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## Using Bio-Control As Part of an IPM Program

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2009 Greenhouse Tomato Short Course  
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March 12<sup>th</sup>, 2009




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IPM

## Integrated Pest Management

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System of pest control that combines biological, cultural, environmental and chemical measurements with the objective to minimize the harmful impact on the environment. An important aspect is hygiene, monitoring, and biological control. Sometimes it is necessary to apply treatments with compatible or selective pesticides.



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## Pest Control


Cultural Control: hygienic standards

Physical Control: heat treatments, UV-light, ...

Mechanical Control: elimination of infested parts, avoid pest entrance (use of nettings), mass trapping (use of sticky traps),


Chemical Control: Use of pesticides

Biological Control: Use of beneficial organisms  
→ parasites,  
→ predators,  
→ entomopathogenics



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## Myths, facts and advantages of biological control



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## Myths about biological control


- With bio-control, I will always have higher pest levels in my greenhouse.
- I can't use bio-control because my customers have 'zero' tolerance for pests.
- Bio-control is more difficult.
- I need to have an entomologist on staff to make this work.



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## Myths about biological control


- When using bio-control, I can't spray any pesticide without killing all the 'good' bugs.
- When using bio-control, I will never have to spray again.
- I will only have to introduce bio-control agents (BCA's) once and they will live forever.
- Biological control is more expensive



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### Facts about biological control


- Bio-control can help in management of pesticide resistance.
- Bio-control requires technical knowledge about pest and BCA's.



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### Facts about biological control


- Bio-control is often considered when pesticides are no longer (as) effective or when problems arise (too late).
- If bio-control failed (history), it is often because it was started too late. Bio-control requires a more proactive approach
- Bio-control is a solid part of pest management program when used properly



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### Advantages of bio-control


- Bio-control does not require a pesticide application license (anyone can help/apply)
- No REI's, no PHI's.
- No pesticide disposal issues ( run-off ).
- Safer workplace: improved worker safety (and happiness).



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### Advantages of bio-control

- Improved plant/fruit quality (no phytotoxicity).
- No resistance to BCA's (pesticide resistance management)
- "Green"-added value to products



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### Keys to a successful program






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### Keys to a successful program


- Educate yourself and talk to IPM/Biological control specialists.
- Delegate responsibility → appoint someone in organization to monitor and execute strategy.
- Review pest problems of previous year(s).
- Review pesticide use in previous year and more important the last 3 – 4 months.



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### Keys to a successful program


- Develop and start **solid and consistent** monitoring system. Record data on pests, BCA's and pesticides.
- Develop a plan for transition period and set a date for starting bio-control.
- Develop a strategy for bio-control releases and execute.



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### Keys to a successful program

- If possible, start bio-control in propagation part of production. Inspect material (cutting, plugs) coming from outside sources; talk to propagator or supplier about pesticide use and your intentions.
- Don't give up, even if first attempt is difficult.



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### Bio-control vs Pesticides






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### Bio-control vs Pesticides

- Direct and residual effects
- Older pesticides mostly incompatible
- Many newer pesticides more bio-control-friendly
- IOBC guidelines for pesticide compatibility classification
- Department within Biobest's R & D that test compatibility of pesticides (3 full-time scientists)
- Check at [www.Biobest.ca](http://www.Biobest.ca) and look for side effects



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### Bio-control vs Pesticides

1<sup>st</sup> Select pesticide

2<sup>nd</sup> Select BCA

3<sup>rd</sup> Click here for results

Product	Useful organisms
abamectin	Chrysopa
acromycin	Amblyseius californicus
acromycin	Amblyseius cucumeris
acromycin	Amblyseius degenerans
acromycin	Amblyseius swirskii
acromycin	Anthracoris nemoralis
acromycin	Aphidius spp.
acromycin	Aphidius aphidivora / Theridoblasta persicae
acromycin	Bemisia tabaci - formosa - tabaci - tabaci - tabaci
acromycin	Chrysopa carnea



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### Bio-control vs Pesticides

Application

Toxicity

Persistence

Product	Useful organisms
abamectin	Chrysopa
amblyseius	Amblyseius californicus
amblyseius	Amblyseius cucumeris
amblyseius	Amblyseius degenerans
amblyseius	Amblyseius swirskii
anthracoris	Anthracoris nemoralis




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## Bio-control vs Pesticides

Amblyseius californicus	Application Nymph/Adult Persistence	abamectin spraying 4 5 d
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**CATEGORIES FOR NATURAL ENEMIES**

- 1 non-toxic
- 2 slightly toxic
- 3 moderately toxic
- 4 toxic



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## Planning a Bio-Control/IPM Strategy




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## Bio-Control Strategy

**Plan a strategy**

- That fits your operation and your needs
- Focus on propagation and early preventive/proactive actions
- Consider using banker and trap plants
- Include employee(s) that are going to be involved or even carry the responsibility of pest management
- Include some training of employees (understanding why will motivate them).




