Attract & Recognize Your Pest Fighting Pollinators & Other Beneficial Insects

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About the UVM Entlab

- We are a team of scientists committed to the development of effective insect pest management strategies using an integrated pest management “IPM” approach.

- Focus on delivery & effective use of biological control agents against several pests.

- Emphasis is placed on practical aspects of research to solve ‘real world’ problems.

- Provide extension outreach to greenhouse, high tunnel, nursery growers & landscape managers.
General Topic Outline

- Review Integrated Pest Management “IPM” & Biological Control
- Cover the Identification of Natural Enemies
- Discuss Conservation Strategies & Related Research Results
Integrated Pest Management “IPM”

“IPM is an effective & environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests & their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property & the environment” (US EPA).

Goal is to maintain (not eliminate) pest populations at “tolerable” levels.
IPM Strategies

**Intervention**
- Most Toxic (kill on contact)
- Least Toxic (soaps, oils, growth regulators)

**Prevention**
- Predators, Parasitoids, Pathogens
- Insect traps, barriers, hand removal, mulch, prune
- Mowing, moisture management, aeration, nutrient management, pest resistant varieties, plantings to promote beneficial insects

**Scouting/Monitoring**
- Pest & Beneficial Arthropod Identification
- Action threshold establishment

**Timing is Everything**
- (biocontrols, fertilizers, pesticides)
Why Do We Care?

Misuse of broad spectrum synthetic chemicals (pesticides & fertilizers) can have negative effects the environment & non-target organisms (glyphosphate, neonicotinoids, etc.).

Non-target effects: Direct (rapid mortality from exposure) & indirect (through the food chain ‘floral nectar & pollen).

Public awareness & perception of “dangers” drive a demand for alternative, sustainable methods of pest management.

Need to protect & encourage establishment of beneficial insects that perform valued pollination & pest management “services”.
Pollination mediated by animals (insect, bird, mammal) or other factors (wind, water)

Pollinators contribute to $235 - $577 billion (U.S.) worth of annual global food production (primarily honey bees, native bees & flies)

Stressors:

- Habitat Loss (conversion, fragmentation, agricultural intensification/monocultures)
- Diseases, Parasites, Viruses, Disorders
- Pesticides (direct contact, in food chain, avoidance of treated crops)
- Climate change (geographical shifts)

Non-Bee Insect Pollinators

Provide pollination ‘insurance’ – are more adaptable to land use changes than bees

Use resources from a diverse landscape (cover, alternative food sources, etc.)

Flies are second to bees for pollination:

- Some species commercially reared (blue bottle flies for vegetables)
- Cocoa trees pollinated by tiny midges

Some provide pest control services “natural enemies” & are valuable biological control agents → Pest Fighting Pollinators

For many insects, their value as pollinators & biological control agents are yet to be determined
Biological Control

Component of IPM

Uses ‘natural enemies’ → predators, parasitoids & pathogens (bacteria/fungi)

Involves active human role in facilitating use

Types:

- Classical/Importation (introduce to new location)
- Augmentation (purchase & release)
- Conservation (modifying environment to favor native & introduced natural enemy populations

→ Pollinator/Beneficial/Habitat Plantings

Example: Aphid banker plant system for purchased *Aphidius colemani* wasps for green peach and melon aphids in greenhouse ornamentals.
Attracting & Sustaining Beneficial Insects

Habitat plantings/beneficial gardens/pollinator plantings provide food, shelter & reproduction sites.

Hedgerows, borders, rows, mixed planters.

Include native plants, but not exclusively.

Yield a diversity of flowers to ensure blooms will be present all season.

Provide diversity of flower shapes & sizes. Some floral structures may not cater to smaller natural enemies.

Select proper colors (purples, yellows, whites).

Monitor plantings to be sure they are not harboring unwanted pests.

Resource list at end of presentation has several links about plantings for beneficial insects.
Some Attractive Choices

Annuals
- Dill
- Coriander/Cilantro
- Zinnias
- Sunflowers
- Alyssum/Lobularia

Perennials
- Pale-Leaved Sunflower
- Yarrow
- Coneflower
- Anise Hyssop
- Hairy Beardtongue
- Spotted Beebalm
- Sand coreopsis/lanceleaf tickseed
- Culver’s root
Habitat Plantings Examples

- Outdoor nursery mum plantings
- Greenhouse ornamentals
- High tunnel vegetables
- Field vegetable production
Habitat Plantings Examples

Greenhouse-nursery settings

Display gardens

High tunnel herbs

Field vegetable production
What’s That on My Habitat Plant?

Natural Enemy 101
Life Cycle Basics

What life stage am I looking at?

