Biological Control Developments at a Global Level

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inVivo

Cooperation
adds value

BIOTOP

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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

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Changing to Bio-Control

When a grower wants to do less of this …….

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Changing to Bio-Control - Broadcasting *Amblyseius cucumeris*

…and do more of this…….

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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…….

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Changing to Bio-Control –*Aphidius colemani* (here with aphid banker plant)

... or this..

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Changing to Bio-Control: Banker plants to support BCA's

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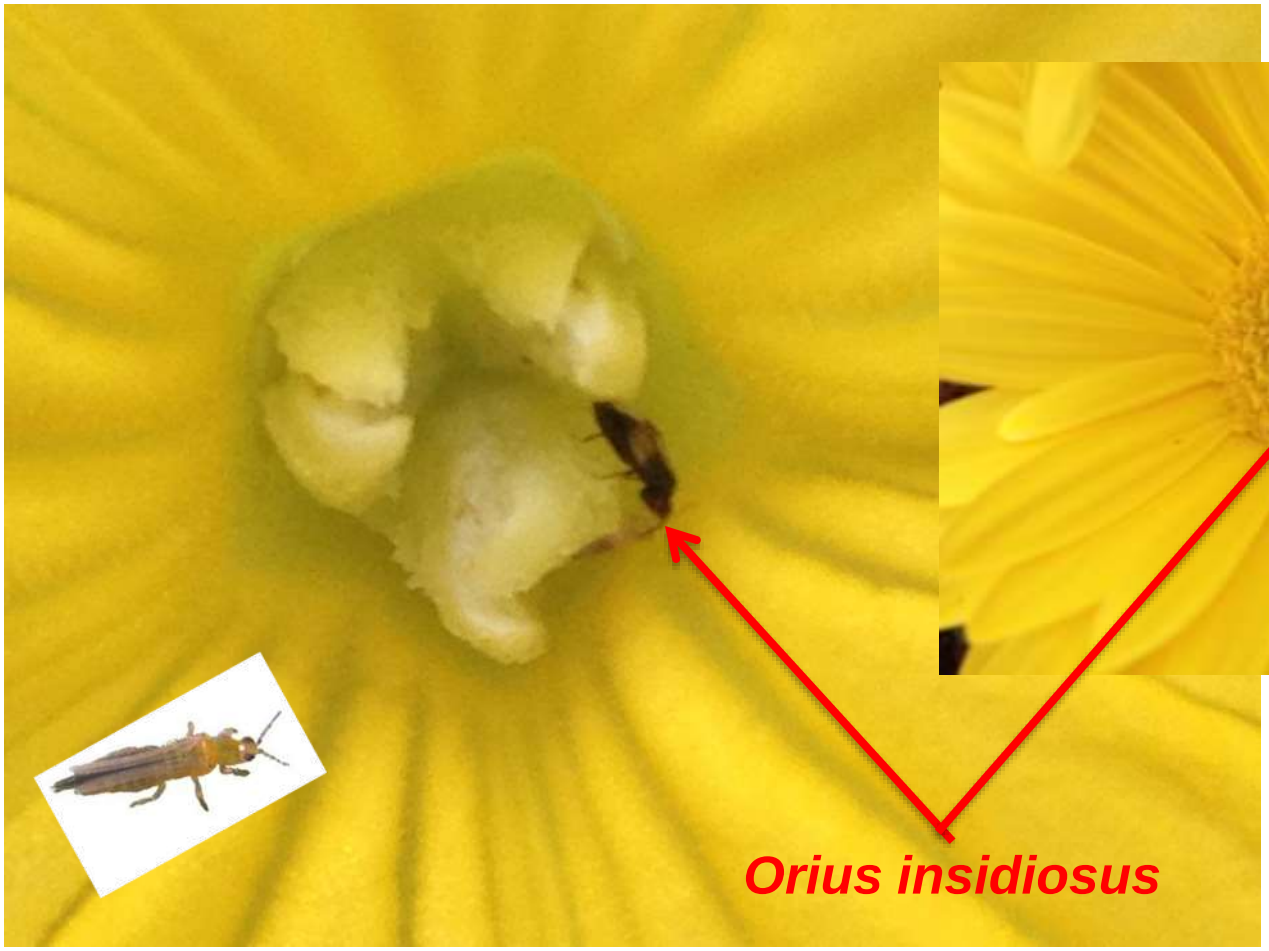
Orius insidiosus - thrips – and banker plants:



Orius insidiosus

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Changing to Bio-Control – applying nematodes

….. or this…..

