Recognizing and Working with Natural Enemies of Insect Pests
Natural Controls

Natural Enemies

Abiotic (Weather) Controls

Topographic Limitations
Temperature Extremes

Heavy Rainfall

Abiotic (Weather-related) Controls of Insects
Natural Enemies

- Predators
  - Hunting wasps
- Parasitoids
- Pathogens
Recognize so you can work with existing natural controls

Life Styles of the Swift and Vicious
Characteristics of Insect Predators

- 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
Some Common Arthropod Predators

- Lady beetles
- Ground beetles
- Lacewings
- Flower flies
- Robber flies
- Mantids
- Assassin bugs
- Predatory stink bugs
- Minute pirate bugs
- Predatory thrips
- Predatory mites
- All spiders
Most lady beetle adults are brightly colored.
Upper left: *Coccidophilus*, a scale predator

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

Below: *Chilochorus* sp., a predator of various scales
The “bad apple” of the lady beetle clan
Mexican bean beetle
- a plant feeding lady beetle

Adult
Eggs
Larva
Pupa
Lady Beetle Life Stages

- **Adults**
- **Eggs**
- **Larvae**
- **Pupae**
Lady beetles with egg masses
Lady beetle larvae at egg hatch
Lady beetle larvae

Predators of small soft-bodied arthropods (aphids etc...)

[Images of lady beetle larvae on leaves]

[Images of lady beetle larvae on leaves]
Lady beetle prepupae (stage just before they molt to a pupa)
Lady beetle pupae
Stages of a newly molted convergent lady beetle
Purchasing lady beetles?
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.

**Regulatory Note:** Under current pesticide law, biological control organisms that involve microbes – such as bacteria, viruses, or fungi – are classified as pesticides and can only be used on crops for which they are labeled. These are in the section *Pathogens of Insects*. “Higher” organisms used for insect control – such as other insects, predatory mites and nematodes – are exempt and can be used on all crops.

**Predators of Insects/Mites**

*Lady Beetles*, *Lady Beetles*, *Wasp and bee*, *Ichneumon wasps*, *Bracon wasps*
LADYBIRDS DO THE WORK...

No More Poison Sprays

Use the safe biological method used by government and large growers to destroy aphids, inchworms, Japanese beetles, fruit scales, leafhoppers, boll worms, corn ear worms, mites, etc. Ladybugs (ladybird beetles) live on larvae, eggs and insect pests. About 9000 Ladybugs to the pint. Instructions.

A000455E ... Ladybugs (1/2 pint) .............. $9.95
A000463E ... Ladybugs (1 pint) ............... $15.95

Purchasing lady beetles?
Convergent lady beetle (*Hippodamia convergens*) – the lady beetle of commerce
Unlike most lady beetles, the convergent lady beetle often masses during the dormant period.
Massed lady beetles in the Sierra Nevada Mountains

Photograph courtesy of James Solomon USDA-FS
Purchasing lady beetles?
Lady beetle releases are fun
Conserve and enhance existing lady beetles
Conserving and Enhancing Natural Enemies

• Don’t kill them
  – Limit use of broad spectrum insecticides

• Provide foods that the adults need
  – Often need nectar, pollen

• Provide foods that the immature stages need
  – Allow there to be some hosts, prey available
Adults of many predators use flowers (nectar, pollen) for sustenance
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 predators and parasites

- Most Apiaceae - (dill, fennel, mooncarrot, etc.)
- Yarrow
- Many sedums
- Spurges
- Alyssum
- Basket-of-gold
- Thyme, several herbs
My favorite plant for insect action

Mooncarrot
Seseli gummiferum
Promote habitat diversity to optimize natural enemies
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

• Provide nest sites, if required
Spirea aphids on my bridal wreath spirea shrub – A pest??
Bridal wreath spirea

Rubber rabbitbrush

Perennial plants that consistently provide predator food sources in my garden
An excellent new publication by the Xerces Society
Green Lacewings

Neuroptera: Chrysopidae
Adult green lacewings maintain themselves on nectar and pollen.
Green Lacewing Life Cycle

**Lacewing Adult [x3]**
Feeds on honeydews, nectars, and pollens. Lives 20-40 days. Each female 10-30 eggs per day.

**Eggs [x5]**

**Cocoon [x3]**

**Lacewing larvae [x7]**
General predator: Aphids, psyllids, mealy bugs, moth eggs and larvae, etc.

10 days

12 days

5 days
Green lacewing eggs are uniquely stalked.
Green lacewing eggs often are laid in groups.

Egg hatch has occurred in the lower picture.
**Left:** Green lacewing larva eating aphid

**Right:** Green lacewing larva eating elm scales
Green lacewing eggs are available from many suppliers that rear/distribute insects.
Flower (Syrphid) Flies
Syrphid flies are excellent mimics of bees and wasps

Honey Bees

Flower (Syrphid) Flies
Honey Bee …or Flower Fly?
Fly or Bee?
Syrphid egg in aphid colony
Flower fly larvae

Brian Valentine

Ken Gray
Syrphid "smear"
Order Mantodea
Mantids
European Mantid

*Mantis religiosa*
European mantid – Armpit “bullseye”
European mantid life stages

Adult female, green morph

Nymph

Egg case (ootheca)

Adult male, brown morph
Mantis Egg Laying
European mantid egg cases
Chinese Mantid

*Tenodera sinensis*
Some newly hatched nymphs

Chinese mantid

Egg case (ootheca)

Nymph feeding on grasshopper

Praying Mantis Eggs

Adult
Chinese Mantid

This mantid is “the mantid of commerce” because its ootheca is commonly sold at garden centers for biological control of pest organisms.
Egg cases of the Chinese mantid are sold by some nurseries and in some garden catalogs.
I hope not!!

