Bio Controls and Organic Products for Nursery Production

Joel Fields, Wilbur-Ellis Company
Thanks for Attending our 2017
Biocontrols℠ USA West Conference & Expo in Reno, NV

During the first week of March, attendees representing 200+ companies
Agenda

• Living Bio Control Agents
  – Bugs in a jug, biopesticides, nematodes

• Non Living Bio Controls
  – Botanicals, oils, plant extracts……

• Organic and natural fertilizers
What is Biological Control?

Biological control involves the release or application of natural enemies including parasitoids (parasitic wasps), predators and pathogens (entomopathogenic fungi and nematodes) to regulate an existing pest population.

– Dr. Raymond A. Cloyd

Minute Pirate Bug *Orius insidiosus*
Biological Controls Introduced!
Bio Controls: Predators, Parasites, Microbials, and Botanicals

- Predatory insects/mites
  Lacewings, minute pirate bug/Orius, persimilis

- Parasites – live and feed in/or on host
  Ex) Wasps and flies; HI’s wiliwili tree

- Entomopathogenic nematodes – vectors of pathogenic bacteria
Bio Controls: Predators, Parasites, Microbials, and Botanicals

- **Micro organisms - fungi, virus, protozoa**
  - *Bacillus thuringiencis* (Bt) – fungus gnats, caterpillars
  - *Beauvaria Bassiana* – fungus controlling aphids, whitefly
  - Spinosyns

- **Botanicals – plant extracts**
  - Pyrethrins, nicotine, aza-diractins
  - Captiva – Bio Insecticide & Repellant
Living Bio Control Agents

- Bugs in a jug, biopesticides, nematodes
Wilbur-Ellis has hired a biological control specialist!!!!!!!!!!!!!!!

- Moriah LaChapell
  Biological Control Agents
- mlachapellschalock@wilburellis.com
Designing a Pest Management System with Bioline™ Beneficial Insects & Conventional Tools
# Beneficial Insects for HRM and Broad Mites

<table>
<thead>
<tr>
<th>Beneficial Insect</th>
<th>Target Pest</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Amblyseius cucumeris</em> (“cucs”)</td>
<td>Type II Selective Predator</td>
</tr>
<tr>
<td><em>Galendromus occidentalis</em> (“occi’s”)</td>
<td>Type II Selective Predator</td>
</tr>
<tr>
<td><em>Amblyseius fallacis</em> (fallacis)</td>
<td>Type II Selective Predator</td>
</tr>
<tr>
<td><em>Amblyseius andersoni</em> (andersoni)</td>
<td>Type III Generalist Predator</td>
</tr>
<tr>
<td><em>Neoseiulus californicus</em> (californicus)</td>
<td>Type II Selective Predator (shares Type III traits)</td>
</tr>
</tbody>
</table>

Galendromus occidentalis  
Amblyseius cucumeris  
Amblyseius andersoni  
Neoseiulus californicus
NemaShield™

- Contains *Steinernema feltiae*
  - 100 Million, 500 Million, or 2 Billion units
- 100 million to 1100 to 3400 sq ft
- Effective on fungus gnat larvae, WFT pupae
- Completely safe to humans
- EPA exempt from registration, no REI
- Compatible with many pesticides
NemaShield HB

• Contains *Heterorhabditis bacteriophora*
  – 50 Million and 500 Million units
• 50 million per 2,000 sq ft; 1 billion to an acre
• Controls black vine weevil, soil dwelling and boring larvae (caterpillars), beetles, flies
• Soil temperature must be 50-85 degrees F
• EPA exempt from registration, no REI
Biological Pesticides
HOW DO THEY WORK? (1)

- The main principle is numbers. Introduce a high enough population of good organisms to overwhelm the bad or ineffective organisms.

Competitive exclusion (competition for nutrients and space)
HOW DO THEY WORK? (2)

Mycoparasitism

RootShield attacking a hyphal strand of *Rhizoctonia* using enzymes to degrade the cell wall of the pathogen.

Cavities left in the pathogen after attack by RootShield.
Disruption of pathogen cell membranes with metabolites, including lipopeptides
Production of antibiotic agents, anti-fungal enzymes
RootShield Granules ®
RootShield WP/PlantShield HC ®

- *Trichoderma harzianum*, T22
- EPA-Registered biofungicide
- Controls Pythium, Rhizoctonia, Fusarium, Thielaviopsis and Cylindrocladium
- Zero Hour REI
- OMRI listed and VeriFlora certified
- No phytotoxicity
What does RootShield Biological Fungicide Do?

