

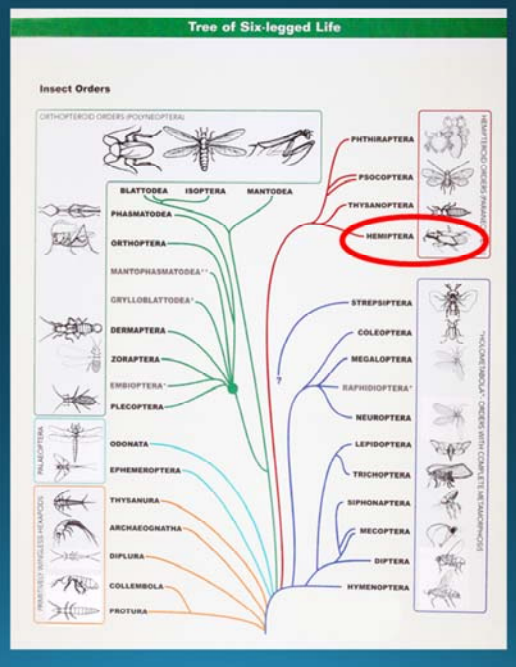
Scale insects and their control

1. Introduction to scales
 1. The Hemiptera (True bugs)
 2. How “bugs” got their name
 3. Difference between Heteroptera and Homoptera
 4. Major scale families
 5. Parts of a scale
 6. Scale life cycles
2. Biology of scales
 1. How scales feed
 2. Honeydew
 3. Scale symbiotic relationships with ants
 4. Parasites and predators of Scales
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3. Controlling scales
 1. Scale protections from insecticides
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1. Important Texas Scale insects
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 3. Coccoideae
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 2. Lecanium scales

Insect classification

- Insects divided into major groups called Orders
 - Orders
 - Suborders
 - Superfamilies
 - Families



Scales belong to the insect Order Hemiptera



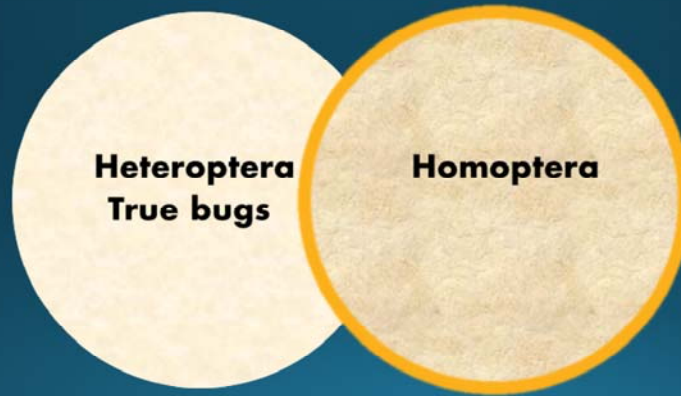
Hemiptera was originally two orders

**Hemiptera,
(true bugs)**

**Homoptera
(leafhoppers,
scales, whiteflies,
aphids...)**

Heteroptera (originally Hemiptera)

Hemiptera now considered one order with two suborders



Heteroptera (originally Hemiptera)

Origin of term "bug"

Middle English
word **BWG**
or
BUGGE
referred to a
spirit or ghost

BOO is a related
word



[As an aside, the term bug is an old Middle English word that meant ghost or spirit. When people woke up in the morning with red, itchy welts, people use to attribute these marks to bugges or mischievous spirits. Of course the red marks were not ghosts at all, but the bites of small insects that we today call bed bugs. The term bug evolved to refer to not just bed bugs but any relative of the bed bug, within the suborder Heteroptera. There are some other bugs that bite, BTW. Kissing bugs are another blood sucking parasite in this group.]



So bed bugs were the original bug. We don't usually call Homoptera "bugs" but they are cousins of the true bugs – the Heteroptera.

Hemiptera

- Heteroptera (true bugs)
- Other homopteran suborders
 - Auchenorrhyncha
 - Sternorrhyncha



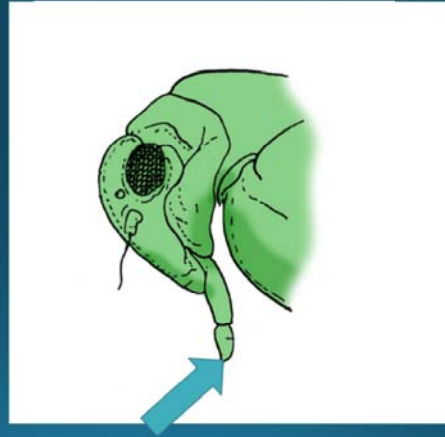
Characteristics of homopteran groups

- Gradual metamorphosis
- Piercing/sucking mouthparts arise from back of head or between legs
- Antennae short, bristle-like, or filiform
- Plant feeders



