An Introduction to “Bugs”

Whitney Cranshaw
Colorado State University
OUTLINE-INSECTS
Spring 2018 Master Gardener Program, Chaffee County

Note to Master Gardeners: This outline is provided to assist you in taking notes on the insect training section. The talk (ideally) will follow this outline. Where there are relevant Colorado State publications, these are indicated and most are hyperlinked. Space has been left where additional information will be presented, so that you may make notes.

INTRODUCTION
A. Characteristics of Arthropods
   Jointed body
   External skeleton (exoskeleton)
   Jointed appendages
   Dorsal heart/Ventral nerve cord
   Bilateral symmetry

Classes of Arthropods
1. **Crustacea** (pillbugs, sowbugs)

2. **Millipedes** ([Millipedes Fact Sheet], [Duff Millipede Fact Sheet])

3. **Centipedes** ([Fact Sheet 5.552], [House Centipede], [Giant Desert Centipede])*

4. Arachnids (spiders, mites, ticks, windscorpions/sunspiders, scorpions)*
CHECKLIST OF COMMON INSECT RELATED EVENTS
- SOUTHWESTERN COUNTY AREAS

Note: This is a generalized checklist of when some of the more important insect related events tend to occur in the Southwestern Area counties. Year to year variations are considerable and this should only be used as a guideline for introductory Master Gardeners to begin to anticipate and help recognize common insect occurrences. Your experiences will be invaluable to further modify and improve this to your local conditions.

Fact Sheets and Extension Bulletins are available that can supplement information on the referred events.

January/February

*Household Insects*

**Fungus gnats:** Adults commonly are observed around windows and around the soil of potted plants where they originate.

**Indian meal moth:** Adult moths emerge from stored foods and can be seen flying around homes.

**Carpet beetles:** Some adults may emerge and be found in homes.

**Boxelder bugs, conifer seed bugs, cluster flies:** Overwintered adults become active in and around homes.

**Firewood insects:** Bark beetles and wood borers emerge from stored wood in homes

**Swallow Bugs:** Overwintered swallow bugs start to become active in anticipation of returning migrant birds - and bite humans.

**Clover mites:** Migrations of mites into buildings may begin by late February, during warm winter days.
The Insect Information Web Site. A source for insect information, and links to the handouts and referred fact sheets used in Master Gardener training, is housed within the Department of Bioagicultural Sciences and Pest Management at Colorado State University [http://www.colostate.edu/Depts/bspm/](http://www.colostate.edu/Depts/bspm/). Click on “Extension and Outreach” to find the “Insect Information” site.

Some Ideas for Your Insect Library


This is a new, and wholly revised edition of a book first published in 2004. Designed as a field guide to North American insects of garden plants, including vegetables, fruits, flowers, trees/shrubs and turfgrass. The most outstanding feature is the photographs, over 3100 in this edition; mention of some 1500 species is made with photographs for most and multiple images for key species.


Developing a guide for insects is difficult given their incredible diversity but this new guide is the easiest to use and look at. It is extensively illustrated with photographs (ca 2,350 images) and well organized.


A book designed for an introductory entomology class that tries to cram in everything-you-need-to-know-about-insects in one class. Lots of photographs.


Probably the best introduction to the world of living insects available. Full of well,
BIOPLOGICAL 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.

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 purchase. After feeding, their babies hatch in about one week.
Over-the-Counter Insecticides for Home, Yard and Garden Use
2015 Survey, Fort Collins, Colorado
(Products arranged by active ingredient)

The following insecticides were recorded from the shelves of 3 local nurseries, 3 hardware stores, and 3 “box stores” during a survey of Fort Collins, 22-29 May, 2015*. The number of times the product was found among the nine surveyed locations is in parentheses ( ).

ACEPHATE (Orthene)
Bonide Systemic Insect Control (2)

ACETAMIPRID
Ortho Bug B Gon Garden Insect Killer Ready-to-Use (1)
Ortho Bug B Gon Systemic Insect Killer (1)
Ortho Flower, Fruit and Vegetable Insect Killer Ready-to-Use (4)
Ortho Flower, Fruit & Vegetable Ready-to-Spray (4)
Ortho Flower, Fruit and Vegetable Insect Killer Concentrate (2)
Ortho Rose and Flower Insect Killer Ready-to-Use (5)
Ortho Rose & Flower Insect & Disease Control Ready-to-Use (with triticonazole) (5)
Ortho Rose & Flower Insect & Disease Control Concentrate (with triticonazole) (1)

ALLETHRIN/TRANS-ALLETHRIN
Ace Flea & Tick Killer for Pet and Home (1)
Ace Wasp & Hornet Killer (with lambda-cyhalothrin) (2)
Ace Ant, Roach & Spider Killer (allethrin, lambda-cyhalothrin) (2)
Insect Information

All materials needed in another accessible format can be made available upon request.

