

IPM for Master Gardeners

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UC Statewide IPM Program

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What is IPM?



- ⌘ Ecosystem-based strategy
- ⌘ Focuses on long-term prevention of pests or their damage
- ⌘ Requires regular monitoring of pests and the ecosystem
- ⌘ Uses a combination of complimentary, environmentally-sound techniques

The landscape ecosystem



- ⌘ Physical environment:
soil, air, weather,
shade, sun, water
- ⌘ Plant variety
- ⌘ Herbivores
- ⌘ Carnivores
- ⌘ Human activity
- ⌘ What factors favor what
pests?

What are pests?

Organisms that are annoying us or damaging our plants or structures

Very personal:

- ⌘ Tree squirrels?
- ⌘ Scotch broom?
- ⌘ Eucalyptus?
- ⌘ Spiders?
- ⌘ Earwigs?

Level of pests: a few aphids do little damage to trees and shrubs. Do they need to be controlled? Aesthetic threshold versus economic thresholds



Plant damage in the landscape can have many causes

⌘ *Living Pests*

- ☑ insects,
- ☑ rodents,
- ☑ disease-causing microbes
- ☑ Snails and slugs

⌘ *Nonliving Abiotic factors*

- ☑ Over- or under-watering
- ☑ Nutrient deficiencies
- ☑ Mineral toxicities
- ☑ Fertilizer damage
- ☑ Herbicide damage
- ☑ Mechanical injury



Leaf curling
due to aphids



Leaf curling
due to 2,4-D

Look-alike damage from different causes



Fertilizer burn



Damage due to fungal disease--Pythium blight



Herbicide (glyphosate) damage

The first step in IPM is to accurately identify problems

- ⌘ **Diagnostic tables in UCIPM books**
- ⌘ **<http://www.ipm.ucdavis.edu>**
- ⌘ **UC Cooperative Extension offices: Advisors in your office or on campuses**
- ⌘ **Agricultural Commissioner's offices/C DFA**



Abiotic Disorders of Landscape Plants

A Diagnostic Guide

Laurence R. Costello
Edward J. Perry
Nelda P. Matheny
J. Michael Henry
Pamela M. Geisel

Use University of California Cooperative Extension Resources to Help Solve Your Problems



WHAT THE PROBLEM LOOKS LIKE	PROBABLE CAUSE
SYCAMORE (<i>Platanus</i> spp.), London plane tree	
Blackening of foliage from sooty mold. Tiny powdery white mothlike insects.	Greenhouse white yellow to green, or
Yellow, then brown spots on leaves. Premature leaf drop. Cottony material in bark crevices overwinter.	Sycamore scale. B that 1/8 inch long, yellow spot on low
Leaves, buds and shoots distorted and discolored. Irregular brown dead areas along leaf veins. Twig dieback.	Anthraxnose, <i>Disc</i> A fungal disease.
White powdery growth on leaves/shoots. Terminals dwarfed and fungus covered.	Powdery mildew, A fungal disease.
Stippled leaves, may become bleached.	Sycamore spider suck sap.
Stippled, bleached leaves with cast skins and varnishlike specks.	Western sycamore
Webbing or silk tents on ends of branches. Chewed leaves.	Fall webworm. Ha larvae, up to 1 inch
Young leaves skeletonized. Holes in leaves.	Sycamore leaf skeletonizers. Greenish inch long, in tubul

OLEANDER LEAF SCORCH

Integrated Pest Management for Professional Landscapers and Home Gardeners

Oleander leaf scorch is a relatively new disease found mainly in southern California. It is caused by the bacterium *Xylella fastidiosa*, which is the same species (although a different strain) that causes Pierce's



Figure 1. Yellow nutcase

GIANT WHITEFLY

Integrated Pest Management for Home Gardeners and Landscape Professionals

The giant whitefly, *Atruradicus digesti*, (Fig. 1) is native to Mexico. It was first discovered in San Diego County in October 1992 and is now found in southern California and elsewhere, including Arizona, Florida, Hawaii, Louisiana, and Texas. Since its introduction into southern California, giant whitefly has spread rapidly northward along the coast.

Giant whitefly can severely infest many ornamental plant species found in nurseries, landscapes, and home gardens. The plant species most affected by the giant whitefly include

IDENTIFICATION AND LIFE CYCLE

Whiteflies go through three developmental stages: egg, a progression of immature stages called nymphs, and the adult stage (Fig. 2). Because immature whiteflies change greatly in appearance during their last nymphal stage, nymphs in this stage are sometimes called "pupae," even though they do not have a true pupal stage. Whitefly nymphs have small, oval bodies with no wings and no antennae. The adult whiteflies are a very small, winged insect that looks like a very tiny mosquito. All stages of development generally occur on the undersides of leaves.



Figure 1. Giant whitefly adult.

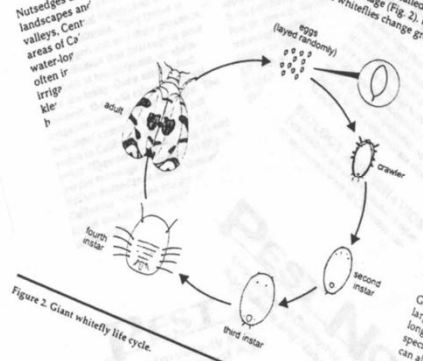


Figure 2. Giant whitefly life cycle.

PEST NOTES

University of California
Agriculture and Natural Resources

Giant whitefly gets its name from its large size (adults can be up to 1/8 inch long) relative to many other whitefly species in North America. This species can also be identified by the spines of the nymphs on leaves. When populations of giant whitefly reach high levels, the whiteflies and their waxy deposits occur on both upper and lower leaf surfaces. Eggs are often laid among the wax deposits. After hatching, the



Search

Announcing...

- [UC IPM Director recruitment seminars](#) scheduled for Sept. 9 through Sept. 25. Faculty, staff, and stakeholders are encouraged to attend.

Solve your pest management problems with UC's best information, personalize it with interactive tools, or find out about pest management research and extension projects.

- ▶ [About UC IPM](#)
- ▶ [2007 Annual Report](#)

What's new
In the news
Forms
Site index
Acknowledgments

Related links
Western IPM Center
Western Plant Diagnostic Network
UC ANR: more topics

How to manage pests



Manage and identify insects, mites, diseases, nematodes, weeds, and vertebrates

- ▶ [Homes, gardens, landscapes, and turf \(including Pest Notes\)](#)
- ▶ [Agriculture and floriculture \(Pest Management Guidelines\)](#)
- ▶ [Natural environments](#)
- ▶ [Exotic and invasive pests](#)

Use tools to help make decisions

- ▶ [Weather data and products](#)
- ▶ [Degree-days](#)
- ▶ [Interactive tools and models](#)

Educational resources



- ▶ [Publications and other materials](#)
- ▶ [Workshops and events](#)
- ▶ [Training programs](#)
- ▶ [Pesticide information](#)

Research and IPM



- ▶ [Grants programs](#)
- ▶ [Results of funded projects](#)
- ▶ [Research tools and databases: California pesticide use summaries](#)

www.ipm.ucdavis.edu



[UC IPM Home](#)

[Search](#)

For more information, see this online resource:



[Touch-Screen Pest Management Kiosks](#)

How to Manage Pests

- Home & garden
- Agriculture
- Natural environments
- Exotic & invasive
- Weather data & products
- Degree-days
- Interactive tools & models

Educational Resources

- Publications & more
- Workshops and events
- Training programs
- Pesticide information

Research and IPM

- Grants programs
- Funded-project results

- What's new
- In the news
- Announcements
- Site index
- Help
- Acknowledgments
- UC ANR: more topics

How to Manage Pests Pests in Homes, Gardens, Landscapes, and Turf

University of California's official guidelines for pest monitoring techniques, pesticides, and nonpesticide alternatives for managing pests, including information Pest Notes and The UC Guide to Solving Garden and Landscape Problems. | [More](#) | [Acknowledgments](#) |

[Pest Notes](#) | [Quick Tips](#) | [Quick Tips en español](#) | [Recent updates](#) | [What is IPM?](#) |

Search home and garden:

Go

[Take the tour](#)