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## Bio-Control Strategy


**Plan a strategy**

- Review pest problems of previous year(s).
- Review pesticide use in previous year and more important the last 3 – 4 months
- Develop and start solid and consistent monitoring system. Record data on pests, BCA's and pesticides.
- Develop a plan for transition period and set a date for starting bio-control.



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## Scouting & Monitoring



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## Scouting and Monitoring

**What is scouting and monitoring?**  
Rapid and frequent detection and observation of the presence and population dynamics of a pest in crops.





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## Scouting & Monitoring

**Keys to success**


- Scouting is critical to successful bio-control
- Regular & consistent → weekly by same employee(s)
- Inspect plants and sticky cards; Identify and count # of pests and beneficials.
- Record data & observations
- Make graphs, map of farm
- Educate yourself and/or employee(s), Involve staff.



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## Scouting & Monitoring

- Average counts should be recorded and/or graphed.
- Trends can be easily seen (pest population increasing or decreasing?)
- Result of pest management actions (BCA's introductions and/or pesticide treatments) can be seen.
- Pest control program can be modified based on results.



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## Scouting & Monitoring

**SCOUT-SHEET**

Weekly observations

Customer name: \_\_\_\_\_ Date: \_\_\_\_\_ Development: \_\_\_\_\_ Area to visit: \_\_\_\_\_ Crop: \_\_\_\_\_ Employee name: \_\_\_\_\_

Pest/Beneficial	Week 1							Average
	1	2	3	4	5	6	7	
Whitefly								0.0
Spider								0.0
Leaf miner								0.0
Plant bug								0.0
Scale								0.0
Mealybug								0.0
Thrips								0.0
Homoptera								0.0
Diptera								0.0
Other								0.0

**INsect BIOLOGICAL SYSTEMS**

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_

State: \_\_\_\_\_


Zip: \_\_\_\_\_

Phone: \_\_\_\_\_

Date: \_\_\_\_\_

Notes: \_\_\_\_\_


1) To obtain the best possible observation, it is recommended to visit 10 days with yellow sticky cards (4000) (10-20 per acre) as a minimum.  
2) The Sticky Cards reader, count the number of each pest and beneficial on each visit card. Make sure that the number of sticky cards is noted in yellow card.



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## Scouting data

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## Bio-Control Agents



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## Whitefly


- Two main types:
  - Greenhouse (GWF),
  - Bemisia (SWF: silverleaf/tobacco/sweet potato)
- Need to identify species for proper control
- Bemisia is naturally yellow; GWF white
- GWF has larger hairs
- GWF sides are straighter



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## Whitefly

	<i>Trialeurodes vaporariorum</i>	<i>Bemisia tabaci</i>
Adults		
Larvae		
Eggs	white → black	yellow → pale brown




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## Bio-control of Whitefly

Three main control agents:  
*Encarsia formosa*,  
*Eretmocerus eremicus*,  
*Eretmocerus mundus*.


- All three are wasps and only sting whitefly.
- Control is from parasitism and host feeding.




*Encarsia formosa*



*Eretmocerus eremicus*




*Eretmocerus mundus*



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## Bio-control of Whitefly

- *Encarsia* against GWF, *E. eremicus* against GWF and SWF, and *E. mundus* against SWF
- *Encarsia* and *E. eremicus* work equally well in cool temperatures but *E. eremicus* performs better in warmer conditions.
- *E. mundus* performs better in cooler and warmer conditions than *E. eremicus*
- Resistance to pesticides: *Encarsia* < *E. eremicus* < *E. mundus*
- *E. eremicus* attacks younger whitefly. Eventually it becomes more common than *Encarsia*.