+ Insect Information
+ Colorado Bug Mugs
+ Arthropods of Colorado
+ Extension Related Insect Information
+ Emerald Ash Borer
+ Hemp Insect Website

Highlight Hot Links

- Colorado Hemp Insect Info
- Bug Wood/IPM Images
- Western Colorado Entomology
- Water Garden Insect Publication
Arthropod Features

- Segmented body
- Exoskeleton
- Jointed appendages
- Bilateral symmetry of design
- Dorsal heart/Ventral nerve cord
Arthropod Characteristics

Segmented bodies
Arthropods – and some other animals – have segmented bodies

- Segmented worms (annelids)
- Onchyphorans (velvet worms)
- Arthropods (insects, arachnids, crustaceans, etc.)
Phylum Annelida
Segmented Worms

Phylum Arthropoda
Arthropods

Phylum Onchynophora
Velvet Worms
Arthropod Characteristics

External Skeleton (Exoskeleton)

Segmented bodies
muscles attached to outside of skeleton
Features of the Insect Exoskeleton

Protection from:
- Pathogens
- Physical trauma
- Insecticides, etc.
Eleodes darkling beetles
(aka “stink beetles”, “skunk beetles”, “circus beetles”)
Primary advantage of an exoskeleton:
*Provides a means for small animals to avoid excessive water loss!*

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**THE EXOSKELETON**

prevents water loss
Features of the Insect Exoskeleton

Allows for development of:
- Appendages

Mobility is enhanced.
Features of the Insect Exoskeleton

Allows for development of:
- Appendages
- Specialized structures

Enhance feeding, defense, movement
Features of the Insect Exoskeleton

Allows for development of:
- Appendages
- Specialized structures
- Arthropod tracheal system of gas exchange

Decreased water loss
The exoskeleton allows for development of the arthropod tracheal system of gas exchange.
The exoskeleton allows for development of the arthropod tracheal system of gas exchange.

Spiracle
Disadvantage of an exoskeleton:

- Metamorphosis
- Exuvium
- Instar III
- Instar IV
- Molting
Darkening of a recently molted lady beetle adult
Soft Shell vs. Hard Shell Lobster Meat Extraction Trial

July 2015
Meat Extraction Soft Shell vs. Hard Shell

Soft shell

Hard shell
Water Component Soft Shell vs. Hard Shell

Soft shell

Hard shell
ARTHROPOD CHARACTERISTICS

- jointed appendages (legs, mouthparts)
- exoskeleton or external skeleton
- segmented bodies
Arthropod Characteristics

Jointed appendages

External Skeleton (Exoskeleton)

Segmented bodies
Arthropod Characteristic

Body plan is bilaterally symmetrical
ARThropod CHARACTERISTICS

ventral nerve cord
dorsal blood vessel
Incorrect
A Cricket’s Valentine
Arthropod Features

• Segmented body
• Exoskeleton
• Jointed appendages
• Bilateral symmetry of design
• Dorsal heart/Ventral nerve cord
Classes of Arthropoda
Arthropod Class

Crustaceans
Terrestrial Isopods*
(Sowbugs and Pillbugs)

*Subphylum Crustacea ; Class Malacostraca; Order Isopoda
Crustacean Features

- Two pair of antennae
- 7 pair appendages
- Distinct head area
- Body usually covered by a shield like carapace
- Oxygen acquired through gills
Seven pairs of legs

Mouthparts
Immature stages of sowbugs and pillbugs are similar in features as the adults, but smaller – a simple type of metamorphosis.
Sowbug

Molting

Front half molts first

Back half molts second
Molting occurs in two stages with the sowbugs and pillbugs
Sowbugs

Pillbug (a.k.a. “roly-poly”)
Sowbugs
Now if only I could roll into a ball...
Pillbug
Arthropod Class

