Biological Control in Ornamental Propagation

Ronald Valentin
Biological Crop Protection Specialist
Technical Trainer and Coordinator
Biobest USA Inc.
Biobest Canada Ltd
Rvalentin@biobest.ca
Propagation to finish products:

- Breeders → Stock plant production world wide (for example Dummen, Selecta and others..)

- Rooting Stations → in USA and Canada (too many to mention)

- Growers of finished products

How many of each of these groups are here today?
What is a ‘clean’ cutting or plant?
ZERO tolerance……..is it possible?:
History of cuttings/plugs/plants is **VERY** important:

- “Clean” → Pest levels
- “Clean” → Residues of pesticides
- Resistance development down the chain!
- Producers of cuttings/Breeders → their actions can affect growers program → ‘Clean’ plugs / plants are important
- Grower to breeders and propagators → growers reaction can trigger their actions.
- Communication breeder ←→ propagator ←→ grower
- It is not a blaming game!
Pesticide overuse (abuse?) to try to attempt ‘zero tolerance’ can contribute to pesticide resistance of pest problem limiting the available tools in the tool box.
How ‘clean’ are cuttings when they come in?
No hitch hikers?

With thanks to Wendy Romero, U. of Guelph, Ontario, Canada and Flowers Canada!
Reason for Wendy Romero’s work at U of Guelph:

• Growers experiencing problems with thrips → Pesticide resistance and high # of thrips earlier in the crop
• Problems year round at potted and cut chrysanthemum growers
• Problems with spring crop growers
• Growers experiencing problems with BCA’s not establishing and keeping up with pest problems
• Biological control is not fixing problems but preventing problems
• Both growers using BCA’s or traditional pest management programs were having problems managing thrips….
Wendy Romero’s work at U of Guelph (Hitchhikers on Mum Cuttings):

• Followed incoming cuttings at potted mum grower from supplier for 8 months (January to August)
• Sampled every 2 weeks
• 5 varieties
• Cuttings where washed out in Ethanol (Adults and Larva)
• **Not one** sample had zero thrips
• Number of thrips were as high as 3 Adult thrips per cutting and even more L1 and L2
• This is visually almost not detectable!
Average number of adults and immature per sample per cultivar

- Chesapeake
- Kory
- Olympia
- Brighthon
- Pelee

**Chrysanthemum cultivar**
Wendy Romero’s work at U of Guelph (Hitchhikers on Mum Cuttings):

• A more interesting challenge was the number of pesticides and frequency of applications used on these stock plants to attempt to achieve ‘zero tolerance’

• International travel of plant material bring pest problems with it as zero tolerance is hard to achieve (if not impossible)…..but also the pests can be resistant to pesticides as well!
How ‘clean’ are cuttings when they come in?

What about pesticide residues?
“clean” cuttings & plugs

History of cuttings/plugs important?:

- Dutch research → Pesticide residues on cuttings
- WHY? → suspicion that pesticide are limiting factor for ornamental growers to implement bio-control successfully!
- Example: Poinsettia in Europe in 2009 → Methomyl (Lannate) used on stock plants outside Europe
- Results in 39 samples taken: Total residues → 302. Considered compatible → 115; somewhat compatible → 55; None compatible → 132
- Residues includes pesticides that are no longer registered in USA and Canada
- Worker safety issues? → Handling / sticking of cuttings & pesticide residues
Poinsettia- cutting production

Pesticide usage on Poinsettia stock plants? (2012):
- Cuttings collected at 10 greenhouse operations
- 24 A.I. of pesticides found
- also 20 A.I. of fungicides found

