
SCALES

Integrated Pest Management for Home Gardeners and Landscape Professionals

Scale insects can be serious pests on all types of woody plants and shrubs. Scales are so unusual looking that many people do not at first recognize them as insects. Adult female scales and many immature forms do not move, are hidden under a disklike or waxy covering, and lack a separate head or other recognizable body parts. Scales have long piercing mouthparts with which they suck juices out of plants. They may occur on twigs, leaves, branches, or fruit. Severe infestations can cause overall decline and even death of plants. Most scales have many natural enemies that often effectively control them.

Armored scales and soft scales are the most common types of scales on woody plants. Common scales in each group as well as several other types of scales that are important on specific host plants are listed in Table 1. Excellent color keys for scale insects in California are available from the California Department of Food and Agriculture; see "References" for titles.

IDENTIFICATION

Armored scales, family Diaspididae, are less than $\frac{1}{8}$ inch in diameter and have a platelike cover (Fig. 1). This cover usually can be removed from the scale body. They are called armored scales because the scale cover is quite dense and provides a degree of protection from pesticides and parasites. The armored scales hatch from eggs, settle down, lose their legs, and form a hard cover that is usually separate from the scale's body. Armored scales do not excrete honeydew. Examples of armored scales include California red scale, greedy scale, oystershell scale, and San Jose scale.

Female soft scales, family Coccidae, may be smooth or cottony and have a diameter of $\frac{1}{4}$ inch or less. They are usually larger and more rounded and convex than armored scales. The surface is the actual body wall of the insect and cannot be removed. Most immature soft scales retain their barely visible legs and antennae after settling and are able to move, although slowly. Soft scales produce large quantities of honeydew, which is modified plant sap, that drips from their bodies. Examples of soft scales are black scale, brown soft scale, and European fruit lecanium.

LIFE CYCLE

Most armored scales have several generations a year, while most soft scales (brown soft scales are an important exception) often have only a single generation. Eggs of both types of scales are usually hidden under the adult female. Eggs hatch into tiny, usually yellow crawlers with legs. Crawlers walk over the plant surface, are blown by wind to other trees, or can be inadvertently moved by people or birds. Armored scales settle down permanently after a day or two in the crawler stage, molt, and begin to form their characteristic covers. Soft scales move around for a while longer but also eventually settle at permanent feeding sites; half-grown individuals of some soft scale species move once again in fall from leaves to wood for overwintering. Adult female scales are immobile and have a characteristic scale cover. Adult male scales are tiny winged insects that superficially resemble parasitic wasps. They are rarely seen, do not feed, and live only a few hours. Females of many soft scale species reproduce without mating. Life

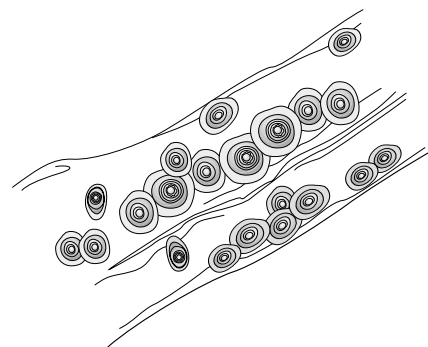


Figure 1. Armored scale infestation on twig.

cycles and stages for scales are outlined in Figures 2 and 3.

DAMAGE

Woody plants heavily infested with armored scales often look water stressed. Leaves may turn yellow and drop, twigs and limbs on trees may die, and bark may crack and produce gum. Many armored scales attack leaves or fruit as well, leaving blemishes and halos on fruit; the fruit damage is often just aesthetic. Some armored scales can kill plants.

Soft scales also reduce tree vigor but seldom kill trees. The major concern with these scales is their production of abundant quantities of honeydew, which gets on leaves and fruit, encouraging the growth of black sooty mold. Honeydew also attracts ants, which protect soft scales from natural enemies; the presence of ants on a tree or shrub is a good indication of an infestation by a honeydew-producing insect. Soft scales infest leaves and twigs and do not attack fruit directly.

