Biological Control Developments at a Global Level

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Bio-control at a global level:

• Changing to bio-control....
• Why are growers implementing bio-control in their IPM program
• Reasons for success/failure

Bio-control developments at a global level:

• Starting with ‘clean’ propagation....
• Starting early
• Implementing banker plants and habitat planting to enhance Biological Control Agents.
• Changes with pest management at young plant production
• Questions and discussion
Changing to Bio-Control

When a grower wants to do less of this .........
Changing to Bio-Control - Broadcasting *Amblyseius cucumeris*

…and do more of this……..
Changing to Bio-Control – Mini *Amblyseius cucumeris* sachets

...or this........
Changing to Bio-Control – *Amblyseius cucumeris* and *Amblyseius swirskii* in propagation (Amblyline Stick and Swirskiline Stick)

…or this………
Changing to Bio-Control – *Aphidius colemani* (here with aphid banker plant)
Changing to Bio-Control: Banker plants to support BCA’s
Orius insidiosus - thrips – and banker plants:
Changing to Bio-Control – applying nematodes

..... or this.....
Changing to Bio-Control - Dipping

..... or this.....
Changing to Bio-Control – Banker plants

..... and use it as a marketing tool (retail).....
Changing to Bio-Control → in retail garden center.

..... and use it as a marketing tool (retail).....
Why do growers change to biological control?
Efficacy problems → Pesticide resistance:
Efficacy problems → Pesticide resistance:

TSWV on peppers
Efficacy problems → Pesticide resistance:
Efficacy problems → Pesticide resistance:
Why do growers change to biological control:

- Efficacy problems → pesticide resistance
- Cost vs Results
- Market/Customer/Consumer demands
- MRL / Residues
- Work environment → REI and size of operations
- Resistance management
- Next generation growers/farmers
- Positive stories from growers who have high level of success……..
- Environmental concerns
What are the reasons bio-control fails?
Development of thrips in 60 days (at 68°F)

One female thrips

30 days → ± 90 thrips

30 days → ± 5800 thrips
Development of thrips in 60 days (at 68°F)

Start here = Success  Too late = Disappointment

One female thrips

± 90 thrips

30 days

± 5800 thrips

30 days
STARTING POINT → Development of Whitefly in 64 Days
(at 20°C/68°F on Tomato)

32 days

± 125 whiteflies

32 days

± 8000 whiteflies
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(at 20°C/68°F on Tomato)

32 days
± 125 whiteflies
Start here = Success

32 days
± 8000 whiteflies
Too late = Disappointment
Reasons for biological control to fail:

- Starting too late!
- ‘Trying’ biological control (commitment)
- Not starting ‘Clean’ → pest and residues
- Scouting and monitoring!
- Reactive vs proactive
- Not taking all pest and disease problem into consideration
- Poor planning → Supply of BCAs
- Poor management → Application
- No technical support
- Check quality at point of arrival
- Fear of loss → bailing at tipping point → Trust
- Expectations vs threshold
- Compatibility with traditional crop protection products
- Cost -> Reducing input
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• Scouting and monitoring!
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• Poor planning → Supply of BCAs (forecasting)
• Poor management → Application
• No technical support
• **Check quality at point of arrival**
• **Fear of loss → bailing at tipping point → Trust**
• Expectations vs threshold
• Compatibility with traditional crop protection products
• Cost -> Reducing input
Should I spray or should I not?
Should I spray or should I not?

Tipping point has been reached = control has been achieved
Sachets with Predatory Mites

Quality check at arrival and longer:
• Take several sachets and run test through sieve
• Sieve takes out most of the bran
• Ratio between predatory mite and bran mite should be 1 to 10
• For exact count take exact volume
• Life span of sachet is harder to determine
• Run out test
• Binder clips and sticky cards
• Greenhouse conditions

Storage:
• DO NOT store in low humidity areas → Dehydration, Storage temp >60°F/15°C
• Sachet can be stored a bit longer as it is breeder material, however, this will affect their lifespan in the crop → Use within 1 week
Sachets with Predatory Mites

• Bran mites vs Predatory mites:
Sachets with Predatory Mites

- Binder clip placed on sticky card.
- Make sure exit hole does not get pinched.
- Shade with mites gets darker in following weeks.
- Replace sticky card in week 3 or 4 and place on new card to see if sachet are still active.
What is a ‘clean’ plant or cutting?
A ‘clean’ plant or cutting?

