

ABOVE AND BEYOND IS WHERE WE BEGIN



LEVELING UP PEST CONTROL WITH BIOS!



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PRESENTATION PREVIEW

Integrated Pest Management:

- Biopesticides
- Natural enemies

Compatibility

Arthropod programs:

- Thrips
- Aphids
- Mites



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INTEGRATED PEST MANAGEMENT





Host Plant Resistance <ul style="list-style-type: none"> • Resistant/tolerant varieties • Other varietal traits
Cultural Control <ul style="list-style-type: none"> • Adjusting planting dates • Modification of irrigation or nutrient management, sanitation • Use of trap crops, crop rotation, etc., mass trapping
Biological Control <ul style="list-style-type: none"> • Conserving natural enemies • Releasing predators or parasitoids
Behavioral Control <ul style="list-style-type: none"> • Baits or traps • Mating disruption
Physical/Mechanical Control <ul style="list-style-type: none"> • Netting and other exclusion options • Vacuuming
Botanical Control <ul style="list-style-type: none"> • Entomopathogenic microorganisms • Microbial metabolites
Chemical Control <ul style="list-style-type: none"> • Natural compounds from plants or other sources • Synthetic chemical compounds

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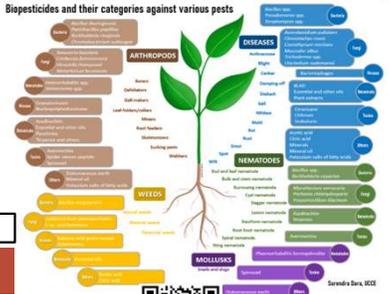
BIOPESTICIDES

Biopesticides are pest control materials based on naturally occurring substances or microorganisms, are considered environmentally friendly, and often have lower toxicity to humans and non-target organisms than traditional chemical pesticides.

TWO BROAD CATEGORIES

Biochemical

Microbial






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BIOINSECTICIDES: ACTIVE INGREDIENTS & THEIR MODE OF ACTION

Biochemical:

- **Botanicals:** azadirachtin, essential oils, pyrethrins, terpenes, plant extracts
- **Toxins:** spinosad, avermectins, spider venom peptide, chitosan
- **Semiochemicals:** pheromones
- **Other:** mineral oil, insecticidal soap, diatomaceous earth, citric acid

Microbial:

- **Fungus:** *Beauveria*, *Metarhizium*, *Cordyceps* (*Isaria*), *Hirsutiella*
- **Bacteria:** *Bacillus thuringiensis* (*Bt*), *Burkholderia*, *Chromobacterium*
- **Nematodes:** *Steinernema*, *Heterorhabditis*
- **Virus:** *Granuloviruses*, *nucleopolyhedroviruses*

Multiple MOAs:

- Infection
- Parasitism
- Suffocation
- Cuticular degradation
- Nerve/muscle
- Growth
- Disrupt midgut membranes
- Induced resistance
- Unknown or non-specific

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COMMON PESTS & THEIR NATURAL ENEMIES

Thrips

- *Orius insidiosus*
- *Amblyseius cucumeris*
- *Amblyseius swirskii*
- *Stratiolaelaps scimitus*
- *Dalotia coriaria*
- *Steinernema feltiae*

Aphids

- *Aphidius colemani*
- *Aphidius ervi*
- *Aphidius matricariae*
- *Aphelinus abdominalis*
- *Aphidoletes aphidimyza*
- *Chrysoperla rufilabris*

Whitefly

- *Encarsia formosa*
- *Eretmocerus eremicus*
- *Amblyseius swirskii*
- *Dicyphus hesperus*
- *Delphastus catalinae*

Mites (spider, broad)

- *Amblyseius cucumeris*
- *Amblyseius californicus*
- *Amblyseius andersoni*
- *Amblyseius swirskii*
- *Phytoseiulus persimilis*

Flies: fungus gnats, shore fly

- *Steinernema feltiae*
- *Steinernema carpocapsae*
- *Dalotia coriaria*
- *Stratiolaelaps scimitus*



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INTEGRATING CHEMICAL & BIOPESTICIDES

Insecticides (rotate across MOAs to avoid resistance)

Ornamental Crops

Apply as foliar sprays at label rates and intervals.