TABLE 1. Some Common Scales Found in California and Their Principal Hosts

Common Scales	Principal Hosts
Armored Scales	
California red scale (<i>Aonidiella aurantii</i>)	acacia, boxwood, citrus, eugenia, euonymus, grape, magnolia, mulberry, olive, palm, podocarpus, privet, rose
cycad scale (<i>Furchadaspis zamiae</i>)	bird-of-paradise, cycads (sago palm)
euonymus scale (<i>Unaspis euonymi</i>)	euonymus
greedy scale (<i>Hemiberlesia rapax</i>)	acacia, bay, boxwood, cactus, ceanothus, citrus, fruit trees, holly, laurel, magnolia, manzanita, palm, pepper tree, pittosporum, pyracantha, redbud
latania scale (<i>Hemiberlesia lataniae</i>)	acacia, <i>Cedrus</i> , euonymus, <i>Fatsia</i> , fuchsia, gladiolus, grevillea, <i>Hedera helix</i> , <i>Kentia</i> , persea, philodendron, rose, <i>Rubus</i> , <i>Salix</i> , yucca
minute cypress scale (<i>Carulaspis minima</i>)	arborvitae, cypress, juniper
oleander scale (<i>Aspidiotus nerii</i>)	acacia, bay, boxwood, cactus, holly, ivy, laurel, magnolia, manzanita, maple, mulberry, oleander, olive, palm, pepper tree, redbud, sago palm, <i>Taxus</i> (yew), yucca
oystershell scale (<i>Lepidosaphes ulmi</i>)	alder, aspen, box elder, boxwood, ceanothus, cottonwood, most deciduous fruit and nuts, holly, maple, poplar, sycamore, willow
purple scale (<i>Lepidosaphes beckii</i>)	citrus
San Jose scale (<i>Quadraspidiotus perniciosus</i>)	acacia, aspen, citrus, cottonwood, most deciduous fruits and nuts, maple, mulberry, poplar, pyracantha, rose, strawberry tree, willow
walnut scale (<i>Quadraspidiotus juglansregiae</i>)	walnut
Soft Scales	
black scale (<i>Saissetia oleae</i>)	almond, apple, aspen, bay, citrus, cottonwood, coyote bush, fig, holly, maple, mayten, oleander, olive, palm, pear, pepper tree, pistachio, poplar, privet, stone fruit, strawberry tree, walnut
brown soft scale (<i>Coccus hesperidum</i>)	aspen, avocado, citrus, cottonwood, holly, manzanita, palm, poplar, stone fruit, strawberry tree, willow
calico scale (<i>Eulecanium cerasorum</i>)	box elder, liquidamber, maple, pear, stone fruit, walnut
citricola scale (<i>Coccus pseudomagnoliarum</i>)	citrus, elm, hackberry, pomegranate, walnut
European fruit lecanium (<i>Parthenolecanium corni</i>) (also called brown apricot scale)	alder, almond, aspen, cottonwood, elm, grape, pear, pistachio, poplar, stone fruit, toyon, walnut
frosted scale (<i>Parthenolecanium prunosum</i>)	ash, birch, elm, laurel, locust, pistachio, rose, sycamore, walnut
green shield scale (<i>Pulvinaria psidii</i>)	begonia, California pepper tree, camellia, croton, eugenia, gardenia, hibiscus, laurel fig or Indian laurel (<i>Ficus retusa</i>), pittosporum, plumeria, <i>Schefflera</i>
irregular pine scale (<i>Toumeyella pinicola</i>)	pine
Kuno scale (<i>Eulecanium kunoense</i>)	cotoneaster, pyracantha, stone fruit, walnut
tuliptree scale (<i>Toumeyella liriodendri</i>)	deciduous magnolias, gardenia, linden, tuliptree (yellow poplar)
wax scales, including barnacle and Chinese wax scales (<i>Ceroplastes</i> spp.)	California bay laurel, citrus, coyote bush, gardenia, holly
Other Scales	
cottony cushion scale ¹ (<i>Icerya purchasi</i> , family Margarodidae)	citrus, cocculus, nandina, pittosporum
European elm scale (<i>Gossyparia spuria</i> , family Eriococcidae)	elm, especially Chinese elm
oak pit scales ² (<i>Asterolecanium</i> spp., family Asterolecaniidae)	oak
sycamore scale ³ (<i>Stomacoccus platani</i> , family Margarodidae)	London plane, sycamore

