brew microbial spraying program as part of his integrated pest management strategy.

Costamagna served as the National Production Manager for Dümmer Orange upon leaving Mid-American Growers. He took up his current position at American Color in 2016.



Tom Costamagna

which is the result of a good scouting program.”

Although American Color internally produces its bio-brews, Costamagna says a majority of the products applied are available commercially. And for those worried about the complexity of implementing such a program, they shouldn't be.

“The biggest thing growers need to realize is that they are not alone in going down this path,” Costamagna says. “There are companies and consultants out there that do not manufacture a commercial product and have the best interest of growers in mind. They are all about solutions that make economic sense and result in the desired control growers need.” ■

BIO-BREWS AT AMERICAN COLOR

The bio-brews Tom Costamagna, Director of Growing at American Color in Orange, VA, uses are unique formulas developed for specific insect and disease targets. They incorporate a number of essential oils, ETOH (200-proof ethyl alcohol), and apple cider vinegar, which kills the active microorganisms while preserving each blend and leaving behind specific metabolites and enzymes. Apple cider aids in the preservation of the product while helping to break the cuticle of insects/mites, allowing the metabolites and enzymes to penetrate and kill. The essential oils in each blend cover the targeted organism to kill it by suffocation and leave a slight film on the leaf that gives the plant a sheen or luster. The blends of oils also agitate and excite the targeted insects and mites while having repellency, anti-feeding, and anti-oviposition properties.

Costamagna incorporates bio-brews into the irrigation water at American Color. He says he purchases latent inoculum of EM-1 from TeraGanix so he has consistency from batch to batch. It is used to make AEM (Activated Effective Microorganisms), which are sold ready to use as AG1000. This is primarily used in growing media but can also be sprayed.



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Biostimulants are Quickly Gaining Traction

This sector is catching the attention of both growers and investors as more is learned about the benefits for agriculture.

“It is important that growers understand how these products augment what they already are doing, from an agronomic and an economic standpoint,”

— DAVID LANCIAULT, Agricen Sciences



By Frank Giles, Editor, Florida Grower
frgiles@meistermedia.com

A LOT OF MONEY is being poured into biological ag products. Analysts put the industry’s value at more than \$3 billion globally. The industry includes soil microbes, biofertilizers, and biopesticides, all the way to beneficial insects. Within the next five years, the biological sector will grow to nearly \$6 billion.

With a large amount of venture capital being invested in the sector, a lot of products and technologies are coming onto the market. That’s creating confusion among growers sorting out what’s what in the biological arena.

Biostimulants in particular are gaining traction. David Lanciault, President and CEO of Agricen Sciences, says research and application in the field shows a promising future for biostimulants.

He adds the first order of business is demonstrating where they fit in within the broader biological sector.

That can be a little tricky when industry, the states, USDA, and EPA have not yet defined what biostimulants are.

“In the current regulatory environment, there is no agreed-upon defined legal term for biostimulants,” Lanciault says. “While we have an industry association (Biostimulant-Coalition.com) and companies all over the world that are commercializing products and participating in technical conferences, it is still a term that lacks clarity and acceptance on where it fits within the regulatory environment. Industry is moving quickly on innovation, and is perhaps a bit ahead of the curve as we work with regulators to build alignment.”

The Biostimulant Coalition in consultation with the Association of

American Plant Food Control Officials have agreed that the defined term “beneficial substances,” may be a useful umbrella under which many biostimulants could seek their own definitions. For example, a specific fulvic acid definition could be developed that might be placed under the beneficial substances category. Beneficial substances means any substance or compound other than primary, secondary, and micro-plant nutrients that can be demonstrated by scientific research to be beneficial to one or more species of plants, when applied.

Lanciault says broadly speaking, biostimulants do three things. First, they help improve nutrient-use efficiency. Second, biostimulants may help plants tolerate abiotic stresses like heat, cold, drought, and too much water. Third, they may help to improve quality attributes like nutritional content, appearance, and shelflife.

Continued on page 8



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TYPES OF BIOSTIMULANTS

While the regulatory definition gets sorted out, Lanciault says growers should think of biostimulants in the larger categories various products fall into.

“When you look at biostimulants, it gets very broad,” he says. “There are probably 30 or 40 different classifications or products you could rattle off, but it is probably easiest to aggregate those into four big segments.”

The first and largest segment is the “acids,” including humic, fulvic, and other organic acids; as well as amino acids, among others. The second segment is “extracts” and includes items like seaweed (or kelp) extracts, plant extracts or botanical oils, and other organic matter extracts. The third category is “microbials” and is very diverse. It includes things like soil fungi and bacteria that help to improve nutrient cycling or availability in the soil; or aid a plant’s ability to uptake and use nutrients. The fourth category is “other,” which includes a mix of materials such as proteins, chemical salts, vitamins, and elements such as silicon. The category also could include small molecules or metabolites derived from organic sources.

RESEARCH YOUR OPTIONS

With the biostimulant industry being so diverse and growing

so quickly, Lanciault suggests growers do their homework on the products available to them.

