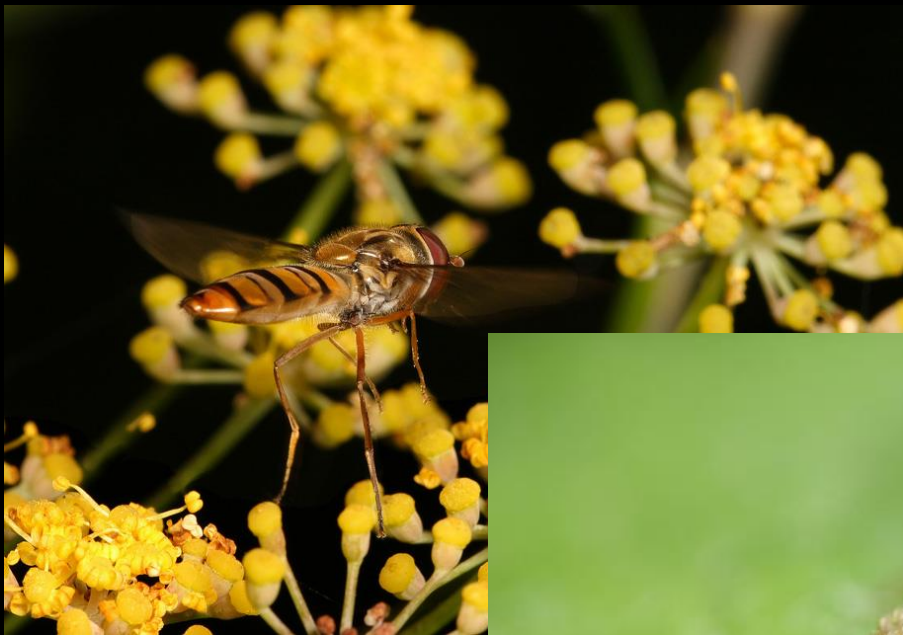


# Recognizing and Working with Natural Enemies of Insect Pests



# 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



Parasitoids



Predators



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**







Photograph courtesy Jim Kalisch, University of Nebraska







**Upper left:** *Coccidophilus*, a scale predator

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

**Below:** *Chilocorus* sp., a predator of various scales







The “bad  
apple” of  
the lady  
beetle clan







Adult



Eggs

# Mexican bean beetle

- a plant feeding lady beetle



Pupa



Larva



Adults



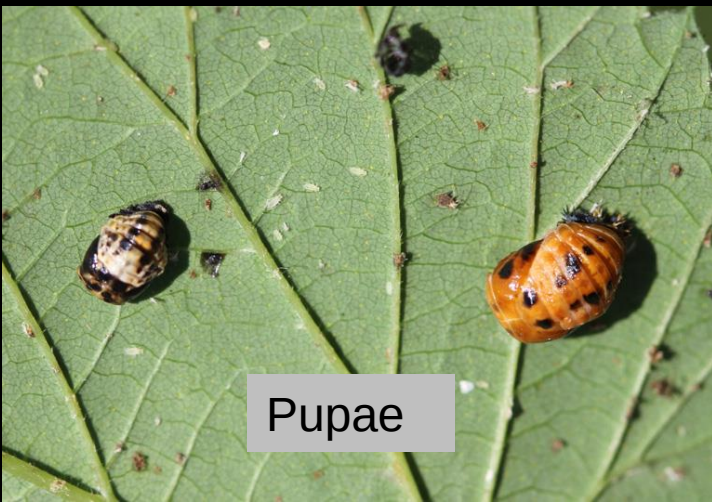
Eggs



Larvae



Pupae



## Lady Beetle Life Stages





Lady beetles with egg masses







**Lady beetle 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**









# 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 (½ pint) ..... \$9.95  
A000463E ... Ladybugs (1 pint) ..... \$15.95



Purchasing  
lady beetles?

## **BIOLOGICAL CONTROL ORGANISMS FOR INSECTS AND MITES**

Whitney Cranshaw, Austin Broberg, and Wendlin Burns  
Colorado State University  
May 31, 2017 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.

**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**



# 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.

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A000463E ... Ladybugs (1 pint) ..... \$15.95



Purchasing  
lady beetles?





Convergent lady beetle  
(*Hippodamia convergens*)  
– the lady beetle of  
commerce

Garden Insects OF NORTH AMERICA







**Unlike most lady beetles, the convergent lady beetle often masses during the dormant period**





A photograph showing a massive aggregation of lady beetles covering a rocky surface and spilling onto the ground. The beetles are a vibrant reddish-orange color with dark spots. They are densely packed on a light-colored, textured rock face, with many beetles having fallen onto the ground below, which is covered with dry grass and some small plants. The scene is set in a natural, mountainous environment.

