

Biological Controls and how to use them effectively

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Outline

- Integrated Pest Management
- What is biocontrol?
- Two ways to use Biocontrol in the landscape:
 - Conservation biocontrol – work with the environment
 - Augmentative biocontrol - Beneficials for hire!
- Is it necessary to kill every last pest? Is there a better and easier way?
- Some examples;
 - Aphids and biocontrol
 - Soil pests; European Chafer, controlling them with nematodes
- What's on the horizon?

Integrated Pest Management and Tolerance Thresholds

How much do you need to manage pest populations? Some pest/weed/disease damage is tolerable in almost any growing system.

Economic Threshold: the point in the development of a pest/weed/disease population when predicted economic loss is greater than the cost incurred to control it. This applies to commercial crops mainly. It's difficult to apply to landscapes in the same way, so we use:

Action Threshold: an indicator that triggers a control action.

Example: aphid honeydew droplets from Tulip trees. The challenge of monoculture.

If some pests are tolerable,
what are the tools available to
manage them?

Biocontrol is one excellent one

What is biocontrol?

Living organisms which exert control on populations of a pest, disease or weed

- Predators, parasitoids, microbial insecticides, diseases, plants, vertebrates
- Examples: Flea beetle to control weeds, parasitoid to control mealy bug



Two ways to use biocontrol in the landscape

- **Conservation Biocontrol** – helping the environment support beneficial organisms that provide control of pests for FREE
- **Augmentative Biocontrol** - introducing biocontrol organisms when conservation is not enough.

Conservation Biocontrol

- Conserve organisms that provide biocontrol of pests (insect, mites) for free.
 - Be aware of what natural enemies could be present and what they need to thrive
 - Give them what they need
 - Food sources for all stages
 - Appropriate microclimates
 - Shelter
 - Water



Bug Garden at Kwantlen Langley campus



So who do you want to conserve???



Bats

Provide good insect control
in BC

Need shelters, bat boxes



Vertebrates: Hummingbirds



Besides pollinating flowers that bees aren't attracted to, hummingbirds eat small insects.

Need flowers for nectar, hummingbird feeders to supplement

Insect Predators and Parasitoids: Beetles and True bugs

- Generalist predators
- Will feed on anything they can catch
- Immature forms are predators too

Need

- Biodiversity
- Ground cover
- Undisturbed soil
(ground beetles)
- Some need open flowers for pollen i.e. sunflower, butterfly weed, blueberry



Ground Beetles

- Wonderful general predators, will eat anything they can catch

Need

- Undisturbed ground, ground cover, biodiversity
- And they need food too – insects, slugs, sowbugs



Immature stages of beetles

- Do you see the pest? It's a beetle too



Ladybird beetles

- Offspring don't look like their parents



Ladybird beetles are available commercially, but will populate a landscape if there are aphids



True Bugs (Hemiptera)



Big-eyed bug nymph
attacking aphid

Minute Pirate bug
attacking aphid



Offspring DO look like their
parents without wings. Some
species are available
commercially

Hymenoptera

Many are parasitoids
and some are predators
of pest insects

Need

Nectar sources, water,
biodiversity



Parasitoids (Hymenoptera); that attack Aphids

- Very effective
- Easy to encourage
- Several species available commercially



Parasitoids – that attack larvae



Can be flies or wasps

Some available
commercially, most need
to be conserved

Parasitoids that attack insect eggs



Trichogramma – 0.3 mm long



parasitized egg

Several species available commercially

Fly (Diptera) predators

Syrphid larvae attack aphids



Clemson.edu



Adults are pollinators

Green and Brown Lacewings (Neuroptera)

Adults



Larvae feeding

Lacewing larvae are fearless, nocturnal, predators, some of the first spring predators. Available commercially



Lacewing larva and eggs

Larva



Eggs



General principals for employing Conservation Biocontrol

Biodiversity!

- Lots of blooming plants , throughout the season, grown in clusters
- Open water – i.e. bird bath, fountains, ponds
- Undisturbed ground
- “Corridors” = continuous habitat for beneficials
- A few pests
- A little bit of **Well planned** disorder

Augmentative Biocontrol

Augment the population of natural enemies where they do not exist in sufficient numbers to control a pest, disease, or weed

Available commercially:

- Predators, Parasitoids
- Microbial organisms (need to be registered, and likely restricted to biogeographical zones)
 - Fungus
 - Bacteria (i.e. *Bacillus thuringiensis*, *B. subtilis*)
- Best used within an IPM program, some require a lot of understanding of the pest lifecycle, some not so much

Now, some examples.

Aphids; often the target for augmentative biocontrol

- All aphids feed on plants with mouthparts that pierce and suck, come in many shapes and sizes
- give birth to a live baby every few hours
- Predators can have a hard time keeping up in hot weather



What's available if you need to control Aphids?

- Predators:
 - Ladybird beetles (with caution)
 - Parasitoids (*Aphidius matricariae*)
 - Aphidoletes
 - Greenlacewings
 - One day, Beauveria bassiana (Botaniguard) will be registered for landscape uses

Aphidoletes



Tiny Diptera who lay eggs in aphid colonies. Orange larvae feed on aphids – almost invisible without magnification. Easy to use, effective.