- MOA 4A – Flagship 20WG, Safari 20 SG, TriStar 8.5 SL
- MOA 4C & 5 – Xopre WG (will not control the Q-biotype)
- MOA 7A – Enstar AQ
- MOA 7C – Distance (will not control the Q-biotype), Fuforum (will not control the Q-biotype)
- MOA 9B – Endeavor (suppression only), Rycar (not for outdoor use)
- MOA 15 – Paderstar (avoid use on poinsettias)
- MOA 16 – Taurus DF (will not control the Q-biotype)
- MOA 21A – Hachi-Hachi SC (suppression only, see label for phyto cautions), Samite (will not control the Q-biotype)
- MOA 23 – Judo (see label for phyto cautions), Kontos (see label for phyto cautions)
- MOA 29 – Aria (suppression only)
- MOA UN tank mixes – BotanGuard, Mycotrol ESO, Preferal, SulfOx-X or Ultra-Pure Oil tank mixed with AzalGuard, Azatin Q or Molt-X

Biopesticide Compatibility?

Natural Enemy Compatibility?

From: Technical Reference Guide For Greenhouses and Nurseries, GGS Pro

USE OF CHEMICAL PESTICIDES IN IPM

Biological programs ≠ no chemicals:

- Intelligent timing and use
- Prevent pest resistance
- Preserve natural enemies and pollinators
- Enhanced safety (workers, environment)

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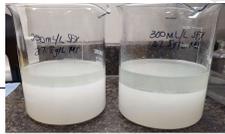
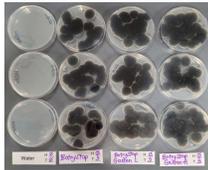
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COMPATIBILITY

Compatibility is an important part of integrated pest management!

- Physical (jar test)
- pH requirements
- Microbial compatibility
- Natural enemy compatibility



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NATURAL ENEMIES & COMPATIBILITY OF CHEMICAL PESTICIDES/BIOPESTICIDES



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BIOPESTICIDE COMPATIBILITY WITH NATURAL ENEMIES

Just because it's a biopesticide doesn't mean it's safe for natural enemies

- **Soaps and horticultural oils:** indiscriminately kill but leave no harmful residue
 - Great for knock down and spot sprays
- **Botanicals:**
 - Azadirachtin: needs to be ingested
 - Pyrethrins: harsh on natural enemies, short residue
 - Essential oils: depends on active and inert ingredients
- **Toxins:** spinosad, avermectins harsh on beneficials
- **Entomopathogenic fungus:**
 - Generally safe for mites – unless oil-based formulation
 - Higher impact on insects like Orius

Side Effects	Target	Insecticidal		Fungicidal	
		SP	OR	SP	OR
Ambrosia nectar	adult	SP	OR	SP	OR
	larva	SP	OR	SP	OR
	egg	SP	OR	SP	OR
Bacterial blight	adult	SP	OR	SP	OR
	larva	SP	OR	SP	OR
	egg	SP	OR	SP	OR
Chlorogenic acid	adult	SP	OR	SP	OR
	larva	SP	OR	SP	OR
	egg	SP	OR	SP	OR
Essential oils	adult	SP	OR	SP	OR
	larva	SP	OR	SP	OR
	egg	SP	OR	SP	OR
Fungicidal	adult	SP	OR	SP	OR
	larva	SP	OR	SP	OR
	egg	SP	OR	SP	OR

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THRIPS NATURAL ENEMY CHEMICAL COMPATIBILITY

Side Effects	Koppert	AVI-2		NEMO-SACHA EC		TRANSPIRE		DISEPTURE		PREDALIN	
		SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
Ambrosia nectar	adult	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	larva	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	egg	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
Bacterial blight	adult	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	larva	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	egg	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
Chlorogenic acid	adult	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	larva	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	egg	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
Essential oils	adult	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	larva	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	egg	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
Fungicidal	adult	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	larva	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR
	egg	SP	OR	SP	OR	SP	OR	SP	OR	SP	OR

Reference to any specific commercial product by trade name, trademark, manufacturer or otherwise does not constitute or imply its endorsement, recommendation or favoring by BioWorks.