## **Massed lady beetles in the Sierra Nevada Mountains**

Photograph courtesy of James Solomon USDA-FS



# 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?





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**



# Farming *with* Native BENEFICIAL INSECTS

Ecological Pest Control Solutions



Identify the beneficial insects  
controlling pests on your farm



Improve crop yields by  
reducing pest damage



Provide habitat for beneficial insects  
with hedgerows and buffer strips

An excellent  
new publication  
by the Xerces  
Society





# Green Lacewings

**Neuroptera:  
Chrysopidae**

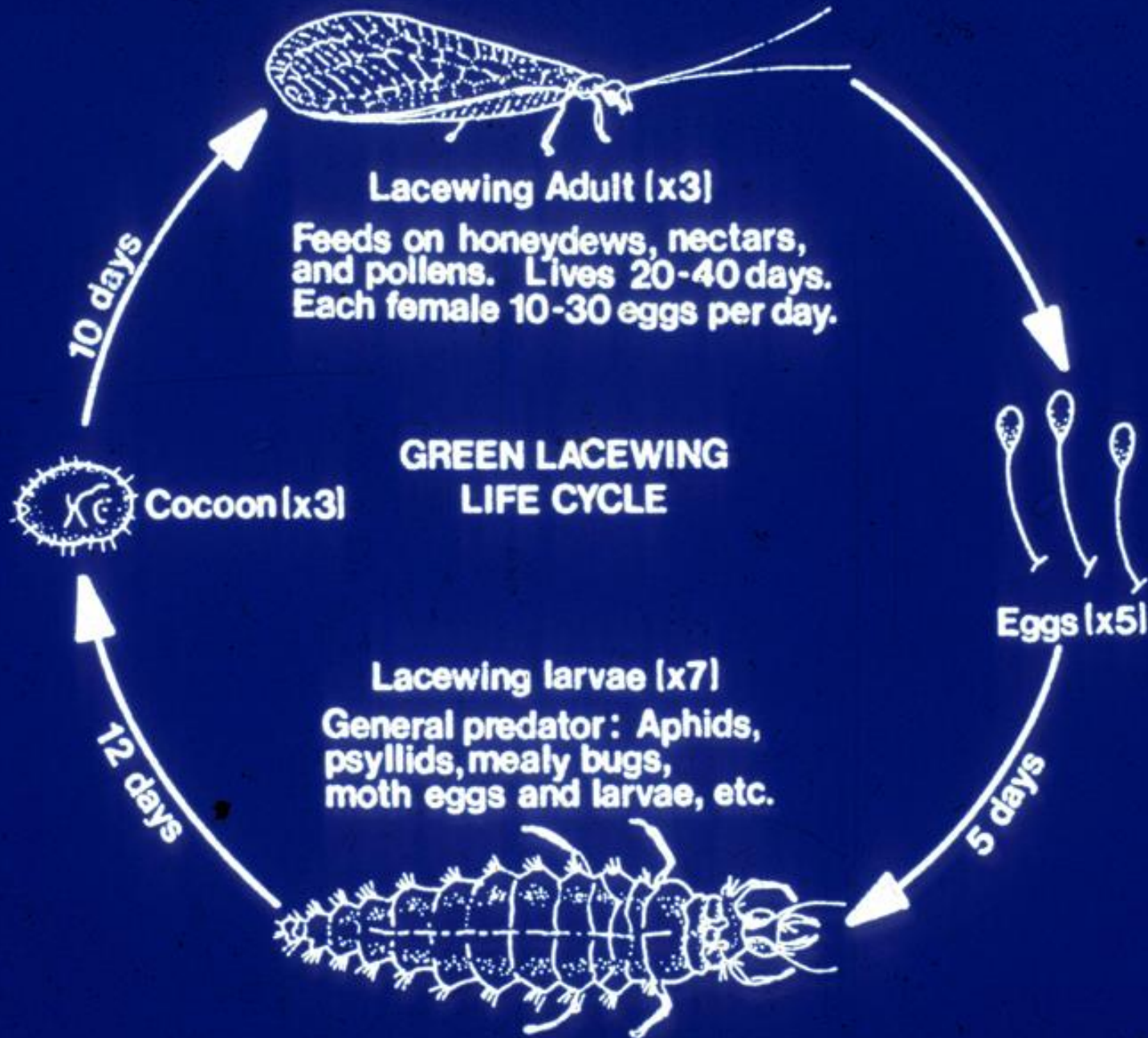




**Adult green  
lacewings maintain  
themselves on  
nectar and pollen**









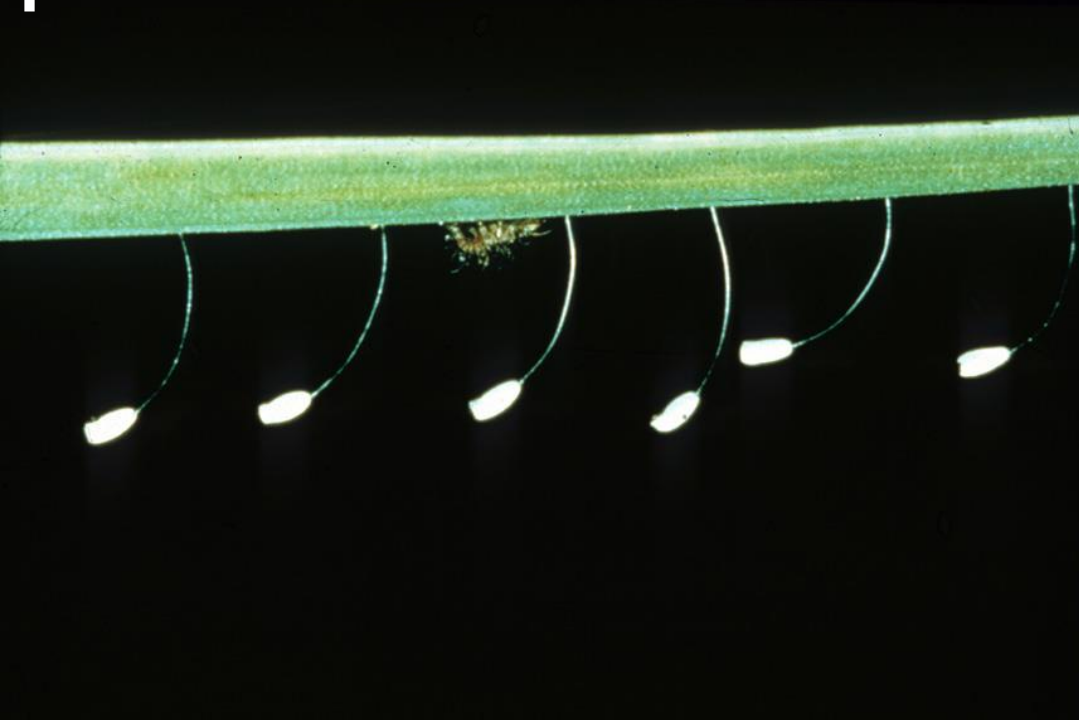
**Green lacewing  
eggs are uniquely  
stalked**