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Changing to Bio-Control - Dipping

….. or this…..

Changing to Bio-Control – Banker plants

….. and use it as a marketing tool (retail)…..

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Changing to Bio-Control → in retail garden center.

….. and use it as a marketing tool (retail)…..

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Why do growers change to biological control?

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Efficacy problems → Pesticide resistance:

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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

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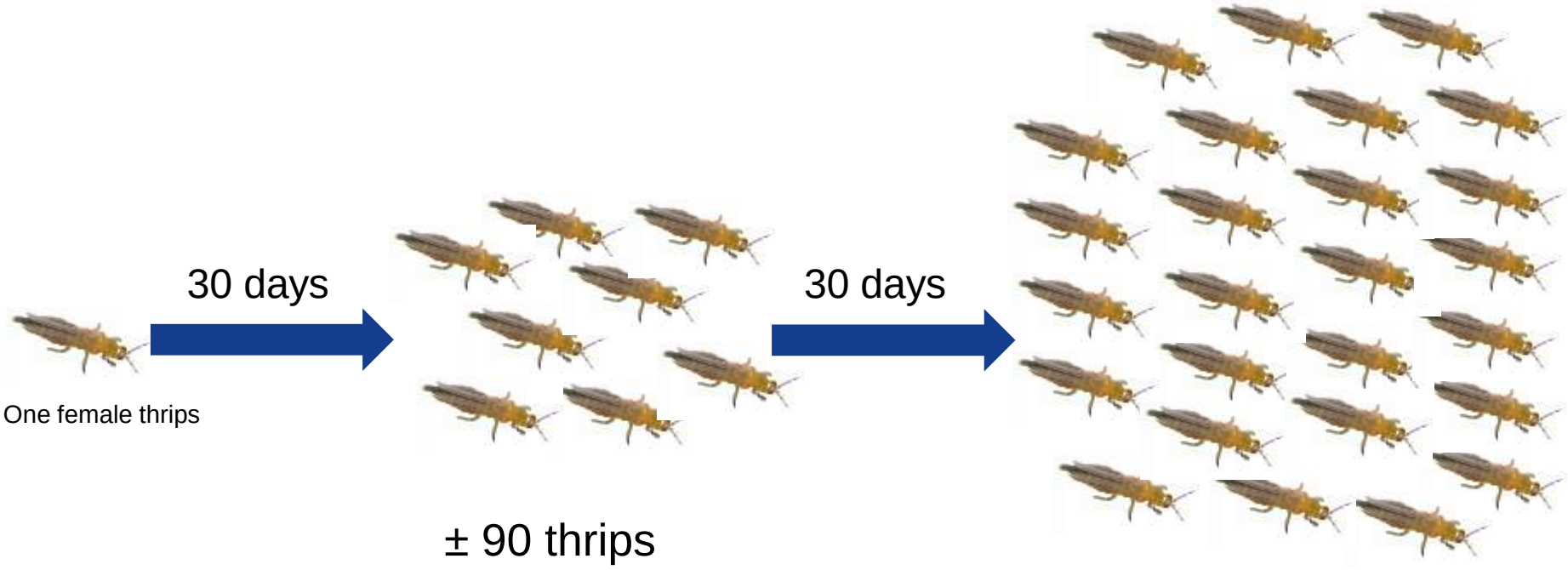
What are the reasons bio-control fails?

Development of thrips in 60 days (at 68°F)