- Insect, mite and disease → what is acceptable?
- What about Pesticide residues? → what is acceptable
- Leaf tissue sampling for residues → affordable
- Zero tolerance…..is it possible?
- Producers of cuttings/Breeders → their actions can affect your program → ‘Clean’ plugs/plants are important for any pest management program
- Grower to breeders and propagators → your reaction can trigger their actions.
- Positive and constructive communication between breeder, propagator, and grower is very important!
- Growers requesting information
- Examples
Starting in propagation in greenhouse vegetable production:

- Early introduction of *Amblyseius cucumeris* or *A. swirskii*

- Development of mini sachets (with hanger or stick) for predatory mites (*Amblyseius spp*)
**Amblyseius spp** (Amblyline Stick, Swirskiline Stick) in vegetable plant propagation:

- Young vegetable plants
- Water resistant and exit hole protected from overhead irrigation/misting
- ‘Signature’ for ICM/IPM ready plant material from propagators to growers
- Timing of introduction for especially thrips and broad mites is critical → early establishment of predatory mites
- *Amblyseius cucumeris* (Amblyline™) Stick most suitable for spring propagation → Climate/Temperature and most cost effective.
- *Amblyseius swirskii* (Swirskiline™) stick → Warmer climate and whitefly susceptible crops
Starting early → Why is it critical to start early?
Example $\rightarrow$ Thrips life cycle and BCA target!

- **Egg** (In leaf tissue)
- **Larva 1 & 2** (on plant $\rightarrow$ exposed)
- **Pupa** (in soil)
- **Adult** (on plant $\rightarrow$ exposed)

68°F  6 days  3 + 3 days  6 days  up to 60 days
Thrips life cycle and BCA target!

- **Egg** (In cell tissue)
- **Larva** 1 & 2 (on plant → exposed)
- **Pupa** (in soil)
- **Adult** (on plant → exposed)

**Temperature and Duration**

- **68°F**:
  - Egg: 6 days
  - Larva: 3 + 3 days
  - Pupa: 6 days
  - Adult: up to 60 days

- **86°F**:
  - Egg: 3 days
  - Larva: 1.5 + 1.5 days
  - Pupa: 3 days
  - Adult: 20 - 40 days
**Thrips life cycle and BCA target!**

- **Egg**
  - (In cell tissue)

- **Larva**
  - 1 & 2
  - (on plant → exposed)

- **Pupa**
  - (in soil)

- **Adult**
  - (on plant → exposed)

- **Amblyseius spp** (L1 only)
- **Orius insidiosus**
- **Steinernema feltiae**

**Temperature and Life Cycle Durations**

- 68°F: 6 days → 3 + 3 days → 6 days → up to 60 days
- 86°F: 3 days → 1.5 + 1.5 days → 3 days → 20 - 40 days

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*Bioline AgroSciences*
Thrips life cycle and BCA target!

- **Egg** (In cell tissue)
- **Larva** 1 & 2 (on plant \(\rightarrow\) exposed)
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- **Adult** (on plant \(\rightarrow\) exposed)

- **68°F**: 6 days
- **86°F**: 3 days
- **3 + 3 days**: 1.5 + 1.5 days
- **6 days**: 3 days
- **up to 60 days**: 20 - 40 days

**Species Targeted**:
- Amblyseius spp
- Orius insidiosus
- S. feltiea
- Hypoaspis miles
- Atheta coriaria
  - (side effect)
- Orius insidiosus
- S. feltiea

**Bioline AgroSciences**
**Thrips life cycle and BCA target!**

- **Egg** (In cell tissue)
  - 68°F: 6 days
  - 86°F: 3 days

- **Larva 1 & 2** (on plant → exposed)
  - 3 + 3 days
  - 1.5 + 1.5 days

- **Pupa** (in soil)
  - 6 days
  - 3 days

- **Adult** (on plant → exposed)
  - up to 60 days
  - 20 - 40 days

- **Amblyseius spp**
- **Orius insidiosus**
- **S. feltiea**
- **Stratiolaelaps scimitus** *(Hypoaspis miles)*
- **Dalotia coriaria** *(Atheta coriaria)*
- **Orius insidiosus**
- **S. feltiea**

- Fecundity in vegetative stage vs when pollen is available
- Fecundity in different crops
What about Thrips and vectoring virus?

- Adult
  - Oviposition
- Egg
  - Eclosion
- 1st instar
  - Acquires TSWV
  - Moulting
- 2nd instar
  - Moulting
- Pupa
  - Emergence
  - Moulting
- Pre-pupa
  - Under the ground
  - Moulting
- TSWV
  - Transmits TSWV
  - Acquires TSWV
What is changing in ornamental cutting production?
Pest management and residues:

- More growers requesting information, especially those who are implementing BCA’s European regulations – residues (changed Jan 2015)
- Better future for ‘cleaner’ cuttings
- Bio-control and IPM at cutting production locations
- Bio-control / IPM at rooting stations
- Greater chance of success for end product growers

