

Using beneficial insects for pest management in organic systems



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Outline

- Key Concepts
 - Biological control
 - Biodiversity
- Creating a plan
- Common beneficial insects



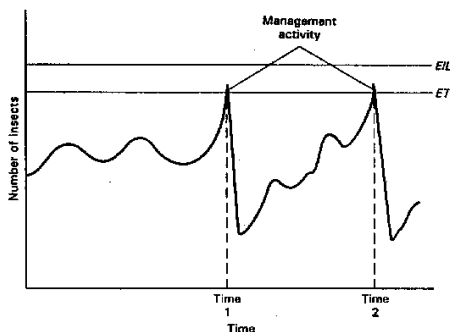
Key Concepts

- Ecological pest management is a 'systems' approach
- Healthy soils and plants withstand pest pressure better than stressed plants
- Pests can be managed by creating favorable environments for beneficial insects
- Careful observation is critical

Biological Control

- Biological control: using natural enemies to manage biological pests (insects, pathogens, weeds, animals etc...)
- Can keep pests from reaching injurious levels-- best when populations are low

Economic Thresholds



Biological Control

Three types:

- Classical—introducing a natural enemy to manage an exotic pest
- Augmentative—supplemental release of mass reared natural enemies to manage pests in a controlled setting
- Conservation—providing habitat and protecting natural enemies that are already present in the environment

Biological Control-Ecology

A **predator** attacks, kills and feeds on several prey

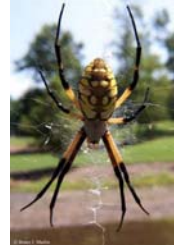
A **parasitoid** lives or feeds in or on a host



Biological Control-Predators

Examples of common predators:

- Lady beetles
- Lacewings
- Minute pirate bugs
- Predatory stink bugs
- Carabid beetles
- Spiders



Biological Control-Parasitoids

Examples of parasitoids:

- Tachinid flies
- Braconid wasps
- Ichneumonid wasps

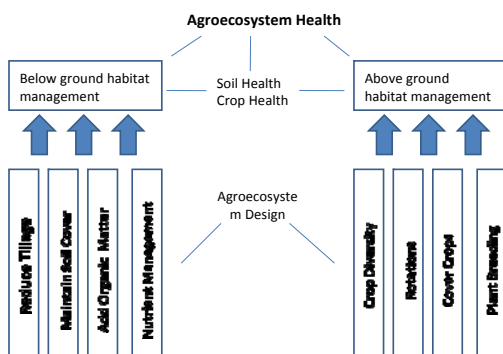


Biological Control and Diversity

Specialist herbivores (i.e. corn borers, cucumber beetles, Colorado potato beetles) are attracted and retained by monoculture of their host plant to a greater extent than in diversified systems



Pillars of Ecological Pest Management



Preventing insect problems

Keep soil healthy:

- add organic matter with compost, cover crops
- use minimal till or no-till
- rotate crops

Keep plants healthy:

- start with healthy transplants
- plant in fertile, well-drained soil
- don't over-fertilize
- space properly



Healthy plants are still attractive to pests, but are able to handle insect pressure better than stressed plants

Providing habitat: Beetle banks

- Habitat for ground dwelling predatory beetles
- Grassy, undisturbed habitat is best
 - Wheat, blue rye
 - Orchardgrass, sudangrass, switchgrass
 - Fescues

Carabid ground beetle



Beetle bank at Oregon State University Corvallis, OR



Providing habitat: Ponds, ditches and riparian areas

- Provides water for wildlife
- Provide another microclimate
- Provide constant habitat



Hedgerows or Windbreaks

- Linear barrier of trees, shrubs or perennial grasses planted along edges or in between fields
- Used to reduce wind, wind erosion, crop desiccation
- Can provide a microclimate and constant habitat



UT Extension

Insectary Blocks, Borders or Strips

- Planting of flowering mixes to attract predators and pollinators
- Ideally should:
 - Time bloom to meet needs of beneficials
 - Not compete with crop
 - Require little additional management



UT Extension

Enhancing Diversity

- Include more species of crops and livestock
- Use legume-based crop rotations
- Intercrop or strip crop
- Mix varieties of the same crop
- Grow cover crops
- Leave strips of wild vegetation at borders
- Leave areas of the farm untouched



Parasitoid-Nectar Provision Hypothesis

- Nectar increases fecundity and longevity of parasitoids
- Providing a constant supply of nectar may increase efficacy of biological control



Nectar Plant Management

- Nectar plants should be blooming throughout the season, the earlier the better
- Plant within 200 yards from target crop
- Let some herbs flower or vegetables bolt

Plants for Natural Enemies

Herbs	Wildflowers
Thyme	Rue
Fennel	Yarrow
Coriander	Alyssum
Dill	Milkweed
Mint	Tansy
Chamomile	Verbena
Rosemary	Buckwheat

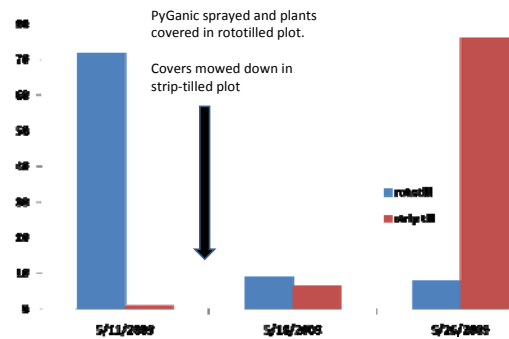
Reduced pest pressure in strip-till broccoli