Pests in the home

- [Household](#)—pests of homes, structures, people and pets



Pests in gardens and landscapes

Choose a plant to find the most likely source of your pest problem

- [Flowers](#)
- [Fruit trees, nuts, berries, and grapevines](#)
- [Lawns and turf](#)—including comprehensive lawn guide
- [Trees and shrubs](#)—including roses and other ornamentals
- [Vegetables and melons](#)



Some common pests and methods ([Pest Notes](#) library)

- [Birds, mammals, and reptiles](#)—vertebrate pests
- [Insects, mites, mollusks, and nematodes](#)—invertebrate pests
- [Plant diseases](#)
- [Weeds](#)
- [Management methods including pesticides and biological control](#)



Pesticide information

- [Hiring a pest control company](#)
- [Pesticides: safe and effective use](#)
- [Pesticides and water quality](#)
- [Information related to specific pesticides](#)
- [Other resources](#)



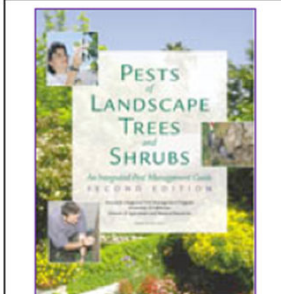
More information ([What is IPM?](#))

- [Identification helpers](#)—including [natural enemies](#) and [weed photo galleries](#)
- [Related publications](#)
- [Pest management kiosk locations](#)
- [UC Statewide Master Gardener Program](#)—find your local Master Gardener program
- [Exotic and invasive pests](#)





[UC IPM Home](#)
[Search](#)



[Pests of Landscape Trees and Shrubs: An Integrated Pest Management Guide](#)

How to Manage Pests

- [Home & garden](#)
- [Agriculture](#)
- [Natural environments](#)
- [Exotic & invasive](#)
- [Weather data & products](#)
- [Degree-days](#)
- [Interactive tools & models](#)

Identification Galleries

- [Natural enemies](#)
- [Weeds](#)

Educational Resources

- [Publications & more](#)
- [Workshops and events](#)
- [Training programs](#)
- [Pesticide information](#)

Research and IPM

- [Grants programs](#)
- [Funded-project results](#)

[UC IPM Home](#) > [Homes, Gardens, Landscapes, and Turf](#) > Trees, Shrubs and Woody Ornamentals

How to Manage Pests
Pests in Gardens and Landscapes—Ornamental Trees and Shrubs

Search trees and shrubs:

The table below lists common, scientific, and family names for ornamental trees and shrubs included in this Web site. Click on a name to link to information about pests commonly found on that plant.

Click on a table heading to sort the column¹. Legend: ▲ = Ascending, ▼ = Descending, ◆ = Unsorted

Common name index—see also [cultural tips](#)

[A](#) | [B](#) | [C](#) | [D](#) | [E](#) | [F](#) | [G](#) | [H](#) | [I](#) | [J](#) | [K](#) | [L](#) | [M](#) | [N](#) | [O](#) | [P-Q](#) | [R](#) | [S](#) | [T](#) | [U-Z](#)

Common name ▲	Scientific name ▲	Family ◆
Abelia	<i>Abelia</i> spp.	Caprifoliaceae (Honeysuckle family)
Abutilon	<i>Abutilon</i> spp.	Malvaceae (Hibiscus family)
Acacia	<i>Acacia</i> spp.	Fabaceae (Pea family)
African fern pine	<i>Podocarpus</i> spp.	Podocarpaceae (Podocarpus family)
Agave	<i>Agave</i> spp.	Agavaceae (Agave family)
Albizia	<i>Albizia</i> spp.	Fabaceae (Pea family)
Alder	<i>Alnus</i> spp.	Betulaceae (Birch family)
Algerian ivy	<i>Hedera</i> spp.	Araliaceae (Ginseng family)
Andromeda	<i>Pieris</i> spp.	Ericaceae (Heath family)
Angelica	<i>Fatsia japonica</i> = <i>Aralia sieboldii</i>	Araliaceae (Ginseng family)
Aralia	<i>Fatsia japonica</i> = <i>Aralia sieboldii</i>	Araliaceae (Ginseng family)
Araucaria	<i>Araucaria</i> spp.	Araucariaceae (Araucaria family)
Arborvitae	<i>Platycladus orientalis</i>	Cupressaceae (Cypress family)
Arborvitae	<i>Thuja occidentalis</i>	Cupressaceae (Cypress family)
Artemisia	<i>Artemisia</i> spp.	Asteraceae (Sunflower family)
Ash	<i>Fraxinus</i> spp.	Oleaceae (Olive family)
Aspen	<i>Populus</i> spp.	Salicaceae (Willow family)

How to Manage Pests

Pests in Gardens and Landscapes

[More trees and shrubs](#)

Rose—*Rosa* spp.

Plant Identification

Roses are deciduous or evergreen shrubs, trees, or groundcovers.

Optimum conditions for growth

Most rose species do well in full sun to light shade. Consistent irrigation improves performance.

Rose flowers



Pests and disorders of *Rosa* spp.

[Invertebrates overview](#)

- [Aphids](#)
- [Armored scales](#)
 - Greedy scale
 - Rose scale
 - San Jose scale
- [Flatheaded borers](#)
 - Flatheaded apple tree borer
 - Pacific flatheaded borer
- [Foliage-feeding caterpillars](#)
 - [Fruittree leafroller](#)
 - Omnivorous looper
 - Orange tortrix
 - Tent caterpillars
 - Tussock moths
- [Foliage miners](#)
 - Leafminers
- [Fuller rose beetle](#)
- [Gall makers](#)
- [Hoplia beetle](#)
- [Leafcutting bees](#)
- [Leafhoppers](#)
 - Rose leafhopper

Invertebrates (cont.)

- [Thrips](#)
 - Madrone thrips
 - Western flower thrips
- [Whiteflies](#)
 - Greenhouse whitefly

[Diseases overview](#)

- [Bacterial blight](#)
- [Black spot](#)
- [Botrytis blight](#)
- [Crown and root rots](#)
- [Crown gall](#)
- [Downy mildew](#)
- [Hairy root](#)
- [Leaf spot diseases](#)
 - *Mycosphaerella* spp.
 - *Sphaceloma* spp.
- [Oak root fungus](#)
- [Powdery mildew](#)
- [Rusts](#)
- [Stem cankers and dieback](#)
- [Verticillium wilt](#)
- [Virus](#)



How to Manage Pests

The UC Guide to Healthy Lawns

for home gardeners and managers of parks, school grounds, and other low-maintenance turf

[Index to contents](#) | [Acknowledgments](#) | [Related UC publications](#) | [References](#) |

All you need to know to grow a lawn using little or no pesticide



Choose and identify your turf species



Prepare the site and plant turf



Lawn renovation



Lawn care for new lawns



Lawn care for established lawns



Manage pests

Other useful UCIPM web features

- ⌘ Natural enemies gallery
- ⌘ Weed photo gallery
- ⌘ Key to Ant species
- ⌘ WaterTox database
- ⌘ Online training courses



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UC IPM Online
 STATEWIDE INTEGRATED PEST MANAGEMENT PROGRAM

UC IPM

Home & garden agriculture
 Weather data & products
 Degree-days
 Interactive tools & models
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 Workshops and events
 CA exam helper
 Pesticide use and safety
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How to Manage Pests
Identification: Weed Photo Gallery
[More weeds](#) | [More ID helpers](#)

Annual sowthistle
 Scientific name: *Sonchus oleraceus* (Family Asteraceae)

DESCRIPTION:
 Annual sowthistle is a widespread annual weed. It is commonly found in California's Central Valley and coastal areas where it grows year-round. Its seeds germinate only in the top 1/2 inch (1.2 cm) of soil, so preplant cultivations and deep plowing are effective controls. Seed leaves are stalked and covered with a powdery, gray bloom. They have smooth-edges and are spoon-shaped. True leaves have wavy edges and prickles. Upper leaf bases clasp the stems with clawlike lobes. Mature plant may reach a height of 3 to 4 feet (0.9 - 1.8 m). Yellow flowers mature into white, fluffy seed heads, similar to common groundsel. Hollow stems secrete milky juice when cut or crushed.

