## Workshop Title: Identifying Beneficial Insects & Integrating Biological Control Practices

**Speaker:** Alana Respondek, Halifax Seed Co.

### Executive Summary

In this workshop Alana gave information about how to identify beneficial insects and effectively integrate biological controls to overcome the problems they pose. The workshop began with a description of each of the biological control agents including predators, parasitoids, microbial insecticides, microbial fungicides, botanical insecticides and insecticidal soaps. An overview of greenhouse and outdoor pests were presented next, followed by what biological controls to use. Next, naturally occurring beneficials for caterpillars and aphids pests are looked at. Microbial insecticides and fungicides are then touched on, and finally the benefits of bumblebees and pollination are presented.

### Detailed Notes

Biological Control is defined as “The manipulation of natural enemies of pests in an effort to reduce pest populations to economically tolerable levels”.

The following are biological control agents and their descriptions:

- Predators
  - Kill by direct contact – death is immediate
  - Consume many prey
  - Larger in size than victims
  - Have chewing or sucking mouth parts
  - Larvae or adults can act as predators
  - Ex. Lady bugs, praying mantis, lacewings

- Parasitoids,
  - Lay eggs on or in the bodies of the host pest
  - The host will die
  - The parasitoid is smaller in size than the host they invade
  - Parasitoids usually attack eggs, larvae and pupae, rarely adults
  - Ex. Hymenoptera (parasitic wasps), Diptera (flies)

- Microbial insecticides and fungicides
  - Liquid product with either bacteria or fungi in suspension
  - Spray onto pests
  - Very specific products – only tend to kill one or two diseases or insects
  - Ex. BTK & Serenade

- Botanical insecticides and insecticidal soaps
  - Liquid form is sprayed on
  - Tend to kill several different soft bodied insects
  - Contact killer, very low residual Ex. Pyrethrums and insecticidal soaps

Greenhouse Pests – Going to your peers for help on how to deal with these pests is the recommended course of action. Beneficials became popular in the 1990s but a lot of mistakes have been made. They have to manage them properly.

**Greenhouse Pests**

*PEST:* Thrips

| Description | Life Cycle | Damage |
|---|---|---|
| • Small insect, elongated, 1 mm,<br>• greyish or yellowish to brown colour<br>• 2 species: western flower thrips (Frankliniella occidentallis) and onion thrips (Thrips tabaci) | • Female deposits eggs into leaf cuticle<br>• Larvae are very mobile & immediately start to feed<br>• Total development time: 20days@20oC to12 days @ 30oC<br>• 1 female can produce 200 young | • Suck plant sap out of plant cells, results in reduced photosynthesis areas.<br>• Silvery colouring on leaves or fruit<br>• Excretement is dark<br>• Deformation of fruit of pepper, cucumber<br>• Discolouration of ornamentals<br>• Vector viruses |

*Thrips Control Products:* Amblyseius cucumeris

| Description | Application | Packaging |
|---|---|---|
| • Predatory mite Adults: Beige, <1mm<br>• High mobility on underside of leaf or in flower<br>• Female mates several times per year<br>• Lays a few eggs/day<br>• Development from egg to adult: 8-11 days @ 25oC<br>• Adults live for 3 weeks<br>• Cucumeris pierce their prey & suck them empty | • Apply when air humidity is >65%<br>• Allow mites to adjust to ambient temperature before use<br>• Sprinkle mites equally throughout plants on leaves or rockwool<br>• Place boxes equally – attach to plants using hangers on box | • Amblyseius Vermiculite System<br>• 2 x 500000 per ha Apply within 1-2 week<br><br>• Amblyseius breeding system<br>• 4 ABS boxes per ha Apply at first bloom |

*Thrips Control Products:* Amblyseius swirskii.