Auchenorrhyncha: cicadas, leafhoppers and spittlebugs

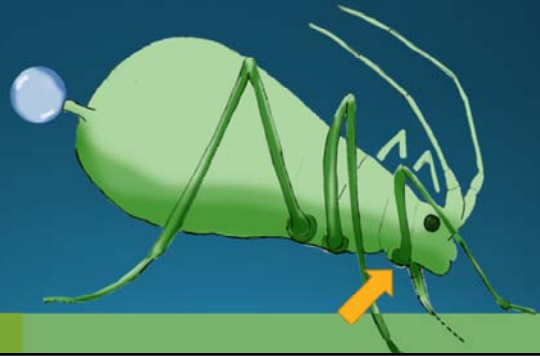
- Name means "snout behind the head"
- Refers to mouthparts that arise "behind" the head



Suborder Auchenorrhyncha

Sternorryhcha: aphids, whiteflies, mealybugs, scales

- Literally means “snout on the chest”
- Refers to mouthparts that arise lower on body, between front legs



Suborder Sternorrhyncha is the group we are going to focus on today, specifically the scales.

Sap feeding Homoptera

- aphids
- mealybugs
- whiteflies
- Scale-like insects



There are four major kinds of insects that feed on phloem sap.

Aphids

- One of most common sap-feeding insects
- Hundreds of species, often specialized in one or a few types of hosts
- Rapid reproducers



Mealybugs

- waxy covering on top of body
- Mobile
- Heavy honeydew



citrus mealybug



pink hiscus mealybug

Two more important sap feeders to be able to recognize.



Because they feed on leaf undersides, whiteflies make an ideal target for systemics. It's especially difficult to kill these insects with standard contact and residual sprays because of their feeding location.

Scale insects
superfamily
Coccoidea

- Related to aphids
- Over 850 species
in America north
of Mexico
- 17 families



Important Coccoidea families

- Pseudococcidae – mealybugs
- Eriococcidae – felt/bark scales
- Cryptococcidae – bark crevice scales
- Kermesidae – gall-like scales
- Asterolecaniidae – pit scales
- Cerococcidae – ornate pit scales
- Lecanodiaspididae – false pit scales
- Aclerididae – flat grass scales
- Dactylopiidae – cochineal scales
- Coccidae – soft scales
- Diaspididae – armored scales

