Working with Biological Controls of Insects

Garfield County AgExpo

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Cabbage looper is a common insect that chews on many kinds of plants. An example of why natural controls are so important.
On average one cabbage looper female moth **may lay 100 eggs.** When the egg hatches the insect feeds and grows, ultimately becoming a new adult.....**if everything goes well.**
On average 98 of those 100 eggs will not produce a new adult. Something gets them along the way.
Natural Controls

Natural Enemies

Abiotic (Weather) Controls

Topographic Limitations
Natural Enemies

- Predators
- Parasitoids
- Pathogens

Parasitoid wasp laying egg in an aphid
Predatory stink bug feeding on a caterpillar
Tent caterpillar killed by virus
Working with Natural Enemies of Insect Pests

• Learn to recognize them – and don’t kill them
  • Provide for food needs of adults
  • Provide for food needs of immature stages
Recognize so you can work with (and avoid working against) existing natural controls

Life Styles of the Swift and Vicious
Characteristics of Predators of Insects

• Immature stages actively hunt prey
• Several prey are consumed in the course of development
• Adults may or may not have similar food needs as immature form
  – Many switch to nectar, pollen
LADY BEETLE
Most lady beetle adults are brightly colored.
Pinkspotted lady beetle
*Coleomegilla maculata*

A species that feeds mostly on eggs and larvae of beetles
LeConte’s giant lady beetle
*Anatis lecontei*

A species that feeds on aphids and mealybugs on trees
Upper left: *Coccidophilus*, a scale predator

Lower left: *Olla* sp., a grey colored lady beetle

Below: *Chilochorus* sp., a predator of various scales
Lady Beetle Life Stages
Eggs of lady beetles are usually laid where prey are nearby that can feed their young, such as aphids.
Lady beetle larvae at hatch from eggs

Lady beetle egg mass
Lady beetle larvae at egg hatch
Lady beetle larvae

Predators of small soft-bodied arthropods (aphids etc...)
Lady beetle prepupae
Lady Beetle Pupae
Lady beetles, also known as “ladybugs” or “ladybird beetles,” are familiar insects. Some 70 species are native to Colorado and about 10 to 12 additional species have established during the past century.

Overwhelmingly, habits of lady beetles are highly beneficial to human interests. Both the adult lady beetles and the grub-stage larvae have chewing mouthparts and are voracious predators of other insects. Although each type of lady beetle has preferences for what they will eat (e.g., aphids, scales, spider mites, mealybugs, etc.), they tend to have fairly broad tastes and feed on almost any small scales (Coccidophilus, Scymnus) usually are uniformly black or dark brown. A few lady beetle species are even striped.

Lady beetles, as all beetles, develop in a pattern known as ‘complete metamorphosis.’ This involves eggs, mobile feeding-stage larvae that molt four times as they develop, transition-stage pupae that undergo changes to the final form, and ultimately the familiar adults.

Most lady beetle eggs typically are spindle-shaped and yellowish or orange-red in color. They are laid in clusters on leaves or other surfaces near aphids and...
Green Lacewings
Neuroptera: Chrysopidae
Adult green lacewings sustain themselves on nectar and pollen.
Green lacewing eggs are uniquely stalked.
Green lacewing eggs often are laid in groups.

Egg hatch has occurred in the lower picture.
Photograph courtesy of Brian Valentine

Green Lacewing Larvae

Photograph courtesy of David Shetlar
Left: Green lacewing larva eating aphid

Right: Green lacewing larva eating leaf beetle larva
Flower (Syrphid) Flies
CAUTION

Insect Mimicry in Action!
Syrphid flies are excellent mimics of bees and wasps.
Honey Bee … or Flower Fly?
Syrphid/flower fly eggs are typically laid near a colony of aphids.
Head end of the flower fly larva

Photograph courtesy Brian Valentine
Flower fly larvae
Mantids
Mantids are generalist predators that hunt by ambush.