| Description | Application | Packaging |
|---|---|---|
| • Predatory mite Adult: orange-yellow oval mite<br>• Optimal development 25 – 28oC, RH @ 70%<br>• Effective at temperatures between 15 – 40oC<br>• Total life cycle from egg to adult 5-6 days<br>• Females will lay 2 eggs<br>• Prefers upper portion of a pollinating crop | • Swirskii System<br>• Disperse 20 pieces/m2 preventively<br>• Disperse 100 pieces/m2 at first sign of thrips<br><br>• Swirskii Breeding System<br>• 1 sachet / 2m2 Repeat every 6 weeks | Swirskii System<br>10,000 in 1L pot with vermiculite & bran<br>$31.50 + SH 25,000 in 1L pot with vermiculite & bran<br>$74.75 + SH<br><br>Swirskii Breeding System<br>Breeding sachets<br>250 A. swirskii/sachet<br>100 sachets/box, 300 A.swirskii / sachet<br>$78.00 + SH<br><br>500 sachets/box, 300 A. swirskii / sachet<br>$355.25 + SH |

*PEST:* Aphids

| Description | Life Cycle | Damage |
|---|---|---|
| • Adults: 1.2-2.6 mm<br>• Small oval body<br>• Yellow, green, black | • Many generations per yr<br>• Give birth to live young<br>• Good hibernation - Hibernates in & on plants and in the greenhouse too<br>• Antennae are long | • Suck plant sap out of plant cells<br>• Excretment is sticky – mould growth occurs<br>• Transmit viruses |

*Aphid Control Products*: Aphidius colemani

| Description | Application | Packing |
|---|---|---|
| • Parasitic wasp<br>• Slender black insect with brown legs & long antennae<br>• 2 mm in size<br>• Female lays eggs in adult or nymph aphid<br>• Total development takes 14 days at 21oC | • Apply preventively @ weekly intervals of 0.15 aphidius / m2<br>• Increase to 0.5-1 aphidius / m2 per week for 3 weeks | • Tubes of 500 mummies $25.00 + SH<br>• Tubes of5000 mummies $216.25 + SH |

*Aphid Control Products:* Aphidius ervi

| Description | Application | Packaging |
|---|---|---|
| • Parasitic wasp<br>• 2 x bigger than A. colemani<br>• Black slender body, brown legs, long antenna<br>• Female lays eggs (350/ lifetime) into aphids<br>• Development time: 26 days @ 14 oC, 13.5 days @ 20 oC | • Apply at first sign of aphids<br>• Spread on leaves in morning or evening<br>• Apply 0.1-0.25 / m2<br>• Increase to 2 / m2 in hotspots | • Tube of 250 mummies $84.70 + SH<br>• Tube of 1000 mummies $236.00 + SH |

*Aphid Control Product:* Chrysopa carnea larva (aka. Green Lacewings)

| Description | Application | Packaging |
|---|---|---|
| • Predator<br>• The adult live in NS<br>• Adults are light green insects, transparent wings<br>• In spring, adults lay 20 eggs / day<br>• Larvae eat 50 aphids / day | • Apply in spring<br>5 larvae / m2 repeat every 2 weeks<br>• Hotspots: 40 larvae / m2, 2 applications | • 500 pieces in cardboard multicells<br>• $36.25 + SH |

*Aphid Control Product:* Lady bugs

| Description | Application |
|---|---|
| • Safe & effective way to control aphids<br>• Indoor or outdoor use Available June – Sept<br>• Larvae eat more aphids than adults<br>• Ladybugs – safe and effective way to control aphids. Indoor and outdoor use. Larvae eat more than adults. | • Keep dormant in fridge until ready to release Release in evening Sprinkle on soil and plant foliage Release a few at a time over 7 days<br>• Wet foliage so ladybugs can have a drink Rate: 1000 / 50 m2 (550 ft2) 1000 ladybugs - $25.00 4500 ladybugs - $44.95 |

*Aphid Control Product:* Praying mantis

| Description |
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| • Purchase an egg case (50-400 eggs)<br>• Eggs hatch and young disperse into garden<br>• May take 2-8 weeks to hatch |