Predatory mites to control spider mite



Native species: *Amblyssius fallacis*, good in cool spring and fall conditions, not so great when it gets hot. Overwinters in the soil and returns next season

Microbial biocontrol

Bacillus thuringiensis (registration required)

- Commonly known as “Bt”: Dipel, BioProtec Eco for caterpillars of many types
- Long available and quite effective
- Use when caterpillars are small
- Good coverage necessary as they need to eat enough to kill them
- Caterpillars stop feeding soon after ingesting Bt but do not die right away
- Harmless to beneficials

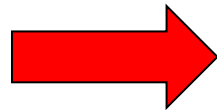


Where can you get biocontrol products for landscapes?

- The Bug Factory (over 200 products)
www.thebugfactory.ca
- Applied Bionomics Ltd. <http://appliedbionomics.com>
- Several garden centers carry their products as well as products from Biobest
www.biobest.be/home/3
and Koppert www.koppert.com



Conservation Biocontrol for European Chafer



No Chafer!

Augmentative Biocontrol for EC



Parasitic nematodes: tiny round worms cruising the soil, looking for insect larvae

Successful attack!



European Chafer – target stage



**Mid July – small larvae
(1st instar)**



**Mid August – medium larvae
(2nd instar)**



**Late Sept. – large larvae
(3rd instar)**



**Winter – large larvae keep
feeding**

Heterorhabditis bacteriophora – the most reliable biocontrol for EC

- Several companies supply this species of nematode for control of EC and sell packages suitable for a home sized lot
- The rate :
 - A 50 million pack will treat grass on 33 ft wide lots (750 sq ft) – suggested retail:\$79.99 (often sold for less)
 - for commercial use: packs of 250 Million will treat 350 M²





Best time to apply Nematodes

When Chafer are small, 3rd – 4th week of July

How?

Irrigate well early in day so there is no dry soil in root zone. Irrigate again for 2 hours prior to application.

Mix according to directions, apply in the evening or on cloudy day. Can be applied through irrigation system with filters removed.

Irrigate for 2 hours after application to wash nematodes into the soil

Continue to irrigate twice per week for 3 weeks

Weevil – control with nematodes



- Larvae are attacked by nematodes in the same way as European Chafer larvae
- Best time to apply nematodes: spring and early fall – when soil temperature is 15C
- Nematodes will live 3 weeks while looking for a host
- As for EC, keep soil moist while they are alive
- Treat around bushes which have adult feeding damage

Future fungal biopesticides from the 2011 bank of BC native beneficial fungi

Objective:

Develop and register new biological products for pest and disease management

- Fungi that attack insects and plant pathogens
- Also beginning work to develop insect viruses

Lab murder trial



Trichoderma for soil treatments



Nursery soil
untreated
20% survival

Nursery soil
+
Trichoderma
85% survival

- Nursery soil with *Rhizoctonia*, *Pythium* and *Phytophthora*
- Half soil untreated, half treated with 4 isolates of native Trichoderma
- 1 week later, seeded lettuce (same result with radish)

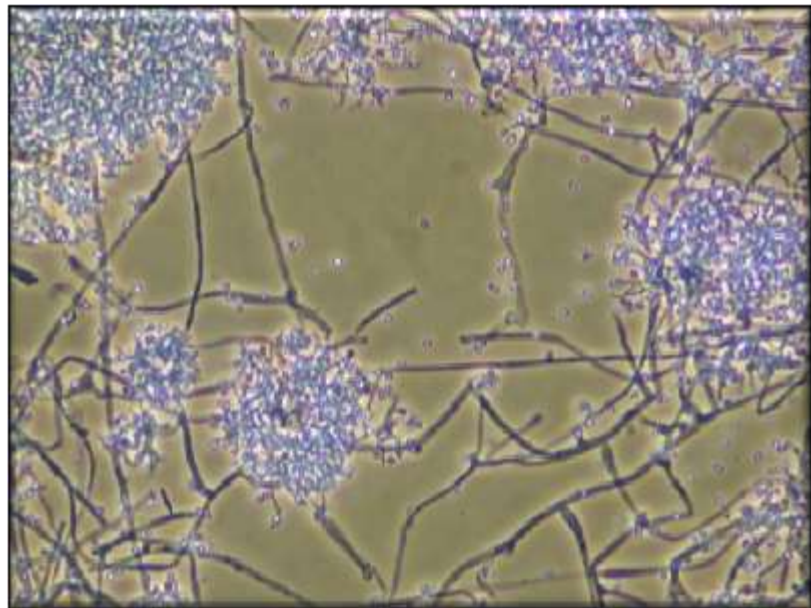
Fungal insect pathogens - soil

- Chafer biocontrol with *Metarhizium* in combination with other natural and biological products



Metarhizium anisopliae

- a local fungal entomopathogen
- attacks through insect cuticle
- multiply within insect
- native to most soils
- part of microbial community around plant roots
- spores released to soil to infect more insects



Chafer larvae killed by *Metarhizium anisopliae*



Once the fungus completes its development, it produces spores that are greenish-brown on the outside of the insect



Neem – work in UK is being repeated here



Native tree in India

Known to control over 600 pest species

Safe to non-target beneficial organisms (we shall see)

disrupts an insect's molting,
Preventing cuticle development

Also has been shown to be anti feedant, larvicide, ovicide

Work at ISH with a local company with aim of registration