“It is important to learn whether or not the product has been validated by an appropriate source like Extension, crop consultants, or other qualified agronomists,” he says. “Make sure this validation was applied research, and not just what may work in a lab. Investigate the track record of the company and the products they are making claims about. There are so many of these products coming to market, it is easy to get caught up in the hype or get confused about what they can do.”

He says most universities are studying these tools, so they are a good starting point to learn more about biostimulants. The companies involved in the industry also are investing in their own research and trials, very often with third-party validators, to learn more about how these materials work. Technology providers are striving to develop products that fit seamlessly into growers’ existing production practices and can be shown to give a provable return on investment by improving nutrient uptake, plant health, yield, and quality.

“It is very important that growers understand how these products augment what they already are doing from not only an agronomic standpoint, but also from an economic standpoint,” Lanciault says. ■



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Bringing Biocontrol To Bear

Researchers are working on management programs for some of your most challenging insect pest problems. Here's where we're headed.

From significant new problems such as brown marmorated stink bug and spotted wing drosophila to a familiar foe like whitefly, researchers are working hard on control measures for key insect pests in fruit, vegetable, and greenhouse crops. We asked three of the presenters from the upcoming Biocontrols USA West 2017 Conference & Expo to provide an update on the development of management strategies for these pests and where they see biocontrol fitting in the process.

■ BROWN MARMORATED STINK BUG

By Nik Wiman, Extension Orchard Specialist, Oregon State University

Brown marmorated stink bug (BMSB) is a highly mobile pest, and adult bugs move in and out of orchards from borders or more distant areas. It also is very good at sensing movement and hiding, and so can be difficult to scout. As a result, growers are often surprised by the damage when they have never seen BMSB attacking the crop. The obvious challenge once the insect is present at economic threshold levels is to manage it successfully. Insecticide programs are intense and there are few indigenous natural enemies to check the BMSB populations. As a result, the integrated pest management (IPM) system is difficult to maintain once BMSB management is necessary and secondary pests may begin to increase.

Management Recommendations:

Keep tabs on overwintering populations. If BMSB are aggregating on buildings in or around the farm in late summer and into the fall, this is a sure sign there is a local infestation that could threaten crops. Monitor using pheromone traps.

Although the traps are not as effective in the early season as they are in late season, they can still aid in detection. Trap thresholds will help growers decide when management is needed. Alternate-row-middle insecticide applications can prove effective for BMSB management while minimizing costs and risks of secondary pests.

The Biocontrol Angle:

Trissolcus japonicus is a key parasitoid of BMSB over its native range in Asia, attacking egg masses. This tiny wasp (1-2 mm) traveled overseas, likely on a cargo ship, and has now been found in the mid-Atlantic, and more recently in Oregon and Washington. In Oregon, we are making efforts to redistribute the wasp around the state after finding it and rearing it in 2016.

■ WHITEFLY

By Tim Engelke, R&D Entomology USA, Koppert

Whitefly, particularly when noticed too late in the crop, can quickly grow to large population numbers. In protected crops — an artificial environment, in addition to growing monocultures and thus one ideal food source — natural enemies are missing and the indoor climate provides highly favorable conditions for whitefly development. Aside from shown resistances, hardly any product has 100% efficacy, partly because good spray coverage is a challenge.

Management Recommendations:

1. Monitoring, monitoring, monitoring. Take a proactive approach. Good management follows an operating procedure built on monitored thresholds.
2. Preventive (or very early curative) introduction of beneficial insects/mites.



BROWN MARMORATED STINK BUG



SPOTTED WING DROSOPHILA



WHITEFLY

Their eyes and noses are better than ours.

3. Proactive hotspot treatment with an integrated approach of beneficial insects/mites and (bio)pesticides.

The Biocontrol Angle:

Scouting/monitoring apps will help with monitoring in general, but this also helps toward a more precision ag approach. Entomophagous fungi are continuously being developed. New effective species or strains are being discovered and tested. Especially in IPM programs, more availability of biofungicides keeps the program alive. Biostimulants can promote plant vigor from belowground, which reduces vulnerability in that the plant

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KEY PESTS

immune system is being boosted. Lastly, yellow sticky tape should be mentioned. It's an oldie, but not used too much, although it's very effective.

■ SPOTTED WING DROSOPHILA

By Cherre S. Bezerra Da Silva, Research Associate, Oregon State University

Spotted wing drosophila (SWD) has a short developmental cycle, a wide range of hosts, high biotic potential, and tolerance to heat and cold. This allows high population levels to be quickly achieved and to tolerate extreme weather conditions. Our chemical control options and effective targeting are also not optimal given these factors. Moreover, as an introduced pest, SWD lacks effective native parasitoids, predators, and pathogens that could help to lower its population growth. Finally, the relatively recent introduction means that monitoring and IPM-oriented control strategies designed for these new environments are yet to be developed. Hence, the insect biology associated with the lack of natural enemies and IPM-oriented control methods make SWD a challenge for most fruit growers.