[Broadleaf ID illustration.](#)

seedling
flower head
mature plant

Click on image to enlarge

STATEWIDE INTEGRATED PEST MANAGEMENT PROGRAM

Home

How to Manage Pests
Identification: Natural Enemies Gallery
[More natural enemies](#) | [More ID helpers](#)

Green lacewings
 Scientific name: *Chrysopa* spp., *Chrysoperla* spp.

Phylum: Arthropoda
 Class: Insecta
 Order: Neuroptera
 Family: Chrysopidae

Common prey: Predaceous on a wide variety of small insects
 Commercially available: Yes

Adult **Egg**
Larva **Pupa**

Click on image to enlarge

DESCRIPTION [Life cycle](#)

Green lacewings are generalist predators and are commonly found in agricultural, landscape, and garden habitats. Adult green lacewings are soft-bodied insects with four membranous wings, golden eyes, and green bodies. Adults often fly at night and are seen when drawn to lights. Some species of green lacewing adults are predaceous, others feed strictly on honeydew, nectar, pollen. Females lay their tiny, oblong eggs on silken stalks attached to plant tissues. Depending on the species, eggs are laid singly or in clusters, each on an individual stalk. Eggs are green when laid, then darken before hatching. Lacewings undergo complete metamorphosis with eggs hatching about 4 days after being laid, and larvae develop through three instars before pupating. Larvae, which are pale with dark markings, look like tiny alligators. Larvae are flattened, tapered at the tail, measure 3-20 mm (1/8 to 4/5 of an inch) long, have distinct legs, and possess prominent mandibles with which they attack their prey. Larvae prey upon a wide variety of small insects including mealybugs, psyllids, thrips, mites, whiteflies, aphids, small caterpillar leafhoppers, and insect eggs. Pupation occurs in loosely woven, spherical, silken cocoons attached to plants or under loose bark. All stages of lacewings can survive mild winters and can be found throughout the year in many agricultural areas of California. Green lacewings are commercially available and are among the most commonly released predators. For information on a less common lacewing group, see brown lacewing.

What is Integrated Pest Management (IPM)?

- **Combines** several different types of management methods
 - ☑ Good cultural practices
 - ☑ Biological control
 - ☑ Mechanical or physical control
 - ☑ Pesticides used only if necessary, as a last resort.
- Focuses on preventing problems.
- Uses least toxic pesticides
- Protects people and the environment



cultural



biological



mechanical

Old pest control paradigm



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IPM paradigm:

Understand why your home/landscape environment favors pests & fix it



For ant info & videos go to: <http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn/411.html>

Prevention: Choose pest resistant or pest tolerant plants



**Fuchsia varieties
resistant to fuchsia gall mite**

UC Statewide IPM Project
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**Crape myrtle varieties
resistant to powdery mildew**



Native plants such as ceanothus

Cultural controls

- ⌘ Site selection
- ⌘ Sanitation
- ⌘ Habitat modification
- ⌘ Water management
- ⌘ Fertilizing



Good cultural practices prevent lawn pest problems



Fertilize properly



Irrigate properly

RECOMMENDATIONS FOR MOWING GRASSES

TURF SPECIES ¹	SET MOWER TO (inches)	MOW WHEN TURF REACHES (inches)
Annual ryegrass	1.5–2	2.25–3
Perennial ryegrass	1.5–2.5	2.25–3.75
Tall fescue	1.5–3	2.25–4.5
Colonial bentgrass	0.5–1	0.75–1.5
Rough bluegrass	1–2.5	1.5–3.75
Bermudagrass	1–1.5 0.5–1 (for hybrids)	1.5–2.25 0.75–1.5 (for hybrids)
Zoysiagrass	0.5–1	0.75–1.5

1. For help in identifying your turf grass species, see the *UC Guide to Healthy Lawns* at the UC IPM Web site, www.ipm.ucdavis.edu/TOOLS/TURF.

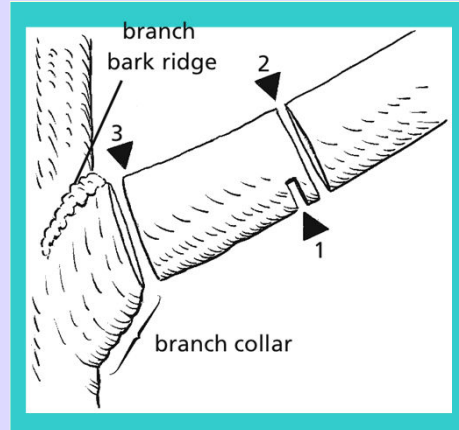
Mow at proper height

Cultural Practices: If you prune, do it right

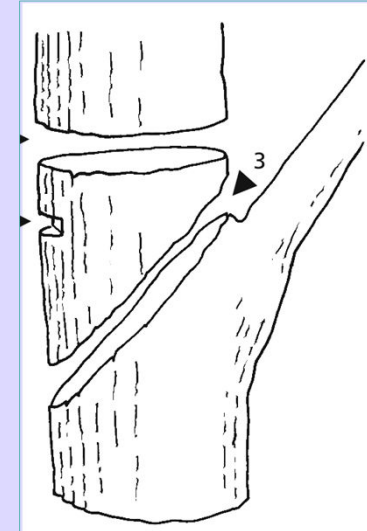
Bad pruning leads to pest problems.



Topped tree



Removing a branch



Use drop crotch pruning instead of topping.



Flatheaded borer larva



Wood decay fungi

Physical/Mechanical Controls

- ⌘ Cultivation
- ⌘ Mowing
- ⌘ Flaming
- ⌘ Mulches
- ⌘ Traps
- ⌘ Screens
- ⌘ Barriers



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Mulches

MATERIALS

- Bark chips
- Wood chips
- Compost
- Rock
- Landscape fabric
- Newspaper
- Plastic



Apply bark chips/coarse mulches 3–4 inches deep and fine mulches 2 inches deep.



Landscape fabric under bark or rock mulch can last 4 or more years



If mulches not maintained, weeds will invade.

What is biological control?

- ⌘ Any activity of one species that reduces the adverse effects of another
- ⌘ Living natural enemies are the agents of biological control



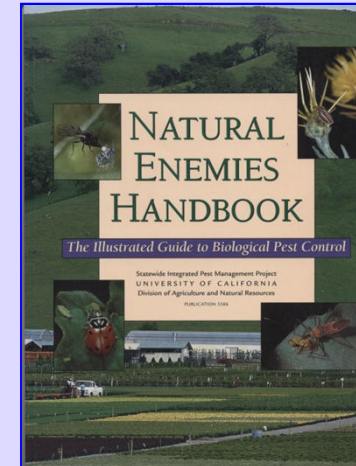
Types of Natural Enemies



Spider

Predators

- ⌘ Attack, kill, and feed on other prey



Pathogens

- ⌘ Cause disease

Parasites

- ⌘ Live and feed on a larger host



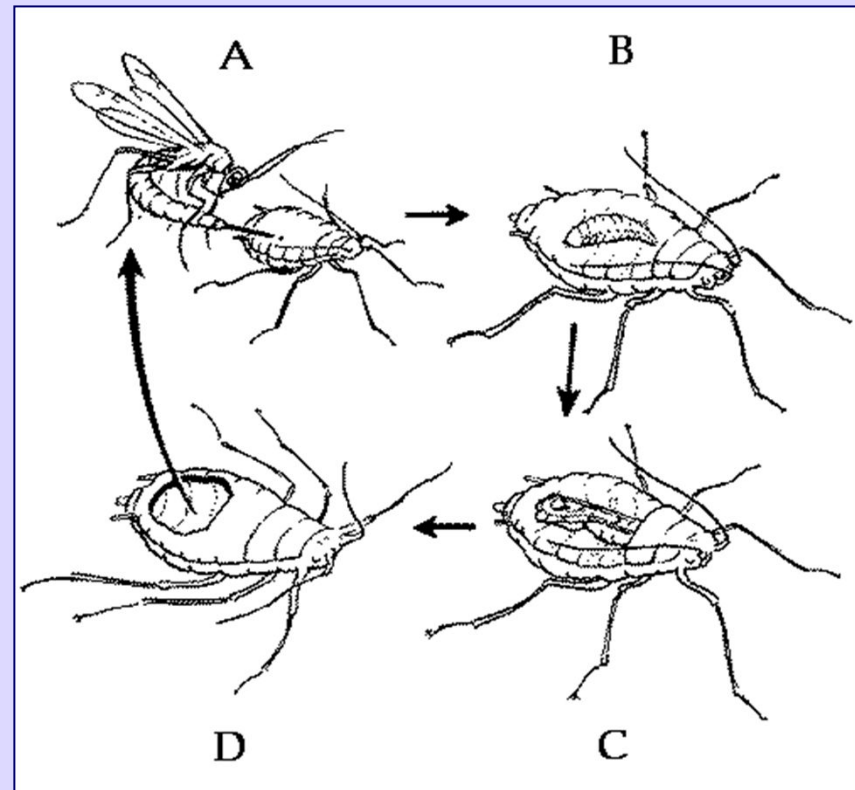
Parasites
attacking aphid
and caterpillar

