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
- 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
LADY BEETLE
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
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...)
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?
BIOLOGICAL CONTROL ORGANISMS FOR INSECTS AND MITES

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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.

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, 8, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 30, 32, 33, 34

Buyers of Lady Beetles. Fitzamann high drying service has been providing lady beetles to the midwest since the 1980s. Their products are all field collected insects and they are available on a limited basis beginning in May.
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
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??
Perennial plants that consistently provide predator food sources in my garden
An excellent new publication by the Xerces Society

The Xerces Society Guide

Farming with Native Beneficial Insects

Ecological Pest Control Solutions
Green Lacewings

Neuroptera: Chrysopidae
Adult green lacewings maintain themselves on nectar and pollen.
Lacewing Adult [x3]
Feeds on honeydews, nectars, and pollens. Lives 20-40 days. Each female 10-30 eggs per day.

GREEN LACEWING LIFE CYCLE

Cocoon [x3]

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

Eggs [x5]

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 leaf beetle larva
Green lacewing eggs are available from many suppliers that rear/distribute insects.
Flower (Syrphid) Flies
Syrphid flies are excellent mimics of bees and wasps.

Flower (Syrphid) Flies

Honey Bees
Syrphid egg in aphid colony
Flower fly larvae

Brian Valentine

Ken Gray
Syrphid “smear”
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
Parasitoid Wasps

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

Females possess an ovipositor ("stinger")
Parasitic Wasps – Male (left) and Female (right)

Ovipositor
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 and Giant Ichneumon Wasp

Fact Sheet 5.604
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

“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>
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<th>Code</th>
<th>Description</th>
<th>Quantity</th>
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(Delivery March thru June)
What’s wrong with this picture?

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A009803E ... WONDER WASPS—3 vials .................. $ 9.95
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A009837E ... WONDER WASPS—12 vials ................. $27.95

(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 Flies
Tachinid fly eggs on caterpillar (above) and squash bugs (upper right) and Japanese beetle (lower right)
Egg (hatched)

Breathing hole for larva
Cluster Flies

*Pollenia* species
Cluster flies are parasitoids of certain earthworms.

Note: They *do not* affect the “red wrigglers” or other worms used in vermicomposting!
Cluster flies are characterized by having golden, curled hairs on the thorax.
Scenario for Cluster Fly Invasion of a Building

- Flies move to sunlit vertical surfaces when seeking winter shelter
- Flies move upward as sun sets
- Flies enter upper areas of building
- Flies often cluster together behind walls during cool season
Hunting Wasps

Families 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
An excellent publication by the Xerces Society
Common Social Wasps

Note: All are annual colony producers

- Social Wasps
  - Yellowjackets
  - Hornets
  - Paper Wasps
    - Hunting Wasps
    - Parasitic Wasps

- Solitary Wasps

- Wasps
Yellowjackets

Vespula species
The most important stinging insect in western North America

Western Yellowjacket (Vespula pensylvanica)
The western yellowjacket feeds its young animal matter – usually carrion or dead insects.
Western yellowjacket scavenging on meat (left), dead earthworm (below, left) and splattered insects on automobile.
They will commonly feed on meaty materials in outdoor dining areas.
...and also take sweets
Yellowjackets produce new nest every year.

Nests are established in spring by a single queen.

Nest are abandoned at the end of the season. Fertilized females – queens – produced near the end of the year are the only stage that survives between seasons.
Yellowjacket nests are always hidden, usually underground.
Western yellowjacket nest exposed by skunk/raccoon digging
Western yellowjacket nest at base of wall and spruce tree in my yard

Note mud at entrance from excavations during colony expansion
Western yellowjacket nest located in an abandoned compost pile. This was dissected on September 28, 2018.
About a foot below the surface the top of the nest was reached.

More complete excavation of the nest showed it to be about a foot in diameter.
The entrance of the nest was about 18 inches from the opening to the outside of the compost pile.
Nests consisted of multiple layers of paper comb.

Cells that are capped and appear white have pupae in them.
Yellowjacket adult wasp tending larvae

Van Waters & Rogers Inc.
1987
subsidiary of Univar
Nest entrances are often inconspicuous.
Nest entrances are usually guarded
Wasp stingers *are not* barbed.
Most “Bee Stings” Are Not Produced By Bees!!!!!

Yellowjackets are involved in 90%+ of all “bee stings”
Yellowjackets as pollinators? *Marginal*, at best.
Nests are **annual**, constructed anew each year.

The only stage surviving between seasons are **fertilized queens**, produced in late summer and early fall.
Ultimate colony size can be many hundreds by the end of summer
Only a few females, fertilized potential future queens will survive between seasons.
Many traps are sold to capture yellowjacket wasps.
Traps that are very poor in capturing yellowjackets
Most effective use of yellowjacket traps?

Probably early in the year targeting overwintered queens.
Hornets

*Dolichovespula* species
Baldfaced Hornet

*Dolichovespula maculata*
Baldfaced Hornet Nests in Trees and Shrubs
Baldfaced hornet chewing on weathered wood

Surface of a baldfaced hornet nest
Aerial Yellowjacket, *Dolichovespula arenaria*
Aerial Yellowjacket nests under eaves and on sides of buildings
The Stinger of Hornets is Not Barbed
Paper Wasps

Polistes species, primarily
Paper wasp gnawing on weathered board for wood fibers
Eggs laid in paper cells

Full grown larvae in paper cells

Larva

Pupa exposed in paper cell
The food fed to paper wasp larvae

Live insects chewed into “bug burger”
Paper wasps native to Colorado
European Paper Wasp

*Polistes dominula*

A new species in eastern Colorado (post 2001)
European Paper Wasp Nesting in Metal Building Support
European paper wasps in our clothes line
European paper wasp nest established on growing sweet corn!
Large Nest of European Paper Wasp
European Paper Wasp vs. Western Yellowjacket

- Predator of insects, primarily
- Produces open nests above ground
- Less likely to sting than most social wasps/bees
- Not attracted to wasp traps

- Scavenger. Commonly visits food and garbage.
- Produces below-ground or hidden nest
- Readily stings when nest disturbed
- Attracted to wasp traps
Some Impacts of the European paper wasp on the Rocky Mountain West

- Added a significant new stinging pest to region
  - Highly visible
- Impacts on yard/garden Lepidoptera
- Stimulates ineffective purchases of wasp traps
Nests are ubiquitous and very frequently observed. Stings are common, although not as common as by western yellowjacket.
Impacts on yard/garden Lepidoptera
Impacts on Butterfly Gardening
European Paper Wasp

Western Yellowjacket
Note trailing legs of European paper wasp

Western yellowjacket
Traps do not capture the European paper wasp or any other paper wasps
WHY Trap
Wasp
Hornet
Yellowjacket
European Paper Wasp
vs. Western Yellowjacket

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