Gradual Metamorphosis

Complete Metamorphosis
(~75% of all insect species)

Timing is everything!
Management using pesticides or biocontrols typically target specific life stages
Predators vs Parasitoids

Predators: actively & kill host
- Larger than prey
- Attack in immature stage, adult stage, or both
- Eat multiple prey
- Mobile to find & catch prey
- Most have broad host range (generalists)

Parasitoids: kill host (parasites don’t usually kill)
- Smaller than host
- Kill pests in larval/developing stage
- Each larva kills one host during its development
- Larvae not mobile in the environment (adults mobile and seek hosts)
- Eggs laid in or on host
- Usually host-specific (specialists)
One of these flying insects is not like the others...
Hoverflies/Flower Flies/Syrphid Flies

Diptera (flies)
Over 6,000 species
Adults feed on pollen & nectars
Important pollinators (more so than bees in some systems – high latitudes, elevations)
Many are effective pollinator due to hairy bodies
Mimic bees/wasps to scare off predators
1 pair wings & halteres (bees have 2 pairs wings)
Mostly short bristle-like antennae (bees have long)
Larvae of many species voracious predators of aphids & other soft bodied arthropods
Basic Syrphid Characteristics

Is it a syrphid?

Other than they resemble bees & have 2 wings......

Observe behavior - called ‘hover flies’ or ‘flower flies’ because of tendency to hover in place around flowers

In case your really inspired to tell it’s a syrphid, check out wings (under magnification)

Floating/false vein in wing (Vena spuria)

Great part of wing edge is without veins
Syrphid Life Cycle

Not all syrphids have predatory maggots, many consume decaying matter.

Generally overwinter as immatures in duff layers.

Adults emerge in spring & seek pollen, nectar &/or sugary aphid honeydew ‘poop’ - need proteins for egg laying & sugars for flight energy.

Adults lay eggs near aphid colonies & are active April-November.

Several generations per year.

Flowering plants encourage localized early establishment & overwintering.
Syrphid Diversity

- **Neoascia sp.**
  - Larvae aquatic
  - *Eristalis tenax* (Drone fly)
  - Honey bee mimic

- **Toxomerus sp.**

- **Allograpta obliqua**
  - Yellow jacket mimic

- **Mallota posticata**
  - Bumble bee mimic

- **Melanostoma mellinum**
  - Larvae ground dwelling & suspected to prey on ants

- **Chrysotoxum sp.**
  - Honey bee mimic

- **Rat tail maggot**

Small pests and decaying matter.
**Cecidomyiidae fly family**

Adults are mosquito looking midges that feed on honeydew & nectar

Many larvae create galls in plant tissues, but some species predatory

- *Aphidoletes* eats most aphid spp. (orange color)
- *Feltiella* eats mites, esp. spider mites (brown-yellow color)

*Feltiella acarisuga* & *Aphidoletes aphidimyza* commercially available & naturally occurring
Paraitoids

Adults lay eggs on or near hosts (caterpillars, beetles & bugs) for larvae to burrow into or ingest

Larvae (maggots) develop within

After consuming host, larvae burrow out to pupate on ground substrates

Parasitized Japanese Beetle by Tachinid fly

Eggs on caterpillar

Resemble houseflies but have stout bristles on tips of abdomen

Pupae

Larva
Other Ruthless Flies

**Thick headed flies (Conopidae)**
Parasitoids of bees. Eggs laid within, larvae develop inside & kill host.

*(Conops sp.)*

*(Common Eastern Physcocephala)*

**Bee flies (Bombyliidae)**
Predatory as adults. Larvae are soil dwelling, some also predatory. Adults have venomous saliva that liquefies prey inside, then fly sucks up contents).

*(Bombylius major)*

**Asilids (Robber/Assassin flies)**
Adults flick eggs into ground bee nests where larvae predate on larvae.
Parasitic & Predatory Hymenoptera

Hymenoptera (Bees & Wasps)

Parasitoids often very small and go unnoticed (few mm in size)

Adult wasp parasitoids lay eggs within/on hosts

Larvae development kills host

Adults mostly feed on nectars & some are predatory

Many species are commercially available

Don’t worry, the parasitoids do not sting people
Wasp Parasitoids

Braconids

*Aphidius* & *Praon* attack aphids

*Cotesia* pupae on hornworm (after larval feeding within)

*Aphidius* larva-pupa ‘mummy’

*Praon* mummy
More Wasp Parasitoids

**Ichneumons**
- Prominent ovipositor
- Attack sawflies & caterpillars

**Chalcids**
- *Aphelinus* mummy
- *Aphelinus* for aphids

**Trichogramma** on moth eggs

**Ichneumons**
- Attack sawflies & caterpillars

**Chalcids**
- *Aphelinus* mummy
- *Aphelinus* for aphids

**Trichogramma** on moth eggs
Wasp Predators

Yellow jacket

Digger wasps (cicada killers)

Hornets & many wasps consume a variety of insect pests in addition to floral resources
Predatory Bugs

Pirate

*Orius*

Nymph

Predatory as adults & nymphs

Damsel

Adult

Assassin

Adult

Spined Soldier

Adult

Nymph

Predatory stink bug (*Posidus*)

Big Eyed

Adult

Nymph

*Geocoris*
Predatory Beetles

Lady Beetles

Predatory as adults & larvae
Some can be crop pests (Mexican bean beetle)
Others consume fungi
Commercially available spp.
- *Hippodamia convergens* wild caught & native
- *Adalia bipunctata* insectary raised & native
- *Stethorus punctillum*, non-native but other spp. natives