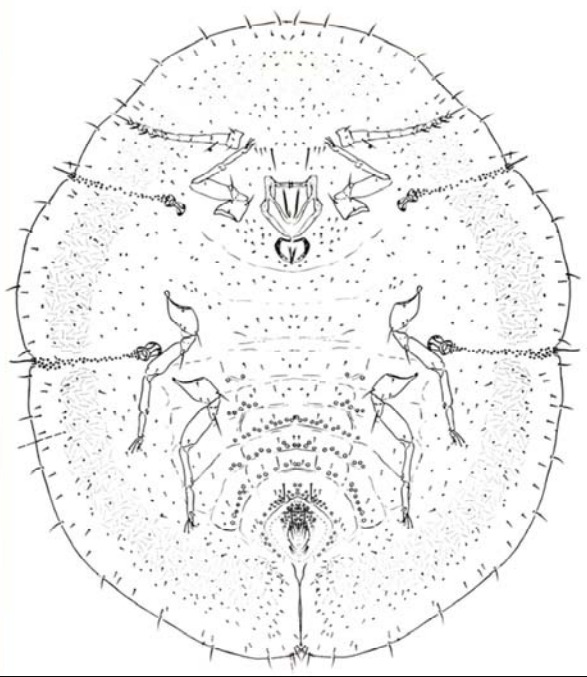


Parts of a scale



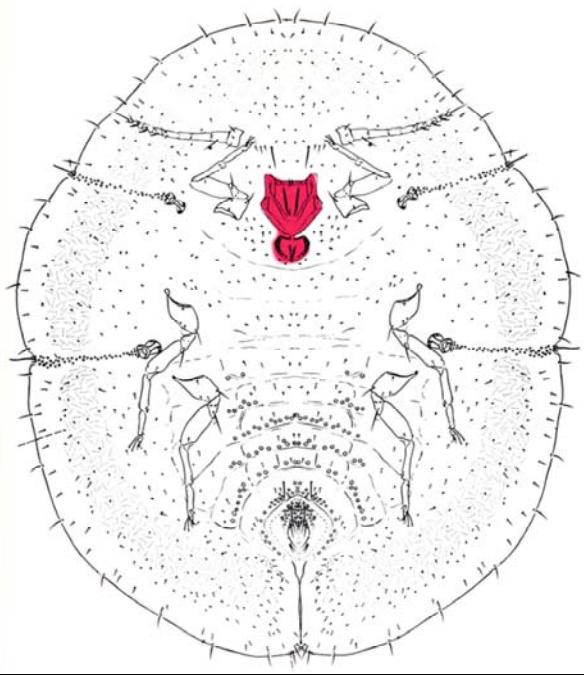
Parts of a scale

Viewed as if mounted on a microscope slide



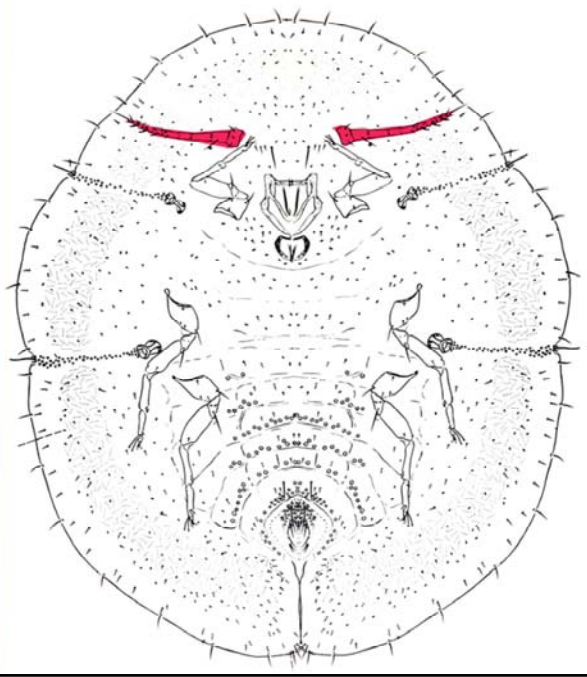
Parts of a
scale

mouth



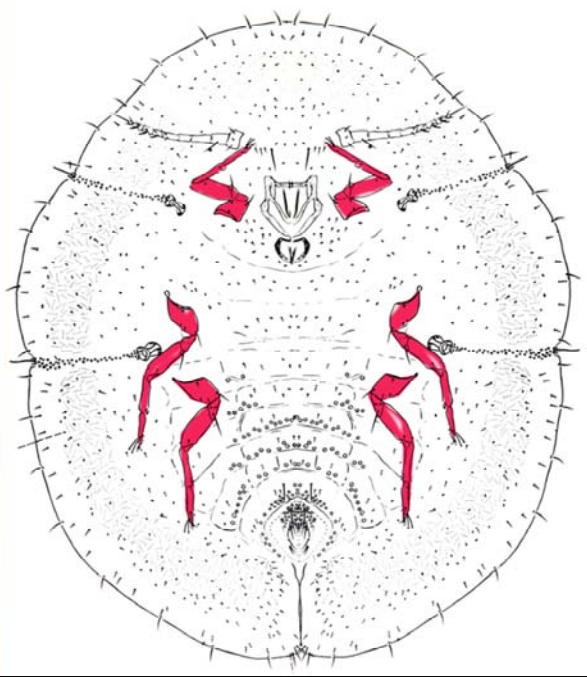
Parts of a
scale

antennae



Parts of a
scale

legs



Typical scale life cycle

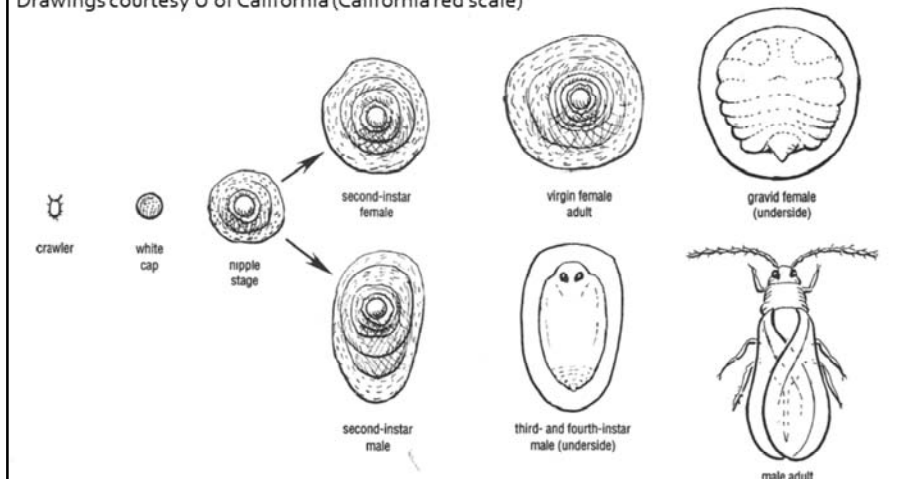
Drawings courtesy U of California (California red scale)