No need for dangerous chemical sprays when you make a valuable ally of the helpful Praying Mantis! Maintain the balance of nature by "planting" its fertile eggs in your own garden—they hatch at the proper time and remain until all harmful aphids, lice and many other pests that plague your precious foliage, fruit, and flowers are devoured. Each hardy egg cluster contains hundreds of eggs which hatch and thrive on insects, then lay their own eggs for next season's life cycle. Comes with full instructions for storage and use.

A06148Y... Praying Mantis Egg Cluster
$1.95 each; 3 for $4.99; 6 for $8.49; 12 for $14.79
European Mantid

*Mantis religiosa*

This is an introduced species to North America and is probably the species most common in Garfield County. **There are 4 native species of mantids in Colorado.**
Mantid Egg Laying
**European mantid life stages**

**Nymph** (immature form) – a predator

**Adults**

**Eggs** – laid in a mass (oothecal). The overwintering stage.
European mantid egg cases
There is a Colorado State University Fact Sheet about the Mantids that are found in the State

Mantids of Colorado
Fact Sheet No. 5.510
Insect Series | Home and Garden
by W. Cranshaw*

Mantids are some of the most distinctive and well-recognized of all the insect groups. All mantids are predators that feed on various insects, including some pest species. Seven species of mantids are found in Colorado (Table 1), five of which are native to the state.

Mantids are very distinctive insects. All have front legs which are large and well-designed for grasping prey. The segment of the body containing these legs (prothorax) is very elongated as is the overall body form.

Quick Facts
- Mantids are large, distinctive insects that feed on other insects, including some pests.
- All mantids survive winter in the egg stage, within a large egg case (ootheca).
- There are seven kinds of mantids that occur in...
Some Common Kinds of Predators that Feed on Insects

- Lady beetles
- Ground beetles
- Lacewings
- Flower flies
- Robber flies
- Hunting wasps
- Mantids

- Assassin bugs
- Predatory stink bugs
- Minute pirate bugs
- Predatory thrips
- Predatory mites
- All spiders
Characteristics of Insect Parasitoids

• The mother hunts, inserting eggs in or on a host insect

• The immature stage develops in the host insect, ultimately killing it
  – Many may develop in one host

• Adults mostly feed on nectar and honeydew
Parasitoid Wasps

Ichneumonidae, Braconidae, Eulophidae, Trichogrammatidae, Encrytidae, Chalcidae and other families
Parasitoid wasps sustain themselves on nectar and pollen.
Parasitoid Wasps

Females possess an ovipositor (‘stinger’). This is used to lay eggs in a host insect.

*They do not sting.*
Parasitic Wasps – Male (left) and Female (right)
Ectoparasitic wasp larvae on fall webworm caterpillar host
Parasitoid larvae emerging from caterpillar host
Parasitoid larvae (*Cotesia glomeratus*) emerging from cabbageworm host and spinning pupal cocoons.
Cocoons of the cabbageworm parasitoid
(Cotesia glomeratus)
Aphid parasitoids
Aphid Mummies

Aphid showing early symptoms of parasitism

Aphid mummies
Parasitized psyllids (above) and soft scale (below)

Parasitized aphids (above) and whiteflies (black forms, below)
Tachinid Flies
Tachinid fly eggs on body of whitelined sphinx caterpillar. Some are indicated with arrows.
Tachinid fly eggs on caterpillar (above), squash bugs (upper right) and Japanese beetle (right)
Hatched egg

Opening for spiracle of tachinid fly larva
Cabbage looper supporting six developing tachinid fly larvae

Tachinid fly pupae within killed cabbage looper larva
Caterpillars killed by tachinid flies

Photograph courtesy of Ken Gray/Oregon State University
Landscaping for Biological Control Agents
Principles of Gardening for Natural Enemies of Insect Pests

• Learn to recognize them – and don’t kill them

• Provide for food needs of adults

• Provide for food needs of immature stages
Lady beetles

(“Lady bugs”, “Lady birds”....)
Lady beetle adults feed on nectar and pollen.
Green Lacewings

Neuroptera: Chrysopidae
Most adult green lacewings maintain themselves on nectar and pollen.
Flower (Syrphid) Flies
Adult flower flies sustain themselves on nectar
Adults of many natural enemies use flowers (nectar, pollen) for sustenance.
Parasitoid wasps maintain themselves on nectar and pollen.
Tachinid fly adults sustain themselves on nectar and pollen.