<table>
<thead>
<tr>
<th>Pesticide Name</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>Abemectine (Avid)</td>
<td>x1 0.01</td>
</tr>
<tr>
<td>Acephate (Orthene)</td>
<td>x1 0.24</td>
</tr>
<tr>
<td>Acetamiprid (Tristar)</td>
<td>x3 0.11 - 0.30</td>
</tr>
<tr>
<td>Bifenthrin (Talstar)</td>
<td>x5 0.38 - 5.2</td>
</tr>
<tr>
<td>Buprofezin (Applaud)</td>
<td>x2 0.01 - 0.04</td>
</tr>
<tr>
<td>Clothianidin? (neonic)</td>
<td>x4 0.03 - 0.37</td>
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<tr>
<td>Cyfluthrin (SP)</td>
<td>x1 0.75</td>
</tr>
<tr>
<td>Cyromazine (Citation)</td>
<td>x1 0.15</td>
</tr>
<tr>
<td>Fenazaquin (miticide)</td>
<td>x4 0.05 - 0.16</td>
</tr>
<tr>
<td>Flonicamid (Beleaf)</td>
<td>x4 0.10 - 0.21</td>
</tr>
<tr>
<td>Imidacloprid (Intercept)</td>
<td>x8 0.03 - 1.4</td>
</tr>
<tr>
<td>Lambda-cyhalothrin (SP)</td>
<td>x1 0.11</td>
</tr>
<tr>
<td>Methamidiphos (Monitor)</td>
<td>x1 0.02</td>
</tr>
<tr>
<td>Methomyl (Lannate)</td>
<td>x1 0.01</td>
</tr>
<tr>
<td>Novaluron (Pedestal)</td>
<td>x1 0.02</td>
</tr>
<tr>
<td>Omethoate (insecticide)</td>
<td>x1 0.05</td>
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<tr>
<td>Oxamyl (Vydate)</td>
<td>x1 0.09</td>
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<tr>
<td>Pymetrozine (Endeavor)</td>
<td>x5</td>
</tr>
<tr>
<td>Pyridaben (DynoMite)</td>
<td>x5 0.03 - 5.2</td>
</tr>
<tr>
<td>Pyriproxifen (Distance)</td>
<td>x6 0.04 - 0.15</td>
</tr>
<tr>
<td>Spinosad (Success)</td>
<td>x1 0.04</td>
</tr>
<tr>
<td>Spiromesifen (Forbid)</td>
<td>x5 0.11 - 8.7</td>
</tr>
<tr>
<td>Thiacloprid (neonic)</td>
<td>x1 0.02</td>
</tr>
<tr>
<td>Thiamethoxam (Flagship)</td>
<td>x4 0.01-0.26</td>
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Poinsettia- cutting production

- Very high pesticide usage → trying to achieve zero tolerance!
- Resistance development due to over use of pesticides?
- Problems world wide
- Zero tolerance is NOT achieved
- Pesticide residues are difficult for growers who are using biological control
- Residue testing!
- Cutting producers → IPM strategy?
- Yoder (producing for Ecke farms) already used BCA approach in 2002 – 2003 → Increased cutting production by 7%
Poinsettia - Can it be done differently?

Experience at KubePak in NJ:
• Kubepak Farms
• 2012 BCA program on stock plants
• Started immediately with program in April 2012
• Whitefly was present on cuttings arriving in April

General approach:
• All un-rooted cuttings were dipped prior to sticking
• Started immediately with release of *Encarsia formosa* and *Eretmocerus spp*
  van April tot Augustus 1st
• 1 sachet of A. swirskii / 6 stock plants in May (plant contact)
• 2014 season *Amblyseius swirskii* and Nutrimite food supplement

Results:
• Whitefly level very low on sticky cards
• Visually no signs of whitefly on stock plants
• ‘Clean’ cuttings (whitefly AND pesticides)
• Used BCA approach 2012, 2013 and 2014

9/19/2014
Poinsettia - cutting production

Kubepak 2012, 2013 and 2014
Poinsettia’s → From beginning to the end…

Start WF control in stock plants….

…Continue in propagation….

…seamless connection in early crop….

…and arrive ‘clean’ at the finish line!
Which pesticides are compatible and / or have a short residual effect?
• Compatible with MOST biological control agents???
• Chain is as strong as the weakest link
• ‘slippery slope’
• full house treatment can trigger the ‘beginning of the end’
• There are very few truly compatible products in the sense that they are completely compatible with all BCA’s
• Check out the side effect list at www.biobest-usa.com
• Also available as mobile application (i-phone, blackberry...)

Compatible with MOST/SOME biological control agents!!!

Looks complicated ????

Compatible with BCA's?