Armyworm
killed by virus



Parasites (parasitoids)

- ⌘ Adults lay eggs in host
- ⌘ Immatures develop within host
- ⌘ Kill host just before pupating
- ⌘ Immatures kill only one host



***Hyposoter exigua*: a parasite of many garden caterpillars**



Familiar predators

- ⌘ Ladybeetles
- ⌘ Lacewings
- ⌘ Praying mantids



Less well-appreciated predators

- ⌘ Spiders
- ⌘ Earwigs
- ⌘ Centipedes



Ways of using Biological Control Agents

⌘ Classical:

import exotic species

⌘ Augmentation:

purchase and release

⌘ Conservation & enhancement:

protect native natural enemies



Ash Whitefly causes severe damage in the early 1990's



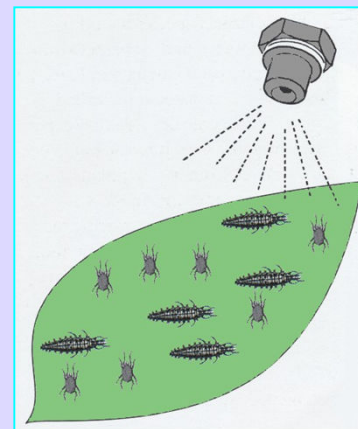
Ash whitefly natural enemies, *Encarsia inaron* and *Clitostethus arcuatus*



Enhancing natural biological control

- ⌘ Provide water, nectar, shelter or alternative food sources
- ⌘ Control ants
- ⌘ Avoid using pesticides that kill natural enemies***

***most important!



Choose insecticides that are least toxic to natural enemies

Less toxic

- ⌘ Bt—*Bacillus thuringiensis*
- ⌘ Insecticidal oils
- ⌘ Insecticidal soaps

Moderately toxic

- ⌘ Pyrethrin
- ⌘ Spinosad

Highly toxic

- Pyrethroids—permethrin, bifenthrin
- Cabaryl-Sevin
- Organophosphates—malathion, acephate
- imidacloprid



Pesticides in the home landscape



- ⌘ Many gardeners have beautiful gardens and never use any pesticides
- ⌘ Pesticides range in toxicity. Some have little negative impact. Others are quite toxic.
- ⌘ We do not understand all the potential impacts of pesticides. “Safe” pesticides have later been discovered to have serious impacts.
- ⌘ Pesticide questions are some of the hardest for Master Gardeners. Rely on written University of California publications for suggestions.

What to look for when choosing a pesticide

- ⌘ Effectiveness on target pest
- ⌘ Safety to people, pets, nontargets
- ⌘ Impact on bees and natural enemies of pests
- ⌘ Environmental impacts, hazard to nontargets
- ⌘ Packaging: ease of use, easy to follow directions, small containers
- ⌘ IS AN PESTICIDE NEEDED AT ALL?

Types of pesticides

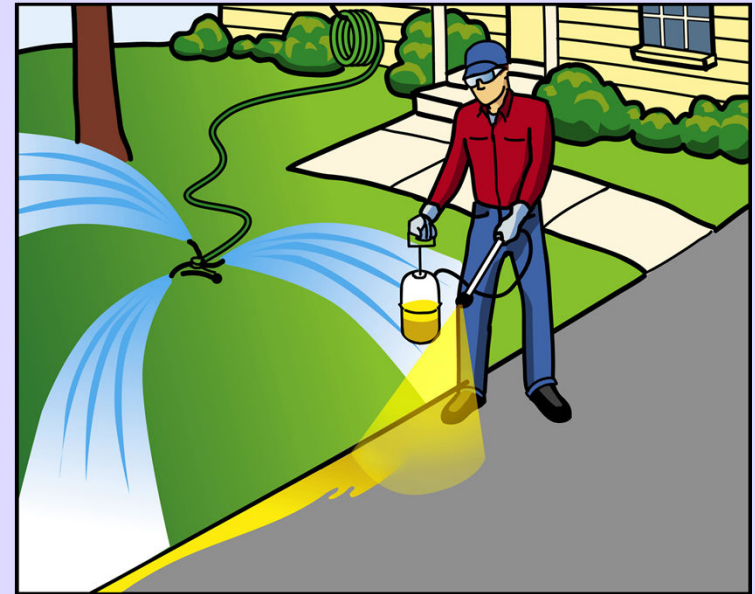
- ⌘ Fungicides
- ⌘ Herbicides
- ⌘ Insecticides
- ⌘ Miticides
- ⌘ Molluscicides
- ⌘ Rodenticides



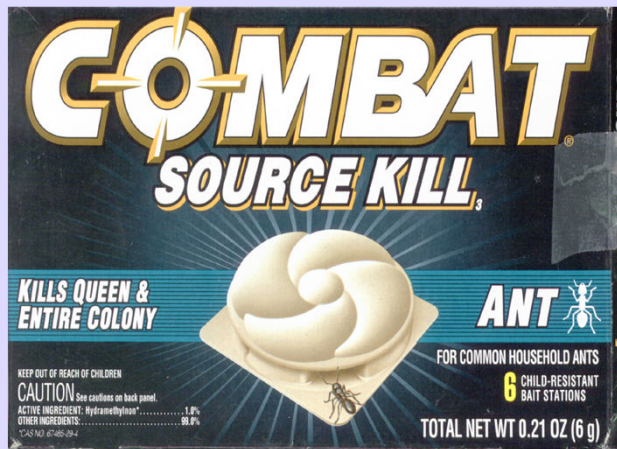
Pesticide use by California residents

(2003 survey by Flint--3 CA areas)

- ⌘ 50-78% have applied pesticides outdoors themselves in last 6 months
- ⌘ About half of them dispose of pesticides improperly
- ⌘ We found 542 different products containing 112 different active ingredients on retail shelves
- ⌘ Most people couldn't remember what product they used.



*Read the active ingredient
One brand name may have products with
different active ingredients!



active ingredient =
Hydramethylnon



active ingredient =
Fipronil

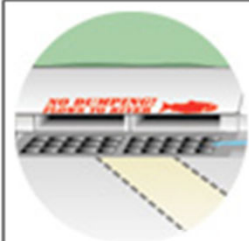


Pesticides and Water Quality

Pesticides applied in your home and landscape affect our creeks, lakes, and rivers!