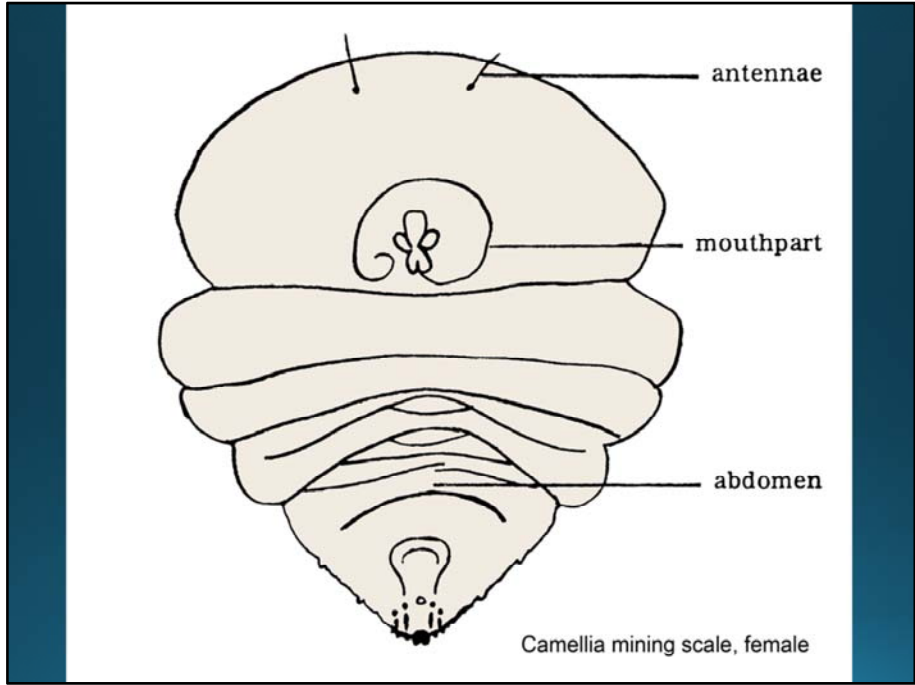
Scales are one of the oddest appearing insects, and have some unique life stages. Drawings courtesy U of California (California red scale)

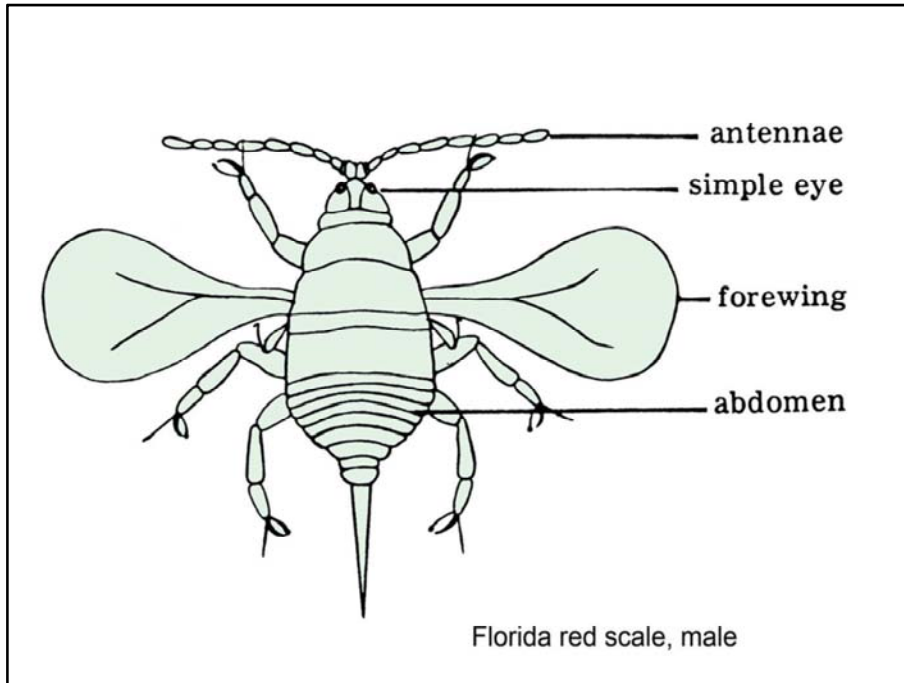
Typical scale life cycle

Drawings courtesy U of California (California red scale)

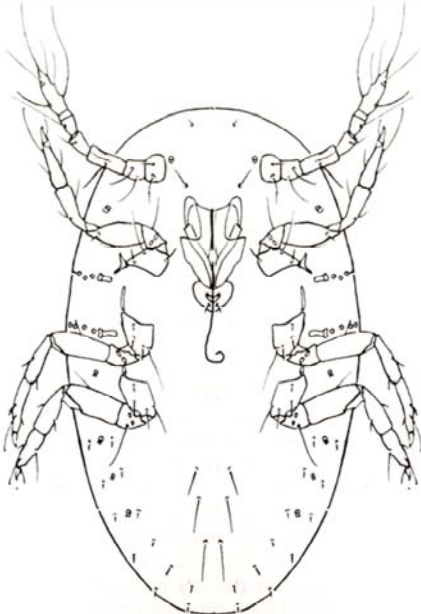


The adult male, unlike the female, is winged. If you bag a branch with scale insects at the right time, chances are good that you will see little flying insects in the bag after several days. These are the males. Males seek sexually mature females by their pheromone scents, and mate. Then the females become gravid and fill with eggs, eventually dying under the scale cover she has spent her entire life under.





crawler



Coccid scale crawler, 1st instar

Scale crawlers

- First life stage after egg
- Only mobile life stage for many scales



Unfortunately every scale species is a little different, so it is difficult to predict when scale emergence will occur without observations. The small, yellow insects on the stem in this picture are crawlers.