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| • Release 3 egg cases / 450 m2 (5000 sq ft)<br>• 1 egg case = $25.00<br>• Praying mantis – egg case hatches and young disperse into garden. May take 2-8 weeks to hatch |

*PEST:* Whitefly

| Description | Life Cycle | Damage |
|---|---|---|
| • Adults: 2 mm, white colour, wings horizontal and overlap slightly | • Female deposits oval eggs on underside of leaf<br>• Eggs turn black in 2-3 days<br>• Larvae and pupal stage not very mobile<br>• On tomato: egg to adult 20 days @ 27oC, 38 dys @ 17oC<br>• Temp & host plant determine # eggs (100 tomato, 200 cucumber, 300 eggplant) | • Larvae & adults suck plant sap<br>• Excretment is sweet, sticky substance<br>• Sooty mould develops on leaves |

*Whitefly Control Product:* Encarsia formosa

| Description | Application | Packaging |
|---|---|---|
| • Parasitic wasp – injects an egg into its host<br>• Adults: 0.6 mm long, black with yellow abdomen<br>• Takes 21 days for adult to emerge from whitefly, if temp is 23oC<br>• Female deposits 10-15 eggs / day Female lives for 2-3 weeks<br>• Adults feed on the body content of whitefly larvae & on the honeydew<br>• During lifetime female parasitizes 250-450 whitefly larvae and kills 30-70 by host feeding<br>• For application and | • Crops: eggplant, tomato, cucumber, strawberry, rose<br>• Introduce Encarsia every week after whitefly detected<br>• Apply between 18-30oC | • Encarsia system cards<br>• $37.00 +SH<br>• 100 pupae/card, 10 cards/pk<br>• $37.00 +SH Loose Pupae in Tubes<br>• 50 pupae/card, 5 cards/ pk<br>• 5000 loose pupae/tube $37.00 +SH |

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| packaging refer to slides | | |

*Whitefly Control Product:* Amblyseius swirskii (see above)

*PEST: Two spotted spider mite*

| Description | Life Cycle | Damage |
|---|---|---|
| • Adult is small, 2mm<br>• 2 red dots on its back | Life cycle<br>• Female deposits round<br>• eggs on underside of leaf<br>• A larvae with 6 legs hatches<br>• Development time varies<br>• Rose leaf: 7 dys @ 30oC, 17 dys @ 20oC<br>• Live in cracks in greenhouse<br>• Prefer warm, dry weather<br>• Live anywhere in greenhouse. It will leave webbing, visible. | Sucks plant sap from<br>• plant cells<br>• Leaves turn yellow<br>Webbing within leaves |

*Two spotted spider mite Control Products:* Phytoseiulus persimillis

| Description | Application | Packaging |
|---|---|---|
| • Phytoseiulus persimillis<br>• Predatory mite<br>• Eggs: oval, light orange colour<br>• Adults: red, oval, 6 legs<br>• Development time: 5 days @ 30oC, 9 days @ 20oC, 25 days @ 15oC<br>• Deposits 54 eggs in 22 days at 20oC<br>• Adult persimillis will consume 20 eggs or larvae or 5 adults per day | • Release persimillis at first site of spider mite<br>• Allow mites to adjust to ambient temperature<br>• Sprinkle material on leaves<br>• Release at RH 65% and temps @ 20oC<br>• 6 persimillis / m2 as soon as TSSM detected<br>• Hot spots: 20 persimillis / m2 | • 1000 / tube with vermiculite<br>• $20.50 + SH<br>• 2000 / tube with vermiculite $32.00 + SH |

*PEST:* Mealy Bugs. *NOTE: The presence of mealy bugs means that the product is unmarketable.