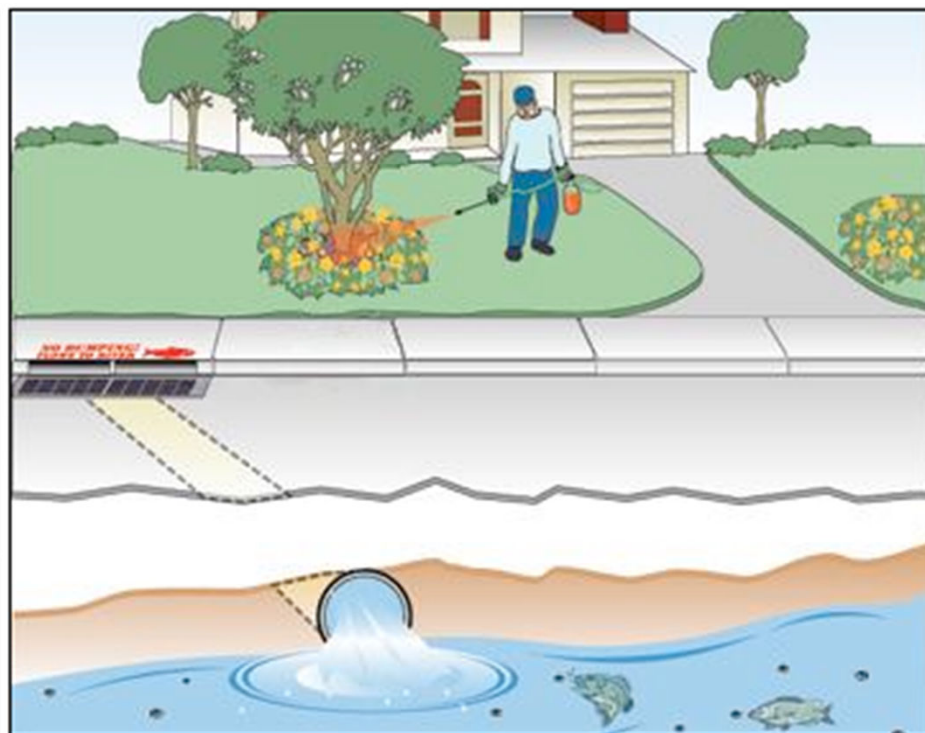
How are pesticides affecting water quality?



How do pesticides get into our creeks and rivers?



What are safer alternatives to pesticides?



Read the Pesticide Label!!

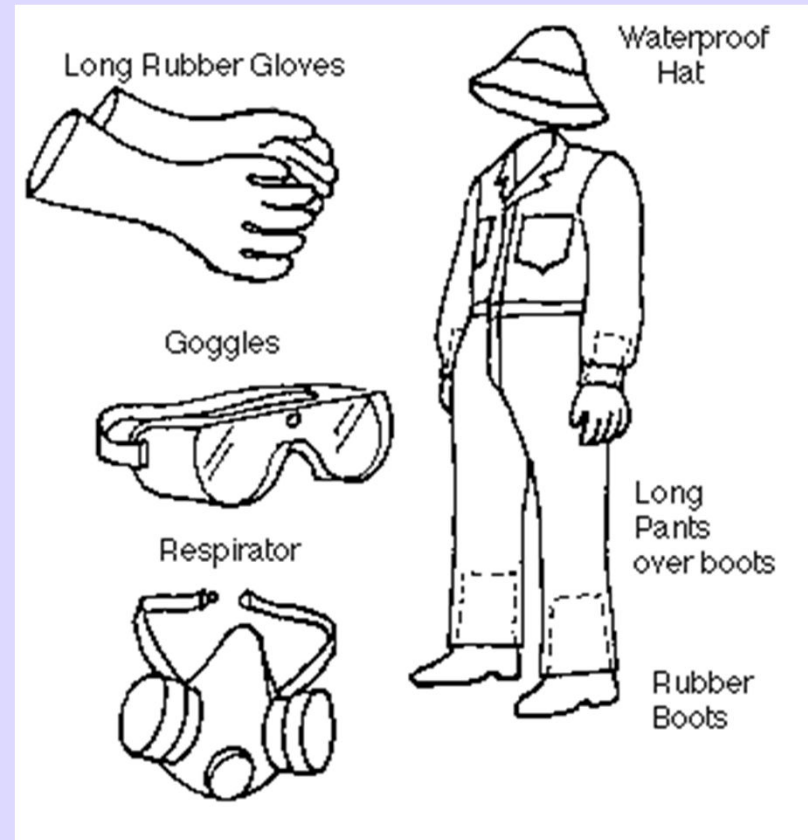


- Product and brand identification
- Active ingredients
- Precautionary statements
- First aid instructions
- Note to physicians
- Directions for use
- Storage and disposal



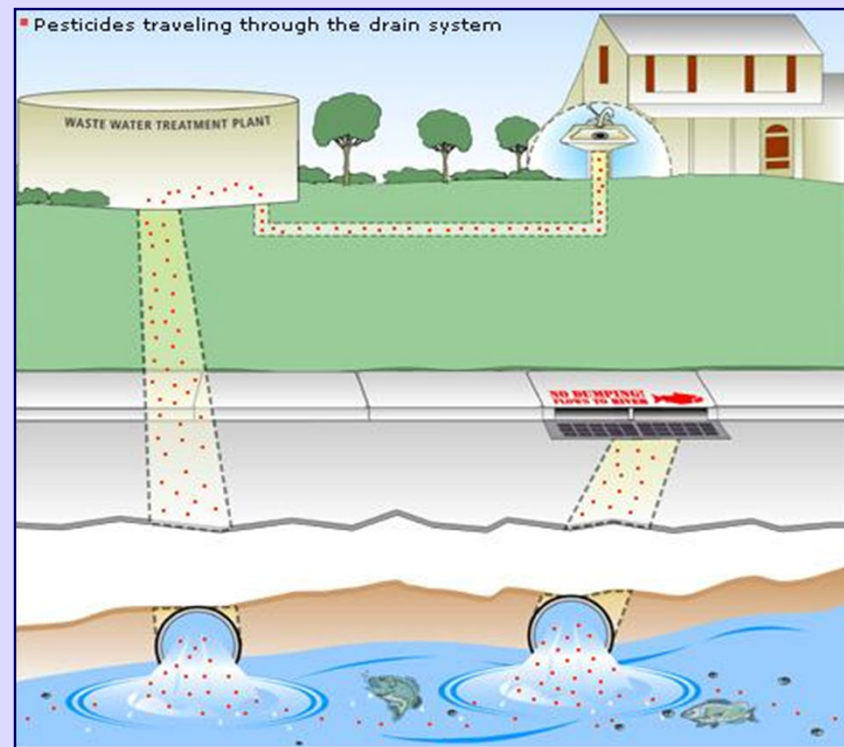
USING PESTICIDES SAFELY

- Be sure plant and site is on the label
- Be sure pest is on the label
- Follow directions for mixing and protective clothing
- Check the label for other precautions



Pesticide Disposal

- **Make only required amount of solution**
- **Spray excess material from sprayer according to label directions**
- **Don't flush down toilet, dump in street gutter, or put in sink or sewer**
- **Take old or unwanted pesticides to Hazardous Household Waste Site-- NEVER IN TRASH!**
- **1-800-253-2687 for HHW closest to you**



Summary: IPM strategy

- ⌘ Less risk to health and the environment
- ⌘ Fewer pest problems

Consult Pest Notes



Remember these steps:

1. Correctly identify the pest and determine if it is a problem.
2. Think about the ecosystem!
3. Identify conditions that favor the pest and change them if possible (prevention).
4. Integrate least toxic control methods.

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IPM for slugs & snails

- ⌘ Recognize habitat that favors slugs and snails
- ⌘ Remove shelter, consider drip irrigation
- ⌘ Choose snail proof plants
- ⌘ Handpicking!
- ⌘ Traps: boards or beer
- ⌘ Copper bands
- ⌘ Baits: iron phosphate, least toxic; metaldehyde, more toxic



Copper barriers



Raised boards to trap snails

IPM for Weeds in perennial landscape plantings

- ⌘ Prevent introductions
- ⌘ Competitive plantings
- ⌘ Design weeds out
- ⌘ Water management (drip)
- ⌘ Install & maintain mulches
- ⌘ Hoeing, flaming, mowing, roguing
- ⌘ Glyphosate for difficult to control invaders
- ⌘ Other herbicides generally not necessary



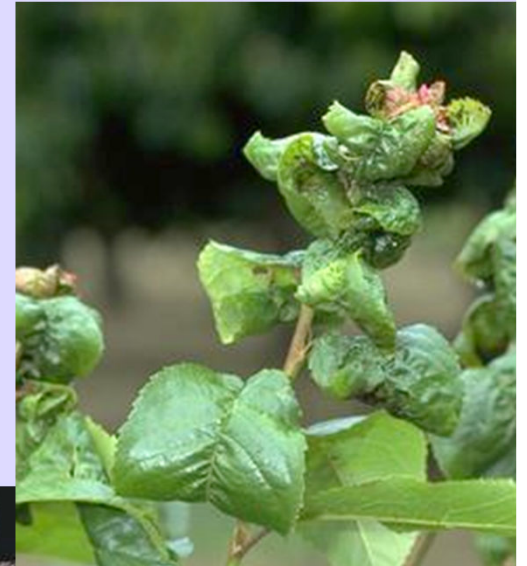
Organic herbicides only burn weeds back.