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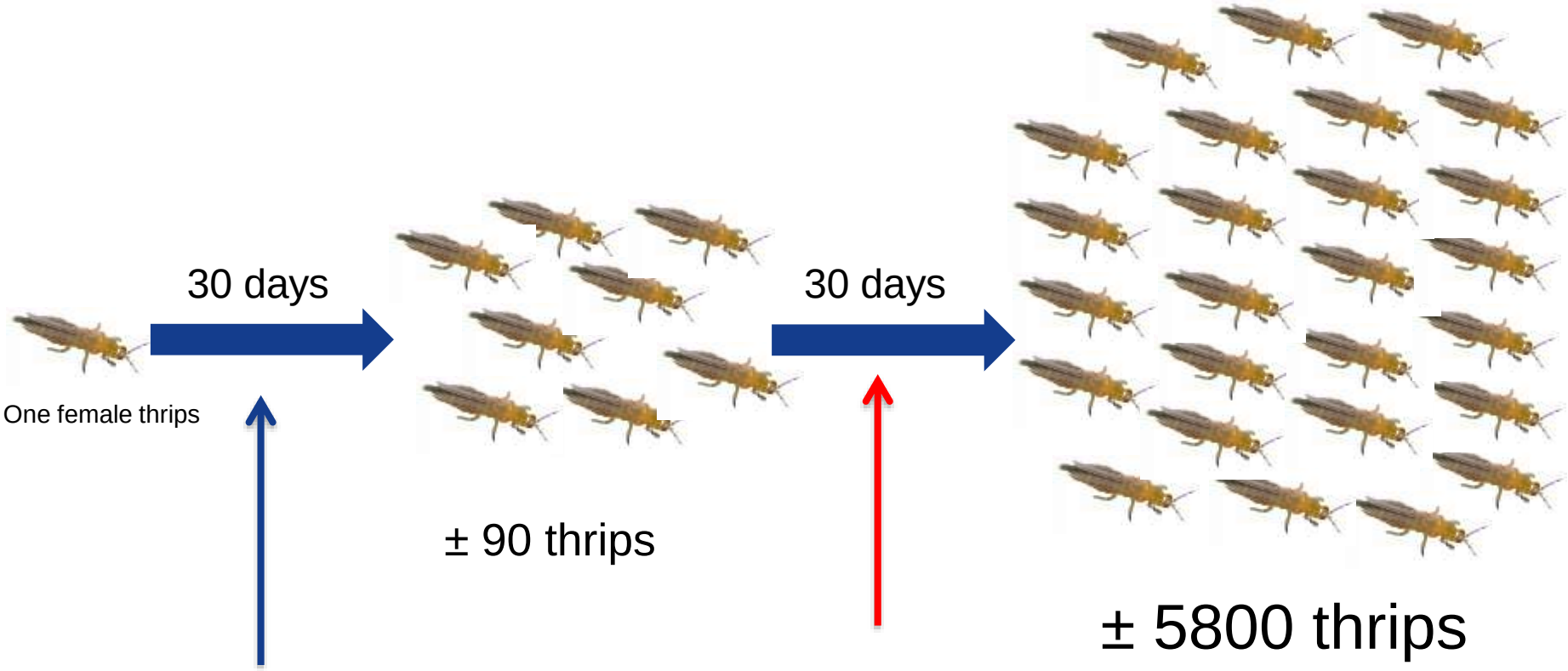