| Description | Life cycle | Damage |
|---|---|---|
| • Oval shape<br>• White colour<br>• Waxy threads<br>• 2 species: Citrus mealy bug (Planococcus citri) & Tomato Mealy Bug (Pseudococcus affins) | • 300-500 eggs laid in a cotton pouch<br>• Young bugs are mobile & disperse to find feeding sites<br>• 3 nymphal stages<br>• Length of cycle depends on temp: 90 days @ 18oC, 30 days @ 30oC | • Suck sap from plant cells<br>• Excretment is sweet and sticky<br>• Sooty mould grows where sticky substance located<br>• Presence of insects makes plants unmarketable |

*Mealy Bugs. Control product:* Cryptolaemus montrouzieri

| Description | Application | Packaging |
|---|---|---|
| • Predatory beetle<br>• Adults: 4 mm, black brown wing case, orange-brown head, thorax & abdomen<br>• Larvae: 13 mm long, white, downy, waxy look<br>• Development time depends on temp:<br>• Female beetle<br>• Lives 2 months Lays 10 eggs/day<br>• Most active on sunny days, 22-25oC, RH @ 70-80%<br>• Beetle is not active if temps <16oC or > 33oC<br>• Adults & larvae eat eggs and larvae of mealy bug | • As soon as mealy bug detected 2-3 adults/ m2<br>• Cool time of day<br>• Sprinkle on plants Low presence of ants | • 25 / plastic tube with filter paper as carrier $11.25 + SH<br>• 100 / plastic tube with filter paper as carrier<br>• $37.00 + SH<br>• 250 / plastic tube with filter paper as carrier<br>• $85.75 + SH |

**Outdoor Pests**

*PEST:* Leather Jackets

| Description | Biology | Damage |
|---|---|---|
| • Larval stage of crane fly<br>• 2.5 cm, greyish black | • In summer, seen in soil<br>• 2 wks later, eggs | • Larvae feed on the roots<br>• Late August, adults |

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| in colour<br>• Adult is a large mosquito type insect – the crane fly<br>• Springtime is when you see them – end of May, beg June. They eat roots of lawn. Turns it brown and kills it. | hatch & overwinter in soil<br>• Larvae feed in spring Pupate in June | emerge as crane flies<br>• of grass<br>• Browning of turf<br>• Adults lay eggs<br>• Late summer, large "mosquitoes" fly out of lawn |

*Leather Jackets Control Product:* Steinernema feltiae

| Description | Application | Packaging |
|---|---|---|
| • It seeks out the leather jackets and attacks by entering.<br>• Seek out leather jackets & attack by entering through natural body openings<br>• Once inside, they release bacteria that stops the pest from feeding<br>• Nematodes reproduce inside the dead pest and release young | • Generic rate is 1 billion / acre.<br>• Not beneficial to apply them proactively.<br>• If there's food they will reproduce.<br>• Moisture on area prior to application<br>• Apply in the evening or when overcast<br>• Use entire package at once<br>• Apply prior to expiry date<br>• Soil temperature >12oC Apply moisture after application to wash into soil Rate: 1 billion / acre | • 50 million (retail size)<br>• $44.99<br>• 250 million<br>• $115.99 |

*PEST:* Black vine weevil

| Description | Biology | Damage |
|---|---|---|
| • Black beetle Long snout<br>• 8-14 mm (1/4 – 1⁄2 inch) in length<br>• Females lay hundreds of white eggs<br>• Larvae whitish-brown<br>• Larvae 'C' shaped, legless, small he<br>• Can attack ornamentals and strawberries etc.<br>• Has no legs. | • Larvae feed & grow in<br>• summer & fall<br>• Larvae pupate and hatch into adults in early spring<br>• Adults emerge in early summer (June), lay eggs immediately<br>• Adults are nocturnal, move quick, play dead when disturbed | • Larvae more destructive<br>• than adults<br>• Larvae feed on plant roots<br>• Adults chew on leaves |

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|---|---|---|
| • They play dead. | | |

*Black vine weevil Control Product*: Steinernema kraussei
*NOTE: Apply one treatment in fall for minor problems. Treat in spring and fall for serious problem. If serious problem apply twice, but normally once.