IPM for Aphids

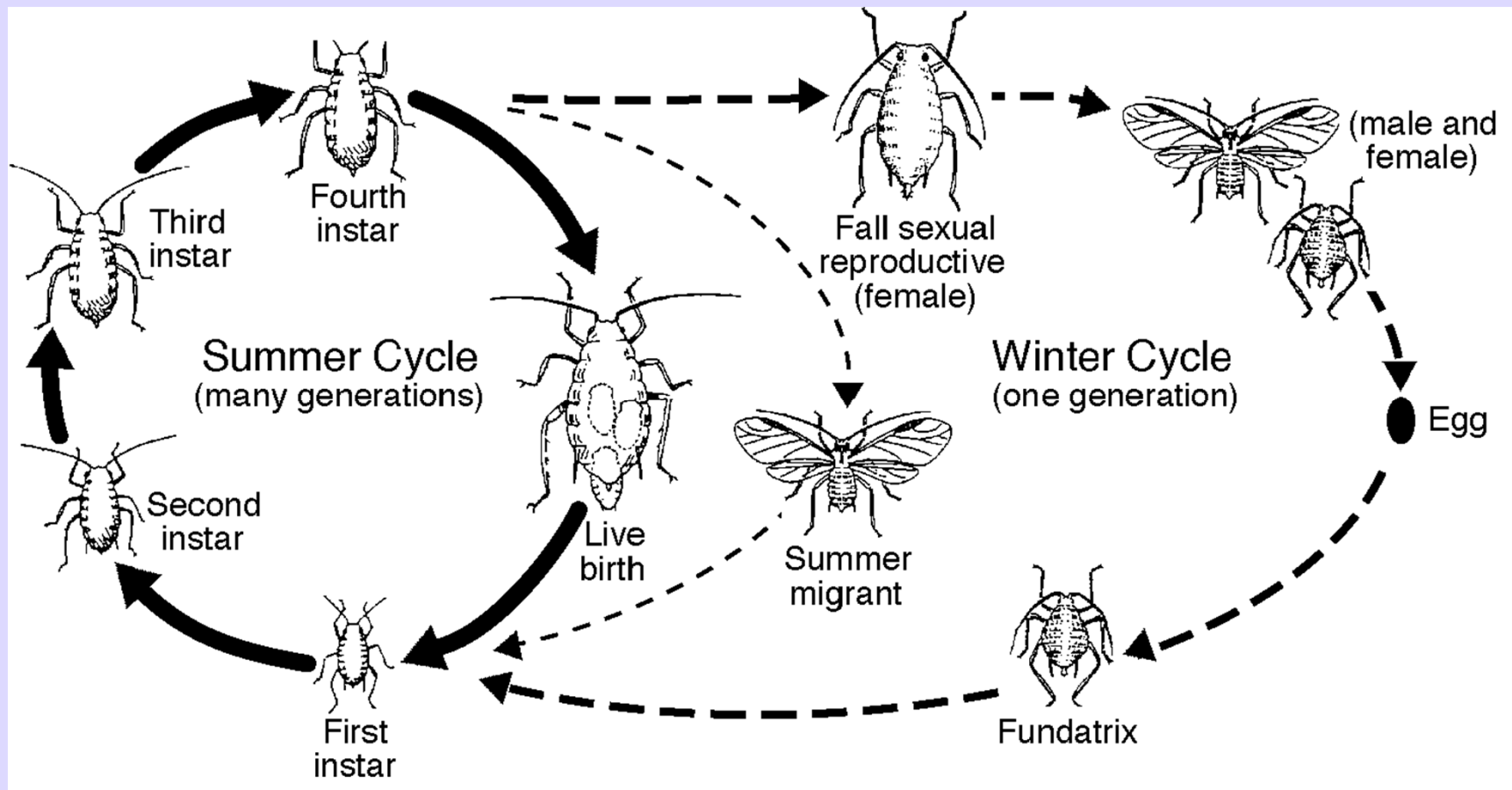


Aphid damage

- ⌘ Primarily aesthetic damage--don't kill trees
- ⌘ Honeydew and sooty mold
- ⌘ Leaf curling or distortion
- ⌘ Gall formations for a few species



General Life Cycle of Aphids



General Management Considerations for Aphids



- ⌘ Don't kill trees; often short term problems in mild weather
- ⌘ Most species are host specific: choose plants without problems. Flowering plums, crape myrtle, roses, tulip trees, apples and vegetables are aphid prone.
- ⌘ Love lush vegetation: over fertilization, irrigation, pruning
- ⌘ Natural enemies are abundant and often effective.
- ⌘ Keep ants out of trees.

Management Tools for Aphids

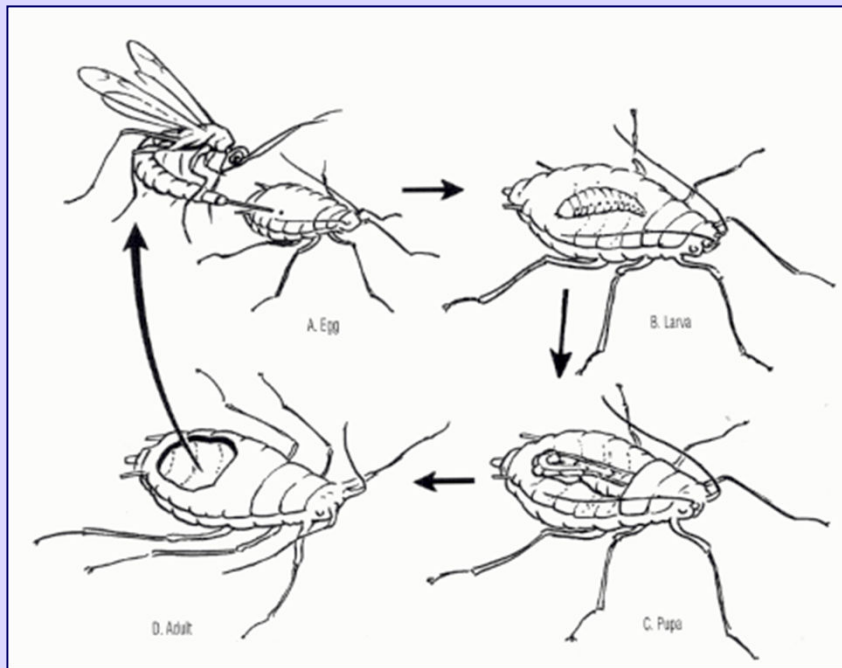
- ⌘ Cultural practices
- ⌘ Natural enemies
- ⌘ Water sprays
- ⌘ Insecticidal oils/soaps
- ⌘ Imidacloprid (soil drench preferred)
- ⌘ Other insecticides