**Green lacewing  
eggs often are  
laid in groups.**

**Egg hatch has  
occurred in the lower  
picture.**



**Photographs courtesy of Brian Valentine**







**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







Photograph courtesy Brian Valentine



**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**







Photograph courtesy Brian Valentine





# Flower fly larvae

Brian Valentine



Brian Valentine



Ken Gray



# Syrphid “smear”







# Order Mantodea

## Mantids

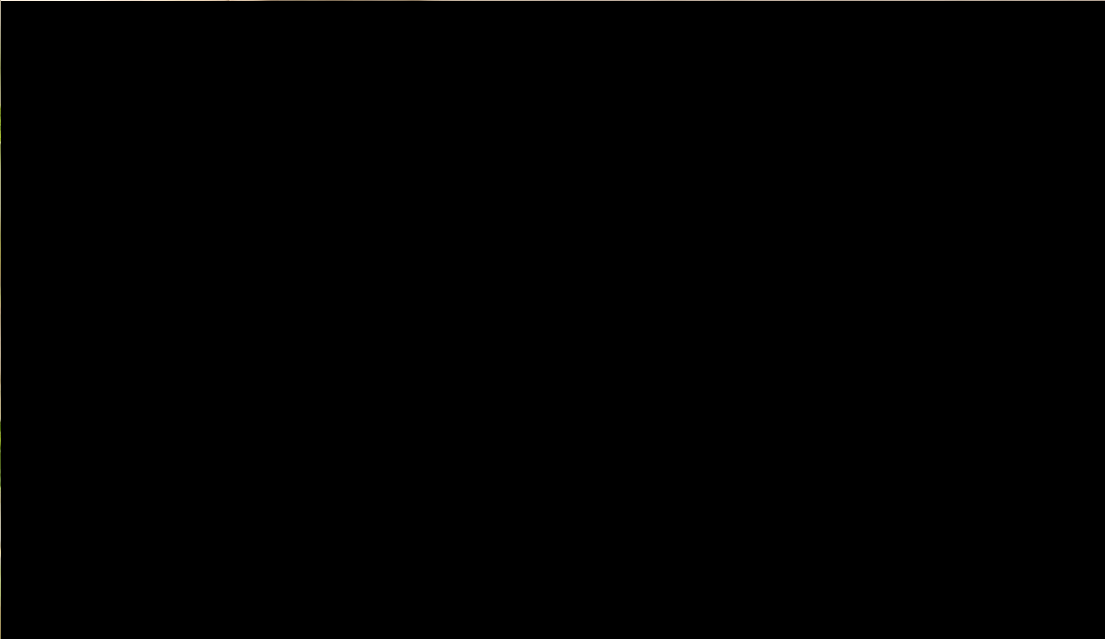
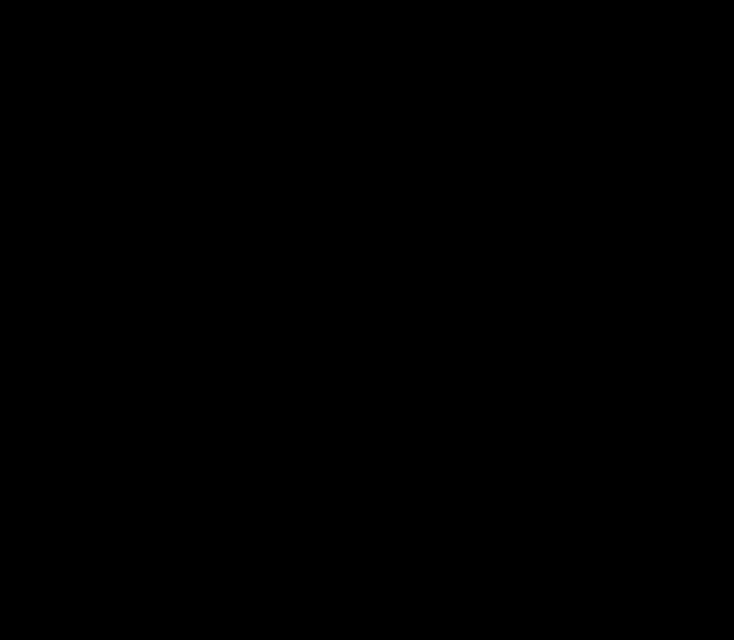


# European Mantid

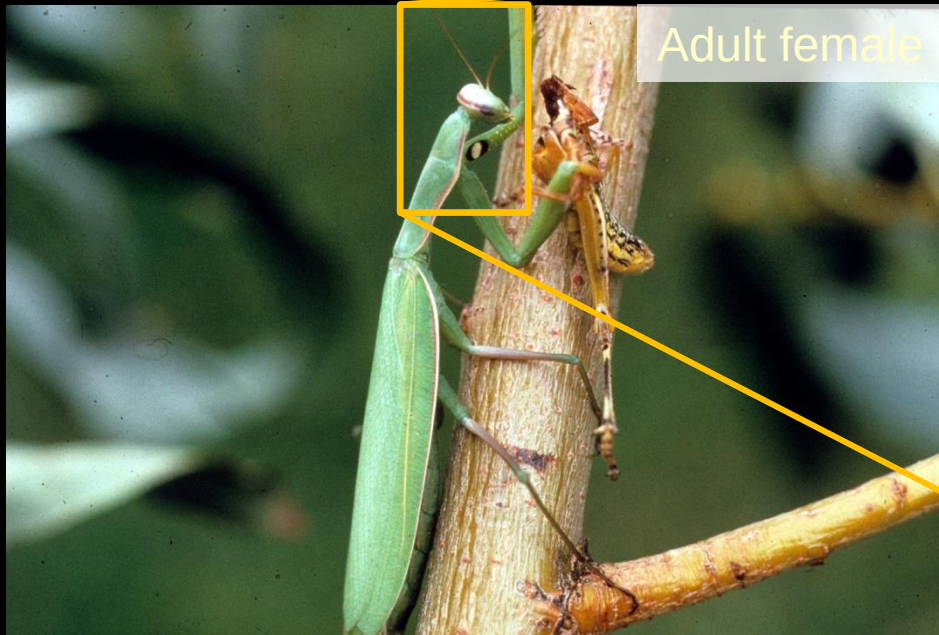
*Mantis religiosa*







# European mantid – Armpit “bullseye”







Adult female,  
green morph



Adult male,  
brown morph

UGA1246025

## European mantid life stages



Nymph

UGA1246023



Egg case (ootheca)