If the female is wingless, how do scale infestations spread?

- Wind (crawlers)
- Rain
- Ants
- Human transport
- Birds, mammals?





Other scale, notably the armored scales feed on non-vascular plant cells, the parenchyma. This type of damage is often seen as discoloration at the site of feeding on the leaves.



Many scale insects feed exclusively on phloem



Honeydew consists of sticky organic sugars and excess water taken up by the scales in their efforts to extract sugars and nitrogen from the plant. Because nitrogen is essential to protein building for the scale, but present in relatively minute amounts in the phloem, soft scales take in and excrete large amounts of sap to grow and reproduce.



Bees
Ants

Symbiotic benefits

- Scales receive
 - Reduction of sooty mold accumulation
 - Protection from natural enemies
 - Protection from weather
- Ants receive
 - Reliable food supply

Acrobat ants tend calico scales



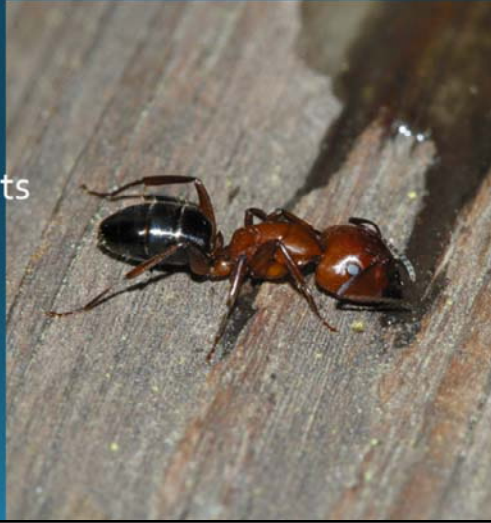
How can scale insects contribute to indoor ant infestations?

- A home landscape is an ecosystem with many living parts
- Scale infestations on plants may sustain ant populations that infest indoor areas
- Controlling scale insects will contribute to integrated control of indoor ants



Ants that will feed on honeydew

- Carpenter ants
- Acrobat ants
- Rover ants
- Odorous house ants
- Argentine ants
- Fire ants
- Crazy ants



Scale predators and parasitoids

- Many natural enemies
 - Parasitoids
 - Encyrtid and Aphelinid wasps
 - Predators
 - Lady beetles
 - Mites
 - Lacewings



Encyrtid wasp parasitizing scale



Twice stabbed lady beetle

Important scale insects on Texas trees and shrubs

- Coccidae – soft scales
 - Seed-like in shape
 - Scale cover attached to body
 - One generation a year
- Diaspididae – armored scales
 - Flattened
 - Unattached cover of wax and cast skins (armor)
 - Multiple generations per yr
- Eriococcidae – felt or bark scales
 - Felt-like egg sac
 - Multiple generations per year



Crape myrtle bark scale

Coccid soft scales

- Feed on phloem and produce copious honeydew
- Some produce egg sacs
- Do not lose their legs, so may move
- Some produce heavy wax

Ceroplastes wax scale





Hemispherical scale on sago palm



Cottony citrus scale on althea



One of the most prominent features of this scale is its large ovisac, an egg mass produced by the female at the end of her life. Identification of these scales is best done just before egg lay.

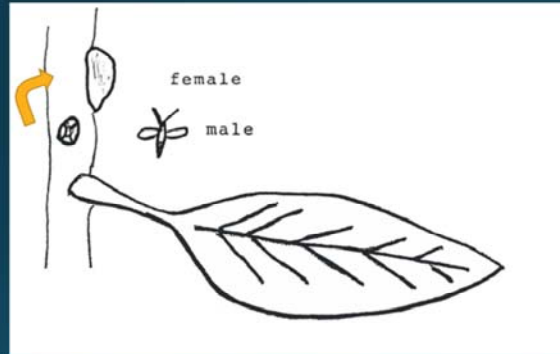


Tropical scale seen mostly on indoor plants



One of the most destructive scales on oak in the area. May require treatment with pyrethroid insecticide during crawler emergence.