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## Bio-control of Whitefly

### Encarsia






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## Bio-control of Whitefly

### Eretmocerus







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## Bio-control of Whitefly

	BCA's	Introduction rate	Timing
Preventive	<i>Encarsia formosa</i>	1 - 3 / m <sup>2</sup>	Weekly
	<i>Eretmocerus eremicus</i>	1 - 3 / m <sup>2</sup>	Weekly
	<i>Eretmocerus mundus</i>	1 - 3 / m <sup>2</sup>	Weekly
Curative	<i>Encarsia formosa</i>	4 - 6 / m <sup>2</sup>	As necessary
	<i>Eretmocerus eremicus</i>	4 - 6 / m <sup>2</sup>	As necessary
	<i>Eretmocerus mundus</i>	4 - 6 / m <sup>2</sup>	As necessary





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### Bio-control of Aphid

*Aphidius colemani* and *Aphidius ervi*

- Both are parasitic wasps.
- Parasitized aphid = mummy (golden-brown and leather-like)
- Good searchers.
- Must know aphid species for control.

Aphidius colemani
Aphidius ervi




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### Bio-control of Aphid

**Banker-System**  
Barley plants infested with cereal aphids (only attack monocotyledonous plants).

- Preventive application (even before aphids found in crop).
- Early establishment and continuous production of *A. colemani*.
- Can be used with other beneficials (e.g. *Aphidoletes*)





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### Bio-control of Aphid

*Aphidoletes aphidimyza* (predatory midge)

- Eats wide range of aphids.
- Works well on all crops.
- Preventive and curative applications.
- Kills more aphids than necessary for development.


Aphidoletes larva
Aphidoletes adult



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### Bio-control of Aphid

	BCA's	Introduction rate	Timing
Preventive	Banker-System (barley plant with cereal aphid)	1 plant / acre	Every 2 weeks, start immediately after planting
	<i>Aphidius colemani</i>	250 / Banker-System	1 week after introduction of Banker-System
Curative	<i>Aphidius colemani</i>	0.5 - 2 / m <sup>2</sup>	As necessary
	<i>Aphidius ervi</i>	0.5 - 2 / m <sup>2</sup>	As necessary
	<i>Aphidoletes aphidimyza</i>	0.5 - 1 / m <sup>2</sup>	As necessary
	<i>Chrysopa</i>	500 / Acre	As necessary





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### Bio-control of Spider Mite

*Phytoseiulus persimilis* (predatory mite)

- Only eats spider mites.
- When conditions are right, *Phytoseiulus persimilis* population growth will be greater than spider mite's.
- Can be used in many vegetable and ornamental crops.
- Tomato-reared *Phytoseiulus* available for use in tomato.






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### Bio-control of Spider Mite

*Feltiella acarisuga* (predatory midge)

- Excellent flyer: spreads easily throughout the crop, and very effective in locating mite colonies.
- Lays its eggs in mite colonies.
- Larvae devour hundreds of mites and eggs in lifetime.
- Works well on many crops.
- Also attacks the carmine mite.
- Easy to use and requires little work.

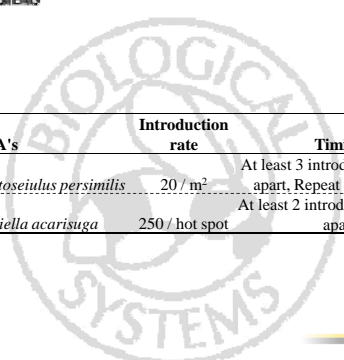

Feltiella larva attacking spider mite
Feltiella adult



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## Bio-control of Spider Mite

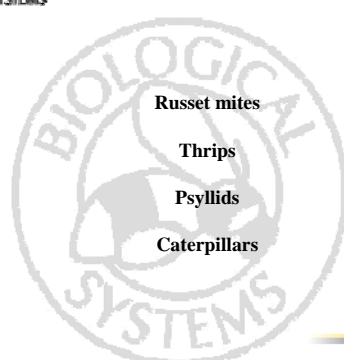

BCA's	Introduction rate	Timing
<i>Phytoseiulus persimilis</i>	20 / m <sup>2</sup>	At least 3 introduction a week apart. Repeat as necessary
<i>Feltiella acarisuga</i>	250 / hot spot	At least 2 introductions a week apart

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## Other pests

- Russet mites
- Thrips
- Psyllids
- Caterpillars

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## Questions and discussion....

**Thank you!**

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