• RootShield protects roots from diseases caused by *Pythium*, *Rhizoctonia*, *Fusarium*, *Thielaviopsis*, and *Cylindrocladium*

• RootShield permits stronger, healthier root systems

• RootShield allows greater soil exploration by roots and enhanced nutrient uptake

• Increased stress tolerance due to better root systems

• Solubilization of phosphate and trace elements (Cu, Fe, Mn, Zn)
• RootShield WP & RootShield® Granules

**RootShield WP**

3-5 oz per 100 gal

**RootShield Granules**

1-1.5 lbs per cubic yd of soil mix
Cease™

- Based on a naturally occurring patented strain of *Bacillus Subtilis* (strain QST 713)
- Contains naturally occurring antifungal and antibacterial lipopeptide compounds
  - *multiple modes of action*
  - *resistance management tool*
  - *valuable addition to any disease control program*
- 4 Hour REI, 0 day PHI
- OMRI Listed
• **Foliar Disease** - *Botrytis, Powdery Mildew, Anthracnose* and several leaf spot diseases such as *Alternaria* and *Entomosporium*

• **Bacterial Diseases** – *Erwinia, Pseudomonas* and *Xanthomonas*
  – *Rotate with coppers or use as preventative stand alone*
  – 2-8 qts / 100 gallons, Re-apply weekly

• **Soil Diseases** - *Rhizoctonia, Pythium, Fusarium* and *Phytophthora*,
  4-8 qts / 100 gallons, Re-apply 21-28 days
Presence of *B. subtilis* spores create a physical **barrier** blocking pathogen access to plant surface

CEASE covers the surface of the leaf
CEASE

Mode of Action

Antifungal lipopeptides

- destroy cell wall integrity
- prevent spore germination
- pathogen cell death
Ancora/Preferal Microbial Insecticide

- Naturally-occurring fungus that infects many arthropod hosts:
  - Whiteflies, thrips, psyllids, leafminers, spider mites, weevils, scale, mealybugs, other pests
  - Infects all life stages (esp. immobile ones)

- Contains Blastospores (like primed seed) for faster germination and infection

- Little or no impact on beneficial insects:
  - Bees, ladybeetles, parasitic wasps, predatory mites, other insect predators (e.g. Orius)

* Formerly known as *Paecilomyces fumosorosea*
Infection Cycle of *Isaria fumosorosea*

**Asian citrus psyllid killed by Ancora**


**Spider mite eggs killed by Ancora**


SEM photos: Z. Landa, Univ. of South Bohemia, Czech Rep.

**3-5 days (temperature dependent)**

- Spore deposition on plant
- Spore germination
- Cuticle penetration
- Host insect
- Internal proliferation
- External sporulation
- Host death
- Hyphae growing on surface of whitefly nymph
Dead Whitefly infected by Preferal
Whitefly eggs infected by Preferal
Madeira Mealy bug killed Preferal
Scale infected and killed by Preferal
Thrips infected and killed by Preferal
Caterpillar infected and killed by Preferal
Ancora Labeling: Target Pests

**Foliar application**

- Whiteflies
- Aphids
- Thrips
- Spider mites
- Liriomyza leafminers
- Citrus leafminers
- Mealybugs
- Psyllids
- Lygus bugs

**Soil application**

- Black vine weevil
- Thrips pupae
- Other crown/root weevils
- Symphylans
- Coleoptera larvae (grubs, rootworms, wireworms)
- Lepidoptera larvae (caterpillars, cutworms)
ANCORA vs. SOIL GRUBS IN POTTED FIR SERICA SP. (COLEOPTERA: SCARABEIDAE)

METHODS
• Randomized complete block with 4 reps (potted fir seedling)
• Each pot infested with 15 grubs.
• Ancora applied 3X at weekly interval. Chemical insecticides applied once.
• Soil drench in 5 – 8 fl oz water per pot, plus Freeway NIS (0.1% v:v).
• Survival assessed by destructive sampling of pots 36 days after treatment.

RESULTS:
• Ancora reduced larval survival by >60%.
• Not as effective as imidacloprid standard, but much better than rynaxypyr.

Columns bearing the same letter are not significantly different (P > 0.05, ANOVA LSD test)

Greenhouse trial CER-2010-144 by J. Cacka, Crop Production Services (Rickreall, OR)
Non Living Bio Controls
Botanicals, oils, plant extracts, organics
Captiva is made from garlic and capsicum varieties chosen for their specific and unique pest defense properties.

- The patented dual extraction method of manufacturing harvests the active properties of each component.