Larvae develop within and kill other insects.
Small, accessible flowers are most commonly used by natural enemies of garden pest insects.
Some plants useful for providing food for adult stages of insect natural enemies

- Most Apiaceae - (dill, fennel, coriander, Ammi, Queen Anne’s lace, etc.)
- Yarrow (some)
- Many sedums
- Spurges
- Sweet alyssum
- Basket-of-gold
- Thyme, several herbs
Two personal favorites for good natural enemy insect action

Ammi (white cultivars)

Mooncarrot
Farm Planning for Conservation Biocontrol

Xerces habitat planting, California almond orchard
Principles of Gardening for Insect Natural Enemies

• Learn to recognize them – and don’t kill them
• Provide for food needs of adults

• Provide for food needs of immature stages
Spirea aphids on my bridal wreath spirea shrub – A pest??
Perennial plants that consistently provide predator food sources in my garden
Intercropping

- Increases diversity of site
- May impact ability of insects to locate crop
- Can provide habitat for natural enemies, including more consistent sources of prey/hosts
An excellent publication by the Xerces Society on improving habitat for natural enemies of insect pests

Want more? Search Conservation Biological Control
Branches of Biological Control of Insect and Mite Pests

- Introduction of new species for permanent establishment
- Rearing/Distribution of natural enemies

- Conservation and enhancement of existing natural enemies
  - Involves on-site manipulations
    - Continuation of favorable practices can provide long-term effects
Branches of Biological Control of Insect and Mite Pests

• Introduction of new species for permanent establishment

• Rearing/Distribution of natural enemies
  – Commercial sources typically used (“Bugs for Hire”)
  – Effects are typically short-lived

• Conservation and enhancement of existing natural enemies
A list of commercially available biological controls. It includes 36 insect predators, 21 parasitoids of insects, and 17 insect pathogens. There are 36 suppliers.

**Predators of Insects/Mites**

Convergent Lady Beetle/Lady Beetles. When sold as “lady beetles” or “ladybugs” the species involved is the convergent lady beetle, *Hippodamia convergens*, a native lady beetle found throughout North America. Purchased lady beetles are all field collected insects, captured in high elevation areas of California where they periodically migrate to and mass aggregate, allowing easy collection. Ability of the collected lady beetles to reproduce is suspended (they are in "reproductive diapause") so eggs are not produced for several weeks after release. (Pre-feeding lady beetles prior to release can allow some egg maturation to start and a few companies provide such "pre-conditioned" lady beetles). Lady beetles tend to readily disperse from the area of release. Since they store well, lady beetles are available most of the year, although supplies often are limited by midsummer.

Sources: 1, 2, 4, 5, 10, 11, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24, 25, 27, 29, 30, 31
Bulk purchase of field collected Hippodamia convergens
Convergent lady beetle (*Hippodamia convergens*) – the lady beetle of commerce
Unlike most lady beetles, the convergent lady beetle often masses during the dormant period.
Lady beetles are the only biological control of insects that are field collected.
Purchasing lady beetles?
Egg cases of the Chinese mantid are sold by some nurseries and in some garden catalogs.
Chinese Mantid

*Tenodera sinensis*

**Note:** This species *does not* seem to survive through winter outdoors in Colorado.
Green Lacewings

These are insects that are able to be economically reared in insectaries.