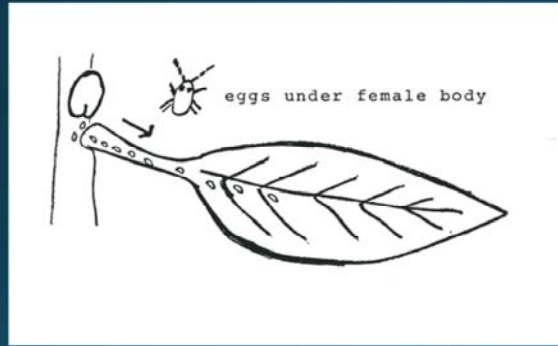
Typical soft scale life cycle



- Early Spring (Mar-Apr)
- Overwintering immature scales on bark molt into adult forms
- Mating occurs now

Drawing: Barbara Rudd

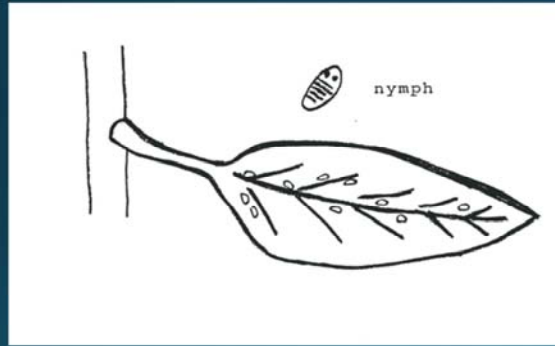
Typical soft scale life cycle



Drawing: Barbara Rudd

- Early summer (Apr-Jun)
- Females enlarge assume typical color pattern
- Heavy honeydew
- Eggs laid and hatch
- Crawlers emerge – good time to treat with insecticide

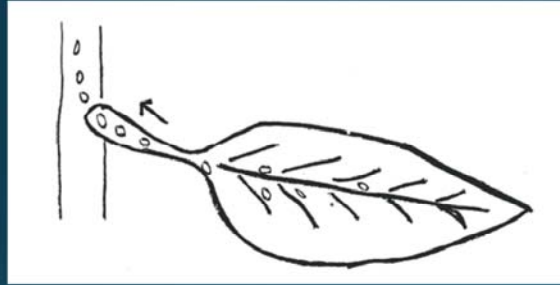
Typical soft scale life cycle



- Mid summer (Jul-Sep)
- Settled crawlers or nymphs continue to feed

Drawing: Barbara Rudd

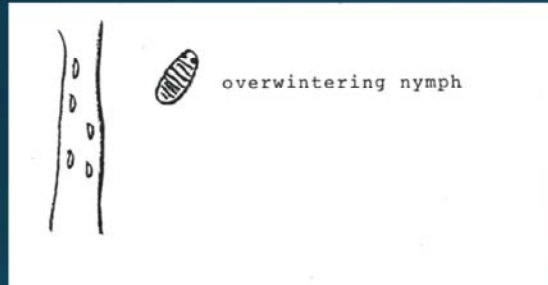
Typical soft scale life cycle



Drawing: Barbara Rudd

- Fall (Oct-Nov)
- Surviving immatures move back to bark to overwinter
- Second chance to treat with insecticide

Typical soft scale life cycle



- Winter (Dec-Feb)
- Immatures overwinter on bark
- Dormant oil sprays may be profitable for some species

Drawing: Barbara Rudd

Detecting scale crawler movement

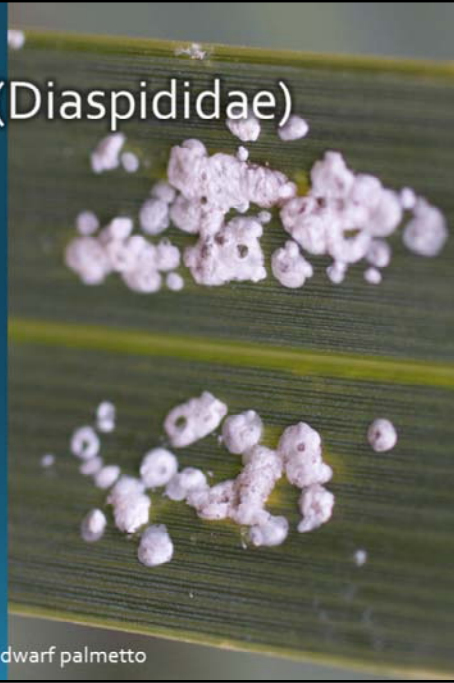
- Use 2X tape wrapped tightly around branches
- Check and replace weekly
- When crawlers are moving, good time to treat



Armored scales (Diaspididae)

- More flattened appearance
- Feed on parenchyma cells, not phloem
- Do not produce honeydew
- Often settle under scale covers of previous generation
- Once settled, do not move
- Multiple generations per year often

Palmetto scale, *Comstockiella sabalis*, on dwarf palmetto



Palmetto scale, *Comstockiella sabalis*, on dwarf palmetto. An endemic on sabals. Usually held in check by parasitoids.