Management Recommendations:

There are no recipes in pest control, including for SWD. Each growing system is unique in terms of climatic conditions, soil, crop phenology, vegetation, antagonists, and production practices. These factors can influence SWD populations so they should be considered in an IPM context for successful SWD

management. Most growers understand no control should be implemented unless the pest is detected at a certain level. The problem here is they lack technology for monitoring SWD: Traps and lures available in the market have produced inconsistent results. Also, growers lack alternatives to insecticides, and successful pest control based solely on chemicals is not realistic. In this scenario, manage SWD as soon as the crop becomes susceptible (basic parameters include increased sugar, decreased penetration values, and increased pH). During crop ripening, growers need to be vigilant to stay on top of the pest. Good principles include regular pesticide applications and closely spaced harvest intervals.

The Biocontrol Angle:

Researchers from California and Oregon have been to East Asia (where SWD is originally from) in search of native parasitoids that could be introduced in the U.S. and used in biological control programs for SWD. Some parasitoid species have already been found and brought to the U.S., where they are in quarantine. This process is time consuming and there is no guarantee any of those species will be allowed to be released in the U.S., and if they are, there is no guarantee they will survive or be effective against SWD in this new environment. But the risk is worth it because the finding of an effective parasitoid would likely lead to less dependency on insecticides. Additionally, research for new lures and safer insecticides are ongoing, although we cannot predict when exactly they will be available for stakeholders.



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Cannabis and the Potential of Biocontrol

There are few simple solutions to help prospective cannabis growers build a pest control program, but biological control is an important option to consider.

THE ACCELERATING LEGALIZATION of cannabis around the U.S. is providing new opportunity in the form of an alternative crop, and just as much uncertainty about what kind of crop protection can be used to grow it. We asked Robert Starnes, Senior Superintendent of Agriculture at the University of California, Davis (UC Davis) in the Department of Entomology and President of Shale Peak Horticulture, for his thoughts on where biocontrol fits for cannabis growers.

Q What's the current situation with available pest control materials in cannabis crops?



Starnes: Cannabis is in a gray area regarding chemical pest management in states where it is legal as a medicinal or recreational crop. As growers receive state and/or county permits to grow cannabis, they must also register with their county ag commissioners. Many growers don't realize all the rules and regulations that accompany this. In California, spray applicators need a

Qualified Applicator License/Qualified Applicator Certification from the Department of Pesticide Regulation. Any grower spraying a commercial crop with a registered insecticide, biopesticide, fungicide, or herbicide must have one of these licenses. Growers must also submit a monthly use report, where inappropriate pesticides would be questioned.

There are, however, a few exceptions in California. Cannabis growers are allowed to spray pesticides that contain an active ingredient exempt from residue-tolerance requirements, and are registered and labeled for a use that is broad enough to include use on cannabis (unspecified green plants) or exempt from registration requirements as a minimum risk pesticide under FIFRA.

Q Why are biocontrols important tools to add to that mix?

Starnes: The best pest management option for cannabis is biological control. Using predatory mites and insects to control pests doesn't require permits or monthly use reporting. Also, insects will never develop resistance to being eaten or parasitized.

Spraying a plant with any pesticide or biopesticide will leave a residue, and it's becoming common practice to test the final cannabis product for residues. If these products test positive they can

be rejected from dispensaries. Some dispensaries set their own rules for residues, but the government may soon regulate which products are acceptable. Even if a product is generally regarded as safe but banned in cannabis use, residues will be discovered and the product rejected for sale. Biocontrol leaves no residue and isn't regulated in terms of final sale.

Our strategy at Shale Peak Horticulture is to design a preventative biocontrol release program to build a standing army of predators. We feed our predatory mites an artificial diet of *Ephestia* sp. eggs mixed with *Artemia* sp. cysts (eggs) in the cannabis crop. This keeps the predatory mites in the crop, ready for the pests to arrive.

Q What's the current legal status of biopesticides with regard to use in cannabis crops?

Starnes: It is the same as conventional pesticides for cannabis use: there are no registered products specifically for use directly on cannabis. Some states have a list of legal products they allow, while most haven't produced much information for cannabis growers. Basically, all registered pesticides and biopesticides are illegal to use on cannabis unless exempted by your state. Your state regulations can be found easily online.

Q How can cannabis growers learn to use biocontrols?

Starnes: Work with your county ag commissioner. They can help you understand which products are legal or illegal to use.

Integrated Pest Management is a complex system. Seek out a biocontrol specialist for advice and help on understanding which organisms will work in your location. Some biocontrols work better at higher temperatures, others at lower temperatures. The same applies to relative humidity. Most biocontrol companies have staff to advise you on which products to use based on the pest pressure you're experiencing. There are also consultants you can hire to help scout your crop for pests and make recommendations on which biocontrol agent will work for you.

Robert Starnes (bob@sphort.com) is a Senior Superintendent of Agriculture at UC Davis in the Department of Entomology, where he conducts research on integrated pest management and remote sensing in agriculture, and President of Shale Peak Horticulture, which offers biocontrol pest management solutions to cannabis growers.

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