Project description:

- ‘Belstar’ broccoli transplanted into rototilled and strip-tilled plots of Austrian winter pea and triticale
- Some plots oversown with red clover and annual ryegrass
- Plant growth, weeds, pest pressure and disease monitored weekly



Flea beetle pressure in broccoli



Flea beetle pressure in strip-till broccoli

Beetle pressure may have been lower in the strip tilled plots because:

1. Beetles were not able to easily find their hosts
2. Beneficial populations were higher in strip-tilled plots



Is there a downside to diversity?

- Providing for natural enemies could help the pests. Pests may have more “hiding places” and natural enemies may become less effective at finding prey.
- Increasing nectar may help pests, too. Pests may consume it themselves, or it could attract hyper parasitoids or result in inter-guild predation.

Monitor and keep track of any changes

Developing a Farmscaping Plan

- What to consider when creating your plan:
 - Ecology of pests and beneficials
 - Timing
 - Identification strategies
 - Establishment costs and approach



Ecology of Pests and Beneficials

- What are the key pests?
- What are the predators and parasites of those pests?
- What are the primary food sources, habitat, and other requirements of both pests and beneficials?
 - Where does the pest infest the crop/beneficial come from?
 - How is it attracted to the crop?
 - How does it develop in the crop?



From ATTRA 'Farmscaping to Enhance Biological Control'

Timing

- When does the pest first appear?
- When do the populations become economically damaging?
- When do the predators and parasites of the pest appear?
- When do food sources (nectar, pollen, alternate hosts, and prey) for beneficials first appear? How long do they last?
- What native annuals and perennials can provide habitat?



From ATTRA 'Farmscaping to Enhance Biological Control'

Prevention Strategies

- How can I reduce pest habitat (reduce overwintering sites, reduce/alter locations from which pest invades)?
- How can I increase beneficial habitat (insectary establishment, hedgerows, natural areas)?



From ATTRA 'Farmscaping to Enhance Biological Control'

 Extension

Establishment Cost and Approach

- What/where are the seed/plant sources?
- What is the cost of ground preparation, planting and maintenance for:
 - At least one year following establishment of perennials?
 - Number of plantings needed per season of beneficial habitat?
- What are the equipment needs to plant/maintain habitat?



From ATTRA 'Farmscaping to Enhance Biological Control'

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What to Do

- Devote some land to farmscaping plants and experiment with different recommended crops and varieties on a small scale
- Use untreated seed and grow your own transplants if possible
- Monitor at different times of the day to see pollinators and natural enemies in action
- Learn to identify your key pests and beneficials
- Keep records

 Extension

What Not To Do

- Don't plant a large grouping of mixed flowers and expect pest problems to disappear overnight
- Don't expect biocontrol to save your crop when pest outbreaks are above economic injury levels
- Don't use broad spectrum pesticides at the first sign of pest activity

Keys to Success

- Start small
- Patience
- Skill
- Timing
- Persistence



Common Beneficial Insects: Ladybeetles



7-Spotted Lady Beetle



Lady Beetle Pupa



13-Spotted Lady Beetle and eggs



Lady Beetle Larva



Multicolored Asian Lady Beetle

Common Beneficial Insects: Ground & tiger beetles



Common Beneficial Insects: Lacewings



Lacewing larva



Lacewing adult



Lacewing pupa



Lacewing egg

Common Beneficial Insects: Various bugs



Spined soldier bug



Assassin bug



Twospotted stink bug



Bigeyed bug

**Common Beneficial Insects:
Minute pirate bugs**



**Common Beneficial Insects:
Syrphid flies**



Adult



Pupa



Midge

**Common Beneficial Insects:
Parasitoid wasps**



Parasitized hornworm



Braconid wasps



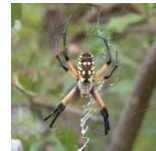
Aphid mummy



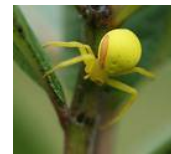
**Common Beneficial Insects:
Spiders**



Wolf spider



Orb weaver



Crab spider



Jumping spider

Birds and bats

The chickadee eats:
-Colorado potato beetles
-Flea beetles
-Weevils
-Flies
and more...



Carolina chickadee

Bats eat:
-Cucumber beetles
-Leafhoppers
-June beetles
-Earworms and corn borers



www.batconservation.org

Guide books and web resources

Photos:
<http://www.insectimages.org/>
<http://bugguide.net>

Guide books:
• Garden Insects of North America by Whitney Cranshaw
• Natural Enemies Handbook by Flint and Dreistadt
• Peterson Field Guides

Attra: 'Farmscaping to Enhance Biological Control'
<http://attra.ncat.org/attra-pub/PDF/farmscaping.pdf>

Resource Guide for Organic Insect & Disease Management
<http://www.nysaes.cornell.edu/pp/resourceguide/>

Thank you!



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Questions?