- A. swirskii
- Eretmocerus eremicus
- Encarsia formosa
- Delphastus spp
- Aphidius spp
- Aphidoletes aphidimyza
- Feltiella acarisuga
- Phytoseiulus persimilis
- Diglyphus isaea
- Orius insidiosus

Compatible
Not compatible
Risky
Something to think about?:

- Propagation that includes (frequently applied) pesticides does **not guarantee** that the young plants/cuttings are free of insects and mites.
- Propagation that includes BCA’s **does not mean** that young plants are having intolerable numbers of insects and mites.
- Propagation that includes BCA’s might mean that young plants have BCA’s already on them at arrival.
- Propagators using long residual pesticides leave very limited OPTIONS for their customers, the growers to implement BCA’s.
- Propagators using selective short residual pesticides and/or BCA’s, leave the option to the grower, their customer, to either use a traditional pest management program OR a program that includes BCA’s.

There are more and more propagators that implementing strategies to leave the option open for their customers to implement BCA’s.
Cuttings and plugs that have long residual pesticides AND pest and/or pesticide resistant pest problems still present, make a difficult start for any pest management program!
“clean” cuttings & plugs

What and where can we improve in ornamental production?
What can we do to improve?:

- Give up on zero tolerance and over use pesticides
- Manage pest problems vs. eradication attempts
- Improve communication and traceability of pest management in all stages of the production process
  - breeder <-> propagator <-> grower
- Growers acceptance/tolerance
- Breeders and propagators adapt to pest management practices that include rotation of pesticides (minimize resistance development), do not use long residual pesticides, minimize pesticide use & investigate and implement BCA’s, and communicate information to the growers.
- In Europe ‘plant reports’ are becoming a procedure/standard
- Choose pesticides wisely (shorter residual products vs. long residual products)
- Learn from the greenhouse vegetable industry
What did the greenhouse vegetable industry do more than 2 decades ago?
Tomato plants in propagation → Main target Whitefly control
Pepper plants in propagation ➔ Main targets Thrips and Aphids

“clean” vegetable plants

Aphid banker plants for aphid control

9/19/2014
"clean" vegetable plants

Cucumber plants in propagation → Main targets WFT, WF and TSSM

*Amblyseius cucumeris*
ABS–mini+stake sachet for thrips control
Definition of a clean vegetable plant (tomatoes, cucumbers, peppers) today:

• Plant with minimal pest (and disease) pressure → low enough to start/continue BCA program successfully

• Some BCA’s might be found on the plants. Part of pest management of young vegetable plants includes release of BCA’s in propagation

• No long residual pesticides are applied to these vegetable plants. Some short residual pesticides are used only when necessary.

• All vegetable propagators supply customers with a ‘plant report’ that includes pest management information

The results: →

• Vegetable growers can continue their pest management program with BCA’s immediately after receiving their plants
Current status on use of IPM and BCA’s in propagation of ornamental crops
Propagation and IPM / Biological control current status:

• Several propagators rooting cuttings are implementing IPM approach for reasons of pesticide resistance and to supply a ‘clean’ plants that has no long residual pesticides on them.

• Off shore cuttings is still a lot of guess work → pest and pesticide history.

• Zero tolerance is still not achieved....

• More and more propagators/growers are interested and request info from their suppliers!!!

• Traditional or BCA approach → Resistance management.

• Not all pesticides are detrimental to BCA’s.
Experience at Harster Greenhouses 2006 – current:

• Large producer of African violets >10 million
• First attempt 2001 (did not succeed for a reason)
• Second attempt 2007 (triggered by resistance thrips)
• Have not sprayed for WFT with pesticides since early 2007
• Promote the use of BCA’s in their production process → growers who receive their plugs can start without any problems with their BCA’s (or if they choose so, can continue with their traditional program)

• Experience at Rainbow Greenhouses in Chilliwack, BC, Canada → Purchased African Violet plugs through Ball (from Harster GH) and detected *Hypoaspis miles*, *Atheta* and *Amblyseius cucumeris* in their violet production
Start Thrips control in propagation trays right after TC ....

...seamless connection in early crop....

...Continue in propagation trays....

...and arrive ‘clean’ at the finish line!
Most commonly used BCA’s in propagation stage (rooting stage):

- **Hypoaspis miles** → fungus gnats, side effect thrips pupa
- **Atheta** → Fungus gnats, shore fly, thrips pupa
- **Amblyseius cucumeris** → Thrips L1, broad mite, cyclamen mite
- **Amblyseius swirskii** → Thrips L1, broad mite, cyclamen mite, whitefly
- **Steinernema feltiae** → Thrips, Fungus gnat larva
- **Beauvaria b.** → thrips, aphids, whitefly
- **Aphidius spp** → Aphid species
- **Banker plants for Aphidius colemanii** → aphids
What can be done to limit hitch hikers and give a pest management program a better start, especially those using BCA’s?