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IMPORTANT CONSIDERATIONS WHEN USING NATURAL ENEMIES

- Dipping to reduce pressure and exposure
- Using short term/no residue biopesticides
- Spot treat hot spots
- Natural enemy application method
- Timing of application – spray then release

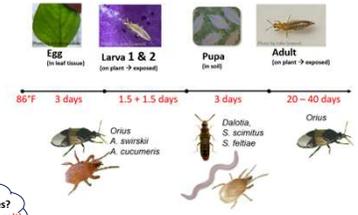


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First line of defense (bios):

- Biopesticide dips/spray/drench:**
- **Biochemical:** Soaps, botanicals, horticultural oils, essential oils, toxins, etc.
 - **Microbial:** entomopathogenic fungus & nematodes, bacteria, virus
- Natural enemy releases:**
- **Foliar:**
 - *Amblyseius cucumeris*
 - *Amblyseius swirskii*
 - *Orius insidiosus*
 - **Soil:**
 - *Dalotia coriaria*
 - *Stratiolaelaps scimitus*
 - *Steinernema feltiae*

WESTERN FLOWER THRIPS PROGRAM



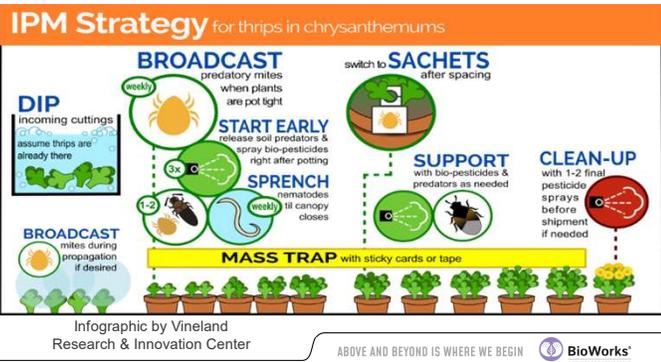
Second line of defense (chems):

- Conventional application:**
- Avid (abamectin)
 - Hachi-Hachi (tofenpyrad)
 - Mainspring (cyantraniliprole)
 - Overture (pyridalyl)

What about Fungicides?
Affirm (polyoxin D zinc salt)
Heritage (azoxystrobin)

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DIPPING: START CLEAN STAY CLEAN

- Reduces initial pest load
- Sets bio-programs up for success
- Better coverage than spraying



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DIPPING ROOTED & UNROOTED CUTTINGS

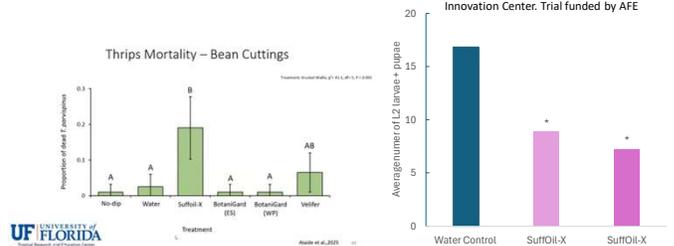


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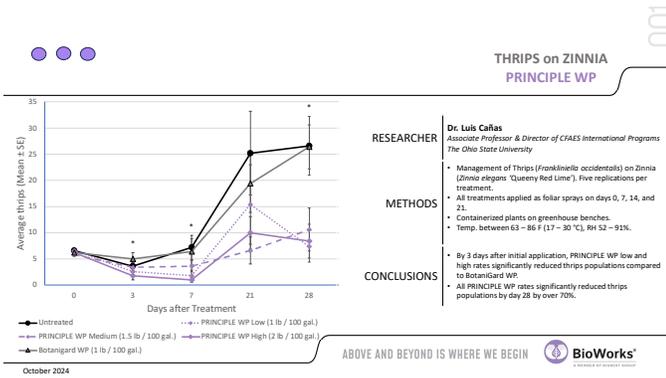
SUFFOIL-X KILLS ALL LIFE STAGES OF THRIPS