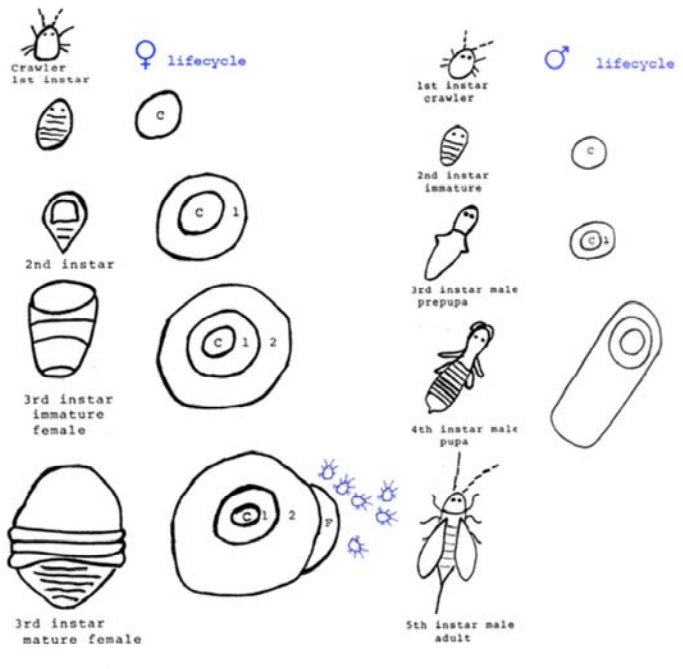
Lifecycle

Drawing: Barbara Rudd



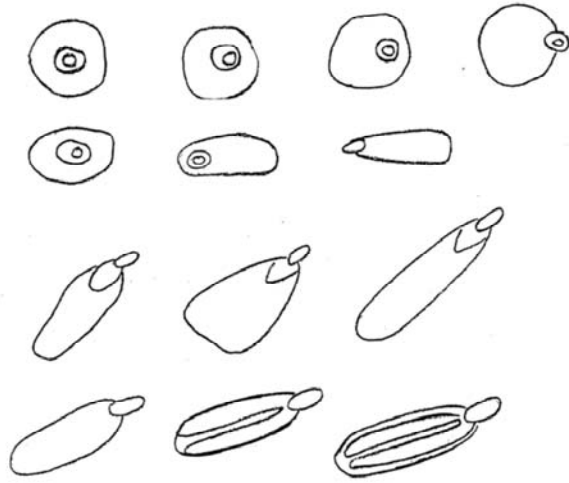
Lifecycle

Drawing: Barbara Rudd



Shape variations in armored scales

Drawing: Barbara Rudd





Bermudagrass scale on bermudagrass

Tropical scale seen mostly on indoor plants



Tropical scale seen mostly on indoor plants



Tropical scale seen mostly on indoor plants

Bark scales (Eriococcidae)

- Adult females (largest scales) enclosed by a white, felt-like egg sac
- Occurs on trunk, branches, roots of host
- Heavy honeydew

Crape myrtle bark scale on crape myrtle





Females have two instars, then the adult. Males have four immature stages. The elongated scales in this image are the males. The large ovisacs are females.





The tree on the left was treated with dinotefuran, the one on the right untreated

Chilocorus cacti, twice stabbed
lady beetle



Adult



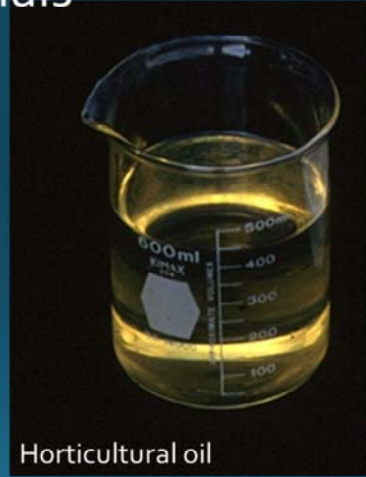
Goals of IPM for scale insects

- Protect and preserve beneficial insects
- Achieve effective and affordable control
- Minimize aesthetic damage due to excess honeydew production



Protecting beneficials

- Protect beneficial pollinators and predators/parasitoids
- Use short-lived contact insecticides
- Avoid applications during or just prior to blooming
 - Especially important on favored nectar trees
- Systemic insecticides applied as a soil drench



Horticultural oil

Insecticides to control scale insects

- **Standard residual insecticides**
 - Some not highly effective on sap feeders
 - Usually destroy beneficial insects
 - Most effective during crawler emergence
- **Contact insecticides**
 - No residual – “you get what you hit”
 - Low impact on beneficials
 - Usually applied during dormant season
- **Systemic insecticides**
 - Water soluble – taken up by the plant’s phloem/xylem systems
 - Can be applied to leaves, trunk or roots
 - Can preserve beneficials if applied to soil
 - May be harmful to pollinators if misapplied



But before we talk about some of these insects, let’s familiarize ourselves with some of the new and old products that control sap-feeders.