- Abamectin (Avid®)
- Buprofezin (Talus®)
- Fenazaquin (miticide)
- Pyridaben (Sanmite®)
- Pyriproxifen (Distance®)
- Spinosad (Conserve®)
- Spiromesifen (Judo®)
- Thiacloprid (neonic)
- Thiamethoxam (Flagship®)
- Novaluron (Pedestal®)

- Acephate (Orthene®)
- Acetamiprid (Tristar®)
- Bifenthrin (Talstar®)
- Clothianidin
- Cyfluthrin (neonic)
- Imidacloprid (Marathon®)
- Lambda-cyhalothrin
- Methamidiphos (Monitor®)
- Methomyl (Lannate®)
- Omethoate
- Oxamyl (Vydate®)
Implementing BCA’s in pest management programs:

(Syngenta FHG site Gilroy, California)
Amblyseius spp (Amblyline Stick) starting in propagation
(Syngenta FHG site Gilroy, California)
Amblyseius spp (Amblyline Stick) starting in propagation
(Syngenta FHG site Gilroy, California)
Amblyseius cucumeris and Amblyseius swirskii (Amblyline and Swirskiline Stick) starting in propagation (Syngenta FHG site Gilroy, California)
Releasing *Phytoseiulus persimilis* for Two Spotted Spider Mite control: (Syngenta FHG site Gilroy California)
Releasing *Amblyseius swirskii* (Bugline) on Chrysanthemum stock plants (*Syngenta FHG site Alva, Florida*) for thrips and broad mite control
Releasing *Phytoseiulus persimilis* for Two Spotted Spider Mite control: *(Syngenta FHG site, Alva, Florida)*
Biological Control & IPM at poinsettia stock plant site: *(Syngenta FHG site, Pollen, Kenya)*
Biological Control & IPM in poinsettia stock plants: (KubePak, Allentown, NJ)

Experience at KubePak in NJ:

• Trouble in 2011 season on stock plants with Whitefly → first signs of pesticide resistance → Motivation to make a change!!!
• 2012 - 2015 BCA program on stock plants
• Started immediately with program in April 2012

General approach:

• All URC were dipped prior to sticking
• Started immediately with release of Encarsia formosa and Eretmocerus eremicus) van April tot Augustus 1st
• 1 sachet of A. swirskii / 6 stock plants in May (plant contact)

Results:

• Visually no signs of whitefly on stock plants
• ‘Clean’ cuttings (whitefly AND pesticides)
Biological Control in Spring Plugs / Propagation:

More locations this spring:
Sachets on Stick

1. **Fits easily in every seed tray** by narrow stick
2. **No fungal growth** as stick doesn’t absorb water
3. **Easy to recognize** by specific paper color and clear description of mite species
4. **Waterproof** by seals and paper
5. **Hole is protected from water** by fold
6. **No closure of the hole** as stick is not central
7. **Sachet can’t fall off** the stick by fold
8. **Transparency of product information** by QR code for consumer and customer
9. **Consumer information**: “Contents non harmful/eco-friendly!”
10. **Easy handling** as there are strips of 6 sachets

**Other benefits:**

- **Crops in trays can be mown** as sachet is just 6 cm high
- **Available** with *A. cucumeris* and *A. swirskii*
Ornamental Propagation – ‘a pro active approach’:

Seed and RC plug trays at rooting stations

- Typical potential pest problems → Fungus Gnats, Thrips, Aphids are most common

BCA’s used during propagation:

- *Amblyseius cucumeris* (sachet on stick)
- *Hypoaspis miles / Stratiolaelaps scimitus* (Hypoline™)
- *Atheta coriaria / Dalotia coriaria* (Staphyline™)
- *Steinernema feltiea* (Exhibitline™ sf)
- *Aphidius colemani* (with banker plants)
Implementing banker plants systems and habitat planting?
Banker plants:

What is a banker plant?

- A banker plant is the introduction of a plant that is a host plant for a BCA.
- Sometimes a banker plant would host an alternative host that is not affecting the crop grown, but still an excellent host for the BCA(s)

What are the current practical applications?

- Aphid banker plants in many different crops → Production of Aphid parasite *Aphidius colemani* – Aphiline c
- Pepper plants → support of *Orius insidiosus* – Oriline i
- Mullein plants → support of *Dicyphus hesperus* - Hesperline
Banker plants

Why banker plants?
- Better efficacy!! → Higher #’s of BCA compared to releases
- Sustainability and efficiencies
- Short term crops, long term BCAs!
- Difficult crops to establish BCAs
- Threshold levels (lower in ornamental crops)
- Growers grow plants → relation between growing plants and beneficial insects
- Excellent educational tool
- Not a ‘new’ system

What to keep in mind with Banker plant systems:
- It is **NOT** a stand alone system → Part of a strategy
- It is not suitable for every crop setting
- System that needs to be taken seriously. Success depends on implementation
- It takes time and effort, but there are rewards!
Aphid banker plants
Aphid banker plants