Mantis Egg Laying







**European mantid egg cases**





UGA1235081

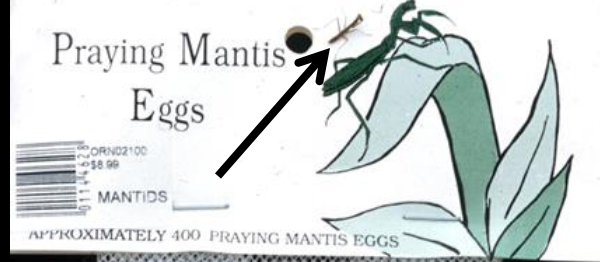
## Chinese Mantis

*Tenodera sinensis*

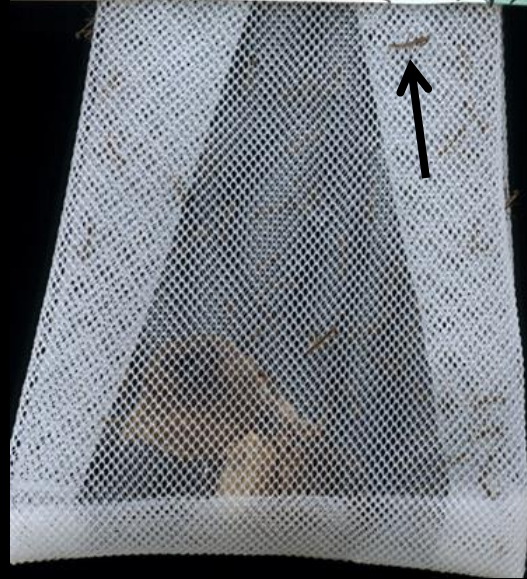




Egg case (ootheca)



Some newly hatched nymphs



Adult

## Chinese mantid

Nymph feeding on grasshopper





# Chinese Mantid

This mantid is “the mantid of commerce” because its ootheca is commonly sold at garden centers for biological control of pest organisms.







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 season's life cycle. Comes with full and use.