¹ See *Pest Notes: Cottony Cushion Scale*, UC DANR Publication 7410² See *Pest Notes: Oak Pit Scales*, UC DANR Publication 7470³ See *Pest Notes: Sycamore Scale*, UC DANR Publication 7409

MANAGEMENT

Scales are often well controlled by natural enemies, especially when predator and parasite activities are not disrupted by ants or applications of broad-spectrum insecticides such as carbaryl, malathion, or pyrethroids applied to control other pests. If scale populations, especially armored scale species, become abundant, you should take action. In the case of soft scales, controlling ants may be sufficient to bring about gradual control of scales as natural enemies become more abundant. If not, well-timed sprays of oil applied either during the dormant season or when crawlers are active in spring (or, in the case of black scale, in summer) should provide good control.

Monitoring

Monitor scales by inspecting plants for crawlers, mature females, or ants. Dead scales from previous generations can remain on plants and it is important to distinguish live scales from dead ones. On landscape plants, action thresholds have not been established for scales. Develop thresholds for your local situation. Monitor and record scale densities and use the density that caused damage (dieback or unacceptable honeydew) as your preliminary control action threshold. Refine this threshold over time as you gain experience.

Examine deciduous plants when leaves are gone in winter. Armored scales overwinter primarily as first-instar nymphs and adult females, whereas soft scales commonly overwinter as second-instar nymphs. On deciduous trees and bushes, twigs and branches heavily infested with scales may retain their leaves during winter and be easy to spot. Citrus, avocado, and other plants that do not enter a winter dormancy can be monitored by examining leaves, twigs, limbs, and fruit for evidence of a scale infestation.

During the growing season, inspect trunks for ants, which may indicate a soft scale infestation. If the descending ants have swollen, almost translucent abdomens, they are probably feeding

on honeydew produced by scales or other insects that suck plant juices.

Cultural Control

Provide plants with good growing conditions and proper cultural care, especially appropriate irrigation, so they are more resistant to scale damage. Prune off heavily infested twigs and branches to eliminate scales when infestations are on limited parts of the

plant. Prune to open up tree canopies in warm-climate areas, such as the Central Valley of California. This increases scale mortality resulting from heat exposure and helps to control black scale and possibly other scale species.

Biological Control

Scales are often controlled by natural enemies, including many species of

Figure 2. Life stages of a typical armored scale, the California red scale.