Diplopoda

Millipedes
Millipedes

Two Pairs of Legs Per Segment
Millipede Feature –
Two pairs of legs per segment
Duff Millipedes
Arthropod Class

Chilopoda

Centipedes
Basic Features of Centipedes

1 Pair Antennae

1 Pair Legs/Body Segment
Most centipedes have 15 to 23 pairs of legs.
Centipedes

- Head
- Pseudohead
Maxillipeds

Prey is captured with the maxillipeds and are injected with a toxin (cytolysin)
Stone Centipede – A common garden resident
Tiger Centipede
(Giant Desert Centipede)
House Centipede
CLASSES OF ARTHROPODS

ARACHNIDA
(Spiders, mites, ticks, scorpions, etc.)
Orders of Arachnids
Arachnid Feature – Two Body Regions

Cephalothorax

Abdomen
Arachnid Feature – Four Pairs of Legs
Chelicerae

Pedipalps

Face of a longjawed spider showing chelicerae and pedipalps

Photo courtesy of Brian Valentine
Spiders

Order Araneae
Some spiders use webbing to snare prey
Some spiders hunt prey without the aid of silk.
Daddy longlegs, Harvestmen

Order: Opiliones
Ticks feed on the blood of vertebrates
Scorpions

Order Scorpiones
Pedipalps (chelae) for prey capture

Scorpion chelicerae (jaws)
Stinger used for defense
Scorpions fluoresce in ultraviolet light.
Scorpions fluorescing under black light
Common striped bark scorpion

*Centruroides vittatus*
Sunspiders, Windscorpions, Solpugids

Order Solifugae
The notorious “camel spider” photograph
Orders of Insects
Arthropod Characteristics

Jointed Appendages

External skeleton/Exoskeleton

Segmented Body
CLASS INSECTA

one pair of antennae
1954

Academy Award Nominee for Special Effects
CLASS INSECTA

three pairs of legs
Three pairs of legs – on the thorax
Larvae of Lepidoptera, known as caterpillars, have 2-5 pairs of abdominal prolegs.

The prolegs are tipped with hook-like crochets.
Lepidoptera larvae (caterpillars) have prolegs on the abdomen.
Inchworms and loopers have only 2 or 3 pairs of prolegs.
Whitelined sphinx (*Hyles lineata*) – The common “hummingbird moth” of the western US
many insects possess wings
CLASS INSECTA

two pairs of wings
Orders of Insects
All Described Species of Life

- Insects
- Arachnids
- Other Arthropods
- Mollusks
- Other Invertebrates
- Vertebrates
- Plants
- Fungi
- Other life forms (algae, bacteria, etc.)
How Many Kinds of Insects Are There on Earth?

- Approximately 1 million different insect species have been described.
- It is estimated that there presently exist probably 4-6 million species of insects; some estimates are higher.
- New species of insects are described at a rate of about 7200/year.
New species are being identified all the time.
How Many Individual Insects Are There on Earth?

About 250 million for every human (mushy guess)
How Many Individual Insects Are There on Earth?

Insect comprise about 80 percent of the biomass of land animals.
The 4 Rs

Reading
The 4 Rs

Reading

WRitting
The 4 Rs

Reading
Writing
ARithmetic
The 4 Rs

Reading
Writing
Arithmetic

Arthropods!
Metamorphosis

‘Change in form’
Metamorphosis

Exuvium

Instar III

Instar IV

Molting
INSECT STADIA

**EGG HATCH**

1. **1st stadium**: $x$ time
2. **2nd stadium**: $x$ time
3. **3rd stadium**: $x$ time

**IMMATURE INSTAR**

**ADULT**
A simple, or gradual pattern of metamorphosis
HOLOMETABOLOUS LIFE CYCLE

2nd instar larva

3rd instar larva

1st instar larva

Egg

Pupa

Adult

(complete metamorphosis)
Mosquito Life Cycle

Adult (left)
Larvae/wrigglers (lower left)
Pupae/tumblers (below)
That's an old photo
Next up: Natural Enemies of Insect Pests
What Should We Cover?

- Hummingbird Moths
- Yellowjackets and Hornets
- Whiteflies
- Slugs
- Earwigs
- Wood borers
- Bark beetles
- Japanese beetle
- Emerald ash borer
- Aphids
- Scale insects
- Spider mites
- Gall insects
- Nuisance invaders
- Grasshoppers
- Codling Moth
- Flea beetles