Most often these are sold as eggs.
Green lacewing eggs are available from many suppliers that rear/distribute insects.
Predatory Mites

Several species are reared and sold to control **spider mites** and **thrips**
Three species of parasitoid wasps are sold to control aphids.
Whitefly parasites – Parasitic wasps that selectively attack whiteflies
Trichogramma wasps, a parasitoid of eggs of various caterpillars (Order: Lepidoptera)
The list of commercially available biological control organism is available at the Insect Information Website.

BIOLOGICAL CONTROL ORGANISMS FOR INSECTS AND MITES: Sources and Uses for Pest Management Situations in Colorado

Whitney Cranshaw and Andrew Miller
Colorado State University
January 1, 2020 Version

A wide variety of beneficial organisms are offered for sale by several suppliers to assist in management of insects and mites. The following is a listing of most of the US suppliers and it is organized into three sections. First is a brief description of organisms with potential applications followed by reference to sources where they may be purchased. This is followed by a brief summary listing of pest groups and the associated potential biological controls. At the end is a listing of addresses of many suppliers/producers.

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Branches of Biological Control of Insect and Mite Pests

- Introduction of new species for permanent establishment
  - Always coordinated by government and regulatory agencies
  - Effects are long-term
- Rearing/Distribution of natural enemies
- Conservation and enhancement of existing natural enemies
The origin of Classic Biological Control

Cottony cushion scale and the Vedalia beetle
Cottony Cushion Scale – Enters California in 1860s and devastates citrus industry within next two decades
To the rescue – the *Vedalia beetle*

- Albert Koebele visits Australia and searches for natural enemies of cottony cushion scale
- Vedalia beetle (and a predatory fly) are introduced into California – 1888
- Complete control of cottony cushion scale within two years after introduction
The vedalia beetle was subsequently introduced into dozens of other areas plagued by the cottony cushion scale.
Control of Cottony Cushion Scale by the Vedalia Beetle

Birth of the ‘Classic’ biological control technique for insect pests
Branches of Biological Control of Insect and Mite Pests

• Introduction of new species for permanent establishment
  – Always coordinated by government and regulatory agencies
  – Effects are long-term

• Rearing/Distribution of natural enemies

• Conservation and enhancement of existing natural enemies
Palisade Insectary
Colorado Dept. Agriculture
Conservation Services Division
Biological Control Program
750 37.8 Rd.
Palisade, CO 81526
(970) 464-7916
Presently the CDA Insectary at Palisade is involved with producing and releasing insects that can help **reduce invasive weeds**

**Biocontrol**

Biological pest control helps decrease agriculture’s reliance on chemical pest control. The Insectary imports, rears, establishes, and colonizes new beneficial organisms for control of specific plant and insect pests. Successful biological pest control reduces production costs, decreases amounts of chemicals entering the environment, and establishes colonies of beneficial insects offering a natural permanent pest control solution.

**Weed and Insect Programs**

Approximately 30 weed predators are being cultured, released, and established on weed infestations throughout the State. In addition to the biological weed control programs, this section conducts control programs for the alfalfa weevil and Oriental fruit moth, with a total of twelve...
Weed and Insect Programs

Approximately 30 weed predators are being cultured, released, and established on weed infestations throughout the State. In addition to the biological weed control programs, this section conducts control programs for the alfalfa weevil, and Oriental fruit moth, with a total of twelve beneficial species. The main function of the Biological Pest Control Section is the rearing and releasing of natural enemies for control of specific plant and insect pests. To request biological pest control please contact our office. This section also acts as the State’s receiving station for biological control agents. New biological control programs are being developed primarily by agencies of the United States Department of Agriculture. Foreign exploration produces several new species each year that are known to control introduced plant and insect pests. These exotic species are exposed to a strict quarantine procedure before they become available to cooperating states for general release. This ensures that potentially hazardous species are not accidentally introduced with the beneficial insects.

Views Fees & Request A Bug
The Insectary at Palisade is celebrating its 75th Anniversary in August!

It is open to tours. Please call ahead.

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