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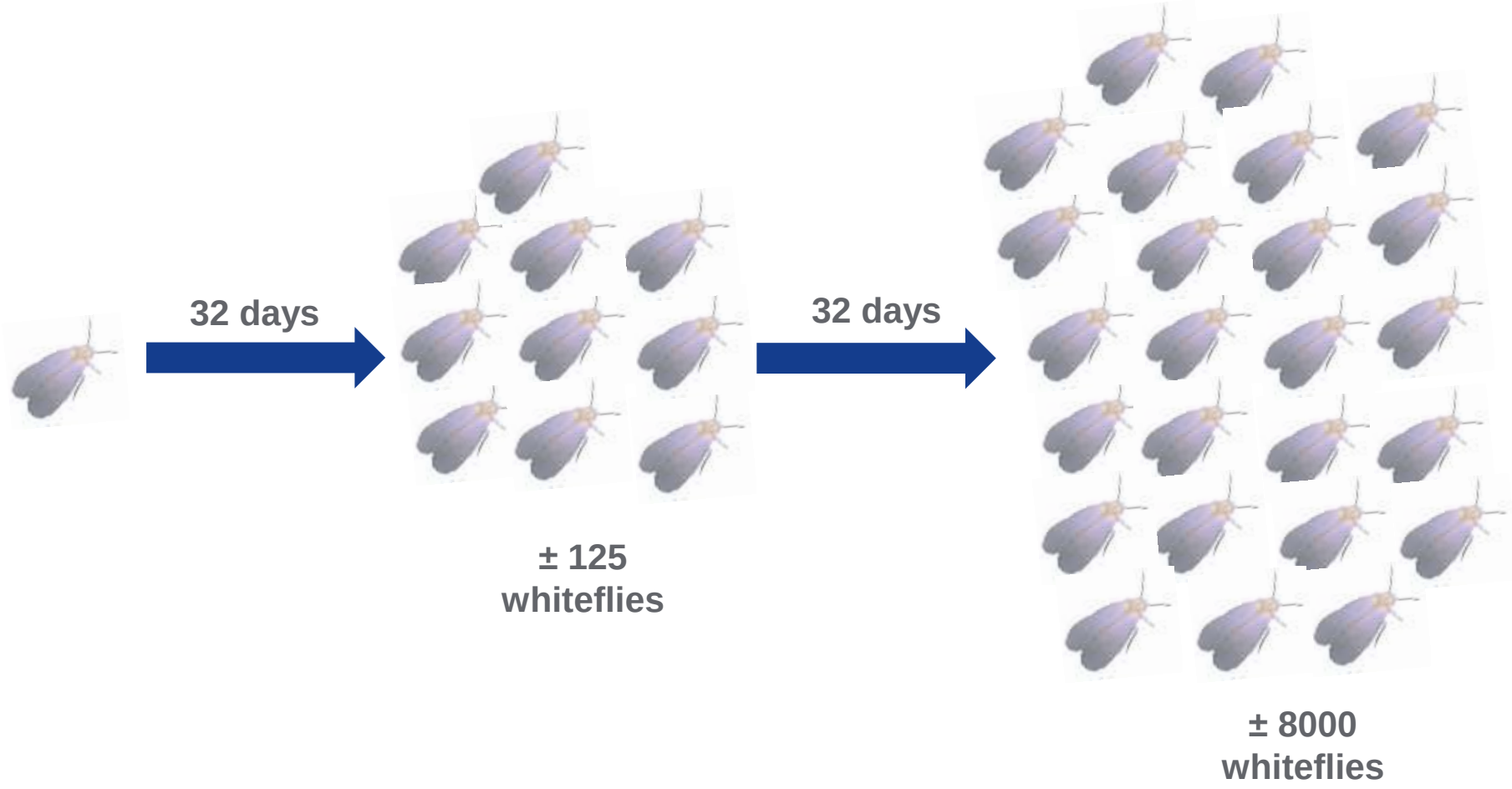
STARTING POINT → Development of Whitefly in 64 Days

(at 20°C/68°F on Tomato)