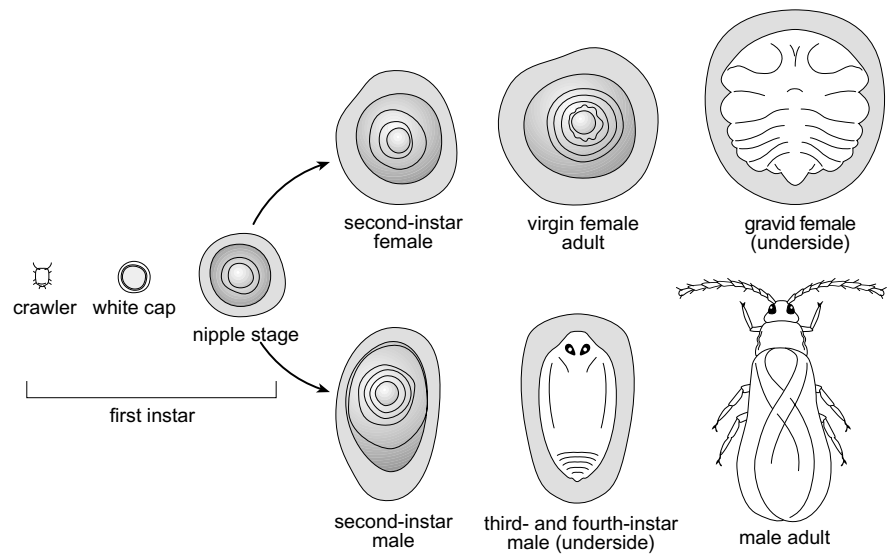
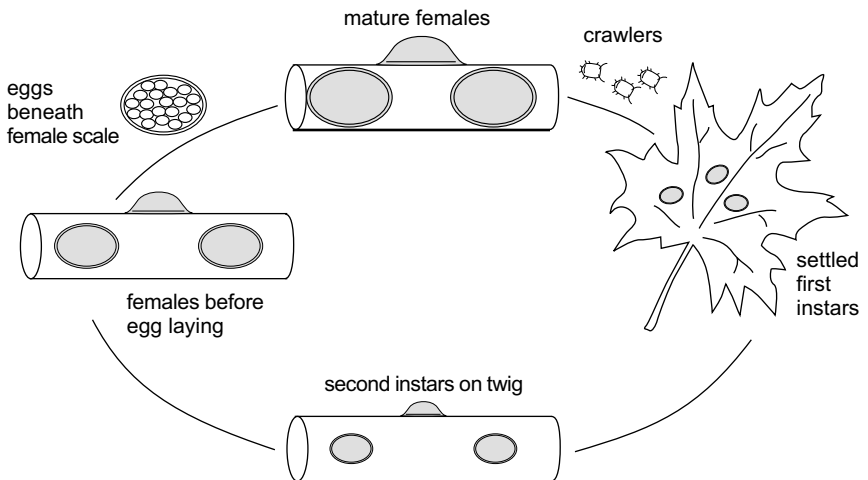


Figure 3. Life cycle of a typical soft scale insect (family Coccidae).



small, dark, lady beetles. *Hyperaspis* species are tiny, shiny, black lady beetles with several red, orange, or yellow spots on the back. *Rhyzobius lophanthae* is a lady beetle that has a reddish head and underside, and a grayish back densely covered with tiny hairs. The twicestabbed lady beetle, *Chilocorus orbis*, is shiny black with two red spots on its back, and reddish underneath. The larvae of certain predaceous lady beetles can be found under the female soft scales feeding on scale eggs and crawlers.

Many parasitic wasps are important natural enemies of scales, including species of *Aphytis*, *Coccophagus*, *Encarsia*, and *Metaphycus*. Estimate parasite activity by checking scale covers for the round exit holes made by emerging adult parasites. Remove the covers of armored scales and examine beneath them for immature parasites. Grow flowering plants near scale-infested trees and shrubs to help augment natural enemies. Adult parasitic wasps live longer, lay more eggs, and kill more scales when they have nectar or honeydew to feed on.

Dust control is crucial to the success of biological control. Wash plant surfaces midseason, or when the foliage is dusty, to encourage biological controls.

Natural enemies are commercially available for release against black scale and California red scale. However, conserving resident natural enemies is a more efficient and longer lasting strategy than buying and releasing them, particularly in garden situations.

Depending on the scale species and the extent to which biological control has been disrupted, it may take several months of conservation efforts before scale populations are reduced by biological control. If current levels of scales are intolerable, use a short residual insecticide such as oil or soap to reduce scale populations while conserving natural enemies.

Ant Control

If large numbers of ants are climbing up trunks to tend scales they should be controlled. Deny ants access to plant canopies by pruning branches that provide a bridge between buildings or the ground and by applying a sticky material (such as Tanglefoot or Stikem) to trunks. If trees are young, thin-barked, or recently pruned, wrap the trunk first with a strip of fabric tree wrap, duct tape, or another material to prevent injuring the tree. Alternatively, or as a supplement, place enclosed pesticide baits such as ant stakes near nests or on ant trails beneath plants.

