

Identifying Common Natural Enemies in High Tunnels



Margaret Skinner & Cheryl F. Sullivan

Univ. of VT, Entomology Research Laboratory

Elsa Sanchez & Kathleen Ayers

Penn State Univ.

&

Mark Hutton & Jason Lilley

Univ. of Maine Coop Extension



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Know the Good Bugs from the “Bad”

It will save you stress and money!

What is going on here?



Biological Control with Plant Mediated IPM Systems

What are Plant-Mediated IPM Systems?

Plants (non-crop), used as a foundation, with other IPM tools, to manage pests

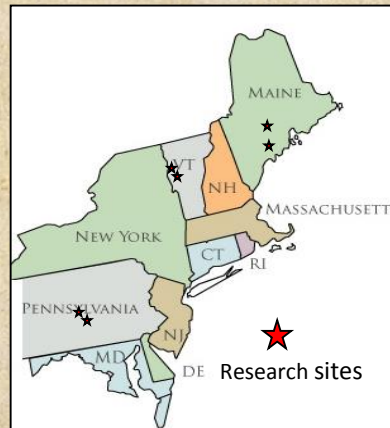
- Site for natural enemy releases providing food & shelter to establish, sustain and increase natural enemies (a breeding ground)
- Site to attract and maintain naturally-occurring biocontrol agents
- Natural enemies disperse into the crop in search of the pest



Banker Plants

Plants that provide food (usually a non-pest host insect or pollen) to produce biocontrol agents

3 States x 2 Sites x 3 Tunnels/Site



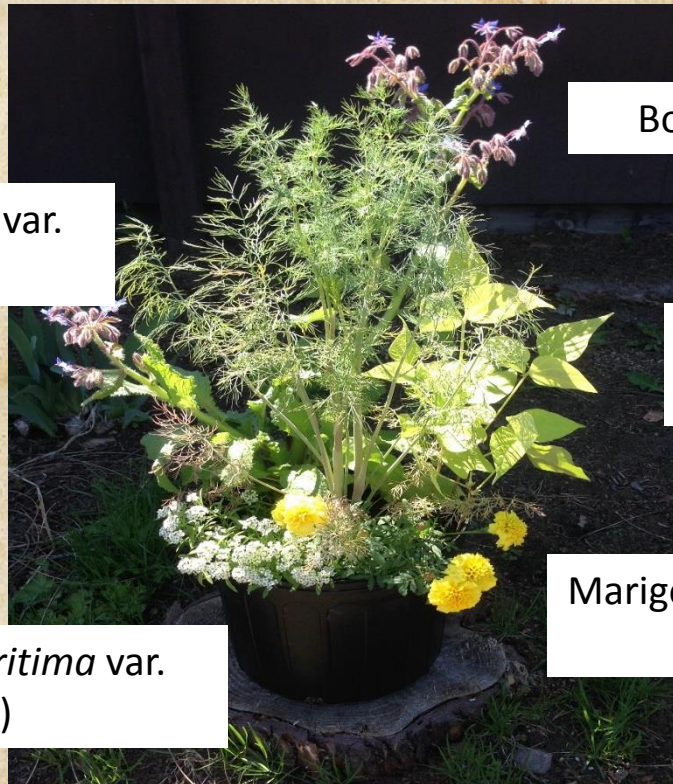
Habitat Plants

Plant combinations that provide food & habitat to attract & sustain biocontrol agents

Natural enemies & shipping is expensive! So, do it yourself!