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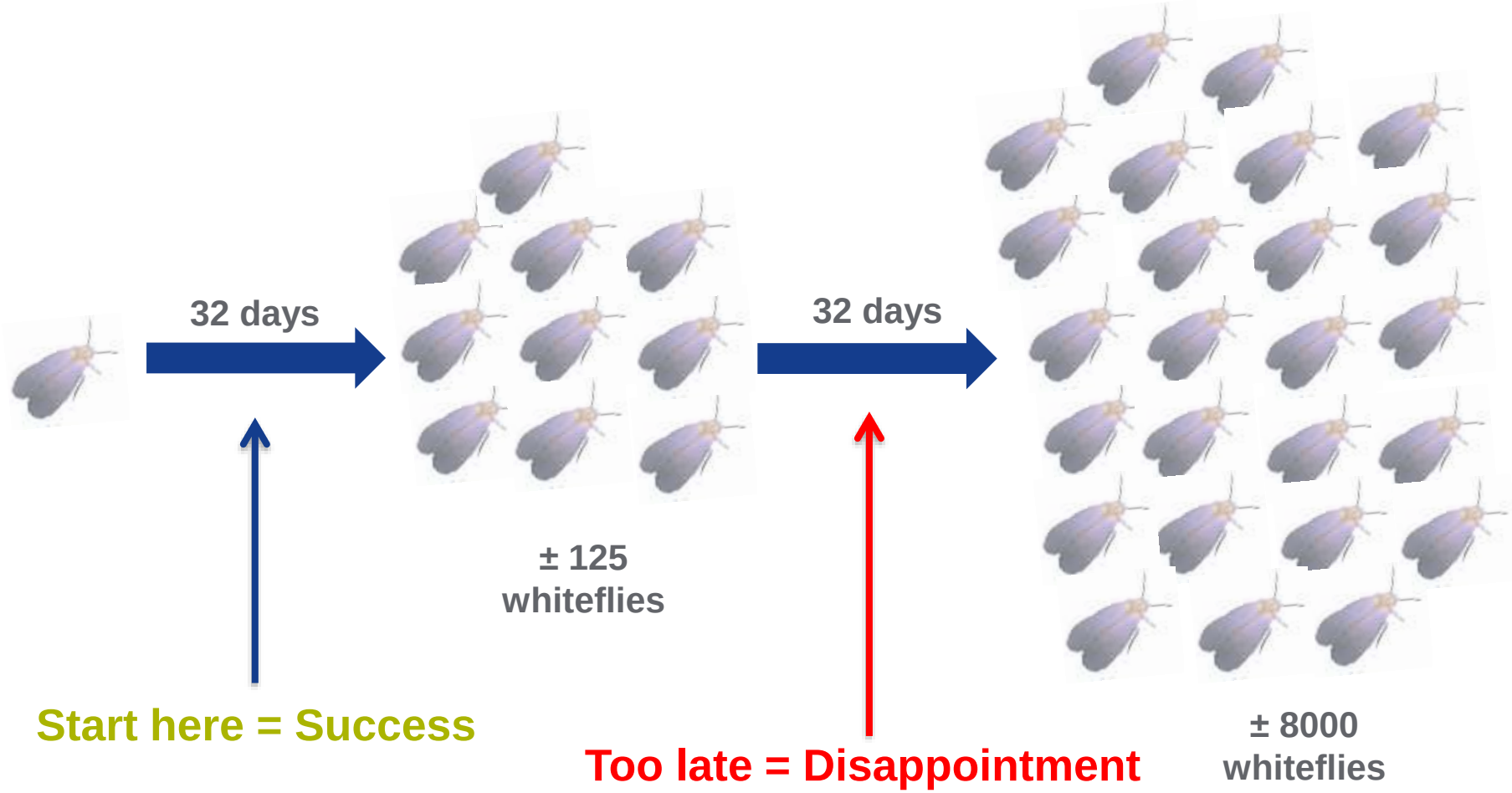

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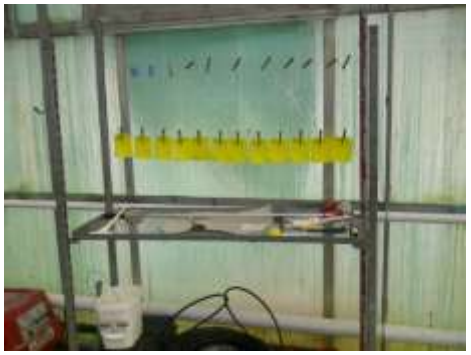
Reasons for biological control to fail:



- 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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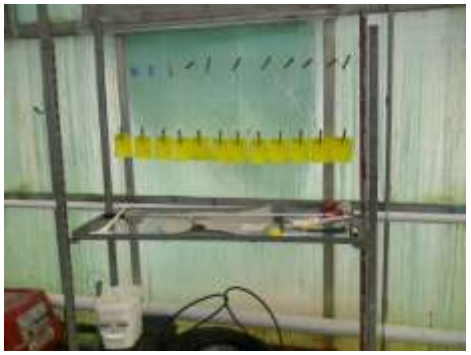
Reasons for biological control to fail:



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Should I spray or should I not?

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Should I spray or should I not?

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 to10
- 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

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Sachets with Predatory Mites

- Bran mites vs Predatory mites:

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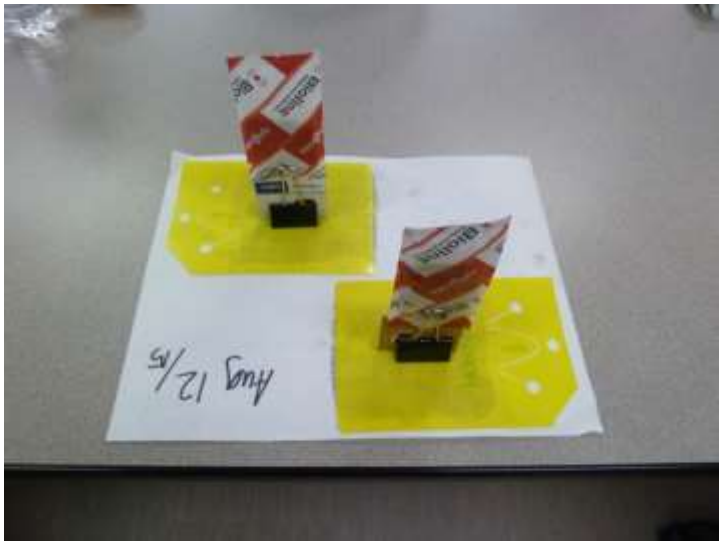
Sachets with Predatory Mites