Chemical Control

Dormant Treatments. Dormant-season applications of specially refined oils, often called narrow-range, supreme, or superior type oils, are effective against most scale pests of deciduous trees and landscape plants, especially San Jose scale, walnut scale, and the lecanium scales, but not against oystershell or olive scales because susceptible stages of these pests are not present during winter. Avoid oils called dormant oil or dormant oil emulsions, which are more likely to injure plants. Treatments can be made any time during dormancy or, for sycamore scale and oak pit scales, during the delayed dormant period, which is the time after the buds swell but before they open. Be sure that the plants are not water stressed to avoid injury. A good time to apply oils is right after a period of rain or foggy weather.

An application of oil or soap alone is usually adequate. One study (of sycamore scale) found that organophosphates (e.g., malathion) combined with oil were no more effective than a properly timed, thorough application of oil or soap alone.

Avoid using the organophosphates chlorpyrifos (Dursban) and diazinon in landscapes and gardens because of

problems from their runoff in urban surface water and contamination of municipal wastewater.

Oil Precautions. Don't apply oils during the fog or rain, or during or before hot or freezing weather (over 90°F or under 32°F). *Do not apply oils to deciduous trees within 30 days before or after applications of sulfur, captan, or certain other fungicides to avoid damage to trees.*

Spring/Summer Treatments. Dormant season applications of oils are not appropriate for scales on citrus or avocado because these trees do not enter a winter dormancy; oils are best applied to these trees in spring or summer. Horticultural oils can also be used in spring or summer against scale crawlers on deciduous plants. Treatment at this time requires more spray volume than a dormant treatment because foliage as well as bark must be thoroughly covered. Spring or summer applications must be carefully timed to reach crawlers, which are the most susceptible stage. Use traps made of double-sided sticky tape to determine when crawlers are hatching. Before crawlers begin to emerge in spring, tightly encircle several twigs or branches on the infested tree with transparent tape that is sticky on both sides (this tape is available at stationery stores). Change the tapes at regular intervals, about weekly, and examine the tapes with a hand lens to identify the crawlers. Once eggs begin hatching, scale crawlers get stuck on the tapes and appear as yellow or orange specks.

If a spring or summer foliar insecticide application is planned, spray after a sharp increase in crawler production occurs or after crawler numbers have peaked and begin to decline. For more information on sticky tape monitoring, consult *Pests of Landscape Trees and Shrubs*, listed in the "Compiled From" section.

In addition to narrow-range oil, insecticidal soap and carbamate insecticides

are registered as foliar sprays for scale control. Foliar sprays of the more persistent, broad-spectrum insecticides (carbamates) cause greater disruption of biological control than oil or soap treatments because persistent residues continue to kill natural enemies migrating in after the application.

Soil applications of imidacloprid (Bayer Advanced Garden, Marathon, Merit) will provide long-term control of soft scales but not armored scales. Additional insecticides are available to licensed pest control applicators for use in landscape plantings. In addition, the insect growth regulators diflubenzuron (Adept—greenhouse use only—and Dimilin) and kinoprene (Enstar II—greenhouse use only) are available and are applied as sprays to infested plants. These materials are relatively slow acting but eventually highly effective.

For more information contact the University of California Cooperative Extension or agricultural commissioner's office in your county. See your phone book for addresses and phone numbers.

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Produced by IPM Education and Publications, UC Statewide IPM Project, University of California, Davis, CA 95616-8620

This Pest Note is available on the World Wide Web (<http://www.ipm.ucdavis.edu>)



This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Pest Management.

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This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.

COMPILED FROM

Flint, M. L. 1998. *Pests of the Garden and Small Farm: A Grower's Guide to Using Less Pesticide*, 2nd ed. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 3332.

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WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash nor pour pesticides down sink or toilet. Either use the pesticide according to the label or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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