Plant-Mediated IPM Systems

Habitat Plants - Summer



Dill (*Anethum graveolens* var. Bouquet)

Borage (*Borago officinalis*)

Bush Bean (*Phaseolus vulgaris* var. Provider)

Alyssum (*Lobularia maritima* var. Snow Princess)

Marigold (*Tagetes patula* var. Little Hero Yellow)

Plant-Mediated IPM Systems

Habitat Plant - Winter



Dwarf Calendula (*Calendula officinalis* var. Yellow Gem)



Alyssum (*Lobularia maritima* var. Snow Princess)



Viola (*Viola tricolor* var. Helen Mount)

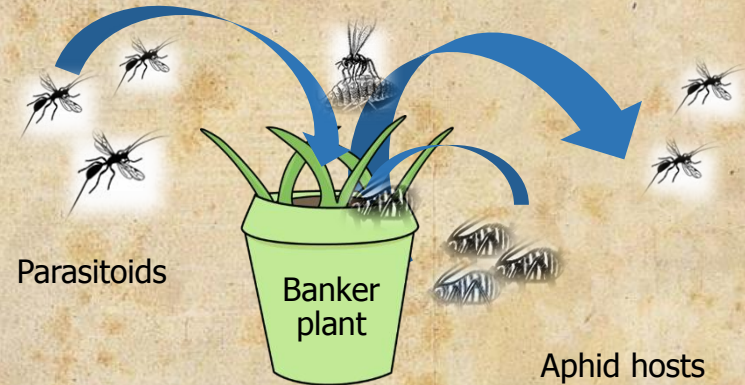
Cold tolerant
Max. height under 18in

Marigold (*Tagetes patula* var. Little Hero Yellow)

Bush Bean (*Phaseolus vulgaris* var. Provider)

More for spring time

Aphid Banker Plant System



Wheat/rye/barley is purchased infested with bird cherry oat aphids, *Rhopalosiphum padi*

Parasitic wasps are released onto the system

Wasps reproduce within the system

Wasps disperse into crop to search for [green peach](#) or [melon aphid](#)

Promotes establishment of general predators

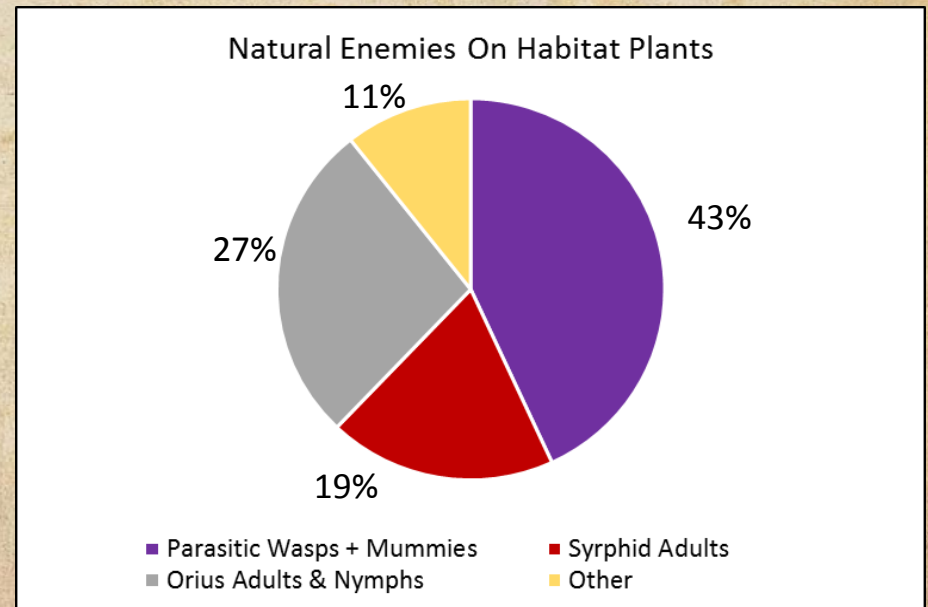
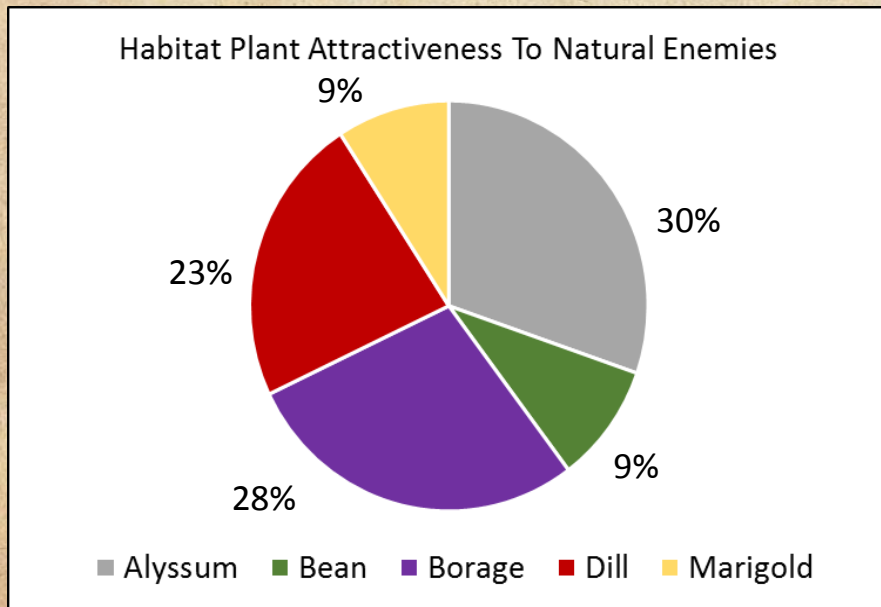
Hard Red Spring Wheat for the summer
Hard Red Winter Wheat for winter