A006148Y . . . Praying Mantis  
 \$1.95 each; 3 for \$4.99; 6 for \$8.99



**Egg cases of the Chinese mantid are sold by some nurseries and in some garden catalogs**







UGA1246031

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



Ground Mantid





Photograph courtesy of Jim Kalisch



North American  
Native



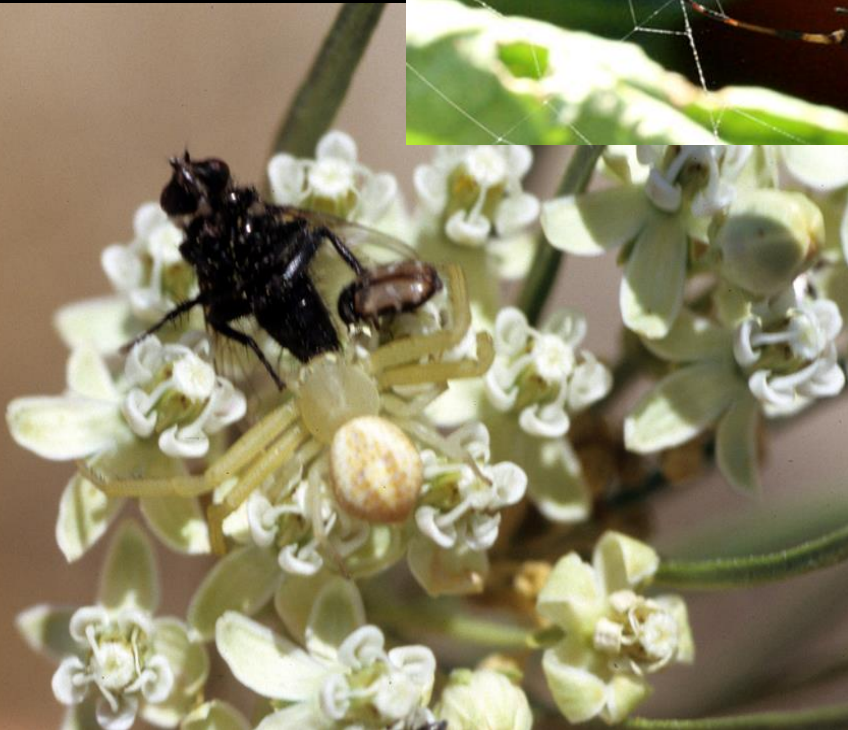
Photograph courtesy of Jim Kalisch



**Carolina Mantid**  
*Stagmomantis carolina*



# 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/katydids





# **Cicada Killers –** Largest hunting wasps





***Pemphredon* wasps  
nest in plant stems  
and hunt small  
insects**











*Pempredon*  
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**











UGA1386036

Photograph courtesy of Joseph Berger





er V  
larva in cell

1983 division of Univar





**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)**

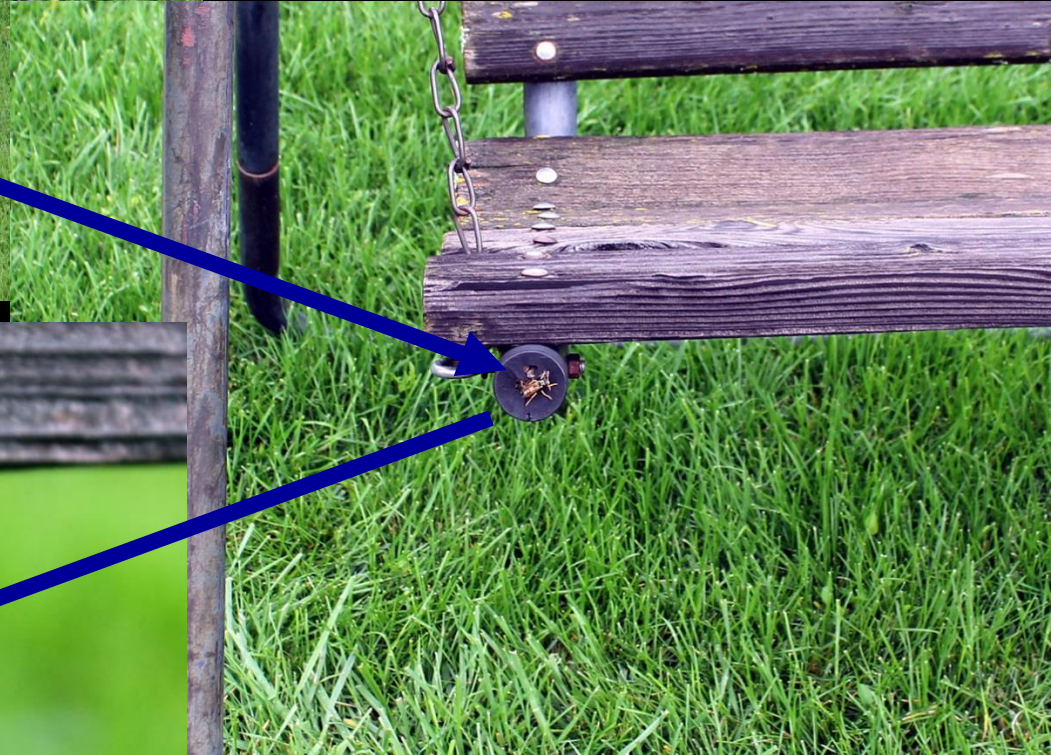
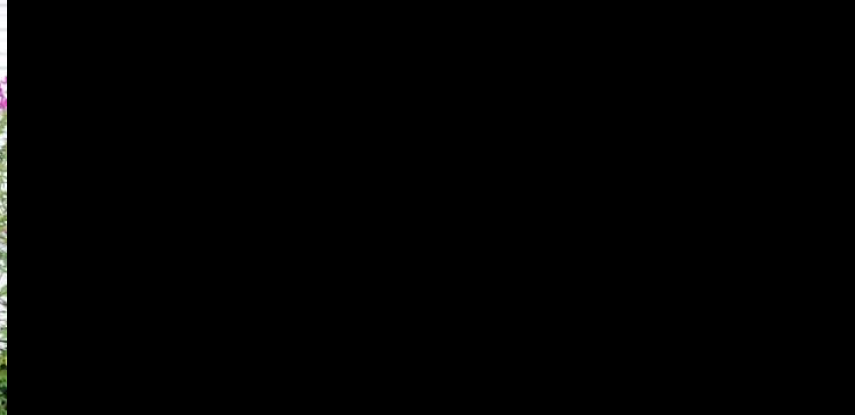