7.6% Capsicum oleoresin extract
23.4% Garlic oil
59.3% Soybean oil
Dual Extraction Yields Multiple Modes of Action

- **VAPOR PHASE**
  - Repellancy lasting 1-3 days

- **AGITATION PHASE**
  - Residual contact agitation lasting 1-7 days

Inhalation of the aromatic essential oils drives the pest out of hiding in search of shelter.

Contact with the oleoresin causes constant irritation, increasing mobility, preventing feeding and depleting energy reserves.

Untreated surface, mites all over  
Treated surface, mites driven to margins
Control at peak thrips population 7-20-13

Radiant = spinetoram
Safety

- Non-toxic to honey bees and other beneficial insects
  Recommend release 2-3 days after Captiva spray
- Plant Safety – no phyto
- 4-hour REI
- For food crops: 0-day PHI, exempt from residue tolerances
- No documented resistance
  Reduces resistance risk for tank mix partners

OMRI Certification status
Active Ingredients:
- Rosemary Oil 10%
- Peppermint Oil 2%

Inerts:
- Wintergreen Oil
- Butyl Lactate
- Vanillin
- Lecithin

Insecticide/Miticide
Product Characteristics / Benefits:

- **Fast-acting contact insecticide/miticide**
- **Broad spectrum control:** including mites, aphids, whiteflies, thrips, leafhoppers, plant bugs, pear psyllid, Small Larva of cutworms, armyworms, loopers,
- **Can be applied throughout growing season** including bloom
- **Effective against all stages of development of most insects/mites species** (eggs to adults)
- **Cost effective** versus most commonly used conventional products
- **Ideal rotational or tank mix partner** with many pest control products
- **Ideal for use in pest resistance programs**
Additional Product Information:

- **Easy to mix / apply** - disperses evenly in spray solution
- **Broad compatibility** with pesticides, nutrients and adjuvants
- **Labeled for use** on vegetables, row crops, nuts, pomes, stones, citrus, soft fruits/berries, grapes, herbs & spices
- **Supplemental label for use** on indoor/outdoor plants, trees and in greenhouses/nurseries
Azadirachata indica: The Neem Tree
Source for the Limonoid - Azadirachtin*

- Known over 2000 years in India
- Researched since 1961
- Crude Uses since 1961
- Inconsistency on efficacy
- Azadirachtin identification - 1970
- Technology development - 1980

*Chemical Class: terpenoids
The Neem Fruit
Azadirachtin has been shown to be affective on over 200 species of insects and mites.

- **ACARINA** such as red spider mites
- **COLEOPTERA** such as beetles, grubs, and weevils
- **DIPTERA** such as flies, fungus gnats, and leafminers
- **HEMIPTERA & HOMOPTERA** such as white flies and aphids
- **LEPIDOPTERA** such as leafrollers, cutworms, loopers, and armyworms
- **ORTHOPTERA** such as grasshoppers
- **SEPHONOPTERA** such as fleas and lice
- **THYSANOPTERA** such as thrips

¹Source: Colorado State University, David Bagge
AzaGuard® Botanical Insecticide/Nematicide

• AzaGuard is a 3% Azadirachtin formulated Insect Growth Regulator (IGR) that offers broad spectrum insecticidal control on over 300 insect species. AzaGuard prevents molting between larval, pupal and nymphal stages and also repels insects in treated areas, reducing insect infestations on turf grasses.

AzaGuard’s natural botanical formula meets all of the requirements of the National Organic Program (NOP).
Pyganic 5.0 EC

- About 200 years ago people in central Asia discovered that dried, crushed flowers of certain chrysanthemums were toxic to insects. During the Napoleonic Wars (1804-1815) this "insect powder" was used to control flea and body lice infestations by French soldiers.

- **Fast** – PyGanic delivers quick knockdown and control of crop-damaging insects.
- **Flexible** – No pre-harvest interval
- **Organically compliant** – PyGanic is OMRI® listed and meets the USDA’s NOP requirements for an input.
- **Broad spectrum** – May be used on over 200 growing crops to control a broad spectrum of insects
<table>
<thead>
<tr>
<th>PyGanic® Formulation</th>
<th>Most commonly used rate</th>
<th>Rates for treating high populations of adult and/or hard to kill insects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PyGanic 1.4</strong></td>
<td>1 Pint 16 fl. Oz.</td>
<td>2 Pints 32 fl. Oz.</td>
</tr>
<tr>
<td>Rate per acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acres per Quart</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Acres per gallon</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Rate for Hand Sprayers</td>
<td></td>
<td></td>
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</tbody>
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| **PyGanic 5.0**      | 4.5 fl. OZ.             | 9 fl. OZ.                                                          | 13.5 fl. OZ.    | 18 fl. OZ.       |
| Rate per acre        |                         |                                                                     |                |                |
| Acres per Quart      | 7                       | 3.5                                                                | 2.4            | 1.8 |
| Acres per Gallon     | 28.4                    | 14.2                                                               | 9.5            | 7.1 |
| Rate for Hand Sprayers |                        |                                                                     | **1.5 - 3 teaspoons of PyGanic 5.0** per gallon of water       |
SILICON