| Description | Application | Packaging |
|---|---|---|
| • Seek out vine weevil larvae & attack by entering through natural body openings<br>• Once inside, they release bacteria that stops the pest from feeding<br>• Nematodes reproduce inside the dead pest and release young | • Moisture on area prior to application Apply in the evening or when overcast Use entire package at once Apply prior to expiry date<br>• Soil temperature >12oC Apply moisture after application to wash into soil Rate: 1 billion / acre | • 5 million (retail size)<br>• $24.99<br>• 50 million<br>• $59.99 |

*PEST:* Grubs

| Description | Biology | Damage |
|---|---|---|
| • Larval stage of June beetle, or chafer beetles<br>• Whitish – cream colour<br>• 1.5 cm (0.6 inch) in length<br>• Legs present Found in soil<br>• Grubs will pupate in springs and change into beetles | • 3 yr life cycle<br>• Adults overwinter in soil<br>• Emerge & lay eggs in late May, early June<br>• In heat of summer, go dormant & move deeper into soil<br>• Pupate in spring and change into beetles | • Larvae feed on grass<br>• Grass turns brown and dies |

*Grub Control Product:* Heterorhabditis bacteriophora
*NOTE: Will also attack European Chafer grub, Oriental beetle grub, Masked Chafer grub, Japanese beetle grub, and Black vine weevil

| Description | Application | Packaging |
|---|---|---|
| • Seek out vine weevil larvae & attack by entering through natural body openings<br>• Once inside, they release bacteria that | • Moisture on area prior to application Apply evening or when overcast Use entire package at once Apply prior to expiry date | • 50 million (retail size) q $39.95 + SH<br>• 500 million<br>• $289.95 + SH |

| | | |
|---|---|---|
| stops the pest from feeding<br>• Nematodes reproduce inside dead pest and release young | • Soil temperature >12oC<br>• Apply moisture after application to wash into the soil<br>• Rate: 1 billion / acre | |

**Naturally Occuring beneficials**
NOTE: Beneficials are dependent on appropriate temperatures.

*Pest:* Caterpillars
- Ground beetle
- Rove beetle
- Spiders
- Daddy long legs
- Ants
- Damsel bugs
- Assassin bugs

*Pest:* Aphids
- Minute pirate bugs
- Big eyed bugs
- Lacewing larvae
- Syrphid flies

**Microbial Insecticides & Fungicides**

BTK NOTE: Can't use if you're certified organic.
- Bacillus thuringiensis var.
- Kurstaki
- Controls cabbage worm, tent caterpillars, gypsy moth, leaf rollers
- Mix with water & spray over plant
- $12.99 retail price
- BTK insecticide – kills caterpillars.

Serenade Garden (Bio Fungicide)
- QST 713 strain of Bacillius subtillis
- Controls: black spot, powdery mildew, rust, gray mold, late blight, scab
- $14.99 retail price

**Question:** Can you plants you can plant to attract insects?
**Answer**: Yes. Companion planting. Dill and carrots – attract ladybugs.

**Question:** What can growers do to encourage the beneficials?
**Answer:** Have to have conditions that each life cycle wants. Healthy soil with lots of food. Study individual life cycles and figure it out. You can't normally get them over winter, but in greenhouses you can.

**Pollination & Bumble Bees**

- Pollination of greenhouse and outdoor crops is essential for fruit set and max production
- Tomatoes, peppers, cucumbers, blueberries, cranberries, strawberries, squash, apples, pears all require pollination
- Supplemental hives will greatly increase the success of pollination in the crop

*Bumblebees*

- Active at low temps (5oC), windy conditions and cloudy skies
- Work well in greenhouses & tunnels
- Not affected by varroa mite

*Honeybees*

- Less effective at low temps (<15oC), cloudy conditions
- Do not work well in greenhouses or tunnels
- Affected by varroa mite