Reduce risk
Understanding thrips and the tools to manage them is important!
Understanding thrips

Egg  
(In leaf tissue)

Larva 1 & 2  
(on plant ➔ exposed)

Pupa  
(in soil)

Adult  
(on plant ➔ exposed)
Understanding thrips

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

- **68F**
- 6 days
- 3 + 3 Days
- 6 days
- up to 60 days
### Understanding thrips

<table>
<thead>
<tr>
<th>Stage</th>
<th>Temperature</th>
<th>Duration 1</th>
<th>Duration 2</th>
<th>Duration 3</th>
<th>Duration 4</th>
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</tr>
<tr>
<td><strong>Larva (1 &amp; 2)</strong></td>
<td>86°F</td>
<td>3 days</td>
<td>1.5 + 1.5 Days</td>
<td>3 days</td>
<td>20 - 40 days</td>
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<tr>
<td><strong>Pupa</strong></td>
<td></td>
<td></td>
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<td></td>
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Understanding thrips

- Fecundity in vegetative stage of crop $\Rightarrow$ 4 – 5 eggs / female
- Fecundity when pollen available $\Rightarrow$ upto 15 eggs per female
### Understanding thrips

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- **Amblyseius spp**
- **Hypoaspis miles**
- **Orius insidiosus**
- **Atheta coriaria**
- **Steinernema f.** (side effect !)

- Fecundity in vegetative stage of crop → 4 – 5 eggs / female
- Fecundity when pollen available → 15 eggs per female
**Thrips (WFT) control**

**Egg**
- (in leaf tissue)
- 20C: 6 days
- 30C: 3 days

**Larva**
- 20C: 3 + 3 Days
- 30C: 1.5 + 1.5 Days

**Pupa**
- 20C: 6 days
- 30C: 3 days
- up to 60 days
- 20 - 40 days

**Adult**
- (on plant exposed)

- 20C: 6 days
- 30C: 3 days

- Fecundity in vegetative stage of crop → 4 – 5 eggs / female
- Fecundity when pollen available → 15 eggs per female
Incoming plant material:

• minimize input of unwanted guests / hitch hikers?
• Inspect plugs / young plants / cuttings
• point of entry → rooted or unrooted
• Pro-actively → dip / submerge
• ONLY work on contact
• Climate / Humidity/ Temperature!
• Insects vs. mites
Nematode *Steinernema feltiae* does effect thrips, but contact is critical

*Steinernema* nematodes exiting from dead thrips larva

*Steinernema* nematodes inside adult dead thrips
Amblyseius cucumeris – predatory mite
Amblyseius cucumeris

Breeder pile
Amblyseius cucumeris
Amblyseius cucumeris

ABS–mini+stake
Mini Breeding Sachets of *Amblyseius cucumeris*:  
- One sachet per plant – Hanging Basket → optimal coverage  
- Needs to be introduced early!  
- Run out of mites peaks at week 4  
- Sachet available with or without hook, or stake  
- Water resistant  
- Exit hole only on one side
Amblyseius swirskii – predatory mite
Hypoaspis spp. – Soil dwelling predatory mite
Biological Control of Thrips

*Atheta* – Rove beetle
Biological Control of Thrips

*Orius insidiosus* (in combination with banker plants → pepper and/or alyssum plants)
Aphid banker plants
Conclusion → take home messages:

• Communicate with your customers (breeders/propagators) or with your suppliers (growers) about pest management during propagation

• Don’t expect a zero tolerance…..

• Implement risk reducing applications

• Reduce the (over) use of pesticides (→ resistance management)

• Implement BCA’s in pest management programs as a first line of defense

• Focus on all possible pest problems
Cutting production and propagation is where it all starts! In an ideal world, cuttings, plants and plugs would arrive ‘clean’ and with BCA’s already present! ☑

Ideal situation for the grower to continue any pest management program, but more important for those who are using BCA’s
Any questions, please don’t hesitate to ask!

Thank you!

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