- 2nd Most Abundant Element in the Earth’s Crust
  2 Forms – Crystal & Amorphous
IMPORTANCE OF SILICON

- ENHANCE PHYSICAL STRENGTH – MAKES THE TISSUE TOUGHER – REINFORCES CELL WALLS
  - STRUCTURAL STRENGTH
  - TISSUE MORE RESISTANT TO INSECTS / DISEASE
- PHYSIOLOGICAL EFFECTS
  - REDUCES ENVIRONMENTAL STRESS – HEAT / DROUGHT
- Biotic
  - Fungal, Bacterial and Viral
- Abiotic
  - Temperature, Drought, Salinity, Nutrient Imbalances
HOW TO USE AgSil

• TAKEN UP BY ROOTS IN THE FORM OF SILIC ACID
  – MOVES WITH THE WATER WITHIN THE PLANT & DEPOSITED IN THE TISSUE
  – DOES NOT MOVE WITHIN THE PLANT
  – NEEDS TO BE REAPPLIED AS THE PLANT DEVELOPS
AgSil APPLICATIONS

FOLIAR SPRAY
LOCALLY SYSTEMIC
COVERAGE VERY IMPORTANT!!!

FOLIAR TISSUE RESISTS FUNGAL / INSECT / MITE PRESSURE
CHEWING MOUTHPARTS DAMAGED
FEEDING DIFFICULT FOR PIERCING / SUCKING INSECTS
The mechanical barrier hypothesis
Cuticle-silica double layer (Yoshida et al., 1962)

Silica layer
Outer cell wall

No infection in the epidermal cell

Epidermal cell
New *Organic* Herbicide from BiosafeSystems
• **Non-selective herbicide** for Ag., commercial and residential use

• **Soap product**- A.I. Ammonium Nonanoate- 40.0% (35% Pelargonic Acid)

• **Scythe has 58% by wt of Pelargonic Acid.**

• **Mode of Action**: Disrupts plant tissue through cell wall penetration, resulting in cease of plant growth and brown necrosis.

• **A Contact spray control or burn down** of annual and perennial weeds and Grasses, moss and liver worts.

• **Non-volatile and water soluble**
• **Application Rates**- 3.0%-15.0% v/v
  - 6.0%-10.0% v/v commonly used

• **Spray Volume**- 30-125 Gallons per Acre
  - 45-75 GPA commonly used

• Rate and spray volume depend on weed species, height, leaf shape and weed density.

• **Use method**- Vegetative burn down, directed and shielded spray, pre- emergence spray and dormant/post-harvest sprays.

• Broad number of crop and non-crop groups.

• **No aquatic applications**
Before AXXE

After AXXE
Organic fertilizers

Nitrogen
- Feather
- Blood
- Fish Meal
- Bat Guano
- Corn Gluten Meal
- Soybean Meal
- Cottonseed Meal

Phosphorus
- Fishbone
- Bone Meal
- Crab Meal
- Shrimp Meal
- Rock Phosphate
- Bat Guano

Potassium
- Potassium Sulfate
- K-Mag
- Greensand

General: Alfalfa Meal, Kelp, Humate, Worm Castings
Pacific Natural® Fresh Fish Fertilizer

N-P-K Rating: 2-3-0
• 2% total Nitrogen (N), 3% available Phosphoric acid (P205), 0% soluble potash (K20)

Process: Fresh fish offal processed with organic non-GMO enzyme and low temperature hydrolysis, twice-filtered (80-mesh), stabilized with phosphoric acid to target pH 3.5 - 3.8.

Available in 5 gallon bucket

http://www.greatpacificbioproducts.com
Organic TRIGGRR® & Organic BioLink® Nutritional Program

The Products:

- Organic TRIGGRR®
- Organic BioLink® All-Purpose Fertilizer 3-3-3
- Organic BioLink® Cal Plus 7%
- Organic BioLink® Micronutrient Fertilizer
THANK YOU

Joel Fields
WILBUR-ELLIS