- 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



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What is a ‘clean’ plant or cutting?

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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

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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)

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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

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Starting early → Why is it critical to start early?

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Example → Thrips life cycle and BCA target!

Egg
(In leaf tissue)

Larva
1 & 2
(on plant → exposed)

Pupa
(in soil)

Adult
(on plant → exposed)

68°F 6 days 3 + 3 days 6 days up to 60 days

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Thrips life cycle and BCA target!

Egg
(In cell tissue)

Larva
1 & 2
(on plant → exposed)

Pupa
(in soil)

Adult
(on plant → exposed)

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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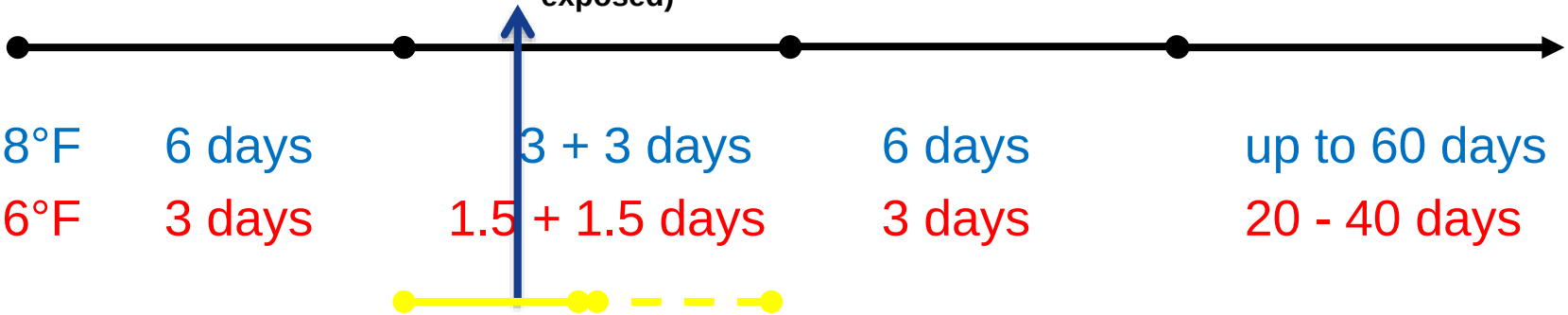

68°F	6 days	3 + 3 days	6 days	up to 60 days
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Amblyseius spp (L1 only)
Orius insidiosus
Steinernema feltiea

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Thrips life cycle and BCA target!

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Amblyseius spp
Orius insidiosus
S. feltiea

Hypoaspis miles
Atheta coriaria
(side effect)

Orius insidiosus
S. feltiea

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Thrips life cycle and BCA target!

Egg
(In cell tissue)

Larva
1 & 2
(on plant → exposed)

Pupa
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Adult
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	Egg	Larva 1 & 2	Pupa	Adult
68°F	6 days	3 + 3 days	6 days	up to 60 days
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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

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What about Thrips and vectoring virus?

Adult

Egg

1st instar

2nd instar

Oviposition

Eclosion

Moulting

Transmits TSWV

Acquires TSWV

Pupa

Pre-pupa

Under the ground

Emergence

Moulting

Moulting

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What is changing in ornamental cutting production?