# European Paper Wasp Nesting in Metal Building Support















# 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

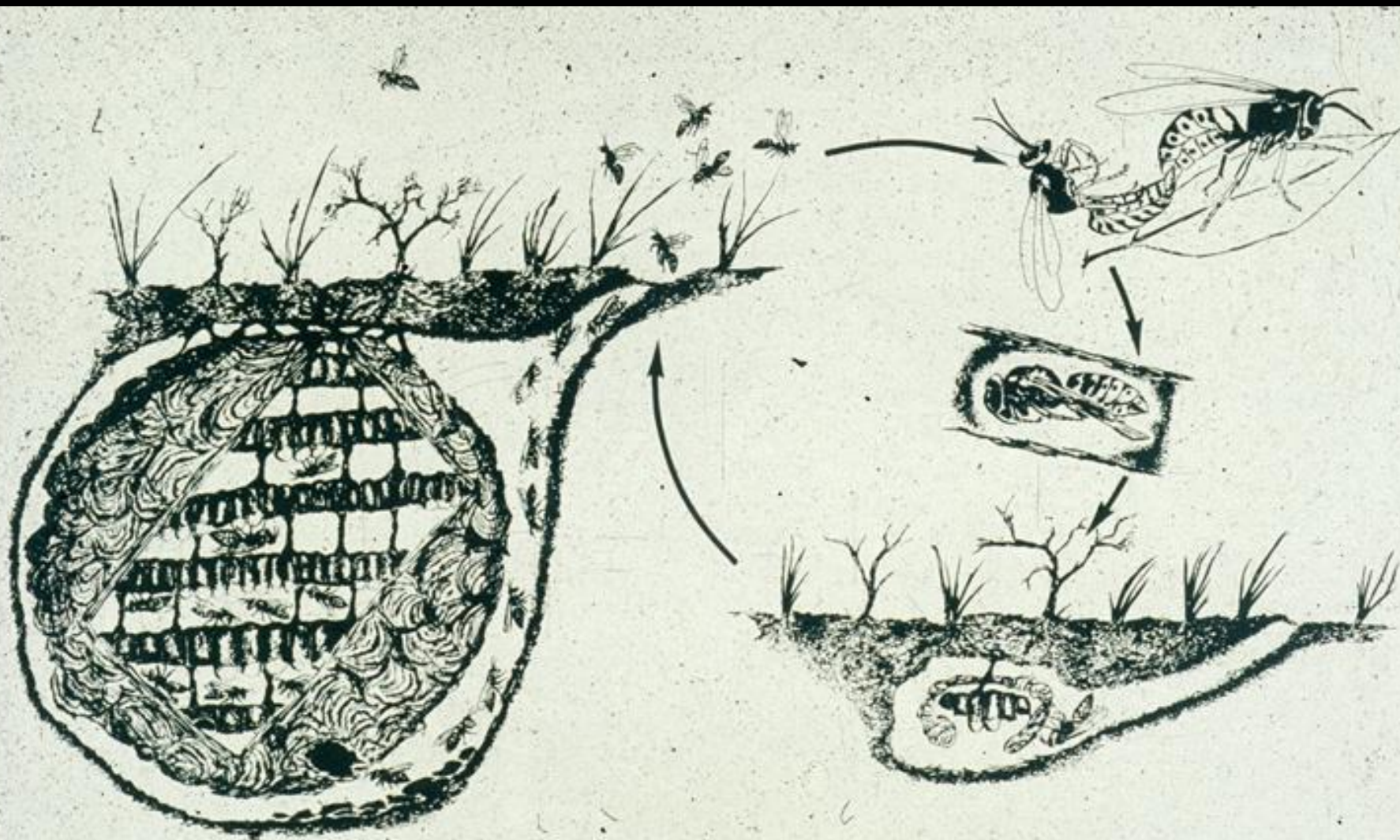


FIGURE 29 — Yellowjacket life cycle (*Vespula pensylvanica*): a, Mating; b, fertilized queen in diapause during winter months; c, queen nest beneath soil surface; d, nest at peak of colony development (J. Krispyn).





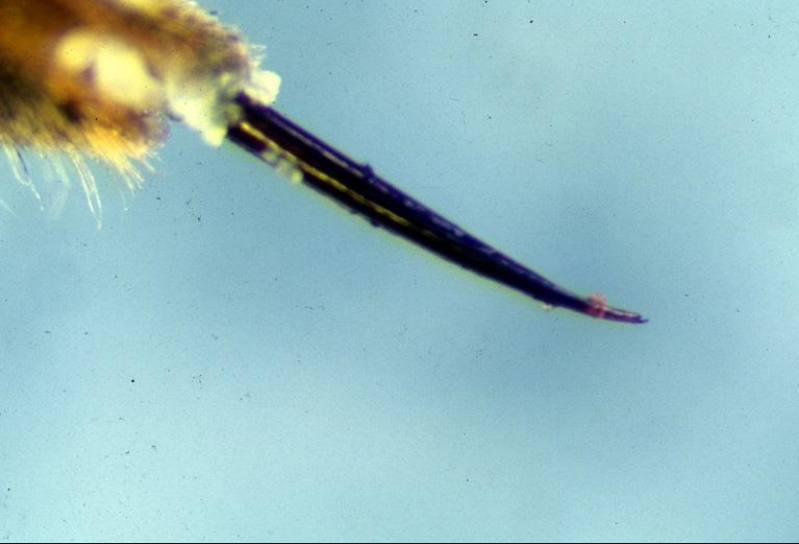












# **Most “Bee Stings” Are Not Produced By Bees!!!!**

**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,  
Encyrtidae, Chalcidae and other families**





## Some parasitic wasps

Females possess an ovipositor (“stinger”)







Photograph courtesy Brian Valentine



# Parasitic Wasps – Male (left) and Female (right)



# Ectoparasitic wasp larvae on fall webworm caterpillar host





# Parasitoid larvae emerging from caterpillar host



UGA1243156



**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**





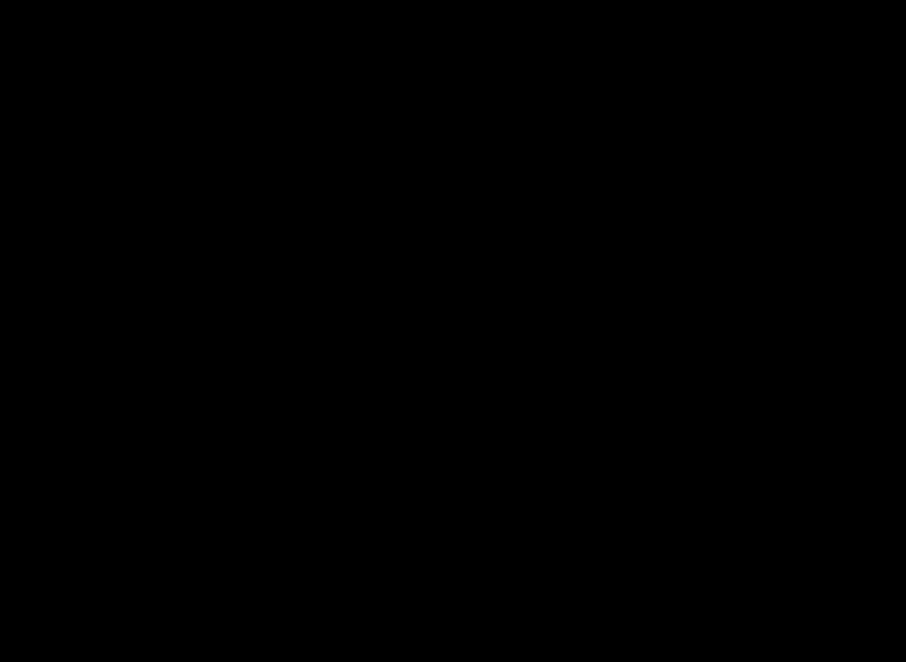




**Giant ichneumon  
wasp – the most  
spectacular natural  
enemy of the pigeon  
tremex**









## Egg parasitoids





# Trichogramma wasps, a type of egg parasitoid



## "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.

|                                         |         |
|-----------------------------------------|---------|
| A009795E... WONDER WASPS—1 vial .....   | \$ 3.95 |
| A009803E... WONDER WASPS—3 vials .....  | \$ 9.95 |
| A009811E... WONDER WASPS—6 vials .....  | \$17.95 |
| A009829E... WONDER WASPS—9 vials .....  | \$24.00 |
| A009837E... WONDER WASPS—12 vials ..... | \$27.95 |