Residual insecticide sprays

- Best used in combination with monitoring tape
- Time sprays when crawlers or immatures are moving on the tree
- Longer residual products like
 - Cyfluthrin
 - Bifenthrin
 - Esfenvalerate
 - Other pyrethroids
- Insect growth regulators



Oil sprays

Photo: Utah State University



Avoid application when temperatures will dip below 32 deg, or above 95 deg. Winter is the best time to use oils because leaves are off most trees and you can use 2X rate without harming the plant. This method is only useful, though, on pests that overwinter on the bark of the tree, and is best on trees that actually lose their leaves in winter.

Systemic insecticides

- Water-soluble, can be absorbed into phloem system of the tree
- Popular products
 - Acephate (Orthene)
 - Imidacloprid
 - Thiamethoxam
 - Clothianidin
 - Acetamiprid
 - Dinotefuran



Which insects would you expect to be well controlled by phloem-transported insecticides?

- Caterpillars
- Leaf beetles
- Soft scales
- Mealybugs
- Armored scales
- Bark scales



Which insects would you expect to be well controlled by phloem-transported insecticides?

- Caterpillars
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- Mealybugs
- Armored scales
- Bark scales



Armored scales are the most difficult scale pest to control

- Dormant oil sprays
- Highly water soluble systemics - soil applied
 - Dinotefuran (Safari)
- Insect growth regulators
 - pyriproxyfen (Distance)
 - Buprofezin (Talus)
- Other possibilities
 - Spinetoram + sulfoxaflor (Xpire)

Oystershell scale, *Lepidosaphes ulmi*



Remember armored scales do not feed in phloem tissue, so only the most highly water soluble systemics will have a chance to be effective. Dinotefuran's high solubility (80X more water soluble than imidacloprid) gives it some unique features when it comes to scale control.

Oystershell scale

THE NEW EPA BEE ADVISORY BOX

On EPA's new and strengthened pesticide label to protect pollinators

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon In the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators. Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to bushes or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at: <http://pesticideenvironmentalstewardship.org/advanceprotection/pages/default.aspx>

Pesticide incidents (for example, bee kills) should immediately be reported to the state/local lead agency. For pesticide incidents for your state/territory, go to www.epa.gov. Pesticide incidents can also be reported to the National Pesticide Information Center at www.npic.orst.edu or directly to EPA at bee@epa.gov

Alerts users to separate restrictions on the label. These prohibit certain pesticide use when bees are present.

The new bee icon helps signal the pesticide's potential hazard to bees.

Makes clear that pesticide products can kill bees and pollinators.

Bees are often present and foraging when plants and trees flower. EPA's new label makes it clear that pesticides cannot be applied until all petals have fallen.

Warns users that direct contact and ingestion could harm pollinators. EPA is working with beekeepers, growers, pesticide companies, and others to advance pesticide management practices.

Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

The science says that there are many causes for a decline in pollinator health, including pesticide exposure. EPA's new label will help protect pollinators.

Read EPA's new and strengthened label requirements: <http://go.usa.gov/jHH4>

Bee Labeling Info Graphic (PDF). U.S. EPA.

<http://www.epa.gov/opp00001/ecosystem/pollinator/bee-label-info-graphic.pdf>

Anemophilous plants

- Less likely to be an important nectar source for bees
- Some pollinators may still harvest *pollen* from anemophilous plants
- Oaks, elms, ashes, beeches, maples, pines, grasses are anemophilous



Trees in urban areas fall into 2 categories from a bee's viewpoint: entomophilous (insect pollinated) and anemophilous (wind pollinated). Entomophilous trees generally include the Rosaceae and Fabaceae as well as lindens and citrus. Bees harvest both nectar and pollen from the obvious flowers on these trees. Anemophilous trees include the oaks, elms, ash, and maples. Bees only harvest pollen from these trees as they do not produce nectar. It should be noted that these wind pollinated trees produce vast amounts of pollen and some of that abundant pollen is readily collected by bees.

Bees will, if given the option, preferentially collect pollen from the entomophilous plants. The issue is that there are times, especially early in the year, when bees are extremely hungry for pollen and there just isn't enough out there for them from their favored plants. We did some pollen collections this spring and were surprised to see that at certain times in early May the bees were collecting 75 or 80% anemophilous tree pollen. I'm not sure about the grass pollen (our pollen analysis hasn't gotten that far through the year's sample yet), but people have definitely shown that bees will collect it as well if there's nothing better. Of course bees, when given no other choice, will begin to collect pollen-like substances like sawdust

and flour.

I don't know of anyone that has looked broadly pesticide residues in these tree or grass pollens. There has been some work on ash pollen, but I can't find it at the moment.

Comments from Reed Johnson at Ohio State University.