Plant Mediated IPM Systems for Our Study



Results on Habitat Plants – Year 1

- Over 700 individual natural enemies observed
- Borage, Dill & Alyssum mostly attracted parasitic wasps, *Orius* adults & nymphs and syrphid fly adults
- Others include various lady beetle life stages, predatory maggots, assassin bugs, lacewing eggs and larvae, etc.
- 6 species of aphids attracted



To Know them is to Love them!



Parasitoids
Predators
Fungi

Naturally Occurring or Commercially Produced

Life Cycles of Insects

Most know the adult stages of beneficials,
but you also need to know the immatures.

Immature insects are Eggs,
NYMPHS or LARVAE or Pupae

METAMORPHOSIS

(changes through molting/shedding their skin)

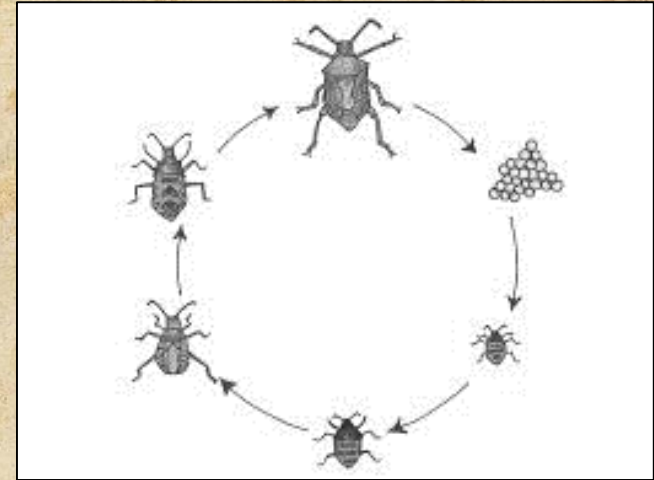
- **Simple** – egg, nymph and adult (grasshoppers, stink bugs, aphids, lacewings)

Immatures - **NYMPHS** (similar body form as adult, not sexually mature & wingless)