**Adults**

*Hippodamia convergens* convergent lady

*Adalia bipunctata* two-spotted

*Stethorus* *mite feeder*

*Psyllobora vigintimaculata*
twenty-spotted

*fungus feeder (powder mildew)*
Predatory Beetles
Common Lady Beetles

*Introduced*

- **Coccinella septempunctata**
  - sevenspotted ‘C-7’

- **Harmonia axyridis**
  - Asian lady beetle

**Natives**

- **Coleomegilla maculata**
  - pink spotted

- **Hippodamia parenthesis**
  - parenthesis

- **Propylea quatuordecimpunctata**
  - checker spot ‘P-14’

- **Hippodamia variegata**
  - variegated
Predatory Beetles

**Soldier**
- Adults highly attracted to flowering plants (goldenrod, herbs) to feed on nectar & pollen

**Carabid**
- Ground beetles (some also eat seeds managing weeds)

**Rove**
- Predatory as adults & larvae
- Vast diet (fungi, small arthropods, decaying matter)
Lacewings
Brown & Green

Eggs single

Predatory as adults & larvae

Eggs stalked

Adults consume pollen & nectars

Mostly predatory as larvae
Predatory Thrips (Yes.. Thrips)

Black hunter thrips (*Aelothrips*)

*Franklinothrips vespiformis*

The sixspotted thrips (*Scolothrips sexmaculatus*)

Banded thrips or Banded-wing thrips

*Aeolothrips fasciatus*
Dragon/Damselflies, Mantids, Spiders
We are providing benefits

We are evaluating the effectiveness of habitat hedges to attract beneficial insects to growing areas to support biological control of common greenhouse, high tunnel & nursery pests.

Encouraging the establishment of natural enemies of key pests could minimize or eliminate the need for chemical pesticides.
Habitat is Happiness

Established habitat hedges of annual plants (approx. 10 x 3ft), just finished year 3

Some harvestable annual habitat plants (to attract consumer attention)

Mix of transplants & direct seed (to provide floral resources all season)

Visual & plant tapping surveys for beneficials (primarily those that manage most common pests)

Also examined perennials during bloom periods in display gardens or container stock

Collected data May-September

Expanding sites for demos for public education
Some Habitat Hedge Constituents

Indian Blanket  Zinnia  Sunflower  Marigold  Plains Coreopsis

Wild Cosmos  Alyssum: Sweet & Royal Carpet  Purpletop vervain  Blue Cornflower  Ageratum

Provide a diversity of colors, structures (floral shapes/sizes & vertical heights) & bloom periods
Examples
Examples
Maintaining Order in the Hedges

Allocation of insect orders present on plants within habitat hedges (357 occurrences during 41 observations over 2 years)
Beneficial Break Down

- Bees 83%
- Bees/Wasps (Hymenoptera)
- Small wasps <0.5cm (23%)
- Large wasps/hornets (27%)
Beneficial Break Down

- Predatory Syrphids (74%)
- Flies (Diptera)
- Parasitic Tachinids (4%)
- Others (39%)
Other Beneficial Visitors

General Predators of aphids, mites, thrips

- *Orius insidiosus* (minute pirate bug) (60% of bugs that were present)
- Lady Beetle spp. (42% of beetles)

Both commercially available

Habitat hedges attract them for free

- **Orius adult**
- **Thrips adult**
- **Lady beetle adult (above)** & **larva (below) eating aphids**
- **Orius adult eating aphid**
Other Beneficial Visitors

- Predatory Thrips
- Soldier Beetles
- Jagged Ambush Bugs
Bee-lieve in the Cause

Spread the word on how property owners can provide habitat plantings to boost beneficials & receive free pest management to help reduce chemical pesticides.

Protect pollinators from direct pesticide exposure if you need to treat:

- Treat plants when least attractive (when blooms closed)
- Early or late in day (when insects not foraging)
- Select least toxic chemistries
- Read label directions & apply at correct rates

Contact Extension agents for advice.
Beneficial Insect Resources


Creating Gardens for Pollinators:: https://protectingbees.njaes.rutgers.edu/


Flower Flies (Syrphidae) and Other Biological Control Agents for Aphids in Vegetable Crops: http://anrcatalog.ucanr.edu/pdf/8285.pdf


NRCS Planting Guides for Native Pollinators: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/plantmaterials/technical/publications/?cid=stelprdb1044847


Protecting Bees and Other Pollinators from Pesticides (EPA): https://www.epa.gov/pollinator-protection

Selecting Plants for Pollinators (Northeast): http://pollinator.org/PDFs/Adirondack.rx2.pdf

Xerces Society Northeast Region: http://xerces.org/pollinators-northeast-region/
Questions?

National Geographic Video Worth Watching: Parasitic wasp & caterpillar: https://www.youtube.com/watch?v=vMG-LWvNcAs

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Thank YOU!

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