(Delivery March thru June)



# What's wrong with this picture?



## "WONDER WASPS"

(*Trichogramma*)

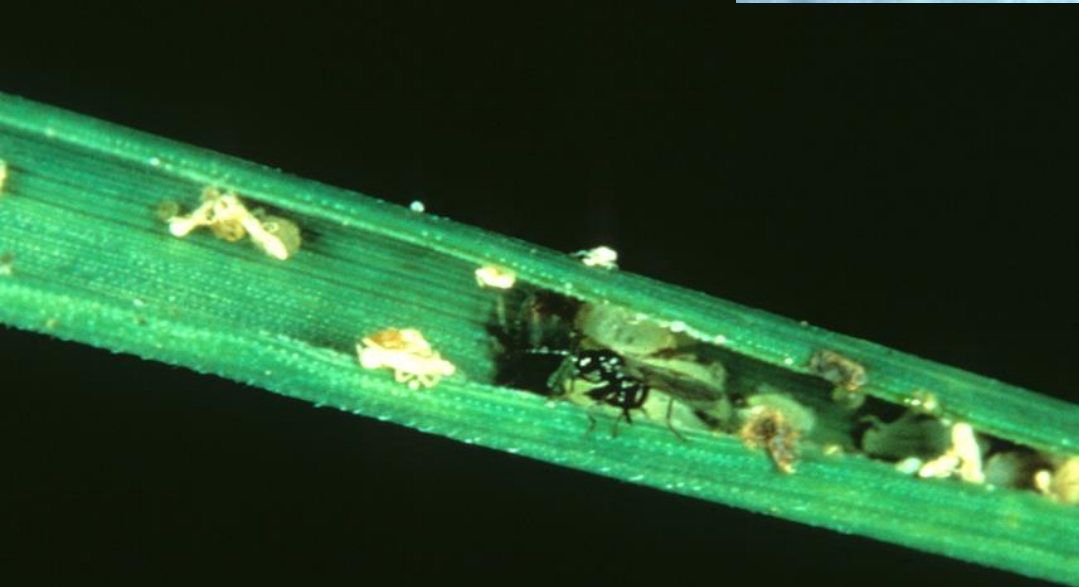
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| A009837E ... | WONDER WASPS—12 vials | \$27.95 |

(Delivery March thru June)