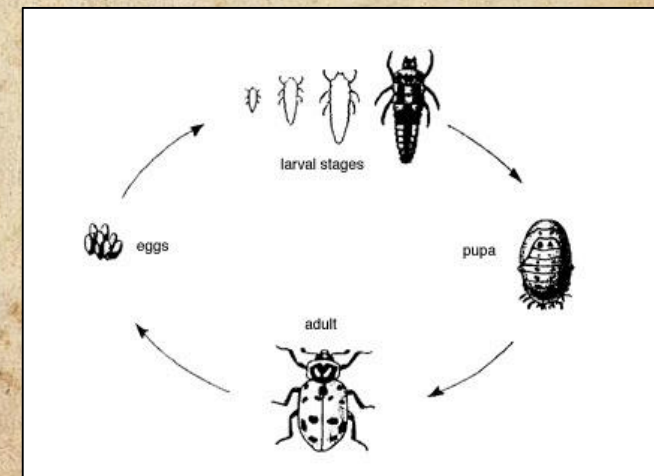
- **Complete** – Immatures - **LARVAE** (look very different from the adult, go through a pupa stage).
ex. beetles, flies, bees & wasps, moths & butterflies

The life cycle of predatory mites is similar
to simple metamorphosis.

Simple



Complete



Parasitoids

**Many different species
from two insect groups**

- **Wasps**
- **Flies**

Some are generalists, others host specific

**Some wasp species also
act like predators.**

Wasp Parasitoids: Aphids

Aphidius spp.

(*colemani*, *matricariae*, *ervi*)

What do they do?

- Adults lay eggs inside aphids
- Larvae-pupae develop inside, turning aphid into 'mummies', killing them
- Adults feed on honeydew
- Work best in cooler temperatures

What to look for:

- Species are difficult to tell apart
- Adults
 - Long antennae and legs & small waist
 - 0.8 inch long (2-3 mm)
 - Black with brown/red highlights
- Larvae-pupae
 - Within golden brown mummies



Adults



Developing larvae-pupae

Wasp Parasitoids: Aphids

Aphelinus abdominalis

What does it do?

- Adults lay eggs inside aphids
- Larvae-pupae develop inside, turning aphid into 'mummies', killing them
- Adults feed on aphids & honeydew
- Works better in higher temperatures



Adult

What to look for:

- Adults
 - Short antennae & legs
 - 0.1 in long (3 mm)
 - Black & yellow
- Larvae
 - Within blackened mummies



Developing larva-pupa

Wasp Parasitoids: Aphids

Not All Wasps Are Created Equal



Parasitoid	Green Peach	Melon	Foxglove	Potato
<i>Aphidius colemani</i>	X	X		
<i>Aphidius ervi</i>			X	X
<i>Aphidius matricariae</i>	X			
<i>Aphelinus abdominalis</i>			X	X

Aphid Parasitoid Challenges

Hyperparasitoids

- Lay egg inside the developing parasitoid killing it and the aphid
- Reduce *Aphidius* efficacy
- Check mummy lids after wasp emerges of signs of hyperparasites.

Aphidius: smooth margin & no lid



Some hyperparasites have lids



Dendrocerus carpenteri
hyperparasitoid jagged & no lid



Other Miscellaneous Parasitoids in Vegetables



Cotesia glomerata pupae on imported cabbage worm



Tomato hornworm with wasp pupae



Cotesia rubecula pupa on imported cabbage worm larva (left), adult wasp (right)



Fly Parasites



Braconid wasps

Predators

**Many different types from
different insect groups**

- **Flies**
- **Bugs**
- **Wasps**
- **Mites**

Some are generalists, others host specific

**Some wasp species also
act like predators.**

Aphid Predators: Flies

Aphidoletes aphidimyza

Aphidol "EAT" es – Eats Aphids

What does it do?

- Adults are midges (flies)
- Larvae (predatory maggots) eat **most types** of aphids
 - Inject them with paralyzing toxin & slurps them up
- Adults feed on honeydew & nectars
- Subject to diapause (need supplemental light early/late)

What to look for:

Adults (like a mosquito or fungus gnat)

- Pink/brown color
- Long legs & antennae
- Swarm at night

Larvae (maggots): Orange/red color

Pupae: Oval & brown in the soil

Eggs: White, like a grain of rice on the leaf



Larvae/Maggots



Pupa



Adult



Egg

Aphid Predators: Flies

Syrphid spp. - Hover/Flower Flies

What do they do?