THE GENTLE GIANT
KIND to humans ... DEADLY to garden pests!

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.

A006148Y ... Praying Mantis Egg Cluster
$1.95 each; 3 for $4.99; 6 for $8.49; 12 for $14.79
Carolina Mantid
*Stagmomantis carolina*

North American Native

Photograph courtesy of Jim Kalisch
All Spiders are Predators
Hunting Wasps (Solitary)

Families Crabronidae, Sphecidae, Pompilidae
Ammophila wasp digging nest (left), carrying caterpillar prey (lower left), at nest entrance with prey (below)
Bembix wasp digging while holding horse fly prey
Golden Digger Wasp – Predator of longhorned grasshoppers/katydid
Cicada Killers – Largest hunting wasps
*Pemphredon* wasps nest in plant stems and hunt small insects.
*Pemphredon* wasps nest in plant stems and hunt small insects.
Condominium Project for Pith Nesting Pempredon Wasps
Hunting Wasps (Social)

Hymenoptera: Vespidae
Paper Wasps

Polistes species, primarily
Paper wasp gnawing on weathered board for wood fibers
Paper wasps feed their young freshly killed insects (mostly caterpillars) that they capture and chew.
Paper wasps native to Colorado
European Paper Wasp

A new species in Colorado (post 2001)
European Paper Wasp Nesting in Metal Building Support
Yellowjackets

Vespula species
Western Yellowjacket (*Vespula pensylvanica*) – Key nuisance wasp of the western United States
Western yellowjacket feeding on fresh chicken parts
Western Yellowjacket scavenging on meat (left), dead earthworm (below, left) and splattered insects on automobile
Yellowjackets almost always nest below ground
Most “Bee Stings” Are Not Produced By Bees!!!!!

Yellowjackets are involved in 90%+ of all “bee stings”
Yellowjackets as pollinators?

_Marginal, at most._
Characteristics of Insect Parasitoids

• Larvae develop in, rarely on, their hosts
  – One or more larvae develop in a single host
• They are invariably lethal to the host
  – “parasitoids”
• Adults often have different food needs
  – Nectar, honeydew
  – Pollen
  – Insect blood feeding may occur
Common Insect Parasitoids

- Parasitic Hymenoptera
  - Braconid wasps
  - Ichneumonid wasps
  - Chalcid wasps
  - Eulophid wasp
  - Trichogrammatid wasps

- Parasitic Diptera
  - Tachinid flies
Parasitic Wasps

Ichneumonidae, Braconidae, Eulophidae, Trichogrammatidae, Encrytidae, Chalcidae and other families
Some parasitic wasps

Females possess an ovipositor ("stinger")
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 cabbageworm parasitoid
Some parasitoids pupate on the insect host.

Left: Buck moth caterpillar
Below: Tobacco hornworm
Giant Ichneumon Wasp, Parasitoid of the Pigeon Tremex Horntail
Pigeon tremex – a wood boring wasp of deciduous trees in decline
Giant ichneumon wasp – the most spectacular natural enemy of the pigeon tremex
Egg parasitoids
Trichogramma wasps, a type of egg parasitoid
What’s wrong with this picture?

---

**“WONDER WASPS”**

*(Trichogramma)*

The Wonder Wasp seeks and destroys the eggs of over 200 pest insects—bollworms, gypsy moths, tomato hornworms, to name a few. She drills into and lays her eggs within the eggs of destructive pest insects, then the newly hatched wasp larvae feed on and destroy the host eggs. These wasps *will not sting* people or pets or harm plants, and they coexist with praying mantis and other beneficial insects. Each container provides enough wasps to protect one-half acre of garden or field crop.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A009795E</td>
<td>WONDER WASPS</td>
<td>1 vial</td>
<td>$3.95</td>
</tr>
<tr>
<td>A009803E</td>
<td>WONDER WASPS</td>
<td>3 vials</td>
<td>$9.95</td>
</tr>
<tr>
<td>A009811E</td>
<td>WONDER WASPS</td>
<td>6 vials</td>
<td>$17.95</td>
</tr>
<tr>
<td>A009829E</td>
<td>WONDER WASPS</td>
<td>9 vials</td>
<td>$24.00</td>
</tr>
<tr>
<td>A009837E</td>
<td>WONDER WASPS</td>
<td>12 vials</td>
<td>$27.95</td>
</tr>
</tbody>
</table>

*(Delivery March thru June)*
Aphid parasitoids
Host evaluation

Oviposition

Photographs courtesy of Brian Valentine
Aphid Mummies
Parasitized psyllids (above) and oystershell scales (below)

Parasitized aphids (above) and whiteflies (black forms, below)
Tachinid Flies
Tachinid fly eggs on caterpillar (above) and squash bugs (upper right) and Japanese beetle (lower right)
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
Larva of the polyphemus moth

Larva of the cecropia moth
Polyphemus moth

Cecropia moth
Pupa of now dead host

Tachinid fly pupa

Adult tachinid fly, recently emerged
An excellent new publication by the Xerces Society