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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®)

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Implementing BCA's in pest management programs:

(Syngenta FHG site Gilroy, California)

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Amblyseius spp (Amblyline Stick) starting in propagation

(Syngenta FHG site Gilroy, California)

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Amblyseius spp (Amblyline Stick) starting in propagation

(Syngenta FHG site Gilroy, California)

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Amblyseius cucumeris and *Amblyseius swirskii* (Amblyline and Swirskiline Stick) starting in propagation *(Syngenta FHG site Gilroy, California)*

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Releasing *Phytoseiulus persimilis* for Two Spotted Spider Mite control: *(Syngenta FHG site Gilroy California)*

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Releasing *Amblyseius swirskii* (Bugline) on Chrysanthemum stock plants *(Syngenta FHG site Alva, Florida)* for thrips and broad mite control

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Releasing *Phytoseiulus persimilis* for Two Spotted Spider Mite control: *(Syngenta FHG site, Alva, Florida)*

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Biological Control & IPM at poinsettia stock plant site: *(Syngenta FHG site, Pollen, Kenya)*

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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)

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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/ecofriendly!"
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*

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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?

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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 implementaton
- It takes time and effort, but there are rewards!

Aphid banker plants

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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)!

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Pepper Banker and Orius plants in action in cucumber production:

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!

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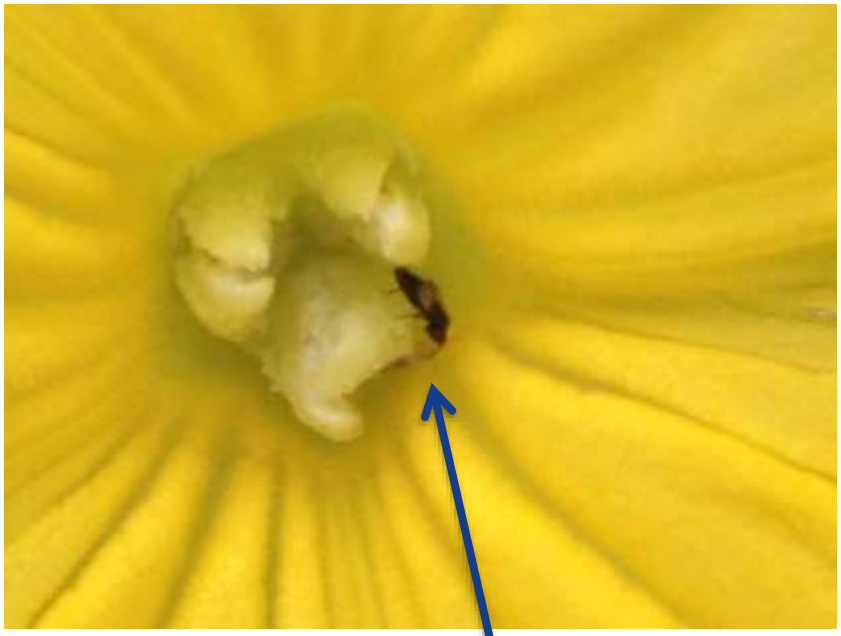
Oriline i – *Orius insidiosus*



Orius insidiosus

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Mullein Plants in Tomato Crop

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Dicyphus hesperus and Mullein plants

Application of Dicyphus 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 *Dicyphus* 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

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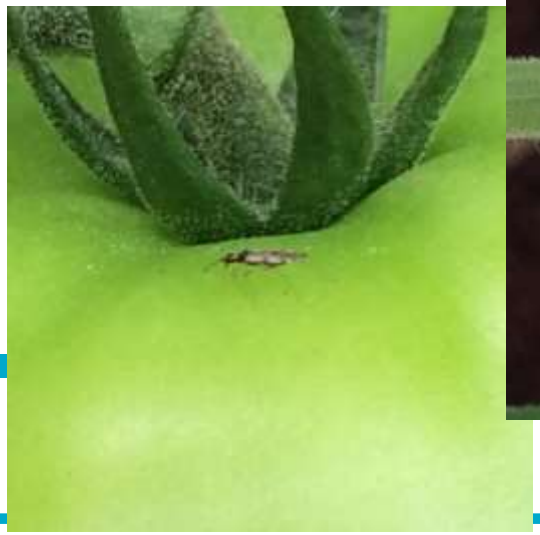
Dicyphus hesperus – Hesperusline



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Habitat planting, taking biological control outdoors

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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

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Habitat planting around the greenhouse:

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Habitat planting in the field (Lilly production):

Habitat planting in outdoor (& indoor) strawberry production:

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Habitat planting in outdoor ornamental production:
(Syngenta FHG site Gilroy California)

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Habitat planting in outdoor ornamental production:
(Syngenta FHG site Gilroy California)

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Habitat planting in outdoor ornamental production:

(Syngenta FHG site Gilroy California)

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What does it take to be successful?