- Adults are flies
- Larvae (predatory maggots) eat **most types** of aphids
- Adults feed on honeydew & nectar

What to look for:

- Adults (look like bees, hover in one place)
 - Black/brown color marked bands/dots, white/yellow
- Larvae (maggots)
 - Pink, yellow, green & brown marked with white/black color
 - Slightly tapered at front
- Pupae – Oval & brown on plant/soil surfaces
- Eggs – Ovoid like a grain of rice

I am not a bee!



Adults



Larvae/Maggots



Eggs



Pupa

Generalist Predators: Bugs

Orius spp.

What do they do?

- Minute Pirate bugs (adults & nymphs)
- Generalist (aphids, thrips, mites, pollen/nectar)
- Pierces & sucks pest juices
- Some undergo diapause
- Needs food source to establish early in season

What to look for:

Adults: black, grey, white & brown

Nymphs: red/brown

Eggs: laid in plant tissue



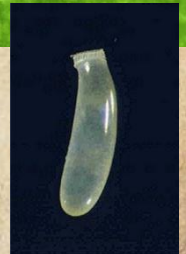
Adult



Nymph



Egg



Generalist Predators : Bugs

What do they do?

- Predatory bugs (adults & nymphs)
- Generalist (aphids, thrips, mites, bugs, caterpillars, pollen/nectar)
- Pierces & sucks pest juices

Damsel bug (Nabidae)

What to look for:

Adults & nymphs: black, grey & brown



Adult

Nymph



Stink bug (Pentatomidae)

What to look for:

Adults: grey & brown
Nymphs: red/brown/orange
Eggs: Barrel shaped, many colors



Adult



Nymph



Eggs

Assassin bug (Reduviidae)

What to look for:

Adults: grey, brown, red, many colors
Nymphs: many colors
Eggs: Barrel shaped, many colors



Nymph



Adult



Eggs

Generalist Predator: Beetles

Lady Beetles

What do they do?

- Predatory beetles (adults & larvae eat aphids)
 - Requires lots food to stick around
- Generalist (also eats thrips, mites & pollen)
- Does well year-round

Appearance

- Red, orange, yellow with black markings
- Larvae alligator-like
- Pupa attached to leaf surfaces

Adult



Larvae

Eggs



Pupa



General Predators: Lacewings



Adults

What do they do?

- Larvae are generalist predators
 - Can be cannibalistic
- Adults consume pollen & nectars (at night)
- Requires a lot food to stick around



Larvae



What to look for:

- Adults green or brown
- Larvae alligator-like, brown
- Pupa cocoons on leaf surfaces
- Green lacewing eggs on stalks



Eggs



Pupa

General Predators: Mites

What do they do?

- Feed on soft bodied insects (whiteflies, thrips, aphids, larvae of shoreflies and fungus gnats)
- Also feed on pollen & nectar

ON LEAVES

Neoseiulus = Amblyseius cucumeris & swirskii



Beige

More effective at cooler temp (66-80°F), humidity 65-72%

Apply early in season



Clear white

Most effective in warmer temps (77-82°F) & higher humidity (70%)

Apply later in season

IN SOIL

Stratiolaelaps scimitus (Hypoaspis miles)