Ant management can improve biological control of aphids



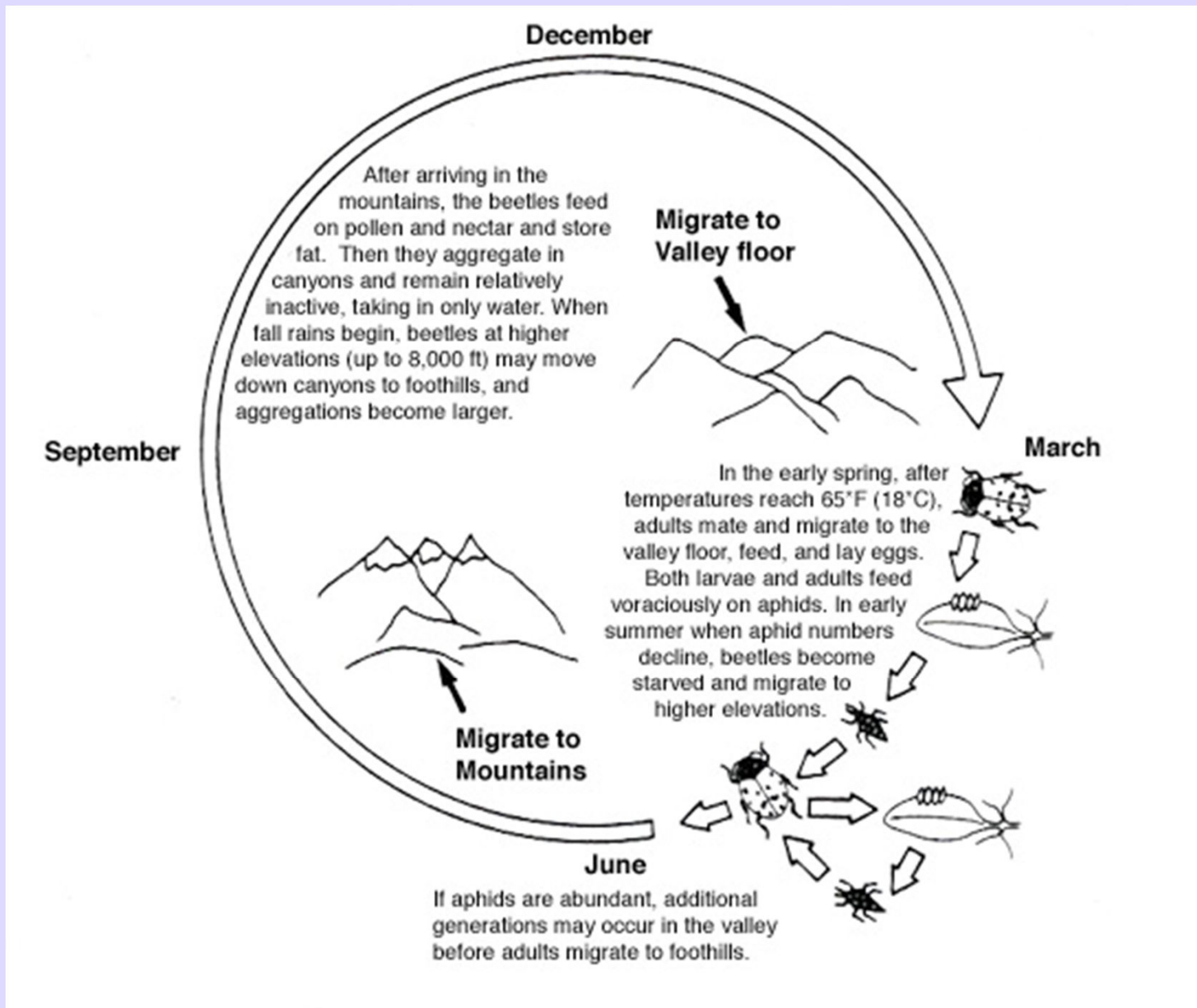
Parasitic wasps that attack aphids are common



Convergent ladybeetle



Convergent ladybeetle cycle



Harmonia--Asian multicolored lady beetle



Green lacewings



Syrphid flies



Soldier beetle (Cantharidae)



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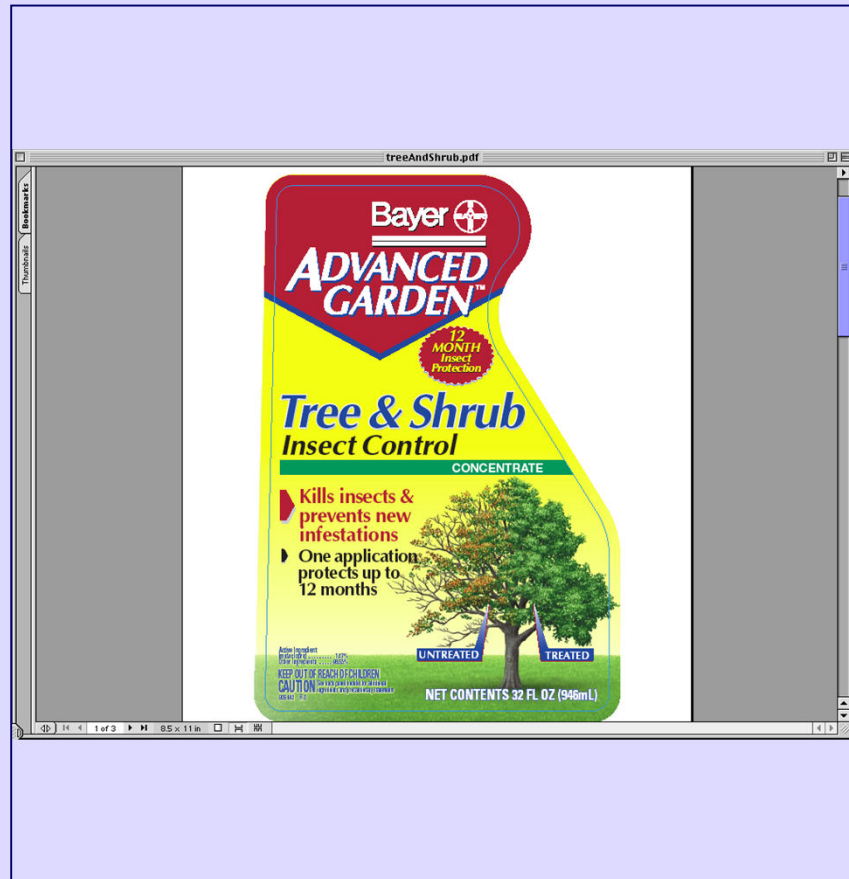
Insecticidal oils and soaps

- ⌘ Kill aphids on contact, no residual
- ⌘ Won't kill aphids curled in leaves
- ⌘ Soft on natural enemies, nontargets
- ⌘ Petroleum or plant oils such as neem, jojoba, canola



Imidacloprid: for big problems on big trees

- ⌘ Use only when you have a persistent problem that can't be treated with soaps, oils or water.
- ⌘ Apply with soil injections or drenches, not foliar or trunk injections.
- ⌘ Keep out of storm drains!
- ⌘ Check label to make sure product is not combined with a pyrethroid.
- ⌘ Toxic to bees, parasites