Method Summary	
Crop	Chrysanthemum (Var. Springdale Purple)
Location	Laboratory
Pest	Western Flower Thrips (<i>Frankliniella occidentalis</i>)
Trial Design	Randomized complete block with 4 replications
Trial Year	2019
Application Method	Dip

Rose Buitenhuis, Vineland Research & Innovation Center. Trial funded by AFE



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APHID PROGRAMS

First line of defense (bios):

Biopesticide dips/spray/drench:

- **Biochemical:** Soaps, botanicals, horticultural oils, essential oils, toxins, etc.
- **Microbial:** entomopathogenic fungus & nematodes, bacteria, virus

Natural enemy releases:

- **Foliar:**
 - *Aphidius colemani*
 - *Aphidius ervi*
 - *Aphidius matricariae*
 - *Aphelinus abdominalis*
 - *Aphidoletes aphidimyza*
 - *Chrysoperla rufilabris*

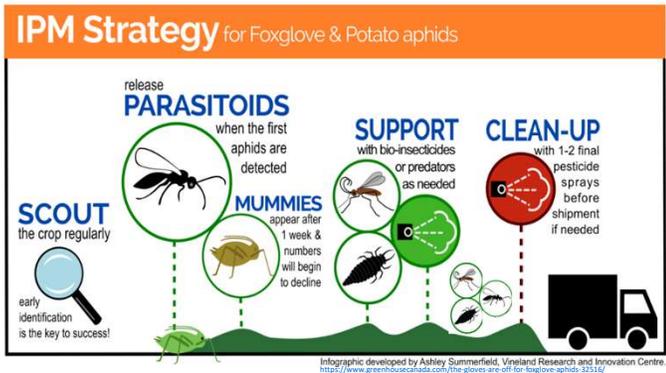
Second line of defense (chems):

Conventional application:

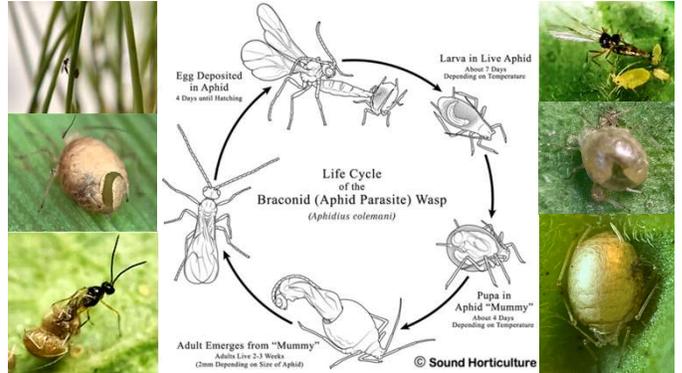
- Hachi-Hachi (tolifenpyrad)
- Altus, Kontos, MainSpring

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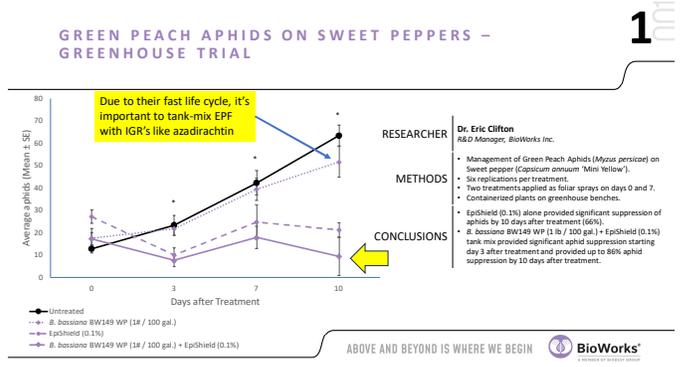
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IDEAL TANK MIXES

Azadirachtin, mineral oils & botanical oils can provide quick knockdown and synergistic efficacy with products containing Beauveria, Cordyceps or Metarhizium!