Important to know about Aphid banker plants:

• Understand the technique (it is not just a matter of seeding some pots with barley or wheat!!!) Growers who do their own, protect the bankers!
• Apply properly → use the correct rate of banker plants → start with 2 per acre and maintain with a minimum of 1 per acre bi-weekly
• It is a system that needs continuity
• Release *Aphidius colemani* – Aphiline™ c - weekly for the first 4 to 5 weeks until *Aphidius* population is established.
• Maintain system properly (watering etc.)
• Many growers hang bankers along main walk way. Hanging baskets seems to be working best.
• Monitor system → watch for other BCAs showing up (usually spring time) and hyper parasites (late summer)
• Watch aphid species showing up in greenhouse (*Aphidius colemani* only effective against green peach and black melon aphid)!
Pepper Banker and Orius plants in action in cucumber production:
Looking for Orius!

Looking for Orius!
Orius Banker Plants

What are the key considerations for a successful Orius banker system?

- Start pepper seedlings early (late October, early November)
- Black Pearl variety has been replaced by Purple Flash (38% better reproduction of Orius → More consistent flowering/pollen)
- If you buy in seedlings…..are there any pesticide residues?!?!
- Focus on 100 plants per acre
- Use an aphid banker system in the same facility → aphid control can affect the Orius development (pesticides)
- Release Amblyseius cucumeris (sachet) on the pepper bankers
- Late February start Orius introductions. 1 Orius per banker plant weekly for 4 to 6 weeks. NOTE: Orius likes warmer temperatures (>66F)
- Feed Orius with Ephestia eggs – Bugfood - increases egg laying
- Start checking bankers around mid April → Tapping the plants
- Look for Orius nymphs (5 nymph stages) → Reproduction
- Maintain the system (watering and pruning)
- Don’t throw out the parts you pruned off right away!
Oriline i – *Orius insidiosus*
Mullein Plants in Tomato Crop
**Dicythus hesperus and Mullein plants**

Application of *Dicithus hesperus* with Mullein:

- Use of Mullein banker plants
- 40 plants per acre
- Find a good spot for Mullein plants in the greenhouse
- Start Mullein plants early (10 to 12 weeks before planting the main crop) → they are slow growers
- Early introductions → start in January
- 8 introductions of 3 to 4 *Dicythus* per mullein plant (weekly)
- During introductions and one month after → feeding with *Ephestia* (BugFood) on Mullein plants
- Mullein plants are now produced for growers by some propagators
- Between 3 and 4 weeks first nymphs should be found, but complete establishment takes much longer → patience
Dicyphus hesperus – Hesperusline
Habitat planting, taking biological control outdoors
Habitat planting:

- Taking banker plant experiences outdoors
- Crop value of agricultural crops → cost of pest management program → taking bio-control outside
- Using banker plants in the field to ‘kick start’ BCA’s outdoors
- Growing banker plants for outdoor crop settings
- Resistance issues outdoors
- Creating ‘barrier’ around greenhouse facilities to limit outside pressure
- Experiences in outdoor perennials, strawberry and outdoor ornamental production
- 1 row/bed per acre
Habitat planting around the greenhouse:
Habitat planting in the field (Lilly production):
Habitat planting in outdoor (& indoor) strawberry production:
Habitat planting in outdoor ornamental production:
(Syngenta FHG site Gilroy California)
Habitat planting in outdoor ornamental production:
(Syngenta FHG site Gilroy California)
Habitat planting in outdoor ornamental production:
(Syngenta FHG site Gilroy California)
What does it take to be successful?
Implementing Bio-control → Important messages for success:

• On-going education, knowledge, communication and networking
• Start as early as possible, even before the crop has started → Planning!
• Pro-active approach → insurance = success rate
• Understand life cycle of both pest and BCA
• Systems approach → don’t let efforts on one pest to be torpedoed by another
• Check compatibility if/when a traditional product is considered
• Communicate → with young plant material suppliers
• Communicate → with specialists and other growers who are successful
• Communicate with producer/supplier of BCAs
• Consider banker plants as part of your strategy
Bioline App:

Information on Bioline App:

- Apple, Android and Microsoft compatible
- Compatibility data
- Trade name and A.I.
- Technical information per pest, BCA and strategies
- Free download from app store
Bioline App:

PREVENTATIVE

Eretline Blister
RATE: 4 / m²  Retreat Interval: 1 Week

Comments: Products should be used in combination.

CURATIVE

Eretline Blister
RATE: 10 / m²  Retreat Interval: 1 Week

Encarsia formosa
Phytoseiulus persimilis
Eretmocerus Spp
Biological control is preventing problems, not fixing them!

Bio-control works!

It is people (managing) that makes bio-control an effective strategy!
Thank You!

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