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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

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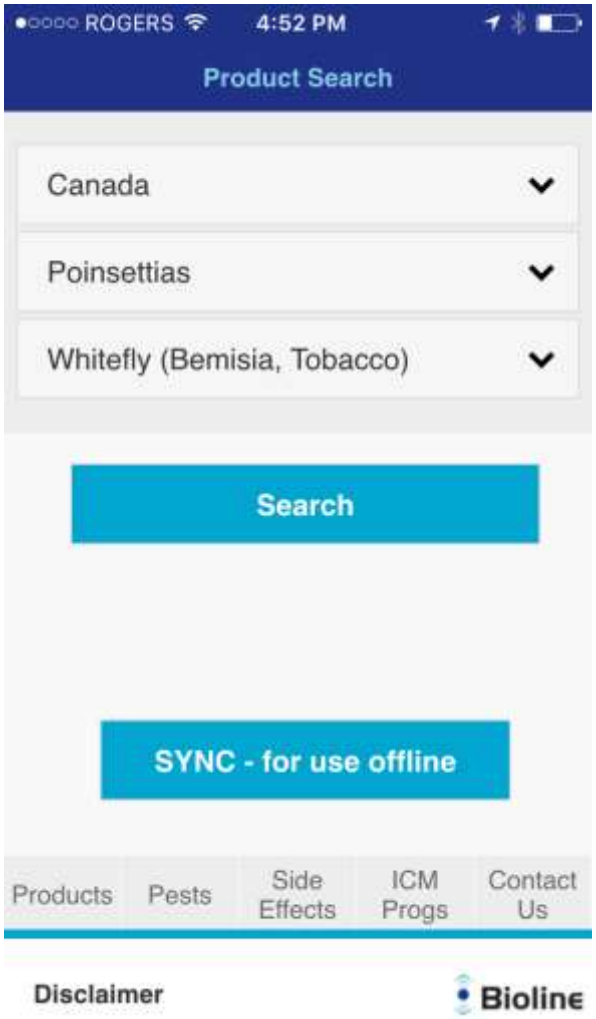
Bioline App:

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



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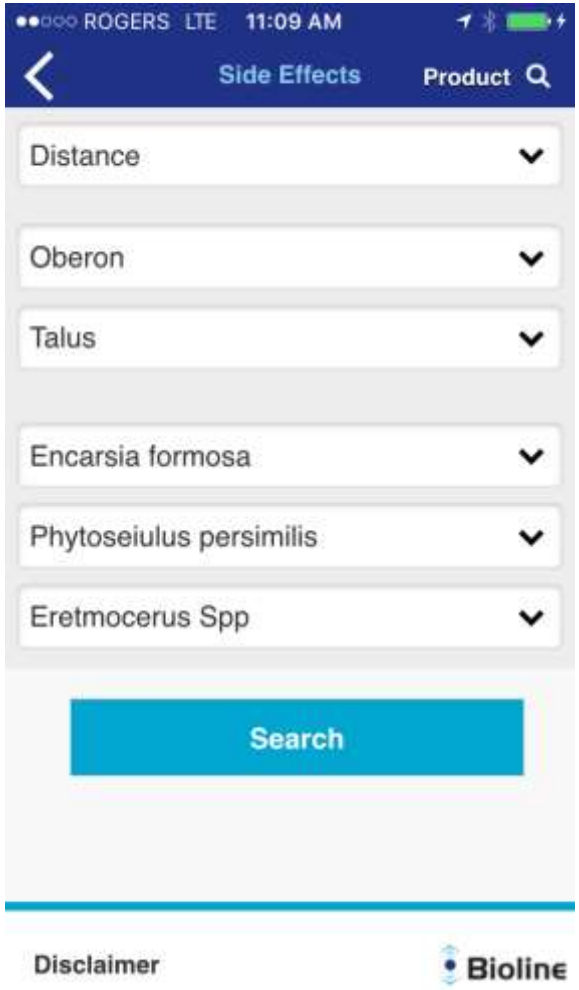

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Biological control is preventing problems, not fixing them!

Bio-control works!

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

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Thank You!

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