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TWOSPOTTED SPIDER MITE PROGRAM

First line of defense (bios):

Biopesticide dips & sprays:

- Insecticidal soaps, botanicals, horticultural oils, essential oils, toxins, etc.

Natural enemy release:

- Phytoseiulus persimilis*
- Amblyseius californicus*
- Amblyseius andersoni*
- Feltella acarissuga*

Second line of defense (chems):

Conventional:

- Floramite SC, Shuttle O, Hexygon
- Avid, Pylon, Judo, Kontos**

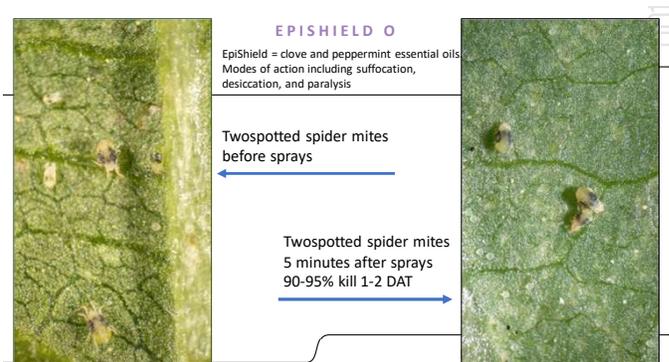
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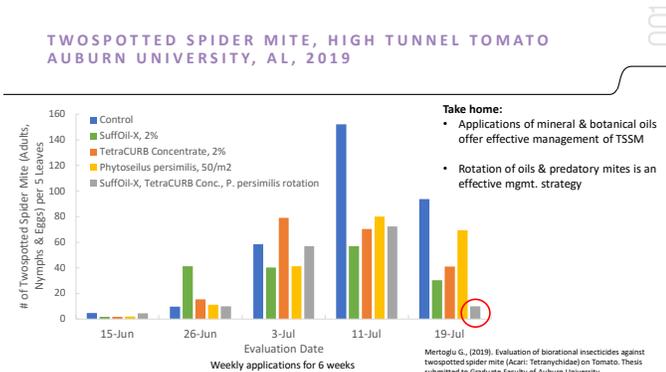
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TAKE HOME MESSAGE

- Use all the tools in the IPM toolbox
- Biopesticides are an integral part of chemical & natural enemy-based IPM programs
- Check compatibility of all inputs
- Develop a program
 - Application timing is important

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THANK YOU!

Title: Leveling up Pest Control with Biologicals

Interested in incorporating biologicals but not sure how or where to start? This presentation will cover **basics, compatibility, and example IPM programs** using biopesticides, natural enemies and chemical pesticides for management of common greenhouse and nursery pests.

Most of the growers that provided responses mentioned **mites, aphids and thrips** all of which have great bio program options. I should be able to cover all three but I will see once the presentation comes together. Feel free to provide suggestions.

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CUCUMBER BEETLE MANAGEMENT

IPM Tools:

- Floating row covers
- Exclusion netting
- Pheromone traps
- Foliar applications:
 - Spinosad
 - Pyrethrins
- Soil drench:
 - Spinosad
 - Azadirachtin
 - *Heterorhabditis bacteriophora*
 - *Beauveria bassiana*
 - *Metarhizium anisopliae*

Application timing:

- Adults overwinter, emerge and lay eggs
 - Foliar spray
- Larvae present for 2-3 weeks
 - Use degree days to get exact timing
- Multiple generations per year
 - Drench root zone around susceptible crops



Striped cucumber beetle (*Acalymma vittatum*)
Photo: Rahul C. Baslow



Spotted cucumber beetle (*Diatraea undecim-punctata*)
Photo: "Pollinator" on Wikipedia

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