# Aphid parasitoids





**Host evaluation**

**Oviposition**



**Photographs courtesy of  
Brian Valentine**



# Aphid Mummies











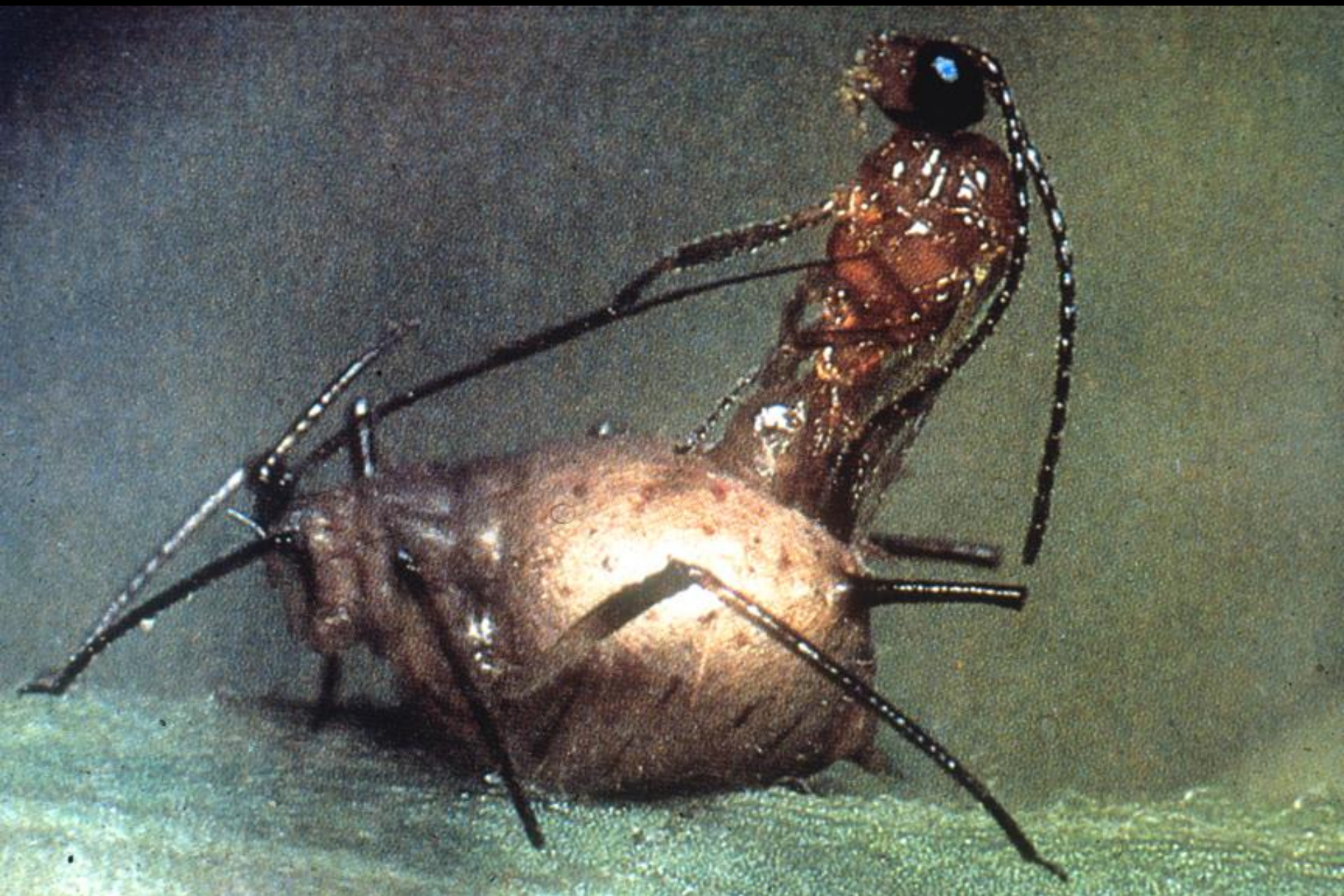




















**Parasitized psyllids (above) and  
oystershell scales (below)**



**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)**











**Cabbage looper supporting six  
developing tachinid fly larvae**



**Tachinid fly pupae within killed  
cabbage looper larva**



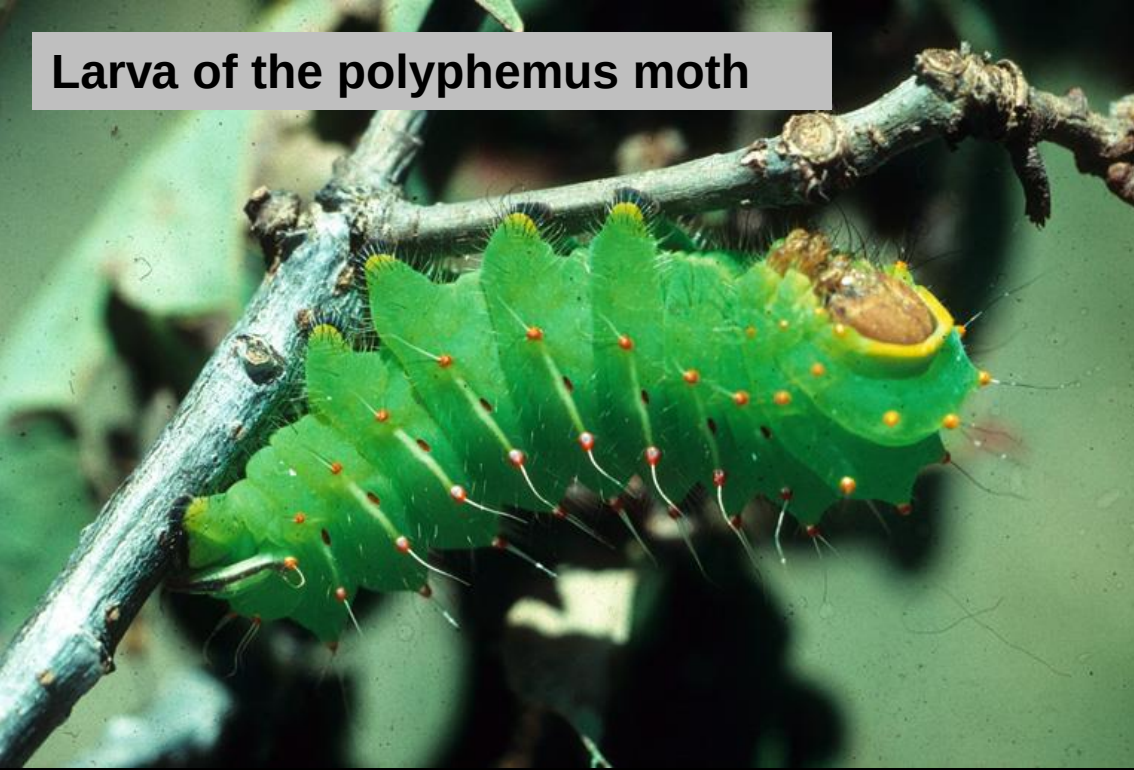
# Caterpillars killed by tachinid flies



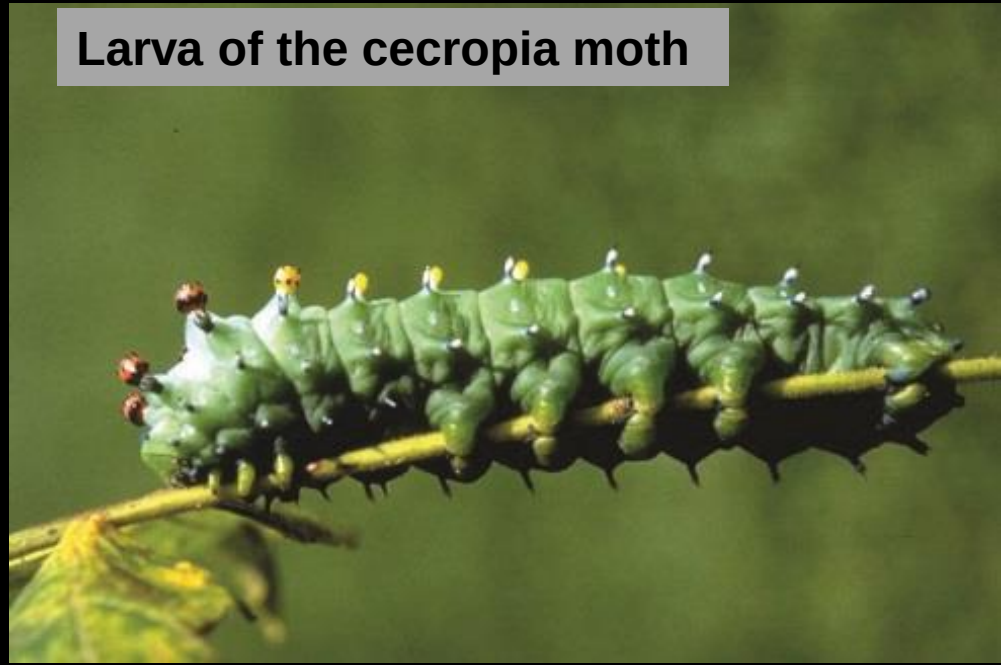
Photograph courtesy of Ken Gray/Oregon State University



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**





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Ecological Pest Control Solutions



Identify the beneficial insects  
controlling pests on your farm



Improve crop yields by  
reducing pest damage



Provide habitat for beneficial insects  
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