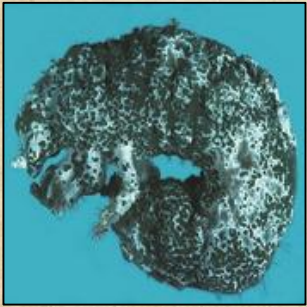


Dark tan above, light tan below

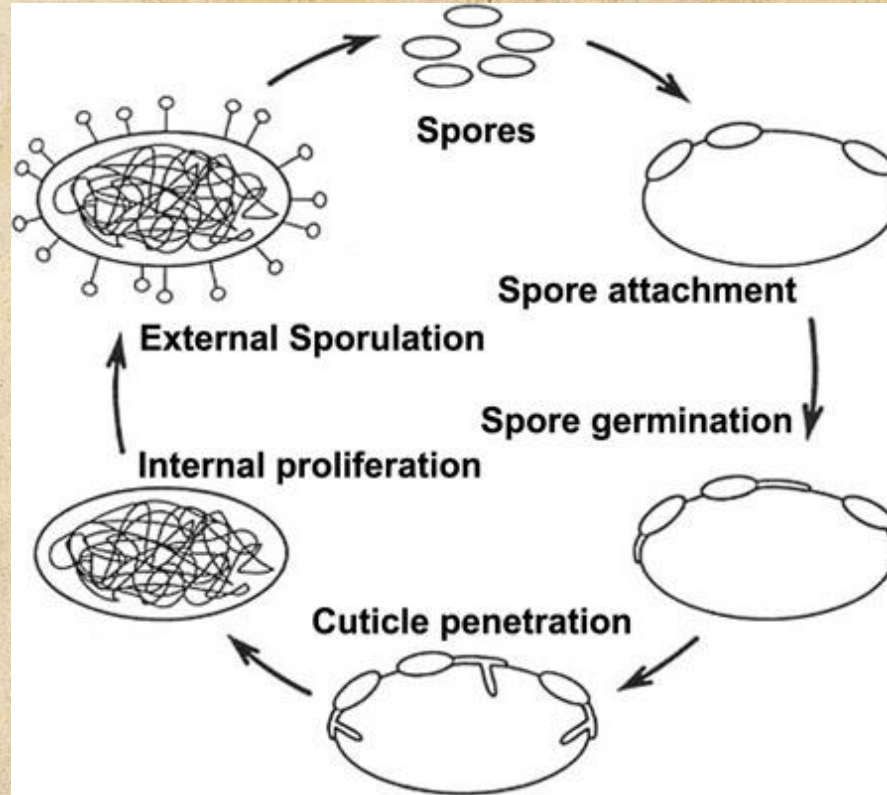
Optimal soil temp (60-72°F), moist conditions

Apply all season

Life Cycle of Insect-Killing Fungi



Metarhizium



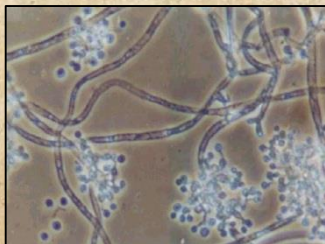
Beauveria

Generally you will only see the External Sporulation phase.

Insect Killing Fungi (entomopathogens)

What does it do?

- Insect killing fungus (entomopathogen)
Beauveria bassiana
Isaria (=Paecilomyces) fumosoroseus
Metarhizium anisopliae
- Broad host range (thrips, whiteflies, predatory beetles, caterpillars)
- Contact is necessary
- Multiple applications usually needed
- Dense plant canopies challenging
- Needs high humidity (>80%)



Spores

What to look for:

- Off color, non-mobile insects
- Whitish, pink or green fuzzy growth on insect body
- Mummified insect body
- Drooping larvae



Symptoms of fungal infection of insects

What can You do?

A Recipe for Success

- ✓ Establish a schedule & IPM program customized for YOU
- ✓ Scout your crops regularly to know what is there
- ✓ Become familiar with the good and “bad” bugs
- ✓ Establish habitat or banker plants early
- ✓ Decide if it is cost effective to release natural enemies
- ✓ Select reliable biocontrol supplier(s)
- ✓ Use chemical or other insecticides with care and only if really necessary
- ✓ Consider compatibility when selecting insecticides
- ✓ Let your customers know about beneficials



Nature is Beautiful and Complex

Diversity promotes Balance

Get to know what is in your high tunnels.

**The more you know, the more you can use
NATURE to your advantage.**

**Do what you can to increase biodiversity while
holding pests below damaging levels.**

Questions?



THANK YOU!!!

Visit our Website!

<http://www.uvm.edu/~entlab/>

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