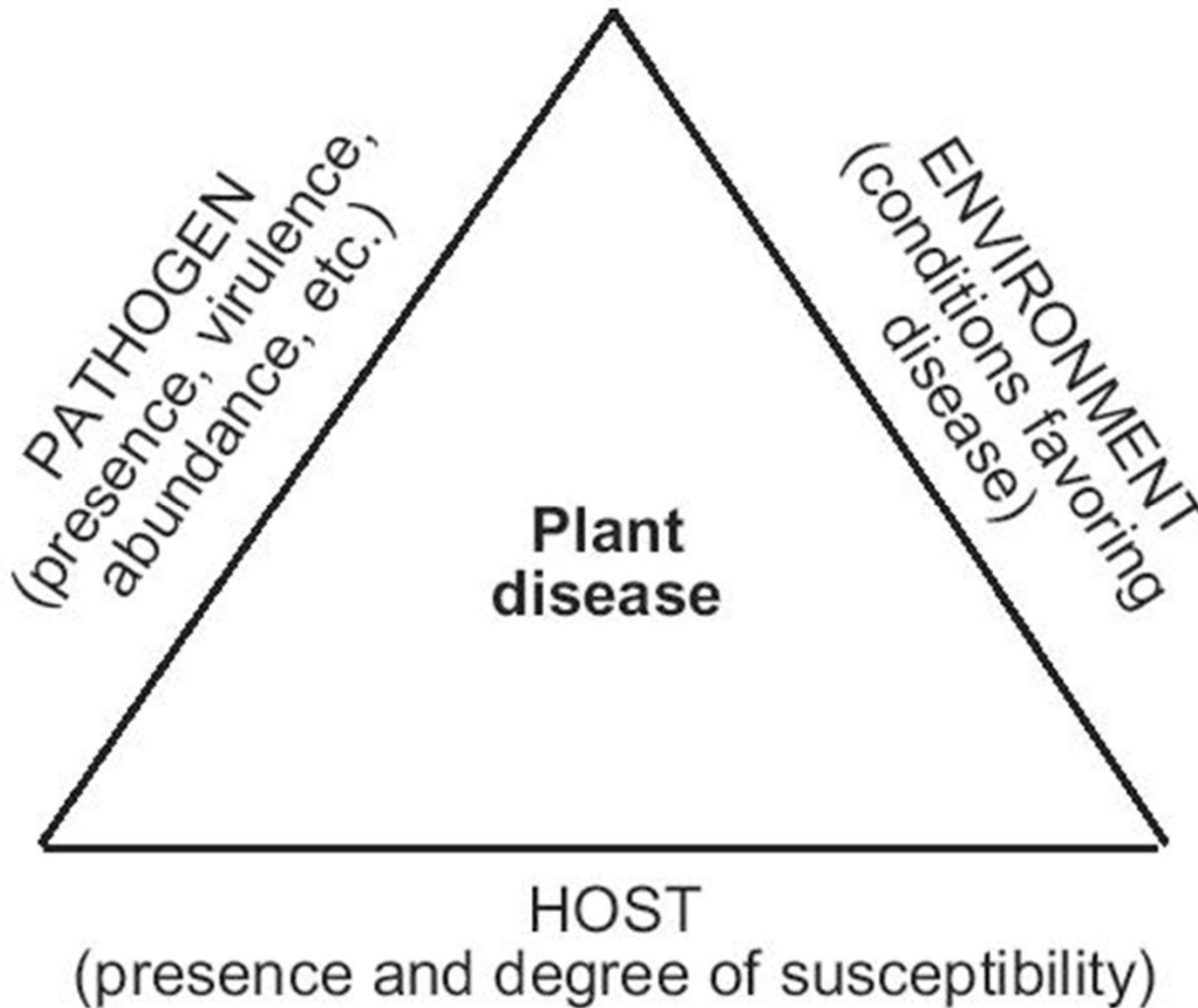
IPM for Aphids



- ⌘ Know they don't kill trees: aesthetic damage
- ⌘ Choose plants that don't have aphid problems
- ⌘ Natural enemies are abundant and often effective
- ⌘ Manage ants
- ⌘ Love lush vegetation and increase with pruning and nitrogen fertilization
- ⌘ Hose them off. Prune them out.
- ⌘ Use insecticidal oils or soaps for exposed aphids
- ⌘ Save imidacloprid for rare situations. Soil not foliar.

The Disease Triangle

(limiting factors for disease)



Powdery mildew on Rose

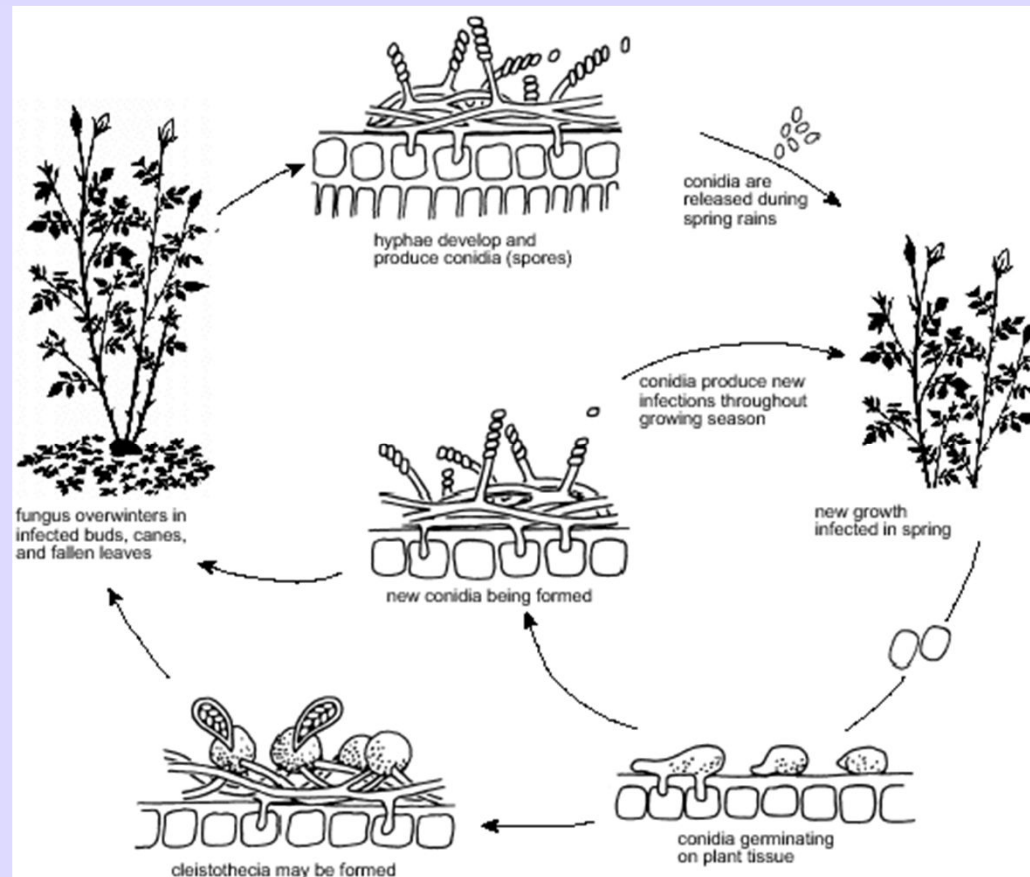
Sphaerotheca pannosa

- ⌘ Favored by warm temperatures
- ⌘ Doesn't need moisture to germinate.
- ⌘ Inhibited by free water
- ⌘ Increased by high nitrogen
- ⌘ Some varieties more susceptible
- ⌘ Favored by shade



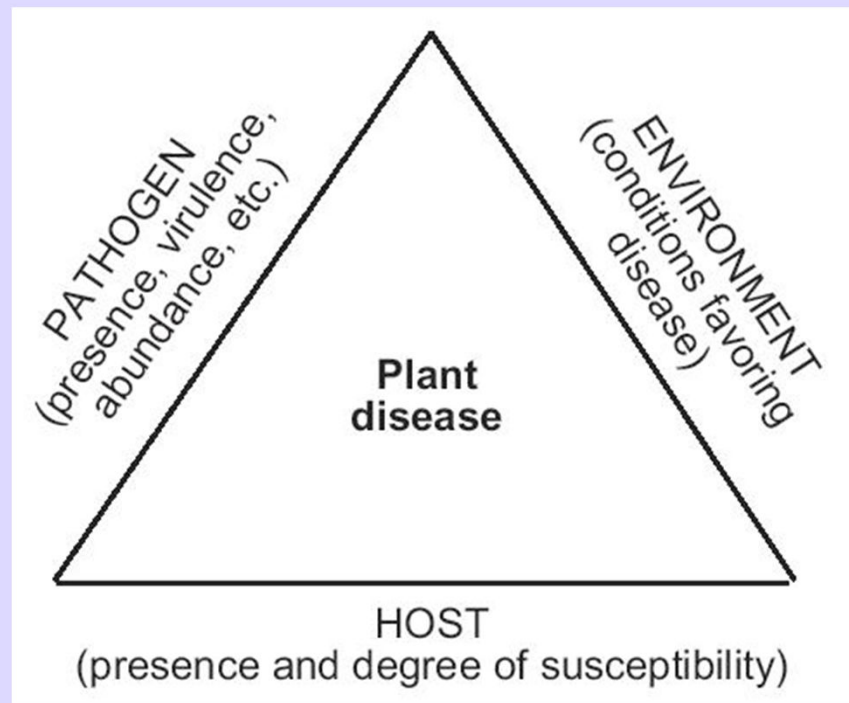
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Life cycle of *Sphaerotheca pannosa* on rose



Using the disease triangle to create an IPM program for powdery mildew

- ⌘ Host: choose less susceptible varieties or don't grow roses
- ⌘ Pathogen: remove infected canes and debris in winter; use fungicides (oils)
- ⌘ Environment: plant in sun, prune for air circulation, don't overfertilize, sprinkle irrigate in AM



Summary: IPM strategy



- ⌘ Less risk to health and the environment
- ⌘ Emphasis on prevention
- ⌘ Fewer pest problems



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